URBIS

HEDLAND JUNCTION STRUCTURE PLAN

WEDGEFIELD INDUSTRIAL ESTATE

PREPARED FOR
DEVELOPMENTWA
APRIL 2022

URBIS STAFF RESPONSIBLE FOR THIS REPORT WERE:

Director	Tim Dawkins
Senior Consultant	Robert Walker
Project Code	P0036926
Report Number	1

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ENDORSEMENT PAGE

This Structure Plan is prepared under the provisions of the Town of Port Hedland Local Planning Scheme No.7.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

08 November 2023

Signed for and on behalf of the Western Australian Planning Commission:

____

An officer of the Commission duly authorised by the Commission pursuant to section 24 of the Planning and Development Act 2005 for that purpose, in the presence of:

Witness: ______________

Date: 15 November 2023

Date of Expiry: 15 November 2033

TABLE OF AMENDMENTS

Amendment No.	Summary of the Amendment	Amendment Type	Date Approved by WAPC

EXECUTIVE SUMMARY

The Hedland Junction (the Structure Plan) applies to all undeveloped land previously subject to the Wedgefield Industrial Estate Structure Plan (WIESP). The subject site is approximately 220 hectares in area, positioned within the Wedgefield Industrial Estate between the towns of Port Hedland and South Hedland.

This Structure Plan promotes industrial development within Hedland Junction that will provide for general industrial uses, with a major focus on transport and logistics to support the wider economy in Port Hedland. The estate is designed to support a wide variety of general industrial uses and will allow for emerging industries to develop when appropriate. Guiding principles for Hedland Junction include:

- **Providing a general industrial estate to suit a range of transport and logistics and emerging general industrial users.**
- **Providing for a development layout which is flexible and can be adapted to meet evolving market demands.**
- **Providing a development layout which allows for a permeable road and movement network which accommodates heavy transport vehicles and facilitates connections to Great Northern Highway.**
- **Encouraging an attractive and high-quality built form that responds to the operational needs of users, Port Hedland's unique climate and the position of Hedland Junction as a 'Gateway' to Port Hedland.**
- **Providing consistency with the portions of Hedland Junction developed under the Wedgefield Industrial Estate Structure Plan.**

The land within the Structure Plan area is zoned 'Industrial Development' and is currently subject to the WIESP. The WIESP was adopted in 2011 and zoned the land "Transport Development" to reflect the intentions to develop the area for large scale transport and logistics uses.

Changes in the planning framework in 2015 and 2021 resulted in a number of inconsistencies between the WIESP and the Town of Port Hedland Local Planning Scheme No.7 (LPS7). Notably there is an anomaly whereby the 'Transport Development' is no longer a zone. There has also been ongoing changes in the market demand which has resulted in multiple changes to the internal structure plan layout. These factors have cumulated in the need for a new structure plan over the land within Hedland Junction which had not yet been titled.

The Structure Plan has the potential to deliver between 80-100 industrial lots of a range of sizes. A focus has been given to the refinement of the transport network and links for RAV rated vehicles, ability for the lots to appropriately provide for a range of general industrial uses with a focus on transport development and the incorporation of water sensitive design at a lot and public realm level.

The proposed movement network within the Structure Plan results in a well-connected and permeable street network which caters to the types of industrial vehicle movements and accurately responds to anticipated traffic numbers into the future. The Structure Plan identifies the triggers for the development of local road to support staging cells, extensions, and upgrades to existing roads and importantly the ultimate connection of Hematite Drive to Great Northern Highway.

As part of the preparation of the Structure Plan, the following technical and supporting documentation has been prepared with key points summarised in this report:

- Local Water Management Strategy (JDA 2022)
- Bushfire Management Plan (Urbaqua 2022)
- Environmental Assessment Report (GHD 2011)
- Traffic Impact Assessment (Porters 2022)
- Infrastructure & Servicing Report (Porters 2022)
- Landscape Plan (UDLA 2022)

Full copies of these documents are provided in the technical appendices.

SUMMARY OF STRUCTURE PLAN

ITEM	DATA	SECTION NUMBER REFERENCED WITHIN THE STRUCTURE PLAN REPORT
Total area covered by the Structure plan:	220.93	Section 2.1
Proposed land use(s) ▪ Industrial	• General Industry	Section 5.2
Estimated lot yield:	80-100 lots	Section 5.2
Estimated area and percentage of public open space	Not applicable	Not applicable

CONTENTS

FIGURES

TABLES

PART ONE
IMPLEMENTATION

1. IMPLEMENTATION

Part One contains the structure plan map and outlines the requirements that will be applied when assessing subdivision and development applications over the land to which the structure plan relates. The structure plan aligns with the local planning scheme and relevant WAPC policy requirements.

1.1. STRUCTURE PLAN AREA

The Hedland Junction Structure Plan (the Structure Plan), once endorsed, will become the guiding document in the consideration of future subdivision and development for Hedland Junction, being the land contained within the inner edge of the Structure Plan boundary line shown on the Structure Plan Map (refer to **Figure 1**).

1.2. OPERATION

In accordance with Clause 22 of Schedule 2 of the *Planning and Development (Local Planning Scheme) Regulations 2015,* this Structure Plan will come into operation on the day in which the Structure Plan is approved by the Western Australian Planning Commission (WAPC). Once approved, decision-makers shall have due regard to the contents of this Structure Plan when making decisions on the subdivision and development of land within the Structure Plan area. This Structure Plan has an effective period of 10 years commencing from the day of endorsement.

1.3. STAGING

It is proposed that the development of the Structure Plan be undertaken within seven (7) stages. The staging of the Structure Plan is mainly influenced by the market demand, site levels and earthworks and the delivery of infrastructure upgrades.

Staging will commence with the lots which have already received subdivision approval and have had site preparations undertaken in accordance with the existing Structure Plan. Future staging will occur adjacent to the Hematite Drive extension to Great Northern Highway before moving east and west to the edges of the Structure Plan area. The southern portion is anticipated to be developed as the last stage. The staging of the Structure Plan may change dependant on market demand and costs associated with delivery of lots and infrastructure.

Further detail as to the rationale behind the staging proposed and how the staging of the development may unfold is included in **Part Two**, **Section 6**.

1.4. SUBDIVISION AND DEVELOPMENT REQUIREMENTS

The Structure Plan Map (refer to **Figure 1**) designates the land use zones applicable to the Structure Plan area. The decision-making authority is to have due regard to the zoning, subdivision and development requirements contained within this Structure Plan when making planning decisions.

Land use and development within the Structure Plan must be consistent with the prescribed zonings and reservations as detailed on the Structure Plan Map as defined under the Town of Port Hedland's Local Planning Scheme No.7 (LPS7).

The Structure Plan area is zoned 'Industrial Development' under the Town of Port Hedland Local Planning Scheme No. 7. Portions of the Structure Plan area immediately north of Powell Road and Wallwork Road are located within Control Area 1, requiring the access to future lots to occur via internal road network as well as additional screening and landscaping requirements.

1.5. OTHER REQUIREMENTS

All lots within the Structure Plan area will be serviced with a reticulated water supply. Existing major water infrastructure is located adjacent the south-west boundary of the Structure Plan area. This includes four (4) water mains that service Port Hedland and the immediate surrounds. The existing water network will be extended by the developer to service future lots, with new water infrastructure located within road reserves or freehold lots and protected by easements.

An electrical connection will also be provided to all future lots. Upgrades to the Horizon Power underground supply network will be undertaken by the developer, with electrical infrastructure located within existing or future road reserves.

1.5.1. Design Guidelines

The Town of Port Hedland has adopted design guidelines for the Hedland Junction Light Industrial Area (LIA2 and LIA3) and the Transport Development Industry Area. Future development within these zones must demonstrate consistency with the relevant provisions of the design guidelines.

The key objectives of the Design Guidelines include:

- To encourage a high standard of development which is appropriate to the climate and conditions of the Pilbara;
- Encourage innovative and sustainable building designs that reduce energy and water use while still maximising functionality and performance;
- To avoid unsightly and poorly planned development and thus enhance and protect the investment of all owners within the estate; and
- Ensure the environmental impacts from development are minimised and contained.

The Hedland Junction - Transport Development Industry Area design guidelines are required to be updated to reflect the Structure Plan layout and requirements.

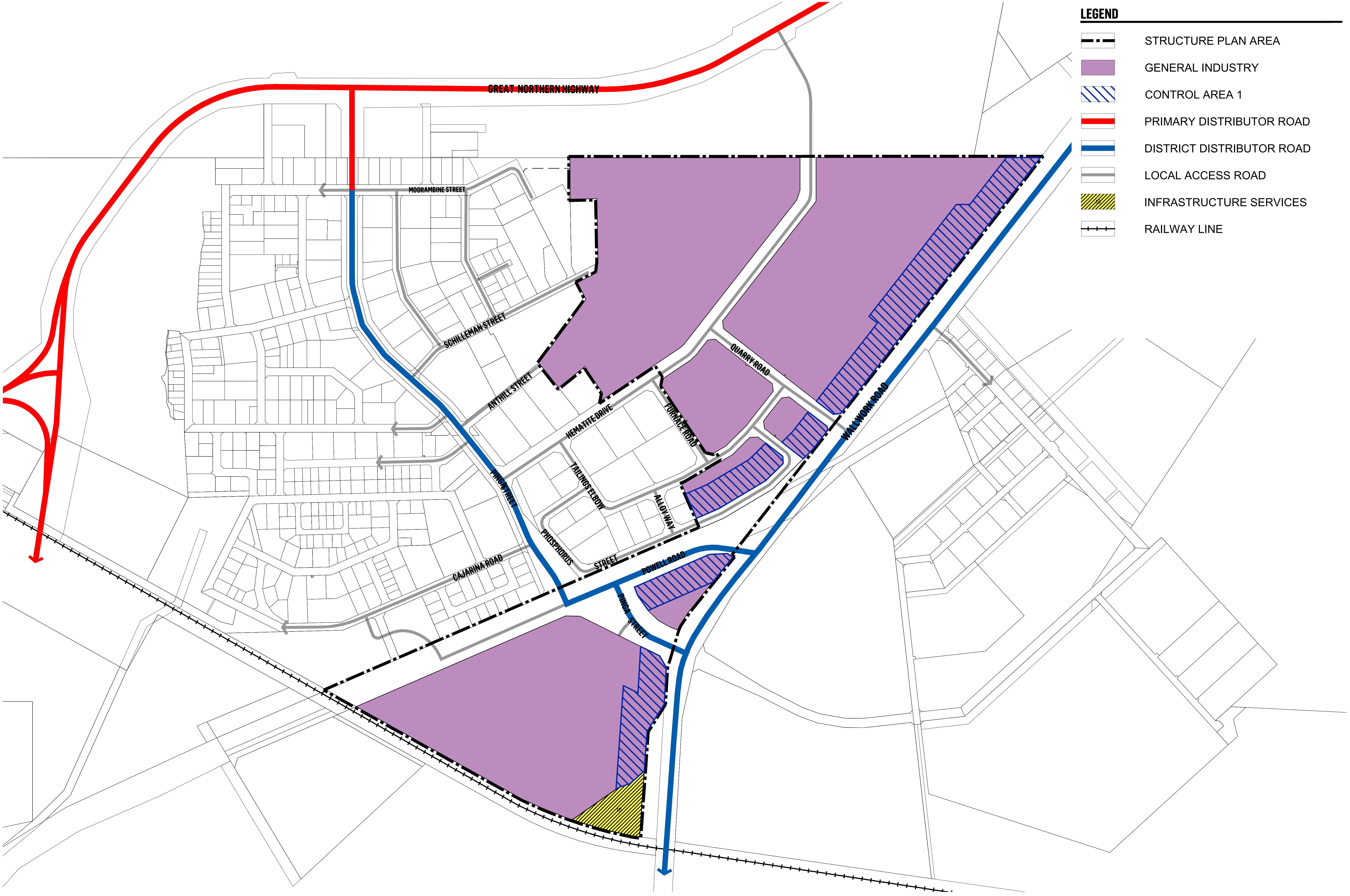
1.6. ADDITIONAL INFORMATION

Table 1 below provides details of the technical information required to be undertaken at future stages of the planning process.

Table 1 – Subdivision and Development Requirements

ADDITIONAL INFORMATION	PURPOSE	APPROVAL STAGE	CONSULTATION REQUIRED
Urban Water Management Plan	To detail drainage construction works, monitoring and maintenance arrangements in accordance with the WAPC's Better Urban Water Management Guidelines.	Condition of subdivision approval	Department of Water and Environmental Regulation
Landscape Management Plan	To detail the ongoing management and maintenance arrangements of landscaping and drainage areas.	Condition of subdivision approval	Town of Port Hedland
Traffic Management Plan	To provide technical specifications relating to road upgrades, construction management arrangements and broader traffic requirements.	As required.	Town of Port Hedland Main Roads WA (if required)
Mulgara Assessment	To confirm the location of Mulgara and any activity as part of the clearing process in order to identify if any further management measures are required.	Condition of subdivision approval for each stage	Town of Port Hedland
Dust Management Plan	To ensure adequate information is provided for assessing potential dust emissions.	Condition of subdivision approval and/or at the stage of development application	Town of Port Hedland

ADDITIONAL INFORMATION	PURPOSE	APPROVAL STAGE	CONSULTATION REQUIRED
Noise Management Plan	To ensure adequate information is provided for assessing potential noise emissions.	Condition of subdivision and / or development application	Town of Port Hedland
Traffic Impact Assessments (TIA)	To be consistent with the Department of Planning, Lands and Heritage TIA Guidelines.	Condition of subdivision approval for each stage	Town of Port Hedland, Main Roads WA
Road Safety Audits	To be consistent with State and federal Government Road Safety Strategies.	Condition of subdivision	Town of Port Hedland
Geotechnical Investigations – Assessments	To ensure the land is physically capable of development or advising how the land is to be remediated and compacted to ensure it is capable of development.	As required	Town of Port Hedland
Mosquito Management Plan	To ensure the risk to the v=community of exposure to nuisance and/or disease carrying mosquitoes is considered.	Conditions of subdivision and/or at the development application stage	Town of Port Hedland, Department of Health
Site and Soil Evaluation	For consistency with the *Government Sewerage Policy 2019*	Development application	Department of Health



URBIS

Hedland Junction - Structure Plan Part I

Wedgefield Industrial Estate

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DISCLAIMER

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Development WA

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PROJECT NO.	DATE
P0006040	25.07.23
DRAWING NO.	REVISION
21	a

PART TWO
EXPLANATORY

1. INTRODUCTION AND PURPOSE

This part of the report provides an explanation of how the Structure Plan was developed with consideration to the site, its characteristics, and the relevant planning framework. Details on the Structure Plan's form, function and key attributes are also included, along with guidance on how the Structure Plan should be interpreted and implemented, inclusive of future reporting.

The purpose of the Structure Plan is to provide a framework that will guide future subdivision, development and land use within the Structure Plan area. This includes future reporting and approvals required to support more detailed planning for the land.

This document has been prepared in accordance with the planning requirements provided in the Town of Port Hedland Local Planning Scheme No.7 (LPS7) and the *Planning and Development (Local Planning Scheme) Regulations 2015*, including the Western Australian Planning Commission's Structure Plan Framework (August 2015).

1.1. BACKGROUND TO HEDLAND JUNCTION AND WEDGEFIELD INDUSTRIAL ESTATE

The Port Headland Land Use Master Plan (LUMP) was adopted by the then Shire of Port Hedland in 2007, which identified the land surrounding the Wedgefield industrial estate as the most appropriate location for the expansion of general industry within the Shire.

In 2011, in response to a market for additional industrial land within Port Hedland, the Wedgefield Development Plan was approved. The Development Plan provided the zoning of the land within the development plan boundary and guidance for the future development of the land. Key aspects of the Development Plan included:

- Zoning of the Transport Development precinct
- Zoning of Light Industrial precincts (LIA3, LIA4 and LIA5)
- Inclusion of special control areas (one since removed in 2019)
- A permeable road network catering for heavy vehicles
- High quality presentation estate as a gateway to Port Hedland

Along with the Wedgefield Development Plan, corresponding amendments were made to the Shire of Port Hedland Local Planning Scheme (LPS5) to introduce the 'Transport Development' zone" and zone-specific land uses. These land uses were largely relating to transport logistics and laydown, reflective of the intentions for the land within the Wedgefield Development Plan.

The Wedgefield Development Plan was updated in 2019 to respond to demand for industrial land to service the transport, mining, construction and export markets in Port Headland, and the broader Pilbara, and renamed as the Wedgefield Industrial Estate Structure Plan (WEISP).

In 2020 the Town of Port Hedland undertook to prepare a new Local Planning Scheme (LPS7), this was gazetted in January 2021. LPS7 follows the conventions of the Model Scheme Text within the *Planning and Development (Local Planning Scheme) Regulations 2015* and as such, the 'Transport Development' zone and several land uses within the WIESP were no longer contained the Scheme. Furthermore, LPS7 normalised the portions of the WIESP which had been subdivided and developed for 'General Industrial' purposes.

The changes in the planning framework resulted in an anomaly whereby the 'Industrial Development' land no longer had an applicable zone and therefore land use permissibility could not be appropriately enforced. This, combined with the ongoing changes in the market demand resulting in multiple changes to the internal structure plan layout has resulted in the need to prepare a new structure plan over the land within Hedland Junction. Further, as development of the Wedgefield Industrial Estate and the wider planning framework has occurred over time, many of the WEISP provisions are no longer relevant and should be amended to reflect current development requirements.

The revised Structure Plan has been prepared to reflect the current planning framework requirements and remove the normalised portions of the previous WIESP area. The boundary of the Hedland Junction Structure Plan now only includes the land subject to the 'Industrial Development' Zone and provides the necessary framework to allow for subdivision and development to occur in accordance with the principles of orderly and proper planning.

2. LAND DESCRIPTION

The following sections examine the context, location, land use and ownership applicable to the Structure Plan area.

2.1. LOCATION & CONTEXT

The Structure Plan area is located within the Wedgefield Industrial Estate which is within the Town of Port Hedland and approximately 1,300km North-North-East of Perth. The Wedgefield Industrial Estate is the Town of Port Headland's main industrial area and is situated between Port Hedland and South Hedland, as shown in **Figure 1**.

Hedland Junction is adjacent to Great Northern Highway, which is a primary transport route providing heavy vehicle access to the port and the rest of the State. The southern boundary of the Structure Plan area abuts the Finucane freight railway (splitting into the Port Hedland – Shay Gap and Port Hedland – Newman lines), allowing surrounding mine operators to transport natural resources to Port Hedland and Finucane Island for overseas export.

The Port Hedland International Airport is located directly to the east of the Structure Plan area.

The Structure Plan area is predominately vacant land awaiting future development and is located immediately to the south and west of the existing Wedgefield Industrial area. Most of the Structure Plan area contains shrubs and grasses, as well as a number of dry creek beds located in the northern portion of the site.

Since the establishment of Hedland Junction in 2011, a number of industrial land uses have established in the first stages off Hematite Drive (adjacent to Pinga Street and Wallwork Road). These uses are large scale developments primarily relating to transport and logistics as per the objectives of the original Structure Plan and previous "Transport Development" zone.

Approximately 8 kilometres south of Wedgefield Industrial Estate is the Boodarie Strategic Industrial Estate. This is an undeveloped estate which will accommodate future strategic industry with downstream processing opportunities, as well as heavy and noxious industries requiring buffers to sensitive land uses. The estate is currently un-serviced and will require a foundation proponent to extend essential service infrastructure prior to development.

A Location Plan showing the subject land is provided in **Figure 1** and Aerial in **Figure 2**.

Figure 1 – Location Plan

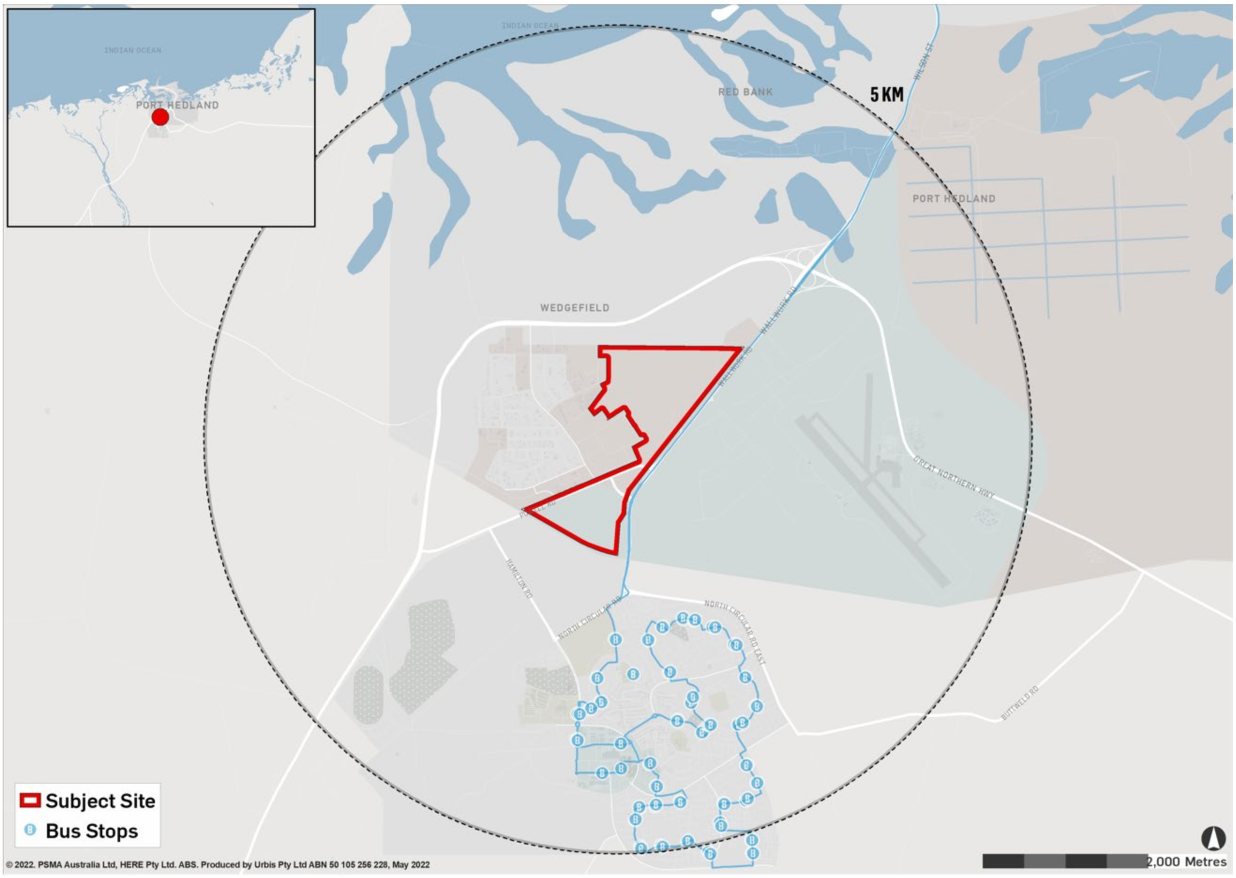

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Figure 2 – Aerial Photograph

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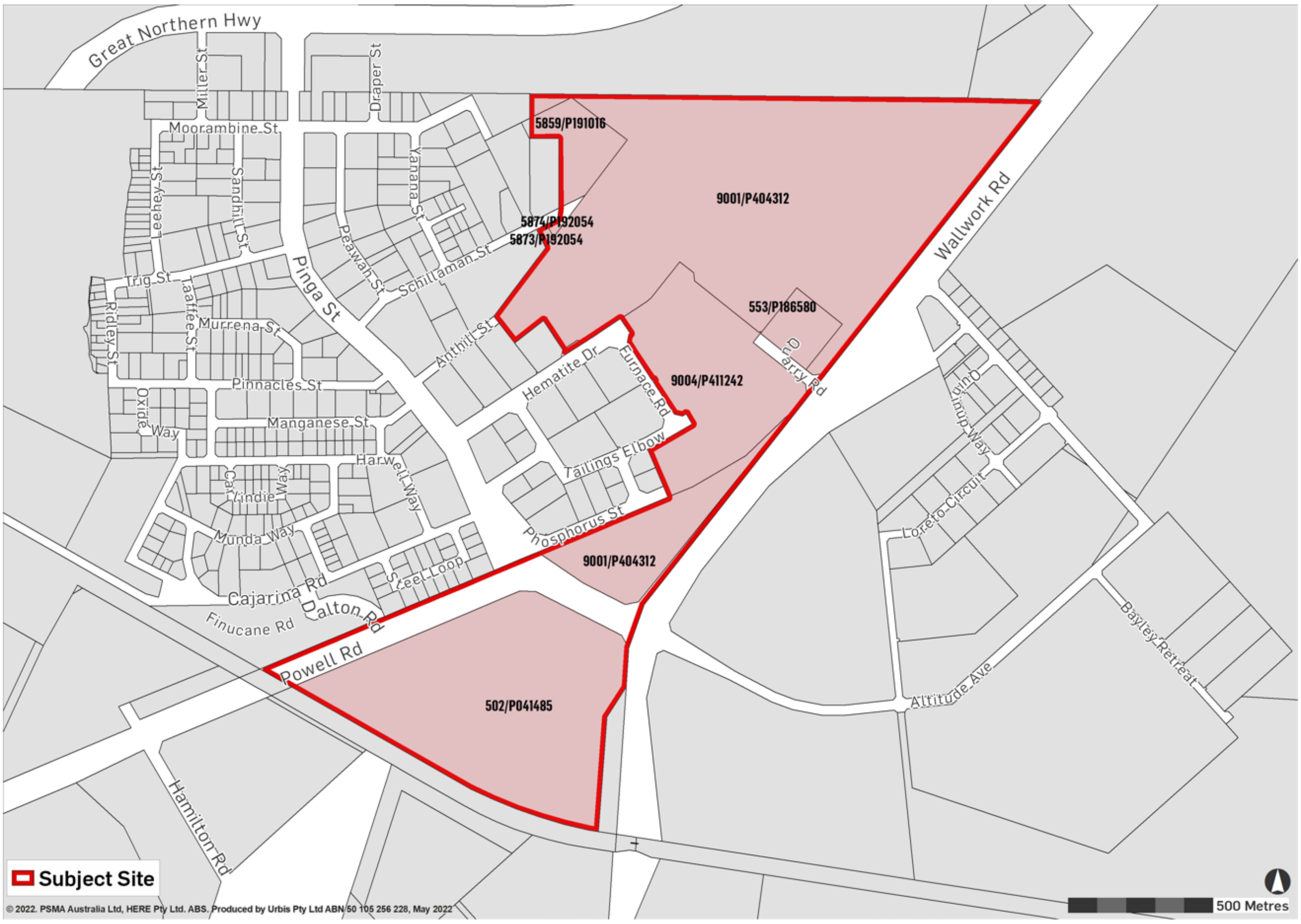
2.2. LEGAL DESCRIPTION AND OWNERSHIP

A summary of the subject site Lot details is provided in **Table 2**, with a copy of the Certificates of Title(s) provided at **Appendix A**. A plan identifying the relevant lots is included in **Figure 3**.

Table 2 – Summary of Lot Details

Lot	Area (Ha)	Plan/Diagram	Vol/Folio	Proprietor
9001	126.154	P404312	3164/983	State of Western Australia
9004	27.6670	P411242	2927/100	Western Australian Land Authority
5859	6.3516	P191016	LR3099/743	State of Western Australia
5874	0.1629	P192054	LR3103/905	State of Western Australia
5873	0.2453	P192054	LR3053/595	State of Western Australia
502	56.5537	P041485	LR3155/996	State of Western Australia

Figure 3 – Cadastre Plan



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3. PLANNING FRAMEWORK

The following sections provide an overview of the relevant planning framework relating to the Structure Plan. This framework influenced the design and provisions of the Structure Plan.

3.1. STATE PLANNING FRAMEWORK

The design response of this Structure Plan has been shaped by the State government strategic planning environment. **Table 3** summarises the relevance of these strategies/policies within the context of this Structure Plan.

Table 3 – State Planning Documents

Documentation	Considerations
State Planning Strategy 2050	The State Planning Strategy is the predominant planning document guiding public authorities and local governments in the formulation of legislation and policy in the planning arena. This includes structure planning and the development of structure plans. The State Planning Strategy sets out objectives and standards to be met during the planning process and principles by which these standards can be achieved.
State Planning Policy 3.7 – Planning in Bushfire Prone Areas (SPP 3.7)	The purpose of SPP 3.7 is to implement effective, risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure. Bushfires cannot be prevented but the damage they cause to infrastructure and the community can be mitigated. SPP 3.7 requires that planning for bushfire needs to be considered at every stage of the planning process to ensure the outcomes represent the lowest possible risk to infrastructure and people. A large portion of the SP area has been designated as bushfire prone by the Commissioner of Fire and Emergency Services. Accordingly, a Bushfire Attack Level (BAL) assessment and additionally a Bushfire Management Plan (BMP) may be required to address the policy requirements. A BAL assessment requires the preparation of a 'BAL contour map' to demonstrate the BAL impact on a site. This includes both pre and post development to ensure that future development can achieve an appropriate BAL rating. Subdivision in areas with a BAL rating above 'Low' also need to be supported by a BMP to obtain development approval. A BMP includes built form strategies to mitigate risk to development and an 'action plan' in the event of a bushfire. A BMP also ensures emergency services are provided with sufficient access to the site (i.e., ensure the road is wide enough for fire engines) and the appropriate equipment (fire hydrants, water sources, etc.). If a sensitive use is proposed for a site in an area with a BAL rating of 12.5-29 then a bushfire emergency evacuation plan (BEEP) will also need to be prepared.

State Planning Policy 4.1 – State Industrial Buffer Policy (SPP4.1)	SPP 4.1 has the purpose of protecting sensitive land uses from industrial emissions and protect industrial land uses from the encroachment of incompatible land uses. SPP4.1 provides guidance with respect to the allocation of a ‘buffer area’ around industrial, infrastructure and some special uses, within which sensitive land uses are prohibited or subject to controls to protect against the impacts of the industrial uses. This policy acknowledges the role of the EPA’s Guidance for the Assessment of Environmental Factors No. 3 in reducing land use conflicts between industrial and sensitive land uses and recognises that these policies should be read in conjuncture with each other. Both documents are highly relevant to further industrial development in the Wedgefield Industrial Estate and the creation of this Structure Plan. The two (2) current uses within the wider Wedgefield area to which this policy specifically applies are the Tox Free facility and a privately owned Wastewater Treatment Plant. The description of industry under the EPA’s policy that best describes the Tox Free facility as Incineration - for biomedical, chemical, or organic waste, with an applicable buffer of 500-1000 metres (based on size). A Wastewater Treatment Plant is not allocated a generic buffer distance under the EPA’s policy, with reference made to ongoing buffer studies in progress to determine appropriate separation distances. Given that no sensitive uses are proposed as part of the SP, these buffer requirements are acknowledged but do not materially impact on the SP area. However, this may impact future development and land use in the area as individual development applications begin to be assessed.
State Planning Policy 5.4 – Road and Rail Noise (SPP 5.4)	The north-western and south-western portion(s) of the Structure Plan area are located within a 300m trigger distance of Strategic Freight routes associated with Great Northern Highway and Finucane Freight Railway. Although industrial land is not classified as a noise sensitive premises, any future development located within these trigger distances proposing a noise sensitive premises will need to consider noise mitigation strategies to ensure future users/occupants are not unduly impacted by transport noise.
Guidance for the Assessment of Environmental Factors No.3 – Separation Distances between Industrial and Sensitive Land Uses	This EPA policy is designed to be applied in conjuncture with SPP 4.1 as the predominant framework guiding industrial buffers in the state. Both documents have the objective being to protect sensitive land uses from industrial pollution and to protect industrial land uses from the encroachment on incompatible land uses. However, these documents have different applications. SPP 4.1 provides a consistent framework that can be applied during the assessment of development applications for heavy or noxious industrial uses.

	This policy provides the specific buffer distances to be applied to land uses depending on their impact and the Government agencies that will provide advice or assess the development application. Any development in the Structure Plan area will need to be compliant with this policy and SPP 4.1.
Development Control Policy 4.1 – Industrial Subdivision	DCP 4.1 – Industrial Subdivision promotes planning of well-designed industrial areas through a set of policy measures. This includes measures such as zoning, lot size and shape, access and road layout, and public open space. DCP 4.1 identifies the elements of an industrial subdivision the WAPC will assess when considering a subdivision application. It is imperative that any subdivision application within the Structure Plan area is compliant with DCP 4.1.

3.2. REGIONAL PLANNING FRAMEWORK

A summary of the relevant regional planning framework considerations is provided in **Table 4** below.

Table 4 – Regional Planning Framework

Documentation	Considerations
Pilbara Planning and Infrastructure Framework	This policy identifies Port Hedland as one of two (2) 'Pilbara Cities' that will accommodate much of the population and economic growth of the region in the coming decades. The report identifies the population of Port Hedland (including South Hedland) is forecast to grow to 50,000 by 2035. This population will support a broad range of economic and employment opportunities. Hedland Junction and Wedgefield Industrial Estate are identified as the main areas to accommodate future industrial growth.
Pilbara Coast – Geology, Geomorphology and Vulnerability	Port Hedland is located at the mouth of the de Grey River Delta which consists of an array of creeks, rivers and tidal flats. Hedland Junction and the Wedgefield Industrial Estate are located between South Creek and South East Creek, both of which feed into the Taylor Inlet, being the natural landform that accommodates the port. The Pilbara Coast report is designed to provide protection for environmental assets and development around coastal areas. This Structure Plan considers how industrial development and natural landforms can co-exist without impeding on each other.

3.3. LOCAL PLANNING FRAMEWORK

A summary of the relevant local planning framework is provided in the following sections.

3.3.1. Town of Port Hedland Local Planning Strategy 2021

The Town of Port Hedland Local Planning Strategy 2021 was gazetted in May 2021 and provides guidance for the long-term growth and development of the town as "*Australia's leading Port Town*".

Wedgefield Industrial Estate is the Towns largest industrial estate, with the Strategy identifying Hedland Junction and Wedgefield Industrial Estate as the primary areas to accommodate future industrial growth. The Strategy seeks to address existing land use conflicts within the older part of Wedgefield by zoning this area 'Light Industry' to curtail further development of incompatible uses. Appropriately, the Strategy aims to transition heavy industrial uses currently located in the older part of Wedgefield to the newer Hedland Junction Structure Plan area which has suitable road and drainage infrastructure to support general industry and transport logistics uses. The Strategy identifies approximately 200ha of land available for development within Hedland Junction.

The portion of the Structure Plan area located south of Powell Road was previously identified as 'Light Industrial' by the Wedgefield Industrial Estate Structure Plan and is identified for this purpose within the Strategy. However, given the oversupply of light industrial land within the Town, it is considered the rezoning of this land to 'General Industry' through this Structure Plan is more appropriate. This will provide an additional 45ha (approx.) of developable land for general industry purposes.

3.3.2. Local Planning Scheme No. 7 (LPS 7)

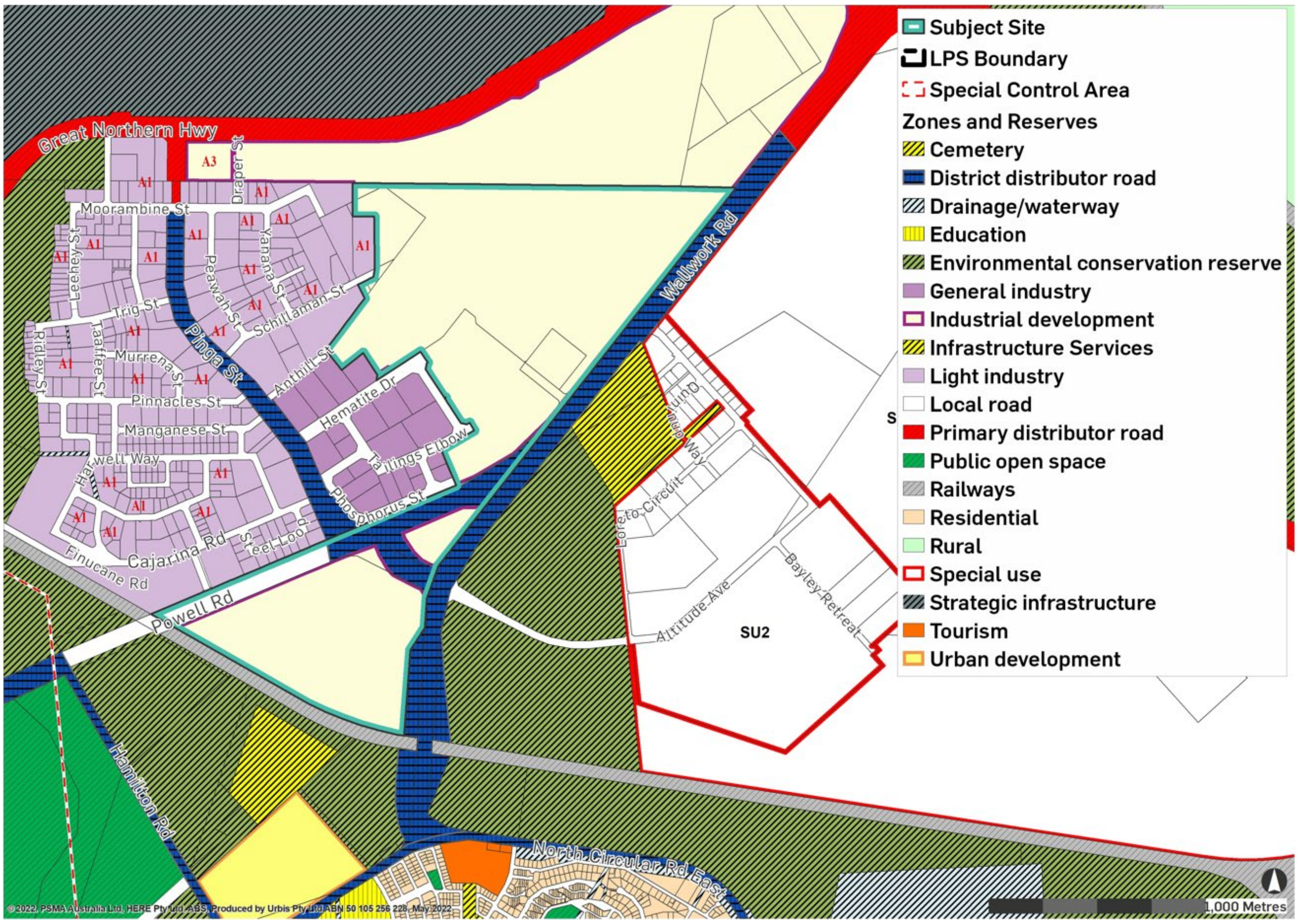
The Town of Port Hedland Local Planning Scheme No. 7 (LPS 7) was gazetted in January 2021, and is the Town's principal statutory planning document, setting out how land is to be used and developed. The Structure Plan area is zoned Industrial Development under LPS 7, with clause 16 providing a basis for the future detailed planning in accordance with the Structure Plan provisions of the Scheme.

Clause 33 of LPS 7 notes there are no additional site and development requirements for areas covered by a Structure Plan. Accordingly, this Structure Plan has been prepared in accordance with Part 4 of the Planning and Development Regulations (Local Planning Schemes) 2015.

Portions of the Structure Plan area adjacent to Powell Road and Wallwork Road are subject to Control Area 1 identified on the Hedland Junction Structure Plan. Control Area 1 requires access to future Lots to occur via internal roads, as well as additional landscaping and screening requirements imposed through the relevant Design Guidelines.

A plan showing the zoning of the Structure Plan area and surrounds in provided in **Figure 4**.

Figure 4 – Zoning Plan



3.3.3. Local Planning Policies

A summary of the relevant local planning policy considerations is provided in **Table 5** below.

Table 5 – Local Planning Policies

Documentation	Considerations
Local Planning Policy No.8 – Port Hedland International Airport	The Port Hedland International Airport is the primary airstrip servicing the Pilbara region. As the WEISP area is located within the Obstacle Limitation Surfaces (OLS) area, additional development controls apply. These include height limits in respect to permanent structures and restrictions on temporary structures such as cranes, floodlights, and antennas. Future development applications within the WEISP area will need to be referred to the aerodrome operators to determine the potential impact on the OLS.
Local Planning Policy No. 11 – Stormwater Management	LPP 11 seeks to ensure future subdivision and development are informed by appropriate stormwater systems that will assist to with reducing the damaging effect of heavy rainfall events on private and public property, and the public drainage network. This policy acknowledges that much of the soil within Wedgefield Structure Plan area consists of collapsible silty sand or clayey sand known as Pindan, which are poor draining and can become saturated easily. Accordingly, water erosion is a significant problem with pindan soils because of intense rainfall events in the Shire.

Documentation	Considerations
Local Planning Policy No. 2 – Advertising Sign	LPP02 aims to provide guidance on signage within the Town of Port Hedland, and outline instances where development approval may not be required from the Town. LPP02 applies to all land within the Town and should be read in conjunction with LPS5 and *Planning and Development (Local Planning Schemes) Regulations 2015*. LPP02 outlines the various types of signs that could be applied for and their development requirements, Should the sign meet the development requirements of LPP02, planning approval is not required. Future development applications within the Wedgefield Structure Plan area should consider the development requirements of LPP02.
Local Planning Policy No. 3 – Shipping / Sea Containers and Transportable Buildings	LPP03 provides guidance on the requirements for the development of transportable buildings and defines acceptable design standards for transportable buildings such as dongas and shipping / seas containers. LPP03 aims to ensure that any transportable building does not detract from the amenity, character and established streetscape of an areas, and fulfill the intended objectives of the applicable planning framework to achieve high quality-built form. Should a future development application seek approval for a shipping / sea container or transportable building, the provisions of LPP03 should be considered.
Local Planning Policy No. 4 – Percent for Public Art	LPP04 establishes when development is required to provide Public Art of a cash-in-lieu contribution as part of their development approval. It also provides the framework for the development, funding and management of public art. LPP04 is linked to the Towns Arts & Culture Strategy 2019-2022 and the Towns Public Art Strategy, as it seeks to increase the social, cultural and economic value of the Town. LPP04 outlines all new development on zoned and reserved land over the threshold value of $2 million shall set aside a minimum of one percent (1%) of the Total Project Cost of the development be put towards Public Art (to an upper cap contribution of $150,000). Where the public art budget can be allocated is outlined in further detail within LPP04 and should be considered as part of the development application process.

3.3.4. Road Naming

The naming of new roads in the Structure Plan area shall be in accordance with the Towns Policy 12/010 – Naming of Roads and Places.

4. SITE CONDITIONS AND CONSTRAINTS

The following section outlines the existing site conditions with the Hedland Junction Structure Plan area which have influenced the development of the Structure Plan and supporting technical studies.

4.1. BIODIVERSITY AND NATURAL AREA ASSETS

4.1.1. Flora

GHD prepared an Environmental Management Plan (EMP) to support the WIESP in 2011 (refer **Appendix B**).

Vegetation across the site is generally uniform and is described as '*Acacia stellaticeps* over mixed tussock grassland of *Triodia epactia* and *T. schinzii* over very open herbs.' While the condition of the vegetation is noted as 'excellent' and 'good', it is acknowledged in the report that this vegetation type is well represented in the region, with approximately 196,000 ha remaining undisturbed. A number of minor vegetation types associated with the tidal/mud flats exist within the northern-most portion of the study area. The site contains a limited variety of plant species and importantly, that no Declared Rare or Priority flora species were recorded.

The vegetation assessment was supported by the recent Bushfire Management Plan prepared by Urbaqua who undertook a vegetation assessment as part of their assessment.

4.1.2. Fauna

During the initial environmental survey undertaken in association with the WIESP in June 2008, potential Mulgara burrows were observed in parts of the site and evidence of active Mulgara burrows, tracks and scats were observed.

In accordance with the management terms set out in the EMP a further Mulgara Assessment is undertaken at each stage of development, prior to any clearing of the land. Should Mulgara be found on site appropriate trapping and relocation of the fauna is to be undertaken.

4.2. LANDFORM AND SOILS

The topography of the Structure Plan area is relatively flat, sloping very gently from around 6mAHD in the south and east to 5mAHD in the northern portion of the site. Where the land is affected by natural drainage, the non-vegetated areas are around 4mAHD.

The soil profile is broadly consistent across the Structure Plan area, comprising of a thin layer of topsoil over silty sand (Pindan), with clayey sands appearing at depths of 2m or more. These soils have low permeability, with rainfall resulting in waterlogged soils and surface runoff overland towards the nearest waterway.

4.3. GROUNDWATER AND SURFACE WATER

The Local Water Management Plan prepared by JDA (refer **Appendix C**) noted that whilst the upper Pindan soils are permeable the underlaying layers are relatively impermeable and low infiltration rates occurred. Testing noted groundwater levels change significantly during periods of dry vs high rainfall. Groundwater is generally brackish to saline due to the proximity to the ocean. Water extraction from groundwater sources is unreliable due to the condition, depths, and availability of the resource.

The pre-development surface water hydrology consists of natural features with some drainage swales which convey drainage from adjacent areas. Flows are generally northward towards the supratidal flats and creeks, which are occasionally influenced by storm and ocean surges.

4.4. EXISTING ROAD NETWORK

The existing road networks applicable to the Structure Plan area are outlined within the Traffic Impact Assessment (TIA) (refer **Appendix D**) prepared by Porter Engineering, as described below:

Great Northern Highway

Great Northern Highway is a primary distributor road under the control of Main Roads WA. The road runs east to west to the north of the Structure Plan area.

Great Northern Highway is a two-lane single carriageway with a divided median and channelised treatments at the intersections where the highway approaches Pinga Street and the future Hematite Drive connection.

Pinga Street

Pinga Street is a local distributor road which provides the key heavy vehicle link to Hedland Junction, intersecting with Hematite Drive.

Pinga Street links to Great Northern Highway Bypass in the north and Powell Street/Wallwork Road in the South. Pinga Street is a two-lane road divided by a painted median

- Width: 14m with localised widening
- Capacity: 4,500vpd at Great Northern Highway intersection and 10,200vpd at Powell Street intersection in peak hours.
- Speed Limit: 70km/hr

Powell Road

Powell Street provides a light vehicle linkage between Pinga Street and Wallwork Road. Powell Road is a single lane median divided road.

- Width: 17m
- Speed Limit: 80km/hr

Hematite Drive

Hematite Drive is the central spine road through Hedland Junction, intersecting with Pinga Street to the south and with the intention of carrying on northward to intersect with Great Northern Highway. Access to the existing development within Hedland Junction occurs via local roads intersecting with Hematite Drive. Future access will be obtained via local roads linking to Hematite Drive.

- Width: 10m
- Capacity: 1,000vpd to 3,000vpd
- Speed Limit: 50km/hr

Quarry Road

Quarry Road is an existing no through road which provides access to the existing service station site. Quarry Road is a RAV2 network allowing for access of fuel tankers and small reticulated vehicles to refuel.

- Width: 10m
- Capacity: up to 1,000vpd
- Speed Limit: 50km/hr

Existing Traffic Volumes

Porter’s undertook analysis of existing traffic volumes by way of utilising MRWA and Town of Port Hedland data and undertaking traffic counts in November 2021.

The traffic counts confirmed that the local road network typically carries 1,700 vehicles per day which is well within the anticipated capacity.

RAV Network

The exiting RAV network to/from and within Hedland Junction provides for RAV10 rated vehicles.

These vehicles currently enter the estate via Pinga Street having come from a northerly or southerly direction via Great Northern Highway.

Traffic data indicates that heavy vehicles make up over 25% of the daily traffic movements.

Light Vehicle Movements

Hedland Junction is identified as an employment attractor from the surrounding residential areas of Port Hedland and South Hedland. Most of the population is based in South Hedland therefore it is anticipated the majority of light vehicle traffic will be coming from a southerly direction.

Pedestrian and Cycle Network

The Town of Port Hedland aims to provide a connected pedestrian and cycle network between Port Hedland and South Hedland. This network runs along Wallwork Road adjacent Hedland Junction. Current stages of the development have established shared paths to provide for pedestrian and cycle movements through the estate and to link to the wider pedestrian and cycle network.

4.5. INFRASTRUCTURE AND SERVICING

The Servicing Report included in **Appendix E** provides a full overview of the preliminary engineering investigations that have been undertaken as part of the formulation of the Structure Plan. The report does not identify any constraints with respect to the site’s ability to be provided with key infrastructure.

4.6. BUSHFIRE HAZARD

A large portion of the Structure Plan area has been designated as bushfire prone by the Department of Fire and Emergency Services. A Bushfire Management Plan (BMP) has been prepared to inform this Structure Plan (refer **Appendix F**).

The Structure Plan area is adjacent to land which has the potential to create a bushfire risk. This vegetation, located within 100 metres of the Structure Plan area cannot be managed by clearances as the land within the Structure Plan area can.

Further details on the Bushfire Management Plan are provided in **section 5.5**.

4.7. LAND USE OPPORTUNITIES AND CONSTRAINTS

Table 6 provides details of the land use opportunities and constraints.

Table 6 – Site Opportunities and Constraints

ITEM	OPPORTUNITY / CONSTRAINT	DESCRIPTION	IMPACT
Topography	Opportunity	The Structure Plan area is generally flat.	Topography is suited for industrial land use.
Ground Water	Opportunity	Depth to ground water is >3m below the surface.	Minimal impact for industrial development and activities to impact on ground water.
Surface Water	Opportunity	The natural hydrology and site features convey the surface water through the site to catchments.	Surface water should be maintained at pre development levels utilising natural paths where appropriate.
Road Network	Opportunity	The Structure Plan area is accessible via the existing road network.	Future Lots can be provided with direct frontage to an existing public road.
Rail Network	Opportunity	The southern boundary of the Structure Plan area is adjacent the Finucane freight railway.	Access may be provided to the existing rail network (subject to rail operator agreement).
Electricity Network	Opportunity	The Structure Plan area can be connected to the existing electricity network.	Future Lots can be provided with an electrical connection.
Water Network	Opportunity	The Structure Plan area can be connected to the existing water network.	Future Lots can be provided with a water connection.
Telecommunications Network	Opportunity	The Structure Plan area can be connected to the existing telecommunication network.	Future Lots can be provided with a telecommunication connection.
Flora	Opportunity	The Structure Plan area does not contain any TEC or PEC flora.	There are no vegetation constraints impacting future subdivision and development.
Local Planning Framework / Zoning	Opportunity / Constraint	The Structure Plan area is zoned Industrial Development.	The Structure Plan provides for the required planning framework for the subject area.

Land Ownership	Opportunity	The Structure Plan area is owned by a single landowner.	The State government has more control over the future development of the Structure Plan area.
Sewer Network	Constraint	A reticulated sewerage network is not available in the locality.	Future development will require onsite effluent disposal.
Gas network	Constraint	A reticulated gas network is not located in the locality.	Future proponents requiring a gas supply will require bottled gas.
Fauna	Constraint	The Structure Plan Area may contain Mulgara.	Field surveys should be undertaken as a condition of subdivision to ensure any Mulgara are relocated prior to the commencement of subdivision works.
Bushfire Prone Areas	Constraint	The Structure Plan area has been designated as bushfire prone.	A Bushfire Management Plan will need to be prepared for all subdivision applications located in a bushfire prone area due to the staged subdivision approach.
Sensitive Land Uses	Constraint	A single dwelling associated with an existing fuel station is located within the Structure Plan area.	Future subdivision and development should consider potential future impacts on the sensitive land use and incorporate mitigation measures to minimise any impacts associated with noise, dust, and odour emissions.

5. THE STRUCTURE PLAN

5.1. INTRODUCTION AND PURPOSE

The Structure Plan provides a coordinated framework to facilitate the industrial development of the subject site. The Structure Plan establishes the planning parameters to guide future, detailed planning stages.

The design developed for the estate addresses the considerations outlined in previous sections in a comprehensive manner as outlined below. The design has responded to the site requirements whilst ensuring a design can be easily implemented.

The Structure Plan in **Figure 6** identifies the estate's core components such as the industrial land, infrastructure, key road linkages and indicative local road and lot layout.

The key design principles for the Hedland Junction Structure Plan area are:

- **Providing a general industrial estate to suit a range of transport and logistics and emerging general industrial uses.**
- **Providing for a development layout which is flexible and can be adapted to meet evolving market demands.**
- **Providing a development layout which allows for a permeable road and movement network which facilitates heavy transport vehicle movements and connections back to Great Northern Highway.**
- **Encouraging an attractive and high-quality built form that responds to the operational needs of users, Port Hedland's unique climate and the position of Hedland Junction as a 'Gateway' to Port Hedland.**
- **Providing consistency with the portions of Hedland Junction developed under the Wedgefield Industrial Estate Structure Plan.**

5.2. DEVELOPMENT PRECINCTS

The Structure Plan incorporates two (2) development precincts based on geographical location as shown in **Figure 5**. Whilst there are no differences between the structure plan provisions for each precinct, they have been referred to as separate precincts for the purpose of access and drainage.

Northern Precinct – formally known as the Transport Development Precinct. This precinct is a general industrial precinct located to the north of Pinga Street and the existing developed area of Hedland Junction.

The Northern Precinct provides an extension of Hedland Junction north and through staged development will provide connections to Great Northern Highway via Hematite Drive, Wallwork Road via Quarry Road and Moorambine Street.

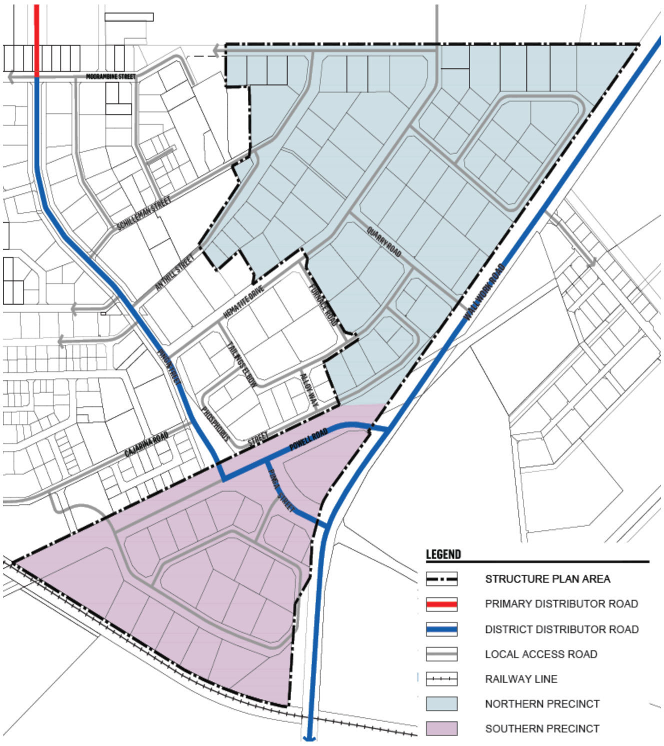
Lot sizes in the Northern Precinct range between 5,000sq.m and 4ha.

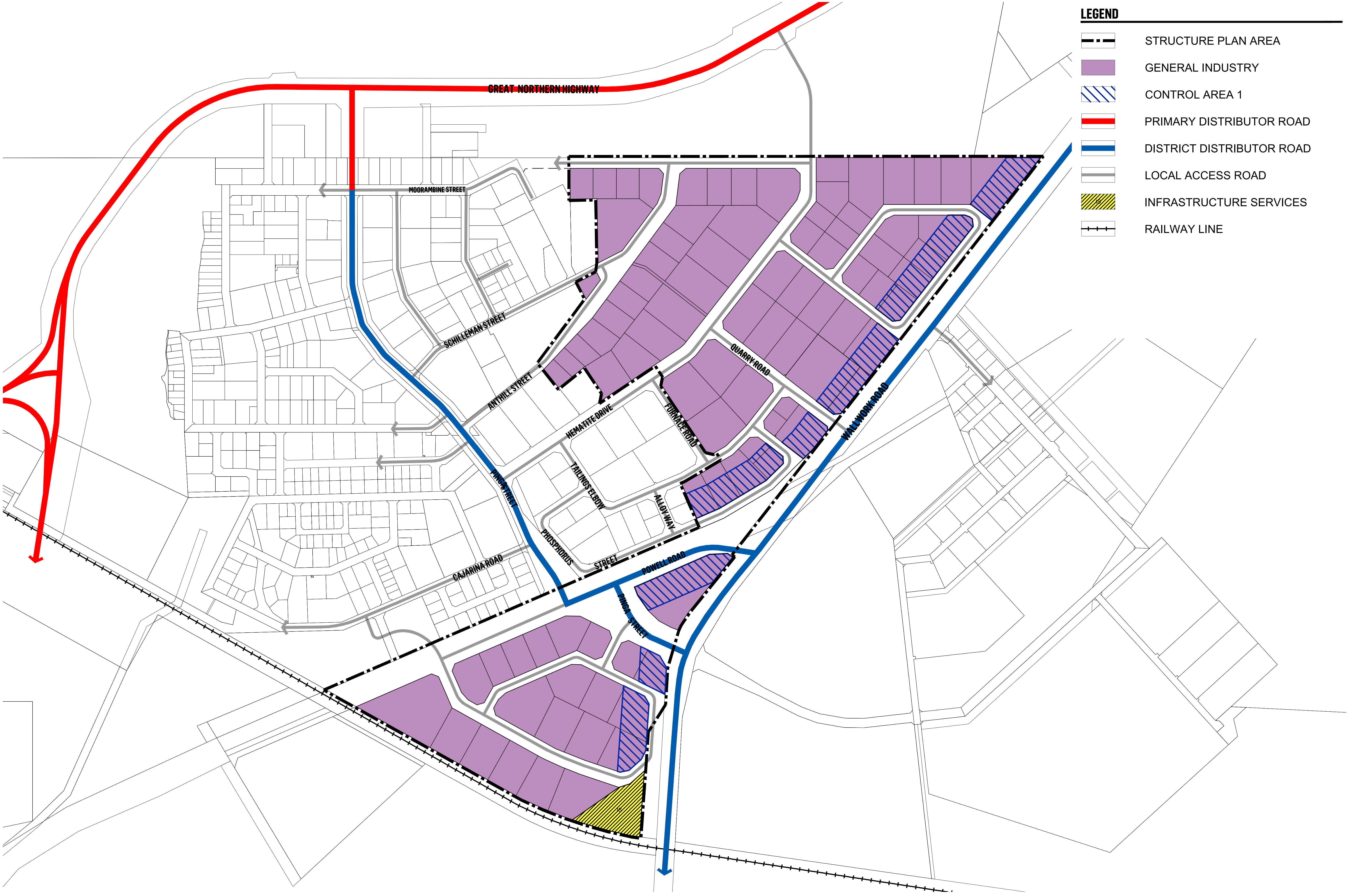
Southern Precinct – formally known as LIA5. This is a general industrial precinct is located to the south of Pinga Street and Powell Road.

The Southern Precinct has been developed to allow heavy vehicle access to the lots via Cajarina Street and Dalton Street. The indicative layout of the precinct allows for all lots to achieve heavy vehicle access via the internal local road.

Lot sizes in the Southern Precinct range between 1ha and 5ha.

Figure 5 – Development Precincts





URBIS

Hedland Junction - Structure Plan Part II

Wedgefield Industrial Estate

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Development WA

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PROJECT NO. P0006040
DATE 25.07.22
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5.3. ZONES AND LAND USE

Consistent with the *Planning and Development (Local Planning Schemes) Regulations 2015* (the Regulations), the intent of the Structure Plan is to utilise the existing zones under LPS7. This ensures the Structure Plan is capable of being normalised.

The Structure Plan zones the land as "General Industry" with a portion reserved for "Infrastructure Services".

As per LPS7, the objectives of the General Industry zone are as follows:

- *To provide for a broad range of industrial, service and storage activities which, by the nature of their operations, should be isolated from residential and other sensitive land uses.*
- *To accommodate industry that would not otherwise comply with the performance standards of light industry.*
- *Seek to manage impacts such as noise, dust and odour within the zone.*

It is the intention that development within Hedland Junction will provide for general industrial uses, with a major focus on transport and logistics to support the wider industries in Port Hedland. The estate is designed to support a wide variety of general industrial uses and will allow for emerging industries to develop when appropriate.

Control Area 1 sits as an overlay for those lots fronting onto Wallwork Road and Powell Road and has the purpose of ensuring a high quality interface with Wallwork Road and Powell Road as part of the estates' role as the 'Gateway' to Port Hedland.

Visually obtrusive uses and development are encouraged to be located away from Control Area 1 towards the centre of the estate.

Additional requirements have been established within the Hedland Junction Design Guidelines to include the requirement for screening of development, provision of landscaping and the requirement for articulation for rear facades fronting these roads.

5.4. MOVEMENT AND TRAFFIC

This section has been directly informed by the Transport Impact Assessment undertaken by Porter Engineering (refer to **Appendix D**). It highlights the key elements and details of the proposed and existing movement networks, the road hierarchy classification and road cross-sections as they apply to the Structure Plan.

This section also provides an overview of the pedestrian and cyclist network within the Structure Plan.

5.4.1. Regional Movement and Access

In the current scenario, Pinga Street provides the main vehicle access into the existing Wedgefield Industrial Area, particularly for Restricted Access Vehicles (or RAVs), which can only access the industrial area from the Great Northern Highway Bypass. Wallwork Road provides access for smaller articulated /light vehicles coming from or going to South or Port Hedland.

Hematite Drive provides connection to Pinga Street for RAV access; and Quarry Road provides access to Wallwork Road. In the ultimate scenario, Hematite Drive is to be extended through to intersect directly with Great Northern Highway. A future intersection was constructed as part of the Great Northern Highway works and will allow for Hematite Drive to extend across the Pilbara Ports land (subject to appropriate agreements and approvals) to connect to this intersection. This will become the primary RAV route into the structure plan area, easing RAV traffic on Pinga Street.

Powell Road is currently being altered to terminate at its intersection with Dalton Road, to remove the existing level crossing for the BHP railway. A new roundabout being constructed at this intersection will align with the proposed vehicle access into the Southern Precinct allowing for RAV access to the wider locality.

5.4.2. RAV Networks

The TIA estimates up to 43% of vehicle movements are attributed to heavy vehicle movements and therefore the road network within Hedland Junction is designed for up to RAV10 vehicles in order to accommodate the end users of the estate.

The road networks as part of the existing stages of the estate have been constructed to allow RAV10 on all roads. This will be extended to all new roads within the future stages of Hedland Junction.

Pinga Street, connecting to Great Northern Highway provides for RAV vehicle access to and from the estate. The future Hematite Drive extension will provide an additional RAV access directly to Great Northern Highway.

The TIA recommends upgrades of the following existing streets at such time they are required to provide access to Hedland Junction (as detailed in

Section 6 Staging and Implementation). These are as follows:

- **Schillaman Street** – upgrade of carriageway to a sealed width of 7.2 metres when required to service lots fronting onto extension.
- **Moorambine Street** – upgrade of kerbs to allow left lane turn movements from Pinga Street.

5.4.3. Traffic Modelling

The TIA included in **Appendix D** details the outcomes of the assessment of the forecast traffic modelling for the Structure Plan area.

Trip generation for Hedland Junction has been undertaken based on site area as opposed the typical gross floor area (GFA) calculations as the future operations can vary significantly in terms of built form areas. Due to the focus on transport and logistics in the area many lots have large expanses of operational area which is not considered under the GFA calculation method. Further interrogation of trip rates was undertaken through surveys of the existing development within Hedland Junction.

Through this robust analysis a trip rate of 7.65 trips per hectare has been established. In total the area within the Hedland Junction Structure Plan is estimated to generate 14,834 vehicle trips per day / 1,182 peak hour trips.

The modelling shows that there is sufficient capacity within the existing road network within the Structure Plan area as well as the surrounding road network to accommodate the final build out of the Hedland Junction Structure Plan area.

The TIA recognises the staged approach for the development of Hedland Junction and confirms the road linkages associated with each stage are sufficient to carry the traffic generated by the introduction of the stage in combination with the existing stages.

5.4.4. Street Types

The primary consideration has been to achieve a street layout and street types that are suitable for industrial development and accommodate the necessary water management (as detailed in **section 5.5**).

Ensuring consistency with Development Control Policy 4.1 (DCP 4.1), all new roadways will to be a minimum of 10 metres in width (providing for a 5 metres wide traffic lane in each direction), with local widening at intersections to accommodate the turning movements of larger vehicles, namely RAV10 vehicles through the estate.

Given the road reserves within Hedland Junction will need to accommodate both the road pavement and open drainage swales, they will typically be either 40 metres or 60 metres wide (dependent on the size of the drainage channel required in particular roads. Final widths to be determined through detailed analysis at the subdivision stage).

5.4.5. Pedestrian and Cycle Network

The existing portions of Hedland Junction include several pedestrian and cycle connections consistent with the Town of Port Hedland's cycle strategy.

The delivery of the road network upgrades and extensions as part of the subdivision process will provide for pedestrian pathways to the same standard as those currently established within Hedland Junction.

5.5. WATER MANAGEMENT

A Local Water Management Strategy (LWMS) has been prepared by JDA Consultant Hydrologists for the Structure Plan area (refer **Appendix C**). The LWMS builds upon an approved LWMS previously prepared in 2011 (including consideration of areas now outside of the Headland Junction Structure Plan area) and has been prepared to support the Structure Plan as outlined in this report.

The LWMS provides the framework for the application of total water cycle management and develops on the principles within the Department of Water and Environmental Regulation's principles on Water Sensitive Urban Design as described in the Stormwater Management Manual and Better Urban Water Management.

The LWMS for Hedland Junction has been developed with the expertise and guidance of the then Department of Water (DoW), Water Corporation, MRWA and Town of Port Hedland to achieve the best practice in water management and sustainable development within the context of the Pilbara region. At the time of preparing the original LWMS for the WIESP, DoW had not published any guidelines to assist development of sites within the Pilbara region, as such, discussions between JDA and DoW in 2010 lead to guidance requirements which are detailed in the original LWMS and which in summary concluded that as Port Hedland has surface runoff issues due to erosion and sedimentation, post-development peak flow rates do not need to be detained to pre-development peak flow rates but post-development velocities should be minimised. The LWMS for Hedland Junction adopts the same approach.

Resulting from the agreed approach noted above, the key elements of the LWMS include:

- Drainage swales within road reserves across the development
- Relocation and formalisation of two (2) existing drain outlets passing through the Study Area
- Conveyance of minor and major rainfall events within swales to the downstream outlets of the Study Area and thereafter into South Creek (southern precinct) and supratidal flats (northern precinct)

The stormwater drainage system will manage a range of rainfall events up to the 1% AEP using a small, minor, and major design approach:

- **Small events** – 18% AEP is to be retained onsite and managed through the onsite landscaping (in particular, the road front landscape strip).
- **Minor events** – 10% AEP will utilise the swale system within the road reserves to convey rainfall to downstream outlets.
- **Major events** – 1% AEP will use the swale system to convey rainfall with flow spilling into the roads in key locations (at appropriately designated culverts)

Design of lots and roads within the Structure Plan area assists with the management of stormwater, and de-risking of development through:

- Grading of lots towards the street to allow rainfall to be collected within the swales.
- Lot levels at a minimum level of 6.0mAHD
- Minimum finished floor levels at a minimum of 6.3mAHD
- Grading of road reserves and associated swales towards the downstream outflow locations.

The LWMS also notes the need for a UWMP as a condition of subdivision approval and that it is to be developer-prepared, and address the following:

- Detailed stormwater management design including the size, location and design of swales, integrating major and minor flood management capability, landscape planting for the swales as related to stormwater function, specific details of local geotechnical investigations and their impact on stormwater design;
- Detail measures to reduce stormwater discharge velocities and prevent erosion and sediment transportation;
- Detail groundwater level monitoring data, management of groundwater levels and if any dewatering is required; and
- Agreed/approved measures to achieve water conservation and efficiencies of water use including sources of water for non-potable use, controls and management and operation of any proposed system; and management of subdivisional works, including management of soil/sediment (dust).

Further details in relation to drainage operation and maintenance, and ongoing monitoring, can be found at Section 5.4 and 5.5 of the LWMS included at **Appendix C**.

5.6. LANDSCAPE DESIGN

A landscaping plan was prepared by UDLA (**Appendix G**) to support the Structure Plan noting landscaping within the public realm being:

- **Internal Local Roads**: low maintenance swale outcome to shoulders of road.
- **Highway Buffer**: Local grasses and trees adjacent the highway and local shrubbery adjacent to the lots.
- **Major Entries**: rock/gravel mounding supported by depressions for planting of local tree special and local shrubbery/grass species.

Future landscaping is to be undertaken having regard to landscaping undertaken as part of the existing stages of Hedland Junction to provide a consistent approach and visual outlook across the estate.

Landscaping within the private realm is required on all lots within Hedland Junction in accordance with the Hedland Junction Design Guidelines which outlines the requirements for a landscape/nature strip along all street frontages (as detailed in **Figure 10)**. The design guidelines set out the following requirements:

- Provision of a mandatory 3 metre landscape strip to be provided by the developer.
- Landscaping and installation of reticulation to the nature strip areas between the table drain and lot boundaries to achieve a uniform quality streetscape within the Estate.
- Landscaping and installation of reticulation infrastructure to the mandatory 3 metre landscaping strip across the frontages of lots located within the estate. Additional landscaping strip of 3 metres in width to be provided for secondary street frontages of corner lots with installation of reticulation.

- The lot owner is responsible for the ongoing maintenance of the landscape strip on the lot and nature strip.
- A detailed landscaping plan shall be provided for all internal landscaping as part of the design guidelines assessment and development application.
- The lot owner is responsible for the ongoing maintenance of the landscape strip on the lot and nature strip.
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- A detailed landscaping plan shall be provided for all internal landscaping as part of the design guidelines assessment and development application.

Figure 7 – Local Road Landscaping

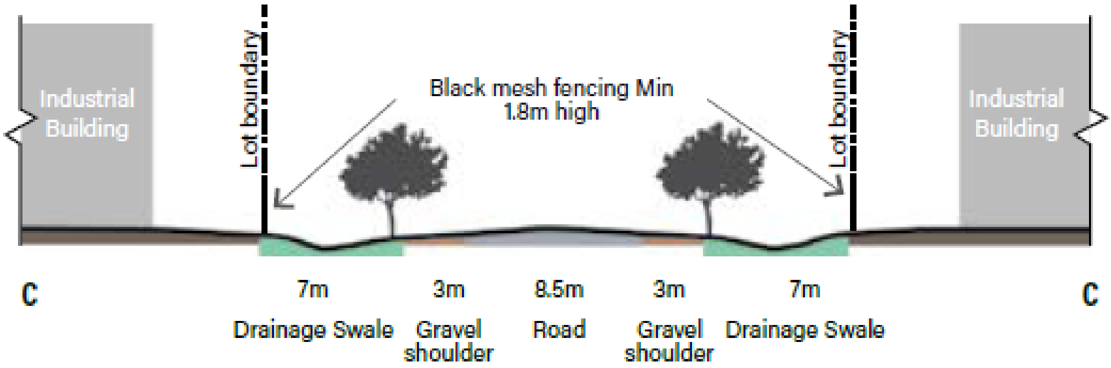


Figure 8 – Highway Buffer Landscaping

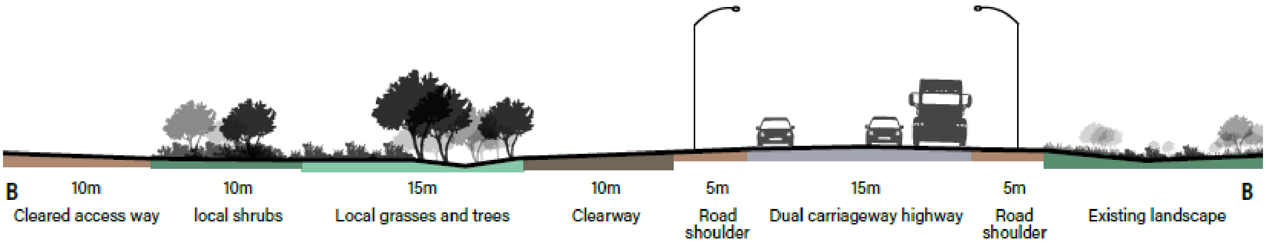


Figure 9 – Entry Statement Landscaping

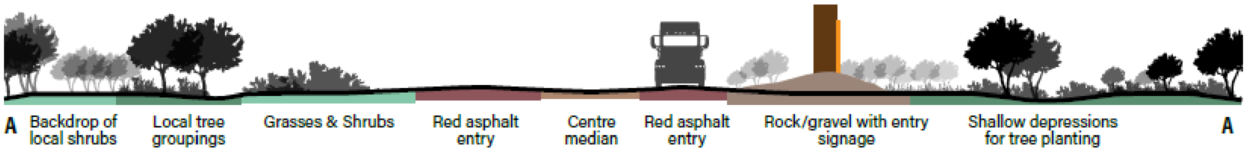
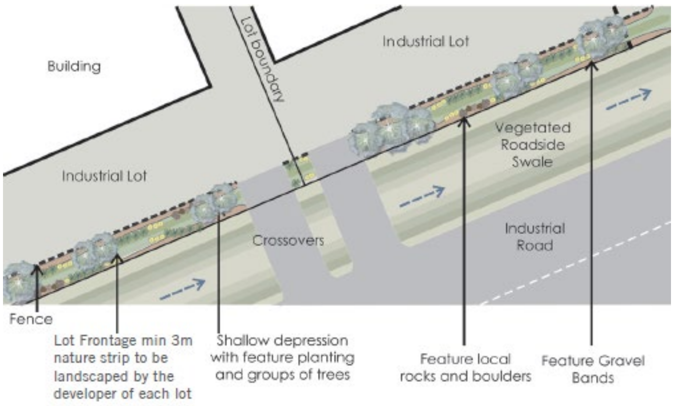


Figure 10 – Private Lot landscaping



5.7. BUSHFIRE MANAGEMENT

A Bushfire Management Plan (BMP) has been prepared for the Structure Plan area (refer to **Figure 12** and **Appendix F**) in accordance with State Planning Policy 3.7 Planning in Bushfire-Prone Areas (SPP 3.7). The BMP provides a compliant bushfire management response for the Structure Plan area based on the indicative design and the proposed post-development scenario for Hedland Junction.

The BMP identifies the BAL ratings which apply across the site along with the identification of Asset Protection Zones. Most notably, the BMP determines that the site can be readily managed through a standard management response as outlined in the Bushfire Protection Guidelines and AS3959.

The bushfire hazard that could threaten the development is primarily concentrated in the bushland adjacent to the Structure Plan Area. This is identified as Class G: Grassland and represents a permanent threat to specific areas of the development as these areas are anticipated to remain undeveloped.

It is considered that the bushfire risk to the proposed subdivision can be adequately managed through location and zoning, appropriate siting, and design of development, as well as the proposed vehicular access and water supply which will be provided as part of future development.

5.7.1. Separation and Asset Protection

The BAL contour map indicates that eleven (11) of the proposed lots (or parts of the lots) are likely to be subject to an extreme level of bushfire risk. APZs of 8 metres should be established on these lots to ensure that the potential radiant heat impact of a fire on any future development will not exceed BAL-29 and that a defendable space is provided for firefighting. The implementation of the APZs will be undertaken via the Hedland Junction Design Guidelines.

The APZs will require the siting of industrial development outside of these areas. As the APZs on the affected lots are located along the rear or side boundaries this is readily achievable.

Further to the APZs, onsite fuel management of low fuel and grassland areas will need to be managed and maintained until they are transferred to the respective landowners, at which time landowners will provide a firebreak consistent with the Town of Port Hedland Fire Breaks Notice 2019. This includes the management of the drainage basins identified as Public Open Space.

5.7.2. Access

The main access to the subject land is provided by a network of regional roads which include Great Northern Highway, Wallwork Road and Powell Road. These also connect via Pinga Street to the Great Northern Highway bypass to the north.

An internal road network is proposed which will provide for at least two (2) different access and egress routes from each of the proposed lots. This includes the construction of a temporary emergency access way onto Great Northern Highway until further stages of the development are constructed.

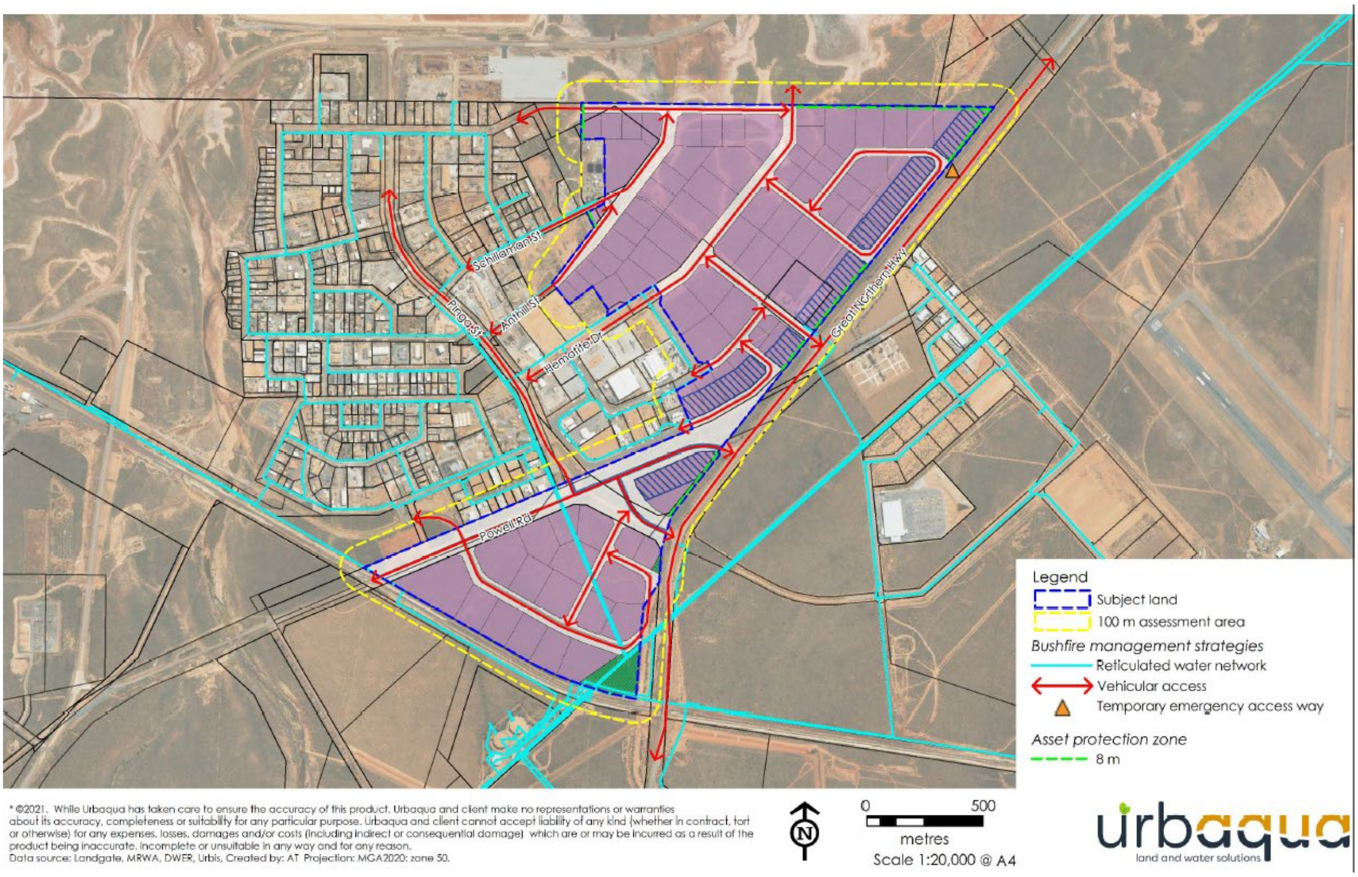
Figure 11 – Bushfire Risks

Class G: Grassland – Tussock Grassland

Low threat exclusion – cleared for development

Low threat exclusion – drainage swale

Figure 12 – Bushfire Management Plan



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Data source: Landgate, MRWA, DWER, Urbis, Created by: AT Projection: MGA2020: zone 50.

6. STAGING AND IMPLEMENTATION

It is anticipated that the development of the Structure Plan be undertaken within seven (7) stages as set out in **Figure 13**. The staging of the Structure Plan is largely influenced by the market demand, site levels and earthworks and the delivery of infrastructure upgrades, such as road connections.

A flexible approach to staging and subdivision is required to ensure the implementation of the structure plan is achievable. The staging of the Structure Plan may change dependant on market demand and costs associated with delivery of lots and infrastructure.

The following sets out the indicative staging proposed for Hedland Junction along with the road network anticipated to be established as part of the development of each stage.

Stage 1: Lots subject to WAPC approval 157742.

Site preparations for these lots has been undertaken and construction of roads will occur in the second half of 2022. This stage will include the extension of Hematite Drive and Quarry Road to their intersection, the extension of Tailings Elbow to Quarry Road and the continuation of Phosphorus Street.

Upon completion of the roads these lots will be titled, and the roads ceded to the appropriate authority. Development is anticipated to begin mid-late 2022 (based on developer readiness).

Stage 2: Lots subject to WAPC approval 160996 and application 161474. Lots fronting Hematite Drive and Quarry Road.

The development of the two (2) southern lots is subject to the formalisation of the road closure of the intersection nib of “Commodity Road” a previously planned road that is no longer required under the new Structure Plan layout.

Stage 3: Lots fronting Hematite Drive from the intersection of Quarry Road heading north to the northern edge of the structure plan area.

This stage will include the extension of Hematite Drive north to the edge of the structure plan area. Hematite Drive is anticipated to continue north to intersect with Great Northern Highway. The connection across the Pilbara Ports land is subject to finalisation of funding, appropriate land agreements and required approvals being achieved.

This stage is subject to receipt of funding and agreement from Pilbara Port Authority and Main RoadsWA to provide the connection of Hematite from the north of the Structure Plan area to Great Northern Highway. Timeframes associated with this stage may be brought forward as a result of receipt of funding and buy in from state agencies.

Stage 4: Lots east of Hematite Drive and north of Stage 2 lots.

This stage will include the construction of a local road (Silicon Road) to service the proposed lots. The proposed road will culminate in a cul-dec-sac in the interim prior to connecting to the Stage 5 loop road.

The intersection with Pinga Street and Hematite Drive will require upgrading to suit the design vehicles (PBS TriDrive Quad Axle Level 4B.3) after Hematite Drive is extended to Great Northern Highway. Design and timing for the upgrading of the intersection will be guided by the traffic assessment that informs Stage 4 of the Structure Plan’s development’s subdivision application.

Stage 5: Lots east of Hematite Drive and north of Stage 4 lots.

This stage will include the construction of a local road (Metallic Loop) connecting with Silicon Road to service the proposed lots.

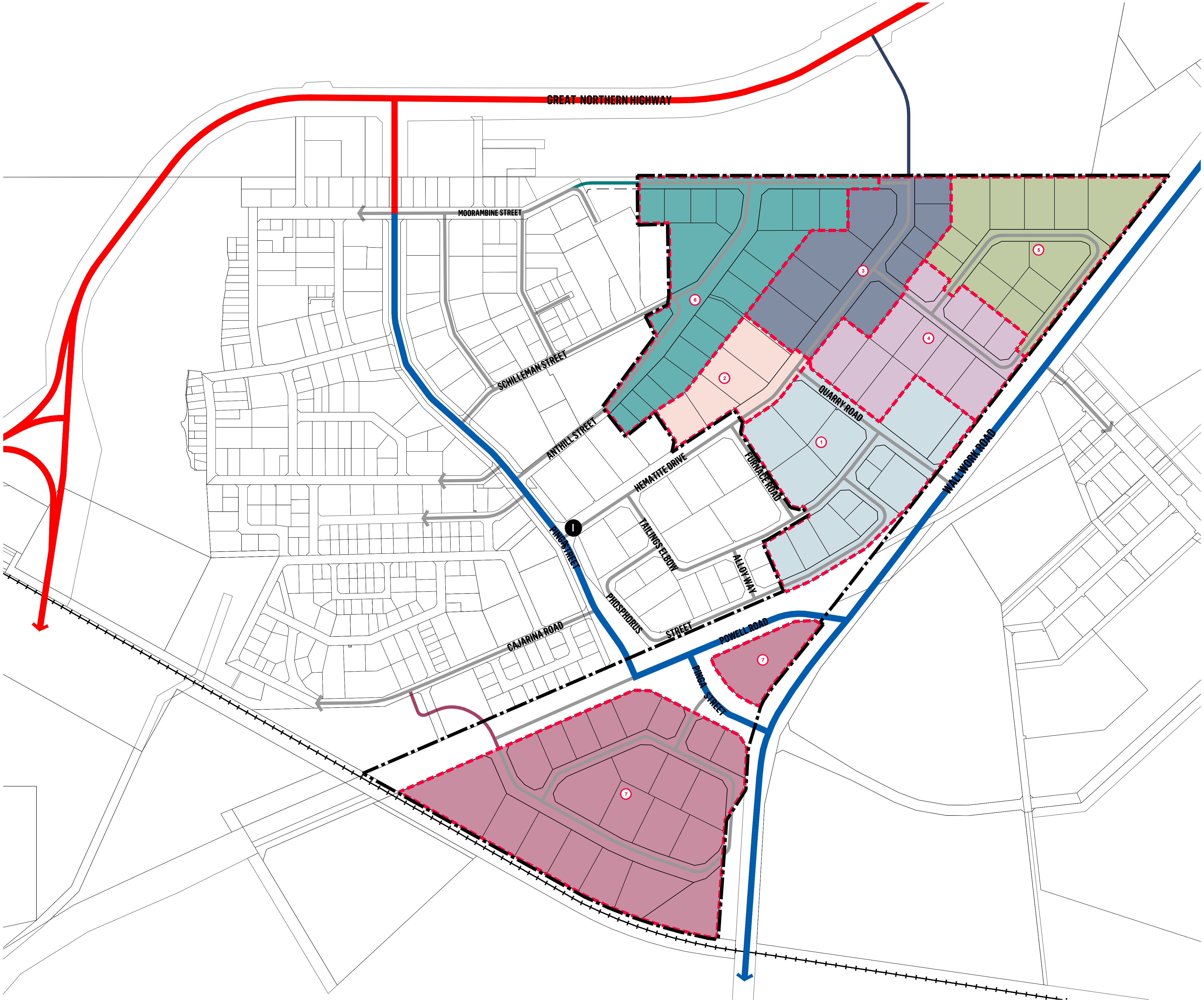
Stage 6: Lots to the west of Hematite Drive and stages 2 and 3.

The approach for this portion of land is currently uncertain and will be subject to market demand. This may result in the stage being further broken down into an additional 2 stages (Stage 6A and 6B).

This stage will include the extension of Moorambine Street from the western edge of the structure plan to the intersection with Hematite Drive (either in a single stage or in two stages) and the upgrade and extension of Anthill Street north to the intersection with Moorambine Street. The intersection of Anthill and Schilleman Street would also be undertaken as part of this stage.

Stage 7: Lots within the Southern Precinct.

The timeframes associated with the development of this cell are currently unknown and will be subject to market demand. This stage will include the construction of a local loop road (Wheelarra Circuit) and a local entrance road from the Pinga Street link (Whaleback Entrance). Upgrades to Dalton Road and the intersection of Dalton Road and Cajarina Road may need to be undertaken at the time the Southern Precinct is developed.



LEGEND

-·-· STRUCTURE PLAN AREA
━ PRIMARY DISTRIBUTOR ROAD
━ DISTRICT DISTRIBUTOR ROAD
━ LOCAL ACCESS ROAD
┼┼┼ RAILWAY LINE

STAGING

- - - STAGING BOUNDARY
🟦 STAGE 1: 30.30HA
🟧 STAGE 2: 9.81HA
⬛ STAGE 3: 21.87HA
🟪 STAGE 4: 20.65HA
🟩 STAGE 5: 25.81HA
🟦 STAGE 6: 31.26HA
🟥 STAGE 7: 58.64HA

ROAD LINK BY STAGE

━ STAGE 3 ROAD LINK
━ STAGE 6 ROAD LINK
━ STAGE 7 ROAD LINK

NOTE

I THE INTERSECTION WITH PINGA STREET AND MEMATITE DRIVE WILL REQUIRE UPGRADING TO SUIT THE DESIGN VEHICLES (PBD TRI DRIVE QUAD AXLE LEVEL 4B.3) AFTER HEMATITE DRIVE IS EXTENDED TO GREAT NORTHERN HIGHWAY. DESIGN AND TIMING FOR THE UPGRADING OF THE INTERSECTION WILL BE GUIDED BY THE TRAFFIC IMPACT ASSESSMENT (TIA) THAT INFORMS STAGE 4 OF THE STRUCTURE PLAN'S DEVELOPMENT'S SUBDIVISION APPLICATION.

II FUTURE INTERSECTION AND INFRASTRUCTURE UPGRADES SHOULD BE INVESTIGATED AND CONFIRMED IN THE TIA'S PREPARED AND LODGED WITH EACH STAGE

URBIS

Hedland Junction - Staging Plan

Wedgefield Industrial Estate

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DISCLAIMER

CLIENT
Development WA

1:12,500 @ A3
0 50 100 250m

PROJECT NO.
P0006040

DATE
24.10.23

DRAWING NO.
23

REVISION
C

ENDORSEMENT PAGE

This Structure Plan is prepared under the provisions of the Town of Port Hedland Local Planning Scheme No.7.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

____ Date

Signed for and on behalf of the Western Australian Planning Commission:

____

An officer of the Commission duly authorised by the Commission pursuant to section 16 of the Planning and Development Act 2005 for that purpose, in the presence of:

____ Witness

____ Date

____________________________ Date of Expiry

APPENDIX A – CERTIFICATE(S) OF TITLE

REGISTER NUMBER
9004/DP411242

DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**2/6/2017**

WESTERN AUSTRALIA

VOLUME	FOLIO
2927	**100**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9004 ON DEPOSITED PLAN 411242

REGISTERED PROPRIETOR:

(FIRST SCHEDULE)

WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 6, 40 THE ESPLANADE, PERTH
(AF N627522) REGISTERED 19/5/2017

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR WATER PURPOSES TO WATER CORPORATION SEE DEPOSITED PLAN 411242
2. EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR ELECTRICITY PURPOSES TO REGIONAL POWER CORPORATION SEE DEPOSITED PLAN 411242

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

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

STATEMENTS:

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

SKETCH OF LAND:	DP411242
PREVIOUS TITLE:	2871-26, 2874-74
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY:	WESTERN AUSTRALIAN LAND AUTHORITY

NOTE 1: P036003 DEPOSITED PLAN 422533 LODGED

REGISTER NUMBER
5873/DP192054

DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME **LR3053** FOLIO **595**

RECORD OF QUALIFIED CERTIFICATE
OF
CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997
NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 5873 ON DEPOSITED PLAN 192054

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: TOWN OF PORT HEDLAND OF CIVIC CENTRE, MCGREGOR STREET, PORT HEDLAND

(XE G023454) REGISTERED 1/1/1995

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

1. G023454 RESERVE 43881 FOR THE PURPOSE OF SERVICE CLUB REGISTERED 1/1/1995.
    G023454 MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED. WITH POWER TO LEASE FOR ANY TERM NOT EXCEEDING 21 YEARS, SUBJECT TO THE CONSENT OF THE MINISTER FOR LANDS. REGISTERED 1/1/1995.
2. H011410 LEASE TO LIONS CLUB OF SOUTH HEDLAND INC OF POST OFFICE BOX 2160, SOUTH HEDLAND EXPIRES: SEE LEASE. REGISTERED 27/1/1999.

Warning:
(1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND:	LR3053-595 (5873/DP192054)
PREVIOUS TITLE:	LR3103-904

END OF PAGE 1 - CONTINUED OVER

PROPERTY STREET ADDRESS:	17 SCHILLAMAN ST, WEDGEFIELD.
LOCAL GOVERNMENT AUTHORITY:	TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY:	DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

NOTE 1:	A000001A	CORRESPONDENCE FILE 873/1967V2.
NOTE 2:		LAND PARCEL IDENTIFIER OF PORT HEDLAND TOWN LOT/LOT 5873 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 5873 ON DEPOSITED PLAN 192054 ON 22-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 3:		THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.

REGISTER NUMBER	
5859/DP191016	
DUPLICATE EDITION **N/A**	DATE DUPLICATE ISSUED **N/A**

WESTERN AUSTRALIA

VOLUME	FOLIO
LR3099	**743**

RECORD OF CERTIFICATE
OF
CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997
NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 5859 ON DEPOSITED PLAN 191016

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: LEASEHOLD

PRIMARY INTEREST HOLDER: WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH

(LC L708221) REGISTERED 16/8/2011

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

1. L708221 LEASE. SUBJECT TO THE TERMS AND CONDITIONS AS SET OUT IN THE LEASE. REGISTERED 16/8/2011.
    O323402 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    O323403 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    O986936 EXTENSION OF LEASE. REGISTERED 21/12/2021.
2. M642176 MEMORIAL. CONTAMINATED SITES ACT 2003 REGISTERED 20/5/2014.
3. N967575 MEMORIAL. LAND ADMINISTRATION ACT 1997. SECTION 17. REGISTERED 17/8/2018.

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

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND: LR3099-743 (5859/DP191016)

END OF PAGE 1 - CONTINUED OVER

PREVIOUS TITLE: LR3099-743
PROPERTY STREET ADDRESS: LOT 5859 SCHILLAMAN ST, WEDGEFIELD.
LOCAL GOVERNMENT AUTHORITY: TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY: DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

NOTE 1:	A000001A	SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES
NOTE 2:		LAND PARCEL IDENTIFIER OF PORT HEDLAND TOWN LOT/LOT 5859 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 5859 ON DEPOSITED PLAN 191016 ON 29-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 3:		THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.
NOTE 4:	L708221	CORRESPONDENCE FILE 00264-2008-06RO

REGISTER NUMBER	
5874/DP192054	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME	FOLIO
LR3103	**905**

RECORD OF CERTIFICATE
OF
CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997
NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 5874 ON DEPOSITED PLAN 192054

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: LEASEHOLD

PRIMARY INTEREST HOLDER: WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH

(LC L708221) REGISTERED 16/8/2011

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

1. L708221 LEASE. SUBJECT TO THE TERMS AND CONDITIONS AS SET OUT IN THE LEASE. REGISTERED 16/8/2011.
    - O323402 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    - O323403 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    - O986936 EXTENSION OF LEASE. REGISTERED 21/12/2021.
2. N967575 MEMORIAL. LAND ADMINISTRATION ACT 1997. SECTION 17. REGISTERED 17/8/2018.

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

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND:	DP192054
PREVIOUS TITLE:	LR3103-905

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE

REGISTER NUMBER: 5874/DP192054   VOLUME/FOLIO: LR3103-905

PROPERTY STREET ADDRESS: 19 SCHILLAMAN ST, WEDGEFIELD.
LOCAL GOVERNMENT AUTHORITY: TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY: DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

NOTE 1: L708221 CORRESPONDENCE FILE 00264-2008-06RO

REGISTER NUMBER	
502/DP41485	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME **LR3155** FOLIO **996**

RECORD OF CERTIFICATE
OF
CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997
NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 502 ON DEPOSITED PLAN 41485

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: LEASEHOLD

PRIMARY INTEREST HOLDER: WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH

(LC L708221) REGISTERED 16/8/2011

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

1. L708221 LEASE. SUBJECT TO THE TERMS AND CONDITIONS AS SET OUT IN THE LEASE. REGISTERED 16/8/2011.
    - O323402 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    - O323403 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    - O986936 EXTENSION OF LEASE. REGISTERED 21/12/2021.
2. N967575 MEMORIAL. LAND ADMINISTRATION ACT 1997. SECTION 17. REGISTERED 17/8/2018.

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

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND:	DP41485
PREVIOUS TITLE:	LR3124-271

END OF PAGE 1 - CONTINUED OVER

PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY:	DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

NOTE 1:	K842929	SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES
NOTE 2:	L708221	CORRESPONDENCE FILE 00264-2008-06RO

REGISTER NUMBER	
9001/DP404312	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME	FOLIO
LR3164	**983**

RECORD OF CERTIFICATE OF CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 9001 ON DEPOSITED PLAN 404312

STATUS ORDER AND PRIMARY INTEREST HOLDER:

(FIRST SCHEDULE)

STATUS ORDER/INTEREST: LEASEHOLD

PRIMARY INTEREST HOLDER: WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH

(LC L708221) REGISTERED 16/8/2011

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

1. L708221 LEASE. SUBJECT TO THE TERMS AND CONDITIONS AS SET OUT IN THE LEASE. REGISTERED 16/8/2011.
    - O323402 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    - O323403 LEASE OF CROWN LAND AND AMALGAMATION ORDER LAND INCLUDED INTO THE LEASEHOLD ESTATE. REGISTERED 15/1/2020.
    - O986936 EXTENSION OF LEASE. REGISTERED 21/12/2021.

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

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND:	DP404312
PREVIOUS TITLE:	LR3161-677
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE

REGISTER NUMBER: 9001/DP404312 VOLUME/FOLIO: LR3164-983

LOCAL GOVERNMENT AUTHORITY: TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY: DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

NOTE 1:	M980320	CORRESPONDENCE FILE 00264-2008-10RO
NOTE 2:	O109870	DEPOSITED PLAN 415099 LODGED

REGISTER NUMBER	
5858/DP191016	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME **LR3099** FOLIO **742**

RECORD OF QUALIFIED CERTIFICATE
OF
CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997
NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE OF WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 5858 ON DEPOSITED PLAN 191016

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: TOWN OF PORT HEDLAND

(XE F613670) REGISTERED 15/7/1994

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

1. F613670 RESERVE 43115 FOR THE PURPOSE OF DRAINAGE REGISTERED 15/7/1994.
   F613670 MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED. REGISTERED 15/7/1994.
2. M642176 MEMORIAL. CONTAMINATED SITES ACT 2003 REGISTERED 20/5/2014.

Warning:
(1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND:	LR3099-742 (5858/DP191016)
PREVIOUS TITLE:	LR3099-742
PROPERTY STREET ADDRESS:	LOT 5858 SCHILLAMAN ST, WEDGEFIELD.
LOCAL GOVERNMENT AUTHORITY:	TOWN OF PORT HEDLAND
RESPONSIBLE AGENCY:	DEPARTMENT OF PLANNING, LANDS AND HERITAGE (SLSD)

END OF PAGE 1 - CONTINUED OVER

NOTE 1:	A000001A	CORRESPONDENCE FILE 2085/1992.
NOTE 2:		LAND PARCEL IDENTIFIER OF PORT HEDLAND TOWN LOT/LOT 5858 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 5858 ON DEPOSITED PLAN 191016 ON 29-AUG-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 3:		THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE.

APPENDIX B – ENVIRONMENTAL MANAGEMENT PLAN (2011)

CLIENTS | PEOPLE | PERFORMANCE

LandCorp

Report for Port Hedland Industrial Land LIA 3,4,5, General Industry/Transport Part A and Part B

Preliminary Environmental Impact Assessment and Biological Survey

October 2009

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Contents

Table Index

Appendices

Executive Summary

Background and Scope

LandCorp has commissioned GHD Pty Ltd (GHD) to complete a combined Preliminary Environmental Impact Assessment (PEIA) and Biological Survey for the proposed subdivision and development of Light Industry Area (LIA) 3,4,5, and the General Industry/Transport Area Part A. An additional flora and fauna survey was conducted in June 2009 of the Transport Use Area Part B at Wedgefield and the Port Hedland Port Authority land for the new loop road. These areas are located approximately 10km south of Port Hedland.

LandCorp is investigating opportunities to deliver further industrial land in Port Hedland to meet an increasing and demonstrated demand from the expanding mining, export, transport, construction and service industries.

The Draft Port Hedland Land Use Master Plan (LUMP) has identified the following Crown Land Areas to provide for industrial growth.

Proposed Light Industrial Area (LIA) Subdivisions are:

LIA 2 (Infill)	8.1 ha at Iron Ore and Pinnacles Streets, Wedgefield
LIA 3 (Infill)	10.4 ha at Pinga Street and Cajarina Roads, Wedgefield
LIA 4 (Infill)	13.3 ha at Cajarina and Dalton Roads, Wedgefield
LIA 5 (Broad acre)	58 ha bounded by Great Northern Highway, Wallwork Road and Goldsworthy Railway, Wedgefield

The above parcels are proposed to be subdivided into lots between 2000m^2 and 8000m^2 for light industrial development.

Proposed Transport Land Subdivisions (Part A and B) are:

- 271 ha between the existing Wedgefield Industrial area and Great Northern Highway.

GHD has undertaken a desktop investigation and site survey of the proposed LIAs in order to ensure that all potential environmental and social issues relating to the proposed land development have been considered.

The field survey for the proposed LIA 3, 4, 5 and the General Industry/Transport Area Part A was undertaken by a qualified ecologist in June 2008. An additional survey of Transport Use Area Part B and the Port Hedland Port Authority land for the new loop road was undertaken in June 2009.

The field assessment included a Level 2 Flora survey (as per EPA Guideline 51) which included:

- Surveying of 50m x 50m quadrats, within representative vegetation types;
- Surveying along targeted and random transects throughout the sites;
- Development of a full flora list;

- Assessment of the vegetation condition and any threatening processes.

Fauna was recorded opportunistically, through examination of scats, tracks, burrows and with a visual and aural survey. An additional visit was made to the area on dusk to attempt to observe any nocturnal species.

Survey and Assessment Outcomes

- The study areas were found to contain similar vegetation across them. The vegetation community is as expected for the area as per existing regional vegetation mapping (Beard, 1974) and remains well conserved.
- Vegetation was in excellent to pristine condition over much of the survey area, with small patches having been degraded by previous activities, tracks and weed invasion.
- No Declared Rare or Priority flora species were identified.
- Evidence of the Mulgara, a fauna species of conservation significance, was identified during the recent field assessment.
- Tidal mudflats occur in the northern boundary of Transport Area B.
- No site contamination or acid sulphate soils are evident or likely to be present.
- Four aboriginal heritage sites have been previously recorded within the study areas.
- Adjacent land uses are compatible with the proposed development.

Actual and Potential Impacts

- Clearing of approximately 353 ha native vegetation in good to excellent condition
- The vegetation of the area is well represented in the Pilbara region, with approximately 196,372.2 ha remaining undisturbed.
- Clearing of fauna habitat as above. The areas are likely to support a range of reptiles which will be killed or displaced as a result of vegetation clearing and land disturbance.
- Clearing of fauna habitat which could support the conservation significant Mulgara. The significance of the impact on the Mulgara would need to be further investigated and the impacts relate specifically to Transport Area B. Further to any development within the Transport Area B, LandCorp will undertake Level 2 fauna assessments and will liaise with DEC regarding potential management of any Mulgara found.
- Post-development impacts on adjacent bushland. The operation of new industrial lots will have potential impacts on bushland remaining in the area. The impacts will primarily be on fauna and issues could include:
  - Light overspill;
  - Litter;
  - Noise and vibration disturbance;
  - Dust production;
  - Increased predators; and
  - Increased traffic.

These issues have the potential to disturb or harm fauna remaining in the adjacent areas.

Physical and Social Impacts

- Alteration to surface drainage. As a result of vegetation clearing and the development of building and hard stands, there will be a reduction in infiltration to the ground and an increase in runoff from the sites. This runoff will be collected in drainage systems and most likely transferred to South Creek.
- Nuisance impacts such as dust or pollutant production and noise and vibration will occur during the construction phases of the subdivision and during development of individual lots. Given the industrial location, it is likely that noise and vibration will not be a significant issue, however some caretaker residences and transient workforce accommodation are present within the existing Wedgefield area. LandCorp has considered a range of planning and development measures in order to mitigate noise risks to these receptors.
- Additional traffic will be generated as a result of new businesses. This will create impacts of noise, safety and possible delays, especially as a result of large turning movements.
- The addition of industrial lots closer to Great Northern Highway will have the potential to create a less desirable visual impact for tourists and travellers. Due to the nature of industrial lots and the likelihood of storage of equipment outside, such areas can be messy and unsightly. Some screening may be required to GNH.

Recommendations

Sensitive design of the proposed developments has the potential to mitigate a number of the potential impacts above. Suitable design and planning controls can reduce the impacts related to:

- Degradation of adjacent bushland;
- Visual impact;
- Changes to hydrology;
- Noise and pollution risks to adjacent land occupiers;
- Traffic risks.

Initial fauna surveys have indicated evidence for the presence of Mulgara, listed as Vulnerable under the EPBC Act, within parts of Transport Area B. Given the likely presence of this species within the northern part of the study area, the project may require referral to the DEWHA for assessment under the EPBC Act and/or referral to the EPA under the Environmental Protection Act.

Further detailed fauna investigations (Level 2 fauna survey) would be required to verify the population size of this species within the study area. This investigation will be undertaken prior to any development of the high risk area of Transport Area B.

Careful management of vegetation clearing and development of a fauna relocation program could reduce the risk of impacts to any Mulgara resident on the site.

1. Introduction

LandCorp has commissioned GHD Pty Ltd (GHD) to complete a combined Preliminary Environmental Impact Assessment (PEIA) and Biological Survey for the proposed subdivision and development of Light Industry Area (LIA) 3,4, and 5, the General Industry/Transport Area Part A and Part B and the Port Hedland Port Authority land for a new access road. These areas are located approximately 10km south of Port Hedland. The study areas are shown in Figure 1, Appendix A.

LandCorp requires a biological survey of the study areas. The purpose of the survey is to provide an appropriate examination and description of the receiving environment to ensure that all aspects of biological/ecological significance are identified and recorded.

This combined PEIA and Biological Survey seeks to determine and assess the potential environmental impacts of the proposed works within the project area. Recommendations to LandCorp on the actions and requirements necessary for completion of this project with legislative guidelines are also provided.

1.1 Background

LandCorp is investigating opportunities to deliver further industrial land in Port Hedland to meet an increasing and demonstrated demand from the expanding mining, export, transport, construction and service industries.

The Draft Port Hedland Land Use Master Plan (LUMP) has identified the following Crown Land Areas to provide for industrial growth.

Proposed Light Industrial Area (LIA) Subdivisions are:

LIA 2 (Infill)	8.1 ha at Iron Ore and Pinnacles Streets, Wedgefield
LIA 3 (Infill)	10.4 ha at Pinga Street and Cajarina Roads, Wedgefield
LIA 4 (Infill)	13.3 ha at Cajarina and Dalton Roads, Wedgefield
LIA 5 (Broad acre)	58 ha bounded by Great Northern Highway, Wallwork Road And Goldsworthy Railway, Wedgefield

The above parcels are proposed to be subdivided into lots between 2000m^2 and 8000m^2 for light industrial development.

Proposed Transport Land Subdivisions are:

- Transport Area Part A - 101 ha between Wedgefield Industrial area and Great Northern Highway;
- Transport Area Part B - 170 ha adjacent to Transport Area Part A, between Wedgefield Industrial area and Great Northern Highway; and

The above transport areas are proposed to be subdivided into lots between 1.0 ha to 2.5 ha for general industry/transport use development. A new loop road is proposed on Port Hedland Port Authority land, part of Transport Area Part B.

This report focuses on the environmental aspects of LIA 3,4,5, the General Industry/Transport areas Part A and Part B and the Port Hedland Port Authority land for the new loop road. A separate report has been prepared for LIA 2.

1.2 Scope of the Report

This PEIA and Biological Survey has been prepared according to the scope of works requested by LandCorp and includes a desktop assessment, contaminated sites assessment and a field biological survey.

1.2.1 Desktop Assessment

The desktop assessment considered all biological constraints, which may be in, or adjoining the project area. This included, but was not limited to, an examination of the following matters:

- Adjoining land use
- Broad vegetation types
- Threatened Ecological Communities (TECs)
- Declared Rare and Priority flora
- Threatened or otherwise protected fauna
- Remnant Vegetation in relation to statutory requirements;
- Listed wetlands
- Public Drinking Water Source Areas (PDWSA)
- Other lists of significant areas

1.2.2 Contaminated Sites Assessment

The contaminated site assessment involved the following:

- Review of existing investigations and other data available made available by LandCorp;
- A search of historical title deeds to determine past owners of the site, and the likely associated site uses;
- A review, on a 10-year basis, of historical aerial photographs showing the site, to assist in establishing the patterns of site development over time;
- A review of any available historical site plans that may be provided to GHD that will help identify the nature and location of any potential contaminant sources at the site;
- A review of information made available to GHD, which documents historical spills, waste disposal, or other potentially contaminating activities at the site;
- A review of regional geology and hydrogeology, which will assist in determining the likely soil type and groundwater regime at the site, including a review of Department of Water Registered Bore Search to ascertain local hydrogeological conditions;

- A Department of Consumer and Employment Protection Dangerous Goods Licence Freedom of Information Search will be requested to ascertain whether underground storage tanks (USTs) are present at the property;
- A search of the Department of Environment and Conservation *Contaminated Sites Register* to ascertain whether the site or surrounding properties have been registered as potentially contaminated sites;
- Contact local planning authorities to determine whether potential environmental issues are likely to exist at the site.

1.2.3 Field Biological Survey

The field survey will seek to verify the desktop study and provide a detailed assessment of the existing environment in the project areas and its relationship to adjoining areas. The survey included the following:

Vegetation and Flora

- An inventory of the vascular plant species in the survey area;
- A review of, and search for, native plant species considered to be rare or potentially endangered. Locations of Declared Rare or Priority Flora will be accurately mapped at a suitable scale. Other species of interest, including those of limited distribution or outliers from their known range, will be discussed.
- An inventory of dominant exotic plants and also including declared noxious plants and environmental weed species;
- Advice on whether weeds are likely to spread to and result in environmental harm to adjacent areas of native vegetation that is in good or better condition;
- A description and location, including mapping, of plant communities.
- A rating of condition of the vegetation communities or areas using a published rating scale (Western Australian Government, 2000);
- A review of the local and regional significance of the plant communities in terms of their intrinsic value, extent, rarity and condition;
- An flora assessment with regards to EPA Guidance Statement No. 51;
- An assessment of the proposed clearing against the 10 clearing principles. Each principle shall be properly assessed in accordance with the Department of Environment and Conservation’s (DEC’s) Guideline to Assessment – Clearing of Native Vegetation.

Fauna

- An inventory of the vertebrate fauna species in the survey area. This does not require a trapping program but will require a targeted search and opportunistic recording of species;
- A review of the fauna species considered to be rare or in need of special protection;
- A review of the presence and abundance of pest, declared or feral animals;
- Habitats of significance and the risks to fauna from loss of the habitat.

Wetlands and Drainage

- A description of existing surface drainage patterns with respect to topography, and to flora and fauna communities;
- An inventory and brief description of any wetlands and their conservation value.

Contaminated Sites

- A brief examination of the area with regard to previous dumping, any surface aspects such as drum storage, obvious contamination.
- Photographs of any potential issues/areas of concern.

2. Desktop Investigation

2.1 Legal Identification

Table 1 Legal Identification

Site	Identification	
LIA 3	Street Address	No Street Address Information Available
	Description	Unallocated Crown Land
	Local Government Authority	Town of Port Hedland
	Ownership	State of Western Australia
LIA 4	Street Address	No Street Address Information Available
	Description	Unallocated Crown Land
	Local Government Authority	Town of Port Hedland
	Ownership	State of Western Australia
LIA 5	Street Address	No Street Address Information Available
	Description	Unallocated Crown Land
	Local Government Authority	Town of Port Hedland
	Ownership	State of Western Australia

2.2 Site Description

The layout and location of the sites is displayed in Figure 1, with site description provided in Table 2.

Table 2 Site Descriptions

Site	Identification
LIA3	The approximate 104,00m^2 and comprises of vegetation common to the Pilbara region. During the site visit no areas of particular interest (such as rubbish or earth disturbance) where noted at this site.
LIA4	The site is approximately 133,300m^2 and comprises of vegetation common to the Pilbara region. During the site visit no areas of particular interest (such as rubbish or extensive earth disturbance) where noted at this site. However the site does contain some cleared areas including vehicle tracks and 4 trenches (unknown use).
LIA5	The site is approximately 580,000m^2 and comprises of vegetation common to the Pilbara region. During the site visit no areas of particular interest (such as rubbish or extensive earth disturbance) where noted at this site. However the site does contain cleared areas including vehicle tracks, overhead power cable clearings and underground water pipes.
Transport	The site is approximately 1,010,000 m^2 and comprises native vegetation.

Site	Identification
Part A	No significant areas of previous disturbance were noted, apart from a small, fenced area which may have been a horse yard.
Transport Part B	The site is approximately 1,700,000 m^2 and comprises predominately of native vegetation. Disturbances to the site include a petrol station, roads and tracks and the existing Wedgefield Industrial area.

In general all the sites display similar levels of disturbance with previous indicators of human activity including cleared areas, roads and tracks, industrial development, petrol station and small amounts of dumped rubbish including old fuel/oil drums, concrete bonded fencing and small areas of pushed up earthen material.

2.3 Climate

The climate of the Pilbara region is arid (semi-desert) tropical with highly variable rainfall, which falls mainly in summer. Cyclonic activity is a significant aspect of the weather in the region.

The closest Bureau of Meteorology weather station to the study area is located at Port Hedland Airport. Recorded climatic data for this weather station is summarised below:

Mean Daily Maximum Temperature:	27.1°C (July) – 36.8°C (March)
Mean Daily Minimum Temperature:	12.2°C (July) – 25.5°C (Jan/Feb)
Annual Rainfall:	313.5 mm
Mean Annual Rain Days:	20.6 days

(Source: BOM, 2009)

2.4 Topography and Soils

The study area is located on the Abydos Plain. The geology of this area is described as Quarternary alluvium near the coast, further inland Archean granite; other Archean rocks outcropping in small hills, ranges and dykes.

The project areas are situated entirely on the coastal alluvium, with the surface soil being red silty sand. At the north eastern corner of the site, the soils become saline, probably as a result of periodic inflows from the coastal flood zone during high tide and storm surge events.

2.5 Hydrology and Hydrogeology

There are no surface freshwater flows within or adjacent to the study area.

The Department of Environment and Conservation (DEC) bore database search indicates that there are seven registered bores within a five kilometre radius. One bore was identified in the proposed Wedgefield Industrial Site in the north and another within one kilometre of LIA 5 in a southerly direction. This bore was stipulated in the DEC database as being used for livestock watering purposes.

No groundwater information is available for the sites.

2.6 Wetlands and Watercourses

No freshwater wetlands or watercourses occur on or adjacent to the project area.

A creekline, South Creek, flows from the south to the north approximately 200 m west of the western corner of the LIA 3. It is likely that runoff from the broader area enter this creek. The creek channel is also possibly inundated during high tide and storm surge events.

The northern boundary of the proposed Transport Part B area is within and adjacent to an area of semi- saline low lands (mudflats) which again, may be inundated during storm surge events. However, there is no wetland specific vegetation within proximity to the project sites. *(Note: further information on the risks of storm surge events and the water levels in the channel will be provided in the engineering report.)*

2.7 Public Drinking Water Source Areas

There are no Public Drinking Water Source Areas within the vicinity of the proposed study areas.

2.8 Acid Sulphate Soils

Acid sulphate soils (ASS) are mapped at Figure 2. The majority of the study areas are situated on an area believed to have no known risk of ASS to a depth of 3 m, however the northern most boundary of the proposed Industrial Site is considered to have a high to moderate ASS disturbance risk to a depth of 3 m.

2.9 Contaminated Sites

As identified from the Department of Environment and Conservation (DEC) Contaminated Sites Search there are no registered contaminated sites located within or adjacent to the study areas. One registered contaminated site was identified approximately 7 km to the north east of the study areas.

Site investigations undertaken by GHD employees did not identify any areas within the project area that would indicate contamination of areas LIA 3, 4 and 5 and Transport Area A. A range of drums, old building materials and general building waste was located as fill under the powerline running north through Port Authority land north of Transport Area B. The powerline fill may warrant more detailed investigation prior to development in the future.

The service station between Transport Areas A and B indicates a potential for hydrocarbon contamination in the water table below the area. This is only of concern if water is to be drawn from bores in the area or if the water table is breached during subdivision earthworks. As the land is relatively low-lying, it is unlikely that earthworks will occur much below natural ground level.

2.10 Surrounding Land Use

The land use surrounding the 3 proposed LIAs, Transport Area A and Transport Area B is described in Table 3.

Table 3 Surrounding Land Uses

Site	Identification
LIA3	The subject site is part of the larger Wedgefield Industrial Estate. Existing industrial / residential properties occur to the north, with both occupied and unoccupied lots existing in this area. South of the site is vacant land and contains vegetation and cleared areas similar to the site under investigation. To the west of the site the land is vacant, and the Wedgefield Industrial area industrial leading down to the tidal/ephemeral South Creek. East of the site is undeveloped land containing tracks and vehicle access paths, this area is predominately undisturbed.
LIA4	The subject site is part of the larger Wedgefield Industrial Estate. Existing industrial / residential properties occur to the north, with both occupied and unoccupied lots in this area. South of the site is the access road and railway to Finucane Island with vacant land beyond. The vacant land contains vegetation similar to the survey site. To the west the land is vacant land and leads down to the tidal/ephemeral South Creek. East of the site is the proposed LIA 3 area and undeveloped land containing tracks and vehicle access paths, this area is predominantly undisturbed.
LIA5	The subject site is part of the larger Wedgefield Industrial Estate. The vacant land of proposed LIA sites 3 and 4 exists immediately to the north with Wedgefield industrial area existing past this. Immediately south of the site is the access road and railway to Finucane Island, and vacant land with South Hedland existing past this. The South Hedland water storage tanks are in this location. To the west the land is vacant land and leads down to the tidal/ephemeral South Creek. The land east of the site vacant land containing tracks and vehicle access paths, this area is predominantly undisturbed bushland common to the area.
Transport Area A	Land to the north west and west is part of the existing Wedgefield Industrial Estate, and includes vacant land at LIA 3 and 5 across Pinga Road. Land to the south east is bordered by the Great Northern Highway, and beyond that unallocated crown land and the Port Hedland Cemetery. Immediately to the north-east is a service station and attached dwelling and an area proposed for General Industry (Transport Part B) which is currently unallocated crown land.
Transport Area B	Transport Area B is bordered by Transport Area A to the south. Land to the west is part of the existing Wedgefield Industrial Estate, with parts

Site	Identification
	of the proposed site already been cleared. Land to the east is bordered by the Great Northern Highway, and beyond that unallocated crown land and the Port Hedland Cemetery. A service station and attached dwelling exists within the south east corner of the site. Tidal flats and a motorcross tracks exists to the north.

2.11 Review of Aerial Photography

GHD has reviewed aerial photographs of the site from 1949 to 2004 to ascertain the development history of the site and land uses and practices that may lead to potential contaminating activities.

The photographs are reproduced in Appendix D and summaries of observations are provided in Table 4.

Table 4 Aerial Photograph Review

Photo Date	Description
19 June 1949	This photograph displays that no development has occurred within or nearby to the site.
13 September 1971	The LIA 5 area is clearly visible. LIA areas 3 and 4 still remain within a larger block of land with some clearing occurring adjacent to LIA 3.
04 August 1993	The proposed LIA areas are clearly visible. The aerial pictures display that activities are occurring within the sites, specifically the creation of tracks or boundary lines. Urban/residential development exists to the north of areas 3 and 4.
31 July 2004	The proposed LIA areas 3, 4, and 5 are clearly visible with no indication from the aerial pictures of development activities occurring within the designated areas. Urban/residential development surrounds the site. A petrol station exists between the Transport Use Areas, along the Great Northern Highway.

2.12 Certificate of Title Review

The ownership of the three LIA sites as identified from the Certificate of Titles for the sites is outlined in Table 5. The Certificate of Titles are provided in Appendix D.

Table 5 Certificate of Title Review

Site	Certificate of Title
LIA3	The Certificate of Title indicates that this land is Unallocated Crown land with the primary interest holder being the State of Western Australia.

Site	Certificate of Title
LIA4	Unallocated Crown Land – No Certificate of Title was available.
LIA5	The Certificate of Title indicates that this land is Unallocated Crown land with the primary interest holder being the State of Western Australia.

2.13 Aboriginal Heritage

The Aboriginal Site Register is held under Section 38 of the State *Aboriginal Heritage Act 1972.* It protects places and objects customarily used by, or traditional to, the original inhabitants of Australia.

Where an activity disturbs an Aboriginal site or object an application for permission to disturb those sites will need to be submitted under Section 18 of the *Aboriginal Heritage Act 1972.* Where an area of previously unknown Aboriginal heritage is to be disturbed, it is advised that a detailed anthropological and archeological heritage survey is undertaken to find if there any sites or objects of significance in that area, as it is an offence to disturb all Aboriginal Heritage sites even those not contained on the Aboriginal Heritage Site Register.

A search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry system in July 2009, indicated that, at that time, ten heritage sites were within 500m of the study area, these are shown in Table 6.

Table 6 Aboriginal heritage sites within the study area

Site ID	Site Name	Site Type
23612	Fmg Par 06-09	Midden / Scatter
23609	Fmg Par 06-06	Midden / Scatter
23605	Fmg Par 06-02	Midden / Scatter
23606	Fmg Par 06-03	Midden / Scatter
23611	Fmg Par 06-08	Midden / Scatter
23548	Fmg Par 06-01 (Shell Midden Scatter)	Engraving
25005	WN 07 - 13	Midden / Scatter
24995	WN 07 - 03	Midden / Scatter
26699	Lan 08 - 02	Midden / Scatter
26700	Lan 08 - 03	Midden / Scatter
26701	Lan 08 - 04	Midden / Scatter

Four of these heritage sites are recorded within the study areas. These are shown in Figure 2, Appendix A.

To confirm the occurrence and significance of sites within the study, a detailed Aboriginal heritage survey was undertaken in November 2008 by Anthropos Australis (March, 2009). This survey and consultation considered the shell midden sites within Transport Area B and made recommendations as to the extent of Site IS 22874, which also impacts Transport Area B.

2.14 Native Title

The Port Hedland area is subject to one Native Title application, that being WC 99/3 for the Kariyarra people. Consultation over the use of Crown Land must be held with representatives of this group prior to development.

2.15 Environmentally Sensitive Areas

The DEC's online Native Vegetation Viewer was searched to determine the location of any Environmentally Sensitive Areas (ESAs) within the vicinity of the project area, as declared by a Notice under Section 51B of the *Environmental Protection Act 1986*.

The search confirmed that there are no ESAs within or adjacent to the study areas.

2.16 Reserves and Conservation Areas

There are no conservation reserves managed by the Department of Environment and Conservation within or immediately adjacent to the study areas.

2.17 Vegetation

2.17.1 Vegetation Description

The study areas fall within the Roebourne subregion of the Pilbara Biogeographic region of Western Australia. The environment of this subregion has been described as coastal and sub-coastal plains with a grass savannah of mixed bunch and hummock grasses and dwarf shrub steppe of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera* (Kendrick and Stanley, 2001). The uplands of the region support *Triodia* hummock grasslands and the ephemeral drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* (Kendrick and Stanley, 2001).

Remnant native vegetation mapped for the project area can be assessed using recently acquired data from the Western Australian Department of Agriculture (Shepherd, 2002; 2005), based on vegetation association mapping undertaken by Beard (1971). The major vegetation association occurring within the study areas is "Hummock grasslands, dwarf-shrub steppe; *Acacia translucens* (now *A. stellaticeps*) over soft spinifex". The vegetation association within the northern boundary of proposed Industrial site is described as "Bare areas; mud flats".

2.17.2 Vegetation Extent and Status

A vegetation type is considered underrepresented if there is less than 30 percent of its original distribution remaining. From a purely biodiversity perspective, and not taking into account any other land degradation issues, there are several key criteria now being applied to vegetation (EPA, 2000).

- The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at 30% of the pre-European / pre-1750 extent for the vegetation type;
- 10% of the pre-European / pre-1750 extent for the vegetation type is regarded as being a level representing *Endangered*; and
- Clearing which would put the threat level into the class below should be avoided.

Such status can be delineated into five (5) classes, where:

- *Presumed Extinct*: Probably no longer present in the bioregion
- *Endangered**: <10% of pre-European extent remains
- *Vulnerable**: 10-30% of pre-European extent exists
- *Depleted**: >30% and up to 50% of pre-European extent exists
- *Least Concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status

Native vegetation types represented in the survey areas; their regional extent and reservation status are drawn from Shepherd, *et al*. (2002), and Shepherd pers. comm. (2005). These are shown in Table 7.

Table 7 Major Vegetation System Associations within the Study Area (after Shepherd, 2002).

Vegetation Association Number	Association Description	Pre-European Extent (ha) in Roebourne IBRA subregion	Current Extent (ha) in Roebourne IBRA subregion	% Remaining	% Pre-European Extent in Conservation Reserves
647	Hummock grasslands, dwarf-shrub steppe; Acacia translucens over soft spinifex	189414	189414	100	0
127	Bare areas; mud flats	179917	177262	98.5	0

The extent of the vegetation in the study areas is considered of *Least Concern*, i.e. intact, with 100% of the pre-European extents of the vegetation type considered to be remaining.

2.17.3 Threatened Ecological Communities

Ecological communities are defined as ‘naturally occurring biological assemblages that occur in a particular type of habitat’ (English and Blythe, 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered, and Vulnerable.

Some TECs are protected under the *EPBC Act*. Although TECs are not formally protected under the State *Wildlife Conservation Act 1950,* the loss of, or disturbance to, some TECs triggers the *EPBC Act*. The Environmental Protection Authority's (EPA's) position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.

Possible TECs that do not meet survey criteria are added to the Department of Environment and Conservation's (DEC) Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3. These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PECs that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

The Department of Environment and Conservation's (DEC's) Threatened Ecological Community (TEC) database was queried for known occurrences of TECs and PECs near the study area. No TECs or PECs have been recorded within or in the vicinity of the study areas.

2.18 Flora

2.18.1 Significant Flora

Commonwealth

Species of significant flora are protected under both State and Commonwealth Acts. Any activities that are deemed to have a significant impact on species that are recognised by the *EPBC Act*, and the *Wildlife Conservation Act 1950* can trigger referral to the DEWHA and/or the EPA.

A description of Conservation Categories delineated under the *EPBC Act* is detailed in Table 11, Appendix B. These are applicable to threatened flora and fauna species.

A search of the *EPBC Act* Protected Matters Search Tool did not identify any Commonwealth protected flora species within 20 km of the survey area.

State

In addition to the *EPBC Act,* significant flora in Western Australia is protected by the *Wildlife Conservation Act 1950*. This *Act*, which is administered by the DEC, protects Declared Rare Flora (DRF) species. The DEC also maintains a list of Priority Listed Flora (PLF) species. Conservation codes for flora species are assigned by the DEC to define the level of conservation significance. PLF are not currently protected under the *Wildlife Conservation Act 1950*. PLF may be rare or threatened, but cannot be considered for declaration as rare flora until adequate surveys have been undertaken of known sites and the degree of threat to these populations clarified. Special consideration is often given to sites that contain PLF, despite them not having formal legislatory protection. A description of the DEC's Conservation Codes that relate to flora species is provided in Table 12, Appendix B.

A search of the DEC's Rare Flora Databases and the Western Australian Herbarium (WAHERB) records was undertaken. Significant flora species recorded in these databases for the general Port Hedland area are outlined databases are outlined in Table 8.

Table 8 Significant flora previously recorded in the Port Hedland area from records of the DEC and WAHERB

Family	Genus	Species	Details and Habitat	DEC Conservation Code
Asteraceae	*Pterocaulon*	sp. A Kimberley Flora (B.J. Carter 599)	Compact shrub, to 0.5 m high. Flowers blue, purple, Apr–Aug. Preferred habitat is sand in coastal areas, saline sandy flats, and pindan sandplain.	P2
Amaranthaceae	*Gomphrena*	*pusilla*	Slender branching annual, herb, to 0.2 m high. Flowers white, March-June. Preferred habitat is fine beach sand behind foredune on limestone.	P2
Amaranthaceae	*Ptilotus*	*appendiculatus* var*. minor*	Prostrate or ascending perennial, herb or shrub.	P1
Asclepiadaceae	*Gymnanthera*	*cunninghamii*	Erect shrub, 1–2 m high. Flowers cream, yellow, green, Jan–Dec. Preferred habitat is sandy soils.	P3
Boraginaceae	*Heliotropium*	*muticum*	Ascending to spreading perennial, herb, to 0.3 m high.	P1
Cyperaceae	*Bulbostylis*	*burbidgeae*	Tufted, erect to spreading annual, grass-like or herb (sedge), 0.03–0.25 m high, spikelets in a simple umbel or rarely solitary; stamens 3; involucral bracts long, hairy. Flowers brown, Mar/Jun–Aug. Preferred habitat is granitic soils on granite outcrops and cliff bases.	P3
Euphorbiaceae	*Euphorbia*	*clementii*	Erect herb, to 0.6 m high. Preferred habitat gravelly hillsides and stony grounds.	P2
Mimosaceae	*Acacia*	*glaucocaesia*	Dense, glabrous shrub or tree, 1.8–6 m high. Flowers yellow, Jul–Sep. Preferred habitat red loam, sandy loam, clay on floodplains.	P3

Family	Genus	Species	Details and Habitat	DEC Conservation Code
Papilionaceae	*Crotalaria*	*spectabilis* subsp. *spectabilis*	Annual herb, ca 2 m high. Flowers yellow.	P1
Papilionaceae	*Tephrosia*	*andrewii*	Ascending, multistemmed shrub, to 0.8 m high. Flowers orange, Apr/Oct. Preferred habitat sand in pindan country.	P1
Papilionaceae	*Tephrosia*	*rosea* var. *venulosa*	Erect shrub, to 1.7 m high. Flowers re, purple, Aug-Sep. Preferred habitat in red sand near creeks.	P1

None of these species has been previously recorded either within or closely adjacent to the study areas. The two large shrub species, *Acacia glaucocaesia* and *Gymnanthera cunninghamii*, are unlikely to have been overlooked during the survey, as there were very few tall shrubs in the study areas. Other species, such as *Gomphrena pusilla, Bulbostylis burbidgeae* and *Euphorbia clementii,* are known to grow on soil types that were not present in the area, so are unlikely to be present.

2.19 Fauna

2.19.1 Fauna Previously Recorded

The Western Australian Museum *NatureMap* online search was conducted for a 20 km buffer of the study areas. The search identifies terrestrial vertebrate species recorded in the collections of the Western Australian Museum and the Department of Environment and Conservation (DEC) records. The search identified the potential presence of twenty-four bird, fifty-nine reptile, seven amphibians and seventeen mammal species.

A full list of species recorded from the WA Museum database is presented in Table 16, Appendix C.

It should be noted that some of the records of the Museum are historical and some of the recorded species may now be locally extinct. Additionally these records may include species (particularly bird species) that are vagrants or present in the general area but not present within the study area due to lack of suitable habitat.

2.19.2 Significant Fauna Species

The conservation of fauna species and their significance status is currently assessed under both State and Commonwealth Acts. The acts include the *Western Australian Wildlife Conservation Act* 1950; *Wildlife Conservation (Specially Protected Fauna) Notice 2003,* and the *EPBC Act*.

The significance levels for fauna used in the *EPBC Act* are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). A description of Conservation Categories delineated under the *EPBC Act* is detailed in Table 11, Appendix B and the circumstances under which a project will trigger referral to the DEWHA are described in Appendix C. The *WA Wildlife Conservation Act 1950* uses a set of Schedules but also classifies species using some of the IUCN categories. These Schedules are described in Table 14, Appendix C. The *EPBC Act* also protects migratory species that are listed under the following International Agreements:

- Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a Range State under the Convention;
- The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);
- The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA); and
- The Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA).

Listed migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The Act also protects marine species on Commonwealth lands and waters.

In Western Australia, the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the Western Australian *Wildlife Conservation Act 1950* but for which the Department feels there is a cause for concern. These species have no special legislatory protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Table 15, Appendix C.

The DEWHA maintains a database of matters of national environmental significance that are protected under the *EPBC Act.* An *EPBC Act* Protected Matters Report was generated (from the website of the DEWHA), for the matters of significance that may occur in, or may relate to, the survey area. A search of the DEC's Threatened Fauna database for any rare and priority species that may occur in the survey area was also undertaken.

From the DEC and DEWHA databases and the records of the Western Australian Museum (WAM), a number of protected fauna species were identified as potentially occurring within the survey area, which are listed in Table 17, Appendix C.

It should be noted that some species that appear in the *EPBC Act* Protected Matters Search Tool are often not likely to occur within the specified area, as the search provides an approximate guidance to matters of national significance that require further investigation. The records from the DEC and WA Museum searches of threatened fauna provide more accurate information for the general area, however some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.

More detail on the likely presence of threatened species in the study areas is provided in Section 3.4 below.

3. Field Assessment

3.1 Field Survey Methodology

The field survey of LIA 3, 4, and 5 and the General Industry/Transport Part A sites was undertaken by GHD on June 23rd 2008 by Anna Napier, an experienced ecologist and Lisa Marwick, an environmental scientist.

An additional flora and fauna survey was conducted on the 11th June 2009 of the General Industry/Transport Area Part B and the Port Hedland Port Authority land for the new loop road. This was undertaken by Georgina Nielssen, an experienced ecologist and Erin D'Raine, an environmental scientist.

3.1.1 Flora and Vegetation Assessment

The field assessments included a Level 2 Flora survey (as per EPA Guideline 51) which included:

- Surveying of 50m x 50m quadrats, within representative vegetation types;
- Surveying along targeted and random transects throughout the sites;
- Development of a full flora list;
- Assessment of the vegetation condition and any threatening processes;

In addition, the presence of Declared Rare or Priority Flora was assessed. Suitable habitat for DRF and Priority Flora species was searched. Vegetation was also assessed to determine the presence of TECs within the study area.

Where identification of flora species was uncertain, confirmation was made at the Western Australian State Herbarium.

3.1.2 Fauna Assessment

GHD's qualified ecologists conducted the fauna investigation in conjunction with the flora investigation. The Level 1 fauna survey included desktop investigations and field surveys, conducted with regard to the EPA's Guidance Statement No. 56, where possible.

The fauna survey was an opportunistic survey and did not involve any fauna trapping. The survey involved visual and aural surveys for any fauna species utilising the study area. The study area was also searched for any fauna signs, such as tracks, scats, bones, diggings and feeding signs.

Surveys also included systematic searching across all habitat types, which is an effective method of surveying for many reptile species. This involved searching through microhabitats where reptiles are known to frequent, including turning over logs or rocks, turning over leaf litter and examining hollow logs. Reptiles were also sighted as they basked during the day.

Species – specific search strategies were used to identify any protected species in the area or evidence that they utilise the study area.

3.1.3 Nomenclature

Nomenclature used in this report follows that used by the DEC's *FloraBase* program and Western Australian Museum *NatureMap* program as they are deemed to contain the most up-to-date species information for Western Australia.

3.1.4 Limitations

Complete flora and vegetation surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present.

Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to above factors. Therefore, while this flora survey was relatively exhaustive, and was conducted at a time of year when the majority of the flora species would be able to be identified, there is the possibility that some species with low abundance in the area have been overlooked.

The flora surveys were also restricted to predominantly flowering plants, with consideration of some other vascular plants such as cycads. Non-vascular plants were not systematically searched for, as the information available on these plants is generally limited.

The fauna survey undertaken was a reconnaissance survey only and thus only sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings etc. Many cryptic and nocturnal species would not have been identified during a reconnaissance survey. Extensive detailed fauna surveys, involving trapping surveys, are required to obtain a more comprehensive list of fauna species that may utilise the site.

This survey was aimed at identifying the terrestrial vertebrate fauna of the study area; no sampling for invertebrates or aquatic species occurred.

3.2 Flora

A total of 123 species of plants was recorded within the combined study areas. Of these, three were introduced weed species and three were planted.

The study areas contain moderate species diversity, due partly to the limited range of habitats (i.e. the area was all flat, near coastal, mostly red sand plain) and also to the size of the survey area. Spinifex (*Triodia*) species dominate the vegetation, with a range of small shrubs and herbs also being present. The most diversity was observed in disturbed areas such as road edges, where grading has disturbed the soil and extra water runoff had produced conditions more suitable for herbaceous species to occur.

It is likely that these species are present over much of the area but are currently dormant (in seed form) and will only appear following a disturbance such as fire and after good rains.

The dominant families are:

Poaceae (grasses)	20 species
Papilionaceae (peas)	17 species
Amaranthaceae (mulla-mullas)	10 species
Mimosaceae (wattles)	10 species
Convolvulaceae (morning glorys)	8 species

Well represented genera were: *Acacia* (wattles), *Ptilotus* (mulla mullas) and *Eragrostis* (grasses).

A complete list of the flora is provided at Table 13, Appendix B.

No Declared Rare or Priority flora species were identified during the survey.

3.3 Vegetation

3.3.1 Vegetation Type

The vegetation is almost completely uniform across the survey areas, with minor changes due to differing dominance of individual grass/Spinifex species, and also to historical disturbance. The northern-most part of the Transport Use Area (Lot B) consists predominately of bare areas with some vegetation associated with tidal/mud flats and contains a mixture of chenopod and saline-adapted species.

Four vegetation types were recorded within the study areas. The vegetation types match the descriptions by Beard (1971) and Kendrick and Stanley (2001) and are described as follows:

1. Low shrubland of *Acacia stellaticeps* over mixed tussock grassland of *Triodia epactia* and *T. schinzii* over very open herbs

This vegetation supports a small range of herbaceous and trailing plants, primarily: *Hybanthus aurantiacus, Eragrostis cumingii, Eragrostis eriopoda, Corchorus walcottii, Bonamia erecta, Cassytha* and the introduced Buffel grass (*Cenchrus ciliaris*).

Occasional patches of taller Acacia species occur, primarily in disturbed areas. The Acacia species include: *Acacia trachycarpa, A. colei, A. ampliceps, A. bivenosa and A. sericophylla*.

2. Bare Areas/Tidal Flats with low scattered shrubs of Chenopod spp.

This area consists of tidal soils with predominately bare, open ground with occasional patches of very scattered low shrublands of Chenopod spp., Mangrove spp., Trianthema spp. with scattered grasses including *Sorghum timorense, Eragrostis falcata, Panicum decompositum* and introduced Buffel Grass (*Cenchrus ciliaris*).

3. Tussock grassland of *Triodia secunda, Triodia schinzii*, and *Sorghum timorense* over scattered herbs and Chenopod spp.

This vegetation occurs along the fringes of the tidal flats/drainage areas in the northern half of Transport Area Part B. This vegetation type supports a small range of herbaceous and Chenopod species including *Commelina ensifolia, Desmodium filiforme, Frankenia ambita, Trianthema* spp.*, Tecticornia* spp.*,* and *Salsola tragus.*

4. Cleared/Disturbed Areas

Heavily disturbed / predominantly cleared areas, with occasional planted species and some disturbance opportunists such as **Cenchrus ciliaris* present

Details of the quadrats representing these vegetation types are provided in Appendix B. The vegetation types have been mapped in Figure 3, Appendix A.

3.3.2 Vegetation Condition

Developed for Bush Forever, the vegetation Condition Rating is a scale that recognises the intactness of vegetation, which is defined by the following (Government of WA, 2000):

- Completeness of structural levels;
- Extent of weed invasion;
- Historical disturbance from tracks and other clearing or dumping; and
- The potential for natural or assisted regeneration.

The scale therefore consists of six (6) rating levels as outlined below in Table 9.

Table 9 Bush Forever (Government of WA, 2000) vegetation condition rating scale.

Vegetation Condition Rating	Vegetation Condition	Description
1	*Pristine or Nearly So.*	No obvious signs of disturbance.
2	*Excellent*	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	*Very Good*	Vegetation structure altered, obvious signs of disturbance.
4	*Good*	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it.
5	*Degraded*	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not in a state approaching good condition without intensive management.
6	*Completely Degraded*	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

The vegetation within the study areas is generally in *Excellent* condition, with small parts having a rating of *Good* to *Completely Degraded* due to clearing and other disturbances. Signs of disturbances across the study areas included old tracks, powerlines, petrol station and an existing industrial area.

There are few weeds species present across the area, with the most common, Buffel Grass, occurring primarily along the edges of tracks and roads and in other disturbed areas.

Vegetation condition is mapped in Figure 4, Appendix A.

3.3.3 Threatened Ecological Communities

No TECs or PECs were identified as occurring on the site during the field survey.

3.4 Fauna

3.4.1 Observed Fauna

A total of twenty bird, four mammal and three reptile species were recorded during the reconnaissance survey of the study areas. These species are listed in Table 18, Appendix C.

This survey only provides a brief snapshot of those species present at the time of sampling (daytime), in one season, over two years (2008 and 2009 surveys). Not all potentially occurring species would be recorded during a single survey due to spatial and temporal variations in fauna population numbers.

A number of tracks (mostly from reptiles) were observed on sand tracks within the LIA sites however, none of these were positively identified.

In addition, a number of fauna burrows were observed. These were present across all sites during both field surveys (Plates 2 and 3 below).

Plate 2 Burrow, LIA 3 (2008)

Plate 3 Burrow, LIA 5 (2008)

Significant Fauna Species

Brush-tailed Mulgara (*Dasycercus blythi*) Priority 4 (Wildlife Conservation Act)

Brush-tailed Mulgara (*Dasycercus cristicauda)* Schedule 1 (Wildlife Conservation Act, Vulnerable, EPBC Act*)*

Dasycercus blythi has been lumped with the *D. cristicauda* (Crest-tailed Mulgara) for the last 40 years or so. Both species of Mulgara have been found, at least in the past, throughout much of the arid zone, but until specimens in museum collections are correctly identified the distribution of each species is uncertain (Van Dyck and Strahan, 2008). *Dasycercus cresticauda* is listed as Schedule 1 under the Wildlife Conservation Act 1950 and Vulnerable under the EPBC Act whereas *D. blythi* is only listed as a Priority 4 species.

The Brush-tailed Mulgara is primarily nocturnal, shelters in burrows and feeds on insects, other arthropods and small vertebrates. This species inhabits spinifex grasslands and, in central Australia, lives in burrows that it digs on the flats between low sand dunes (Van Dyck and Strahan, 2008).

The Schedule 1 species, Mulgara (*Dasycercus cristicauda*) has previously been recorded in surveys of the Fortescue Metals Group land, west of Wedgefield (FMG, pers. comm.). In addition, Mulgara were recently trapped during a Level 2 fauna survey conducted by GHD in the surrounding Wedgefield area.

Burrows recorded during the 2008 survey may have been indicative of this species. A range of photos of the burrows was sent in 2008 to Dr Peter Kendrick at the DEC in Karratha for any advice on their potential occupants. On the verbal evidence of GHD, and the photos, Dr Kendrick was of the opinion that the burrows looked unused and that although some looked like potential Mulgara burrows they were now more likely to be used by lizards (P. Kendrick pers. comm. Aug 2008).

During the 2009 survey of the Transport Area Part B study area, evidence of the Mulgara species, including scats, tracks and diggings, was recorded (locations shown in Figure 2). Most of the survey area is suitable Mulgara habitat but recent use of the area by Mulgara has only been indicated in Transport Area B.

3.4.2 Potential for Other Significant Fauna Species

The desktop surveys indicated that a number of protected fauna may occur within the study area. The habitat requirements of these species and the likelihood of their occurrence in the site (with information from the field surveys) are considered below.

Southern Giant Petrel (*Macronectes giganteus*) Schedule 1, Endangered

The Southern Giant Petrel is a marine bird and occurs over open seas and inshore waters in Antarctic and subtropical waters. In summer they occur predominately in sub-Antarctic to Antarctic waters, usually below 60ºS in the South Pacific and southeast Indian Oceans. During winter most adults disperse widely and are rare in the southern waters of the Indian Ocean. The Southern Giant Petrel breeds on the Antarctic Continent, Peninsula and islands, and on sub-Antarctic islands and South America.

Habitat Assessment: The Southern Giant Petrel is an occasional vagrant within the area. The study areas are considered not to contain significant habitat for this species.

Northern Quoll (*Dasyurus hallucatus*) Schedule 1, Endangered

This species of quoll once occurred across the majority of northern Australia but its range has contracted seriously. It still occurs in the Pilbara region but in disjunct populations, predominantly in the larger conservation reserves. The Northern Quoll inhabits a range of vegetation types but is especially abundant on dissected rocky escarpment and eucalypt woodland within 200 km of the coast. They are predominately nocturnal but occasionally active during the day, particularly during the mating season or in overcast weather (Van Dyck and Strahan, 2008).

Habitat Assessment: The study areas are within the range of this species but do not contain suitable habitat as there are no trees for shelter. Additionally, the proximity to dogs and cats would likely preclude the use of the site by this animal.

Bilby (Macrotis lagotis) Schedule 1, Vulnerable

The Bilby distribution in Western Australia is restricted to the north, including the Pilbara and the Sandy and Gibson deserts. The Bilby usually spends the daytime in burrows, often built against termite mounds spinifex hummock or shrub. After dark they leave their burrows to feed and populations are known to move long distances when current habitat ranges become unsuitable. Bilbies are largely solitary, widely dispersed and found in low numbers. Bilbies have now disappeared from many areas where they were common 10 to 15 years ago, such as between Broome and Port Hedland and the Tanami Desert. Grazing by rabbits and livestock, changes in fire regime, and predation by foxes and feral cats are thought to be the main factors influencing the Bilby’s decline.

Habitat Assessment: No evidence (burrows or diggings characteristic of this species) for the presence of Bilbies was observed during the field surveys. The study areas do not contain significant habitat for this species and is unlikely to occur here.

Banded Hare-wallaby (*Lagostrophus fasciatus* subsp. *fasciatus*) Schedule 1, Vulnerable

This small macropod is herbivorous, and dependent upon dense thickets of shrubs and heath for shelter. The Banded Hare-wallaby is currently restricted to Bernier and Dorre Islands in Shark Bay. It is presumed that the mainland populations of this species are now extinct. The last specimen from mainland Australia was collected in 1906 (Richards, 2003). An attempted reintroduction to Peron Peninsula showed that the species is highly vulnerable to predation from cats as well as foxes.

Habitat Assessment: The study area is outside the current range of the Banded Hare-wallaby. Given that the mainland populations of this species are thought to be extinct, it is unlikely to occur within the study areas.

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) Priority 1, Vulnerable

The Pilbara Leaf-nosed Bat roosts in deep caves or mines in the wet season and forages nearby. This species occurs in the Pilbara region of WA where its populations are scattered and localised. There are a few known populations of this species in the western Pilbara, roosting in caves formed in gorges that dissect massive siliceous sedimentary geology. It is most often observed in flight over waterholes in gorges, but appears to be rare even in the Hamersley Range where this habitat is common (Van Dyck and Strahan, 2008). Optimal roosts are thought to occur in caves that form between ascending rock layers, where humidity is maintained from seeping groundwater (Van Dyck and Strahan, 2008).

Habitat Assessment: There are no suitable roosting areas for this species within the study areas making it unlikely to occur, except possibly as a forager.

Woma (*Aspidites ramsayi*) Schedule 4

The Woma Python is a nocturnal snake that feeds on lizards, snakes, birds and small mammals. This species occurs in the arid zones of Western Australia, favouring open myrtaceous heath on sandplains, and dunefields dominated by spinifex. They often inhabit animal burrows but may also use their head and neck to excavate shelters under hummock grasses or dense bushes. Land clearance and introduced predators have results in significant declines of this species. Populations are known from the Pilbara coast, north to the Eighty-mile Beach area, and south-west Western Australia, from Cape Peron south and east to the eastern Goldfields.

Habitat Assessment: Suitable habitat for the Woma Python occurs within the study area. This species may occur within or in the vicinity of the study areas.

Little North-western Mastiff Bat (*Mormopterus loriae* subsp. *cobourgiana*) Priority 1

The Little North-western Mastiff bat occurs along the Western Australia coast from Lake McLeod to Point Torment, occurring sparsely across its range. The Western Australian population have only been recorded from mangrove stands, particularly those that include mature Grey Mangroves (Van Dyck and Strahan, 2008).

Habitat Assessment: There are no suitable roosting areas for this species within the study area. The study area is considered not to contain significant habitat for this species however it may utilise the area for foraging.

Australian Bustard (*Ardeotis australis*) Priority 4

The Australian Bustard occurs across much of Australia, including across most of Western Australian, excepting heavily wooded areas in the south. The Australian Bustard occurs mainly in open country, such as low heath or lightly wooded grassland.

Habitat Assessment: This species may occur within the study areas as it contains potential habitat and has been recorded utilising the nearby Boodarie area. However, due to the likely prevalence of cats and dogs in the vicinity it is highly unlikely that the Australian Bustard would utilise the area. In addition, this species is widespread and the study area is not considered to contain significant habitat for this species. Impacts associated with the proposed activities are unlikely to have a significant impact on this species.

Eastern Curlew (*Numenius madagascariensis*) Priority 4

The Eastern Curlew is a large, migratory wader. It is widespread in coastal regions in the northeast and south of Australia and is rarely seen inland. This species is found on intertidal mudflats and sandflats, often with seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons (Australian Museum, 2008)

Habitat Assessment: The study area does not contain significant habitat for this species and is unlikely to occur here.

Star Finch (Western) (*Neochima ruficauda* subsp. *subclarescens*) Priority 4

This species is endemic to Australia where it is found from the Pilbara to south-eastern Australia. Its population has not been estimated but the species is typically patchy and highly variable in abundance. The Star Finch is a nomadic species which inhabits reedbeds, grasslands and eucalypt woodlands along permanent waterways. It typically nests in March and April and its nest is usually built in reeds up to several metres above ground. The main threat to this species is considered to be overgrazing by stock along waterways, which destroys the riparian vegetation on which they depend (Garnett and Crowley, 2000). Records from the DEC database have shown one confirmed sighting of this species recorded in South Hedland in 2005.

Habitat Assessment: The Star Finch was not recorded during the field surveys. There are no permanent watercourses or significant habitat for this species within the study area therefore this species is unlikely to be a permanent resident in the area. This species however, may utilise the study area while moving through areas and for foraging.

Migratory species

Two migratory species were observed over the study areas, the Black-shouldered Kite and Black Kite. Two marine species were observed over the study areas', including the Black-faced Cuckoo-Shrike and Nankeen Kestrel and one species recognised as Marine and Migratory, the Rainbow Beet-eater, was also recorded. Most of these species were observed flying over the study area; however the Rainbow Bee-eater was observed utilising the area for feeding. No existing breeding areas for the Rainbow Bee-eater were observed during the field surveys. The study areas are not deemed critical habitat to the above species for survival.

In addition to those species recorded during the field survey, a number of species included in the list of significant fauna species that could potentially occur in the study area were migratory terrestrial, marine and wetland species. There is the potential for these bird species, such as the White-bellied Sea-Eagle, to occur occasionally within the study area. However most of these species require wetlands where they feed (Oriental Plover, Oriental Dotterel, Egrets, Little Curlew) or trees, cliffs or embankments where they roost or breed (White Bellied Sea eagle and Southern Giant Petrel). It is not considered that the study areas provide any suitable feeding or breeding habitat for migratory species.

Other Species

In addition to the above species, the DEC and *EPBC Act* Protected Matters Search also recorded a number of marine mammals, shark species, ray-finned fishes and marine reptiles, listed under the *Wildlife Conservation Act 1950* and/or the *EPBC Act 1999*, to occur within the search area. The study area is located in close proximity to the coastline and therefore the marine environment was included in the 20 km buffer area. Given that this is a terrestrial ecological survey and the proposed projects will not impact on the marine environment, these species have not been considered in this report.

3.4.3 Introduced Fauna

Evidence of two introduced species were recorded during the field surveys, including the Feral Cat and Dog (domestic/wild).

3.4.4 Fauna Habitat

The field fauna assessment covered two main fauna habitat types, including:

- Low open shrubland over tussock grasslands; and
- Tidal mud flats/Chenopod shrubland.

The study area was dominated by low open shrubland over tussock grasslands which were found to provide ideal fauna habitat, particularly for reptiles and small mammals.

Evidence of the Mulgara species (scats, burrows and prints) was found within the vegetation type described as ‘Low shrubland of *Acacia stellaticeps* over mixed tussock grassland of *Triodia epactia* and *T. schinzii* over very open herbs.’ The location of Mulgara evidence is in the north of the development site, in Transport Area B. Most of this area will be not developed for some 8 to 10 years.

Within the northern half of the proposed transport use area, tidal mudflats are present that support numerous bird and potentially fiddler crab species.

Habitat Value

The majority of the study areas were considered to contain native vegetation in excellent condition, offering suitable habitat for native fauna. The low open shrubland over tussock grasslands of the study area is considered to be potentially good Mulgara habitat. However, this vegetation type covers some 189,000 ha in the near-coastal Pilbara, as indicated by the Shepherd *et al.* data provided in Section 2.17.2.

Native vegetation, including the vegetation types found within the study areas (including the Mulgara habitat) is found outside the survey areas in the surrounding area and is of similar condition to that of the survey area.

Clearing for tracks, roads, petrol station, motocross track and other infrastructure that have occurred within and adjacent to the study areas have reduced the habitat value within some sections of the study areas.

Habitat Linkages

Habitat linkages are important to allow animals to move between areas of resource availability. Habitat linkage is important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction.

Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can also lead to edge effects, leading to degradation of the habitat. Where the distance between habitat fragments is small, species may still be able to move between these habitat areas, but may be more exposed to predation pressures in the cleared areas.

Clearing of the native vegetation remaining within the study area could cause breaks to habitat linkages for the Mulgara population within and outside the survey areas. Fragmentation of this habitat may restrict the species from accessing temporary refugia and other members of the population, which may in turn lead to a local decline of these species. It could also result in direct mortality to the species during clearing.

4. Clearing of Native Vegetation

Any clearing of native vegetation will require a permit under Part V Division 2 of the *Environmental Protection Act 1986* (EP Act), except where an exemption applies under Schedule 6 of the Act or is prescribed by regulation in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and it is not in an Environmentally Sensitive Area (ESA).

Table 10 provides an assessment of the proposed project against the "10 Clearing Principles" as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003* to determine whether it is at variance to the Principles. These Principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

This project has been assessed to "*may be at variance*" to Principle (b) and not at variance or not likely to be at variance with any of the other 9 Clearing Principles.

The project may be at variance to Principle (b) due to the potential presence of the Mulgara species, which is classified as Vulnerable and Schedule 1, in the study areas.

Table 10 Assessment against the Ten Clearing Principles

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	The study area is not considered to be of higher biodiversity than the surrounding areas, and the proposed clearing is unlikely to have any significant impact on the biodiversity of the region.	The proposal is unlikely to be at variance with the Principle.
(b)	Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous Western Australia.	The project areas are likely to support a number of reptile, bird and mammal species. The 2008 survey of the LIAs and Transport Area A sites appeared to have supported small mammals but burrows seemed to be unused. However during the 2009 survey of the Transport Area B, evidence of the Mulgara species, including scats, tracks and diggings, was recorded. Mulgara are a conservation significant fauna that are known to occur within the Port Hedland and Wedgefield area. *Dasycercus cristicauda* (Mulgara) has recently been recorded by GHD in the nearby Wedgefield area. Due to the proximity of the sites to human populations and the presence of feral cats and dogs, the Mulgara may no longer occur in much of the study area. A detailed fauna survey would be required to verify the population of this species within the study area.	The proposal may be at variance with the Principle.
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Declared Rare flora species are known from the general area. Some Priority species could potentially be present but none were recorded during the field survey.	The proposal is unlikely to be at variance with the Principle.

Principle Number	Principle	Assessment	Outcome
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	No TECs are known to occur within or adjacent to the study area.	The proposal is unlikely to be at variance with the Principle.
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	The extent and status of vegetation identified for the study area (Beard, 1973; Shepherd pers. comm., 2005) has indicated that the vegetation association, Hummock grasslands, dwarf-shrub steppe; *Acacia translucens* (now *A. stellaticeps*) over soft spinifex has 100% remaining and is classed Least Concern.	The proposal is unlikely to be at variance with the Principle.
(f)	Native vegetation should not be cleared if it is growing in or in association with a watercourse or wetland.	There are no wetlands or permanent watercourses within the study area.	The proposal is not at variance with the Principle.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Clearing of the land is unlikely to cause appreciable degradation to adjoining land. Clearing will create runoff to constructed drainage systems which will eventually flow into the saline coastal tidal zones during heavy rainfall events. The major weed of the area, Buffel grass, is widespread on adjacent tracks and disturbed areas. Clearing may create further weed spread. These potential impacts can be mitigated by use of appropriate management plans.	The proposal is not likely to be at variance with the Principle.

Principle Number	Principle	Assessment	Outcome
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	There are no conservation areas within or in the vicinity of the study areas.	The proposal is not at variance with the Principle
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Clearing will create runoff to constructed drainage systems which will eventually flow into the saline coastal tidal zones during heavy rainfall events. This may create additional sedimentation for short periods but is unlikely to cause deterioration of surface water overall.	The proposal is unlikely to be at variance with the Principle
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the intensity of flooding.	Runoff from the study areas will be directed into constructed drainage and then to South Creek and the coastal tidal zone. A potential flood analysis is being undertaken.	The proposal is unlikely to be at variance with the Principle.

5. Impacts and Management

5.1 Actual and Potential Environmental Impacts

The proposed development of LIAs 3, 4 and 5, Transport Area Part A and Part B and the Port Hedland Port Authority land will have a range of impacts on the environment.

Biological Impacts

- Clearing of native vegetation in good to excellent condition as follows:
  - LIA 3: 10.4 ha
  - LIA 4: 13.3 ha
  - LIA 5: 58 ha
  - Transport Part A: 101 ha.
  - Transport Part B: 170 ha
- The vegetation of the area is well represented in the Pilbara region, with approximately 196,372.2 ha remaining undisturbed.
- Clearing of fauna habitat as above. The areas are likely to support a range of reptile and small mammal species which will be killed or displaced as a result of vegetation clearing and land disturbance. Although none was observed during the survey, evidence of the Mulgara species (Vulnerable, Schedule 1) was recorded within Transport Area Part B. A detailed (Level 2) fauna survey would be required to verify the population size of this species within the study area of Transport Area Part B. Clearing of Mulgara habitat may have a significant impact on the population of this mammal species in the Port Hedland area, dependent on the outcomes of a detailed survey. Transport Area Part B will not be developed for at least 10-15 years. It is the last of the areas proposed for development as part of this project.
- Clearing within potential Mulgara habitat may cause breaks to habitat linkages within the Mulgara population.
- Post-development impacts on adjacent bushland. The operation of new industrial lots will have potential impacts on bushland remaining in the area. The impacts will primarily be on fauna and issues could include:
  - Light overspill;
  - Litter;
  - Noise and vibration disturbance;
  - Dust production;
  - Increased predators; and
  - Increased traffic.

  These issues have the potential to disturb or harm fauna remaining in the adjacent areas.

- Changes to natural drainage from clearing may impact on the vegetation types and fauna in the area.

Physical and Social Impacts

- Alteration to surface drainage. As a result of vegetation clearing and the development of building and hard stands, there will be a reduction in infiltration to the ground and an increase in runoff from the sites. This runoff will be collected in drainage systems and most likely transferred to South Creek.
- Nuisance impacts such as dust or pollutant production and noise and vibration will occur during the construction phases of the subdivision and during development of individual lots. Given the industrial location, it is likely that noise and vibration will not be a significant issue, however some caretaker residences and transient workforce accommodation are present within the existing Wedgefield area. LandCorp has considered the potential noise risks to the existing transient workforce accommodation and has developed the following mitigation:
  - Changes to the estate layout;
  - a sale strategy;
  - design guidelines; and
  - planning controls.

  This mitigation is detailed in a letter to the DEC of September 2009 which is attached at Appendix E.
- Additional traffic will be generated as a result of new businesses. This will create impacts of noise, safety and possible delays, especially as a result of large turning movements.
- The addition of industrial lots closer to Great Northern Highway will have the potential to create a less desirable visual impact for tourists and travellers. Due to the nature of industrial lots and the likelihood of storage of equipment outside, such areas can be messy and unsightly. Some screening may be required to GNH.

5.2 Possible Impact Management Actions

Some of the actual and potential impacts of the development of the LIA and Transport landuses will be manageable through design, construction controls and by-laws. Other impacts cannot be easily mitigated.

Biological Impact Management

Clearing of native vegetation cannot be mitigated in the immediate area. The loss of vegetation is not considered significant regionally, but will have an impact visually and on native fauna.

Suggested management actions are as follows:

- Ensure lot design provides for retention of ‘nature strips’, particularly bordering Great Northern Highway;

- Minimise clearing adjacent to the development during construction phases;
- Ensure cleared bushland and topsoil is removed from site or used in rehabilitation of any adjacent disturbed areas (i.e. not retained in mounds or windrows);
- During major clearing, allow any existing fauna to move off-site, if possible, and discourage or prohibit the presence of dogs. This can be achieved with the following actions:
  - clear vegetation from disturbed areas towards undisturbed (or outward from already developed areas);
  - use experienced fauna clearance personnel to spot and catch Mulgara which may be disturbed and which are moving away from clearing machinery; and
  - develop a relocation program.
- Mulgara are not readily trapped and avoidance of active burrows is recommended over relocation. Where avoidance of active burrows is not possible, trapping and relocation to nearby similar vegetation immediately prior to clearing is recommended. Trapping and relocation works are to be done by suitable qualified and experienced fauna consultants only, and in consultation with the DEC.

Physical and Social Impact Management

- Ensure drainage design reduces the risk of scour and sedimentation into South creek;
- Provide planning guidelines with regard to developing new caretaker residences in the development areas and with regard to noise impact on existing caretaker residences and transient workforce accommodation;
- Follow Council by-laws with regard to construction noise and dust, and DEC Guidelines where appropriate;
- Consider traffic flows during design and develop a traffic management plan for the initial construction phase; and
- Provide lot development guidelines for setbacks, verges and fencing. Provide screening design along Great Northern Highway.

6. Environmental Approvals

6.1 Referral to the Department of Environment, Water, Heritage and the Arts (DEWHA)

Referral to the Commonwealth Department of the Environment, Water, Heritage and the Arts under the *Environment Protection and Biodiversity Conservation Act 1999* (the *EPBC Act*) is triggered by seven major issues. These are:

- World Heritage properties;
- National Heritage places (from 1 January 2004);
- Ramsar wetlands of international significance;
- Nationally listed threatened species and ecological communities;
- Listed migratory species;
- Commonwealth marine areas; and
- Nuclear actions (including uranium mining).

The *EPBC Act* is also triggered if a proposal is likely to have a significant environmental impact on Commonwealth Land.

Initial fauna surveys have indicated evidence for the presence of Mulgara, listed as Vulnerable under the EPBC Act, within parts of Transport Area B. Given the likely presence of this species within the northern part of the study area, the project may require referral to the DEWHA for assessment under the EPBC Act.

Further detailed fauna investigations (Level 2 fauna survey) would be required to verify the population size of this species within the study area. This investigation will be undertaken prior to any development of the high risk area of Transport Area B.

6.2 Referral to the Environmental Protection Authority (EPA)

Projects may require referral to the EPA under Part IV of the *Environmental Protection Act, 1986*, if the project will have significant impacts on any of the following matters:

- Native remnant vegetation;
- Rare flora and fauna species and threatened communities;
- Wetlands;
- Watercourses and rivers;
- Estuaries and inlets;
- Coastlines and near shore marine areas;
- Catchments with special requirements;
- Contaminated soils;
- Noise and vibration;

- Public Drinking Water Source Areas - groundwater and surface water;
- Aboriginal heritage;
- European cultural heritage; or
- Adjacent land uses.

Matters relating to this proposal which could require referral under this Act include:

- Impacts on threatened fauna.

Mulgara are listed as a Schedule 1 species under the *Wildlife Conservation Act 1950*. The clearing and proposed development of the study areas could cause breaks to habitat linkages for the Mulgara population within and outside the survey area.

Further detailed fauna investigations (Level 2 fauna survey) are recommended to verify the population size of this species prior to any development in Transport Area B.

Formal assessment of the project would preclude the requirement to obtain a separate Clearing Permit. Clearing Permits are required under the *Environmental Protection Act (Clearing of Native Vegetation Regulations) 2004* for any loss of native vegetation. However, if the project is formally assessed, the provisions for a clearing permit would be considered as part of that assessment.

The DEWHA has signed a Bilateral Agreement with the DEC. This agreement gives the DEC the power to assess some projects which would otherwise be assessed by the DEWHA. Projects which trigger the *EPBC Act* must still be referred under that *Act* but there will not be a duplication of assessment at both a State and Federal level.

7. References

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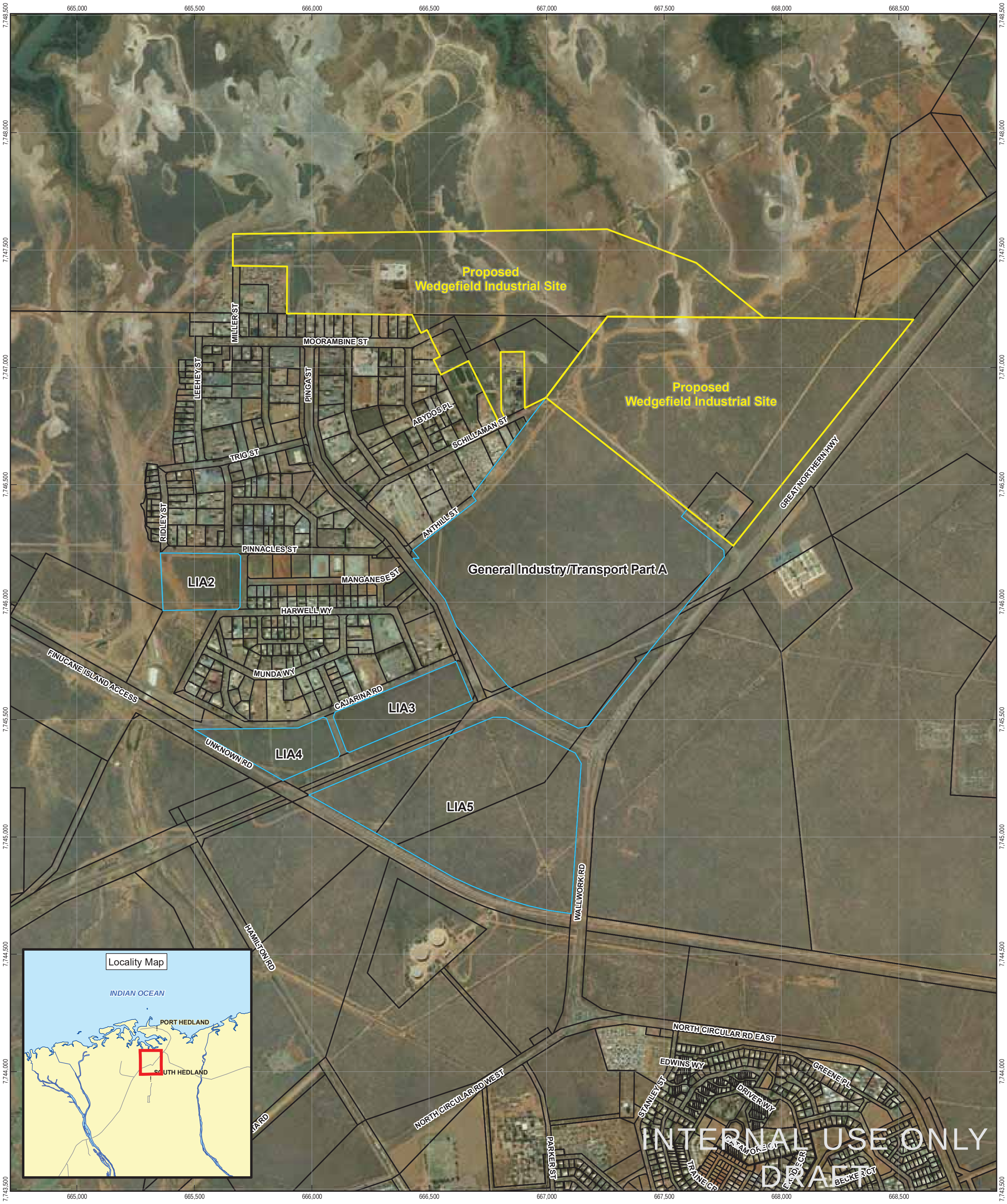
Appendix A

Figures



LEGEND

🟨	Proposed Wedgefield Industrial Site
🟦	Areas of Interest
☐	Cadastre

1:15,000 (at A3)

0 75 150 300 450 600 750

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 50

O

CLIENTS | PEOPLE | PERFORMANCE

Landcorp
LECP - Port Hedland Industrial Land PEIA

Job Number	61-22635
Revision	A
Date	20 JUL 2009

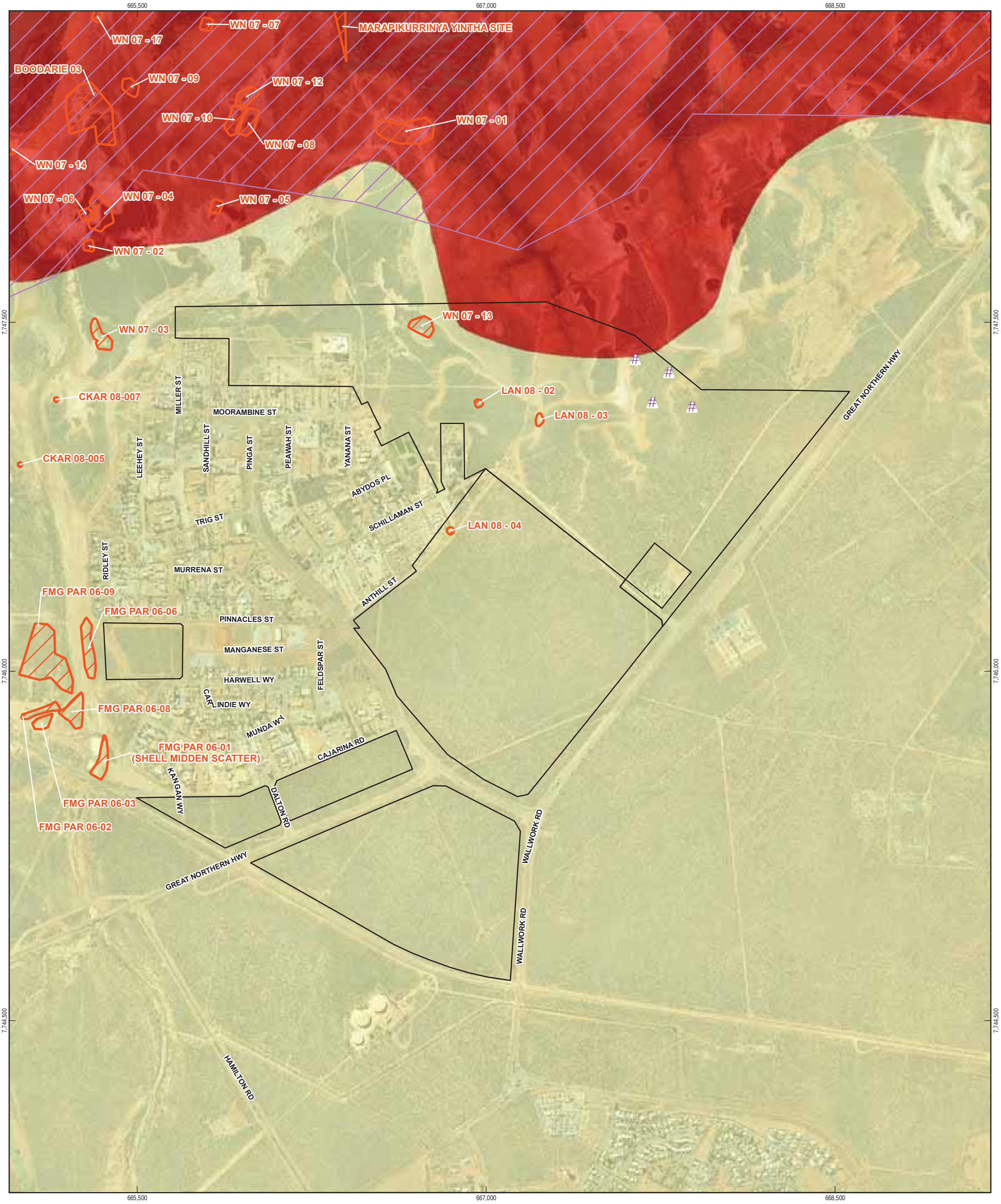
Locality Map

Figure 1

G:\61\22635\GIS\mxds\6122635-G009_RevB.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: Landgate: Pt Hedland Mosaic - 2008; MRWA: Cadastre - 200811, Roads - 2009; GHD: Boodarie Industrial Estate (incl. Alternative Site) - 20090716. Created by: slee2



LEGEND

#	Evidence of Mulgara (Vulnerable Fauna)	▨	Aboriginal Heritage Sites		**Acid Sulfate Soils**
		▨	Register of National Estate	🟥	High to moderate ASS disturbance risk (<3m from surface)
		☐	Study Area	🟧	Moderate to low ASS disturbance risk (<3m from surface)
				🟨	No known ASS disturbance risk (<3m from surface)

1:15,000 at A3

0 75 150 300 450 600

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 50

O

LandCorp

LECP - Port Hedland Industrial Land PEIA

Environmental Constraints
LIA 3, LIA 4, LIA 5, General Industry/Transport Part A, B

Job Number	61-22635
Revision	1
Date	20 OCT 2009

Figure 2

G:\61\22635\GIS\mxds\6122635-G01_Rev01.mxd

239 Adelaide Terrace Perth WA 6004 Australia **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: Landgate: Port Hedland Townsite Mosaic - 200208 (SLIP: 20090811); GHD: Study Area - 20090811, Mulgara (Vulnerable Fauna) - 20091020; DIA: Aboriginal Heritage Sites - 20090715; DEH: Register of National Estate - 2006; DEC: Acid Sulfate Soils - 20060906. Created by: C Hoermann, K Iralu

1:5,000 (at A3)

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 50

LEGEND

▭	Study Area
▭	Cadastre

Vegetation Type

🟧	Cleared/Disturbed areas
🟩	Low shrubland over mixed tussock grassland over very open herbs

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LECP - Port Hedland Industrial Land
PEIA

Job Number	61-22635
Revision	0
Date	20 AUG 2009

LIA 3, LIA 4, LIA 5
Vegetation Type

Figure 3

G:\61\22635\GIS\mxds\6122635-G013.mxd

GHD House, 239 Adelaide Terrace Perth WA 6004 T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data Source: GHD: Study Areas (LandCorp) - 20090811, Vegetation Type - 20080904; Landgate: Cadastre - 20090727; Landgate: WA Wedgefield Project Port Hedland Jun 2008 Mosaic - June 2008 (SLIP: 20090820). Created by: kdiralu

1:7,500 (at A3)

0 37.5 75 150 225 300

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 50

LEGEND

▭ Study Area

▭ Cadastre

Vegetation Type

🟧 Cleared/Disturbed areas

🟩 Low shrubland over mixed tussock grassland over very open herbs

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LandCorp
LECP - Port Hedland Industrial Land
PEIA

General Industry/ Transport Part A Vegetation Type

Job Number	61-22635
Revision	0
Date	20 AUG 2009

Figure 3

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GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: GHD: Study Areas (LandCorp) - 20090811, Vegetation Type - 20080904; Landgate: Cadastre - 20090727; Landgate: WA Wedgefield Project Port Hedland Jun 2008 Mosaic - June 2008 (SLIP: 20090820). Created by: kdiralu

1:10,000 (at A3)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 50

LEGEND

▭	Proposed Wedgefield Industrial Estate
▭	Cadastre

Vegetation Type

🟩	Bare areas/tidal flats
🟧	Cleared/Disturbed areas
🟩	Low shrubland over mixed tussock grassland over very open herbs
🟥	Tussock grassland over scattered herbs

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LandCorp
LECP - Port Hedland
Industrial Land PEIA

General Industry/
Transport Part B
Vegetation Type

Job Number	61-22635
Revision	0
Date	20 AUG 2009

Figure 3

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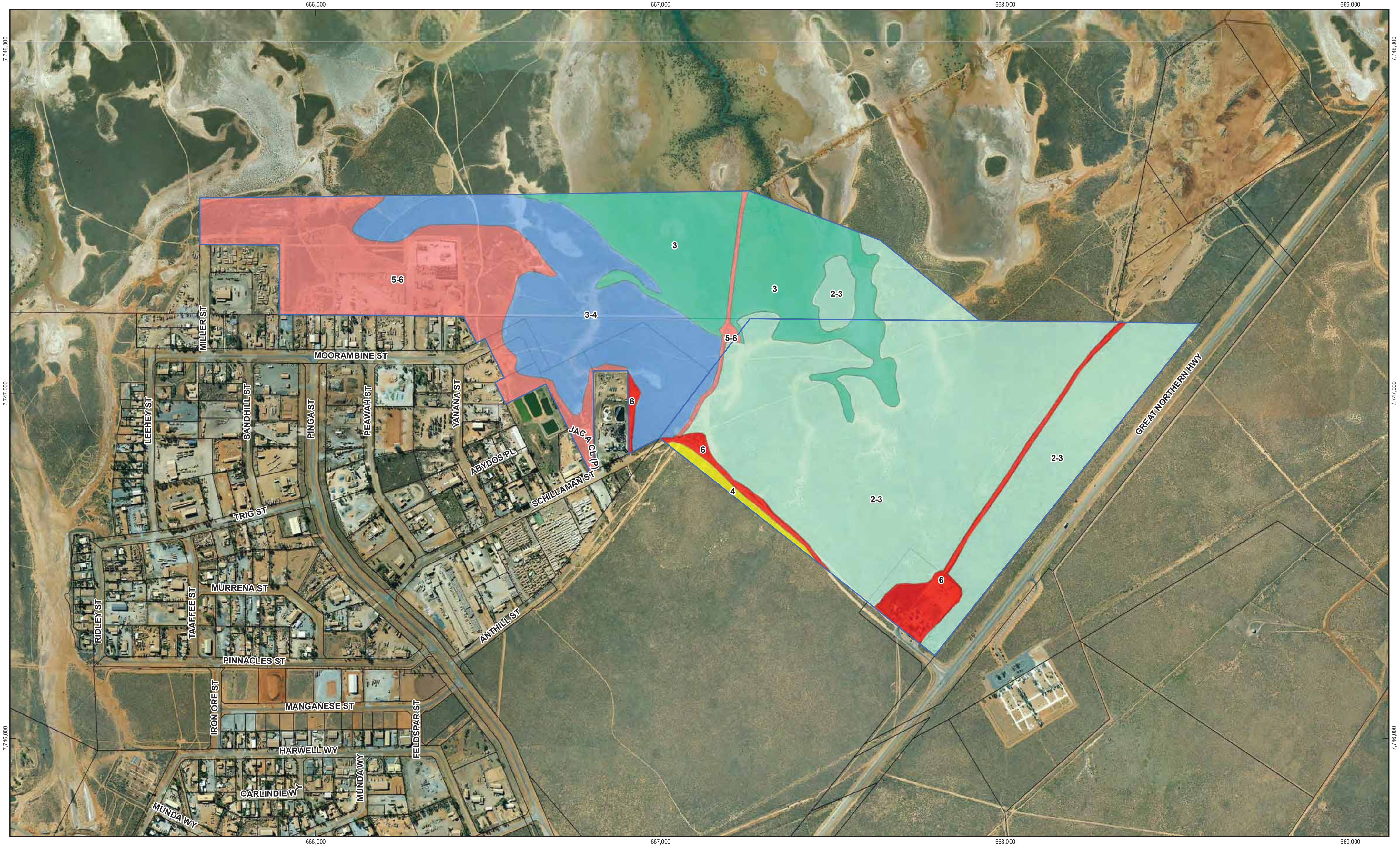
Data Source: GHD: Proposed Wedgefield Industrial Estate - 20090716; GHD: Vegetation Type - 20080904; Landgate: Cadastre - 20090727; Landgate: WA Wedgefield Project Port Hedland Jun 2008 Mosaic - June 2008 (SLIP: 20090820). Created by: kdiralu

GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au



1:10,000 (at A3)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 50

O

LEGEND

▭	Proposed Wedgefield Industrial Estate
▭	Cadastre

Vegetation Condition
1. Pristine or nearly so
2. Excellent
3. Very Good
4. Good
5. Degraded
6. Completely degraded

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LandCorp
LECP - Port Hedland
Industrial Land PEIA

Job Number	61-22635
Revision	0
Date	20 AUG 2009

General Industry/Transport Part B
Vegetation Condition

Figure 4

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GHD House, 239 Adelaide Terrace Perth WA 6004 **T** 61 8 6222 8222 **F** 61 8 6222 8555 **E** permail@ghd.com.au **W** www.ghd.com.au

Data Source: GHD: Proposed Wedgefield Industrial Estate - 20090716; GHD: Vegetation Condition - 20080904; Landgate: Cadastre - 20090727, WA Wedgefield Project Port Hedland Jun 2008 Mosaic - June 2008 (SLIP: 20090820). Created by: kdiralu

Appendix B

Flora

Conservation Categories and Definitions for *EPBC Act* Listed Flora and Fauna Species

Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species

Flora Species Recorded within the Study Areas

Quadrat Data

Table 11 Conservation Categories and Definitions for *EPBC Act* Listed Flora and Fauna Species

Conservation Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Table 12 Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species

Conservation Code	Description
R: Declared Rare Flora – Extant Taxa	Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
P1: Priority One – Poorly Known Taxa	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2: Priority Two – Poorly Known Taxa	Taxa which are known from one or a few (generally<5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3: Priority Three – Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
P4: Priority Four – Taxa in need of monitoring	Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.

Table 13 Flora Species Recorded within the Study Areas

Family	Genus	Species	Common Name	Status
Aizoaceae	*Trianthema*	*pilosa*		
Aizoaceae	*Trianthema*	*turgidifolia*		
Amaranthaceae	*Aerva*	*javanica*	Kapok Bush	*
Amaranthaceae	*Gomphrena*	*canescens* ssp. *canencens*		
Amaranthaceae	*Gomprena*	*sordida*		
Amaranthaceae	*Hemichroa*	*diandra*		
Amaranthaceae	*Ptilotus*	*?macrocephalus*	Featherheads	
Amaranthaceae	*Ptilotus*	*arthrolasius*		
Amaranthaceae	*Ptilotus*	*austrolasius*		
Amaranthaceae	*Ptilotus*	*axillaris*	Mat Mulla Mulla	
Amaranthaceae	*Ptilotus*	*fusiformis*		
Amaranthaceae	*Ptilotus*	*obovatus*	Cotton Bush	
Amaranthaceae	*Ptilotus*	*polystachyus*	Prince of Wales Feather	
Apocynaceae	*Carissa*	*lanceolata*		
Asteraceae	*Pterocaulon*	*sphacelatum*	Apple Bush	
Asteraceae	*Pterocaulon*	*sphaeranthoides*		
Asteraceae	*Streptoglossa*	*liatroides*		
Avicenniaceae	*Avicennia*	*marina*	White Mangrove	
Bignoniaceae	*Dolichandrone*	*heterophylla*		
Boraginaceae	*Heliotropium*	*vestitum*		
Caesalpiniaceae	*Senna*	*artemisioides*		
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *oligophylla*		
Caesalpiniaceae	*Senna*	*glutinosa* subsp. *glutinosa*		
Caesalpiniaceae	*Senna*	*notabilis*		
Caryophyllaceae	*Polycarpaea*	*?corymbosa*		
Chenopodaceae	*Neobassia*	*astrocarpa*		
Chenopodaceae	*Tecticornia*	*pergranulata*		
Chenopodaceae	*Tecticornia*	*pterogosperma*		
Chenopodiaceae	*Dysphania*	*kalpari*	Rat's Tail	
Chenopodiaceae	*Salsola*	*tragus*		
Chenopodiaceae	*Threlkeldia*	*diffusa*	Coast Bonefruit	

Family	Genus	Species	Common Name	Status
Commelinaceae	*Commelina*	*ensifolia*		
Convolvulaceae	*Bonamia*	*linearis*		
Convolvulaceae	*Bonamia*	*alatisemina*		
Convolvulaceae	*Bonamia*	*erecta*		
Convolvulaceae	*Evolvulus*	*alsinoides* var. *villosicalyx*		
Convolvulaceae	*Ipomoea*	*muelleri*	Poison Morning Glory	
Convolvulaceae	*Ipomoea*	*pes-caprae*		
Convolvulaceae	*Merremia*	*davenportii*		
Convolvulaceae	*Operculina*	*aequisepala*		
Cucurbitaceae	*Cucumis*	*maderaspatanus*		
Cyperaceae	*Bulbostylis*	*barbata*		
Cyperaceae	*Cyperus*	*hesperius*		
Euphorbiaceae	*Euphorbia*	*australis*	Namana	
Euphorbiaceae	*Euphorbia*	*coghlanii*	Namana	
Frankeniaceae	*Frankenia*	*ambita*		
Goodeniaceae	*Goodenia*	*forrestii*		
Goodeniaceae	*Goodenia*	*muelleriana*		
Gyrostemonaceae	*Codonocarpus*	*cotinifolius*	Native Poplar	
Lamiaceae	*Clerodendrum*	*floribundum*	Lollybush	
Lauraceae	*Cassytha*	*filiformis*	Love Vine	
Malvaceae	*Abutilon*	sp.(insufficient material)		
Malvaceae	*Hibiscus*	*brachychlaenus*		
Malvaceae	*Sida*	*clementii*		
Malvaceae	*Sida*	*rohlenae* subsp. *rohlenae*		
Mimosaceae	*Acacia*	*ampliceps*		
Mimosaceae	*Acacia*	*colei*	Cole's Wattle	
Mimosaceae	*Acacia*	*sericophylla*		
Mimosaceae	*Acacia*	*stellaticeps*		
Mimosaceae	*Acacia*	*trachycarpa*	Minni Ritchi	
Mimosaceae	*Acacia*	*ancistrophylla*		P
Mimosaceae	*Acacia*	*bivenosa*		
Mimosaceae	*Acacia*	*pyrifolia*	Kajni bush	
Mimosaceae	*Acacia*	*tumida*		
Mimosaceae	*Neptunia*	*dimorphantha*	Sensitive Plant	

Family	Genus	Species	Common Name	Status
Molluginaceae	*Mollugo*	*molluginea*		
Myrtaceae	*Eucalyptus*	*victrix*		P
Myrtaceae	*Melaleuca*	sp. (insufficient material)		P
Myrtaceae	*Melaleuca*	*lasiandra*		
Papilionaceae	*Cajanus*	*cinereus*		
Papilionaceae	*Cajanus*	*marmoratus*		
Papilionaceae	*Cleome*	*viscosa*	Tickweed	
Papilionaceae	*Crotalaria*	*cunninghamii*	Bird flower	
Papilionaceae	*Crotularia*	*ramosissima*		
Papilionaceae	*Cullen*	*pognocarpum*		
Papilionaceae	*Cullen*	*stipulaceum*		
Papilionaceae	*Desmodium*	*filiforme*		
Papilionaceae	*Indigofera*	*linifolia*		
Papilionaceae	*Indigofera*	*linnaei*		
Papilionaceae	*Indigofera*	*monophylla*		
Papilionaceae	*Rhynchosia*	*minima*	Rhynchosia	
Papilionaceae	*Sesbania*	*cannabina*	Sesbania Pea	
Papilionaceae	*Swainsona*	*pterostylis*		
Papilionaceae	*Tephrosia*	*leptoclada*		
Papilionaceae	*Tephrosia*	*rosea*		
Papilionaceae	*Vigna*	*lanceolata* var. *lanceolata*		
Plumbaginaceae	*Muellerolimon*	*salcorniaceum*		
Poaceae	*Aristida*	*holathera* var. *holathera*		
Poaceae	*Cenchrus*	*ciliaris*	Buffel Grass	*
Poaceae	*Chloris*	*barbata*	Purpletop Chloris	*
Poaceae	*Digitaria*	*brownii*		
Poaceae	*Eragrostis*	*cumingii*		
Poaceae	*Eragrostis*	*dielsii*		
Poaceae	*Eragrostis*	*eriopoda*	Woollybutt Grass	
Poaceae	*Eragrostis*	*falcata*		
Poaceae	*Eragrostis*	*speciosa*		
Poaceae	*Eriachne*	*aristidea*		
Poaceae	*Eriachne*	*obtusa*	Northern Wanderrie Grass	

Family	Genus	Species	Common Name	Status
Poaceae	*Panicum*	*decompositum*	Native Millet	
Poaceae	*Paraneurachne*	*muelleri*	Northern Mulga Grass	
Poaceae	*Paspalidium*	*constrictum*		
Poaceae	*Sorghum*	*plumosum*		
Poaceae	*Sorghum*	*timorense*		
Poaceae	*Triodia*	*epactia*		
Poaceae	*Triodia*	*schinzii*		
Poaceae	*Triodia*	*secunda*		
Poaceae	*Yakirra*	*australiensis*		
Portulacaceae	*Calandrinia*	sp. Pinga		
Portulacaceae	*Calandrinia*	*stagnensis*		
Proteaceae	*Hakea*	*lorea*	Witinti	
Santalaceae	*Santalum*	*lanceolatum*	Northern Sandalwood	
Sapindaceae	*Dodonaea*	*coriacea*		
Scrophulariaceae	*Stemodia*	*grossa*	Vicks bush	
Solanaceae	*Solanum*	*diversiflorum*		
Sterculiaceae	*Waltheria*	*indica*		
Thymelaceae	*Pimelea*	*ammocharis*		
Tiliaceae	*Corchorus*	sp.(insufficient material)	‘Round leaf'	
Tiliaceae	*Corchorus*	sp. (insufficient material)	‘Linear leaf"	
Tiliaceae	*Corchorus*	*walcottii*	Woolly Corchorus	
Tiliaceae	*Triumfetta*	*appendiculata*		
Tiliaceae	*Triumfetta*	*ramosa*		
Violaceae	*Hybanthus*	*aurantiacus*		
Zygophyllaceae	*Tribulus*	*occidentalis*	Perennial Caltrop	

*	Introduced
P	Planted

QUADRAT DATA – Field Survey June 2008

LIA 3 Quadrat 1

Field Vegetation Description: *Acacia stellaticeps* and *Triodia* very low shrubland over scattered herbs.

Landform/soil: Flat; red sandy loam

Open ground: 20%

Leaf Litter: <5%

Rocks 0%

Condition: 1/2

Disturbance: Scattered Buffel Grass. Occasional rubbish.

Quadrat 1 species data

Family	Genus	Species	Status	Height (m)	Coverage (%)
Mimosaceae	*Acacia*	*stellaticeps*		<0.5m	30-40%
Poaceae	*Triodia*	*epactia*		0.6	10
Poaceae	*Triodia*	*schinzii*		0.6	10
Poaceae	*Eriachne*	*obtusa*		0.5	10
Mimosaceae	*Acacia*	*colei*		2	<2
Papilionaceae	*Indigofera*	*monophylla*		0.3	<2
Convolvulaceae	*Bonamia*	*erecta*		0.3	2-10
Violaceae	*Hybanthus*	*aurantiacus*		0.3	2-10
Lauraceae	*Cassytha*	*filiformis*		N/A	2-10

Family	Genus	Species	Status	Height (m)	Coverage (%)
Tiliaceae	*Corchorus*	*sp.*		0.4	<2
Poaceae	*Cenchrus*	*ciliaris*	*	0.5	<2

LIA 4 Quadrat 1

Field Vegetation Description: *Acacia stellaticeps* and *Triodia* very low shrubland over very scattered herbs.

Landform/soil: Flat; red sandy loam

Open ground: 25%

Leaf Litter: <5%

Rocks 0%

Condition: 1/2 Very mature (long unburnt), plants ageing.

Disturbance: Very scattered Buffel grass.

Quadrat 1 species data

Family	Genus	Species	Status	Height (m)	Coverage (%)
Mimosaceae	*Acacia*	*stellaticeps*		<0.5m	30%
Poaceae	*Triodia*	*epactia*		0.6	20
Poaceae	*Triodia*	*schinzii*		0.6	10
Poaceae	*Eriachne*	*obtusa*		0.5	2-10
Poaceae	*Cenchrus*	*ciliaris*	*	0.5	<2

LIA 5 Quadrat 1

Field Vegetation Description: *Acacia stellaticeps* and *Triodia* low shrubland over scattered herbs.

Landform/soil:	Flat; red sandy loam
Open ground:	20%
Leaf Litter:	<5%
Rocks	0%
Condition:	1/2
Disturbance:	Buffel grass.

Quadrat 1 species data

Family	Genus	Species	Status	Height (m)	Coverage (%)
Mimosaceae	*Acacia*	*stellaticeps*		<0.6m	30-40%
Poaceae	*Triodia*	*epactia*		0.6	10
Poaceae	*Triodia*	*schinzii*		0.6	10
Poaceae	*Eriachne*	*obtusa*		0.5	2-10
Convulvulaceae	*Bonamia*	*alatisemina*		0.2	2-10
Amaranthaceae	*Ptilotus*	*macrocephalus*		0.5	<2
Amaranthaceae	*Ptilotus*	*austrolasius*		0.4	<2
Lauraceae	*Cassytha*	*filiformis*		N/A	2-10
Caesalpinaceae	*Senna*	*nemophila*		0.4	<2
Poaceae	*Cenchrus*	*ciliaris*	*	0.5	<2

LIA 5 Quadrat 2

Field Vegetation Description: *Acacia stellaticeps* and *Triodia* low shrubland over scattered herbs.

Landform/soil: Flat; red sandy loam

Open ground: 25%

Leaf Litter: <5%

Rocks 0%

Condition: 1/2

Disturbance: Buffel Grass.

Quadrat 2 species data

Family	Genus	Species	Status	Height (m)	Coverage (%)
Mimosaceae	*Acacia*	*stellaticeps*		<0.7m	30%
Poaceae	*Triodia*	*epactia*		0.6	10
Poaceae	*Triodia*	*schinzii*		0.6	10
Poaceae	*Eriachne*	*obtusa*		0.5	10
Convulvulaceae	*Bonamia*	*alatisemina*		0.2	2-10
Poaceae	*Cenchrus*	*ciliaris*	*	0.5	15%

Transport Area A Quadrat 1

Field Vegetation Description: *Acacia stellaticeps* and *Triodia* very low shrubland over scattered herbs.

Landform/soil: Flat; red sandy loam

Open ground: 20%

Leaf Litter: <5%

Rocks 0%

Condition: 1

Disturbance: None.

Quadrat 1 species data

Family	Genus	Species	Status	Height (m)	Coverage (%)
Mimosaceae	*Acacia*	*stellaticeps*		<0.3m	10-15
Poaceae	*Triodia*	*epactia*		0.4	40
Poaceae	*Eriachne*	*obtusa*		0.4	30
Poaceae	*Sorghum*	*plumosa*		0.6	2-10
Violaceae	*Hybanthus*	*aurantiacus*		0.2	<2
Cyperaceae	*Cyperus*	*bulbosus*		0.5	<2
Lauraceae	*Cassytha*	*filiformis*		0.2	2-10
Papilionaceae	*Indigofera*	*linifolia*		0.3	2-10
Convolvulaceae	*Bonamia*	*alatisemina*		0.2	<2
Sapindaceae	*Dodonaea*	*coriaceae*		1.0	<2
Tiliaceae	*Corchorus*	*walcottii*		0.5	<2

Transport Area A Quadrat 2

Field Vegetation Description: *Triodia* and tussock grassland

Landform/soil: Flat; red sandy clay loam

Open ground: 20%

Leaf Litter: <5%

Rocks 0%

Condition: 1

Disturbance: None.

Quadrat 2 species data

Family	Genus	Species	Status	Height (m)	Coverage (%)
Poaceae	*Triodia*	*epactia*		0.4	<60
Poaceae	*Triodia*	*schinzii*		0.4	15
Poaceae	*Sorghum*	*plumosa*		0.6	2-10

QUADRAT DATA – Field Survey June 2009 (Transport Area B)

Quadrat 1

Field Vegetation Description: *Acacia stellaticeps* over *Triodia epactia* and *T. schinzii* hummock grassland

Landform/soil:	Flat; red sand
Open ground:	20%
Leaf Litter:	<5%
Rocks	0%
Condition:	1/2
Disturbance:	None.

Quadrat 1 species list

Family	Genus	Species	Common Name	% Cover
Mimosaceae	*Acacia*	*stellaticeps*		50
Poaceae	*Triodia*	*epactia*		5-10
Poaceae	*Triodia*	*schinzii*		20
Poaceae	*Eragrostis*	*cumingii*		1-2
Cyperaceae	*Bulbostylis*	*barbata*		2
Euphorbiaceae	*Euphorbia*	*coghlanii*	Namana	2
Poaceae	*Eragrostis*	*speciosa*		2
Asteraceae	*Streptoglossa*	*liatroides*		1

Amaranthaceae	*Ptilotus*	*fusiformis*		1
Sapindaceae	*Dodonaea*	*coriacea*		1
Caesalpiniaceae	*Senna*	*glutinosa* subsp. *glutinosa*		1
Amaranthaceae	*Ptilotus*	*obovatus*	Cotton Bush	1
Amaranthaceae	*Ptilotus*	*polystachyus*	Prince of Wales Feather	1
Mimosaceae	*Acacia*	*sericophylla*		1

Quadrat 2

Field Vegetation Description: *Triodia epactia* and *T. schinzii* hummock grassland over low open shrubland of *Acacia stellaticeps*.

Landform/soil: Flat; red sand

Open ground: 5%

Leaf Litter: <5%

Rocks 0%

Condition: 2

Disturbance: Some old vehicle tracks

Quadrat 2 species list

Family	Genus	Species	Common Name	% Cover
Poaceae	*Triodia*	*schinzii*		40

Poaceae	*Triodia*	*epactia*		40
Mimosaceae	*Acacia*	*stellaticeps*		5
Poaceae	*Eragrostis*	*cumingii*		5
Violaceae	*Hybanthus*	*aurantiacus*		1
Cyperaceae	*Cyperus*	*hesperius*		1
Asteraceae	*Pterocaulon*	*sphacelatum*	Apple Bush	1

Quadrat 3

Field Vegetation Description: *Acacia stellaticeps* over *Triodia epactia* and *T. schinzii* hummock grassland

Landform/soil:	Flat; red sand
Open ground:	20%
Leaf Litter:	<5%
Rocks	0%
Condition:	2
Disturbance:	Old vehicle tracks

Quadrat 3 species list

Family	Genus	Species	Common Name	% Cover
Poaceae	*Triodia*	*schinzii*		25
Mimosaceae	*Acacia*	*stellaticeps*		30

Poaceae	*Triodia*	*epactia*		5
Poaceae	*Aristida*	*holathera* var. *holathera*		5
Amaranthaceae	*Ptilotus*	*arthrolasius*		1
Tiliaceae	*Corchorus*	*walcottii*	Woolly Corchorus	1
Sterculiaceae	*Waltheria*	*indica*		1
Violaceae	*Hybanthus*	*aurantiacus*		1
Poaceae	*Eragrostis*	*cumingii*		1
Malvaceae	*Hibiscus*	*brachychlaenus*		1
Amaranthaceae	*Ptilotus*	*polystachyus*	Prince of Wales Feather	1
Bignoniaceae	*Dolichandrone*	*heterophylla*		1
Lamiaceae	*Clerodendrum*	*floribundum*	Lollybush	1

Quadrat 4

Field Vegetation Description: *Acacia stellaticeps* over *Triodia epactia* and *T. schinzii* hummock grassland

Landform/soil: Flat; red sand

Open ground: 20%

Leaf Litter: <2%

Rocks 0%

Condition: 2

Disturbance: Minor disturbance – old tracks

Quadrat 4 species list

Family	Genus	Species	Common Name	% Cover
Poaceae	Triodia	schinzii		50
Mimosaceae	Acacia	stellaticeps		15
Poaceae	Digitaria	brownii		5
Poaceae	Triodia	epactia		5
Poaceae	Eragrostis	eriopoda	Woollybutt Grass	1
Boraginaceae	Heliotropium	vestitum		1
Molluginaceae	Mollugo	molluginea		1
Poaceae	Yakirra	australiensis		1
Tiliaceae	Corchorus	walcottii	Woolly Corchorus	1
Cyperaceae	Cyperus	hesperius		1
Poaceae	Eragrostis	cumingii		1

Quadrat 5

Field Vegetation Description: *Triodia epactia, T. schinzii* and *Sorghum timorense* grassland.

Landform/soil: Flat; red sand

Open ground: 10%

Leaf Litter: <2%

Rocks 0%

Condition: 2

Disturbance: No evidence of disturbance

Quadrat 4 species list

Family	Genus	Species	Common Name	% Cover
Poaceae	*Sorghum*	*timorense*		20
Poaceae	*Triodia*	*epactia*		40
Poaceae	*Triodia*	*schinzii*		30
Poaceae	*Eragrostis*	*cumingii*		1
Mimosaceae	*Acacia*	*stellaticeps*		1
Asteraceae	*Pterocaulon*	*sphaeranthoides*		1
Cyperaceae	*Cyperus*	*hesperius*		1

Appendix C

Fauna

EPBC Act Fauna Conservation Categories

Western Australian Wildlife Conservation Act 1950 Conservation Codes

DEC Priority Fauna Codes

WA Museum / DEC “NatureMap” Fauna Records within 20 km of the Study Area

Listing of Potentially Occurring Significant, Rare and Priority Fauna Species within 20 km of the Study Area, with Information Source

Fauna Species Observed within the Study Area During the Field Survey

EPBC Act Fauna Conservation Categories

Listed threatened species and ecological communities

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- extinct in the wild,
- critically endangered,
- endangered, or
- vulnerable.

(See Table 11)

Critically endangered and endangered species

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*, or
- interfere with the recovery of the species.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

Vulnerable species

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- lead to a long-term decrease in the size of an important population of a species, or
- reduce the area of occupancy of an important population, or
- fragment an existing important population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of an important population, or

- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.

Listed migratory species

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened.

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or
- result in invasive species that is harmful to the migratory species becoming established* in an area of important habitat of the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of thespecies.

An area of important habitat is:

1. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
2. habitat utilised by a migratory species which is at the limit of the species range, or
3. habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation.

The Commonwealth marine environment

An action will require approval from the Environment Minister if:

- the action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment, or
- the action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment in a Commonwealth marine area.

An action has, will have or is likely to have a significant impact on the environment in a Commonwealth marine area if it does, will, or is likely to:

- result in a known or potential pest species becoming established in the Commonwealth marine area*, or
- modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results, or
- have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (eg breeding, feeding, migration behaviour, and life expectancy) and spatial distribution, or
- result in a substantial change in air quality** or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or
- result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.

*Translocating or introducing a pest species may result in that species becoming established.

**The Commonwealth marine area includes any airspace over Commonwealth waters.

Table 14 *Western Australian Wildlife Conservation Act 1950* Conservation Codes

Conservation Code	Description
Schedule 1	"…fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection."
Schedule 2	"…fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection."
Schedule 3	"…birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection."
Schedule 4	"…fauna that is in need of special protection, otherwise than for the reasons mentioned [in Schedule 1 – 3]"

Table 15 DEC Priority Fauna Codes

(Species not listed under the *Wildlife Conservation Act 1950*, but for which there is some concern).

Conservation Code	Description
Priority 1	Taxa with few, poorly known populations on threatened lands.
Priority 2	Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
Priority 3	Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
Priority 4	Rare taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.
Priority 5	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Table 16 WA Museum / DEC "NatureMap" Fauna Records within 20 km of the Study Area

Species	Common Name	Status
Amphibians		
Cyclorana australis	Giant Frog	
Cyclorana maini	Sheep Frog	
Litoria rubella	Little Red Tree Frog	
Neobatrachus aquilonius	Northern Burrowing Frog	
Notaden nichollsi	Desert Spadefoot	
Opisthodon spenceri	Centralian Burrowing Frog	
Uperoleia russelli	Northwest Toadlet	
Birds		
Ardeotis australis	Australian Bustard	Priority 4
Arenaria interpres subsp. *interpres*		
Artamus cinereus subsp. *melanops*		
Artamus leucorynchus	White-breasted Woodswallow	
Calidris ruficollis	Red-necked Stint	
Corvus orru subsp. *cecilae*	Western Crow	
Eopsaltria pulverulenta	Mangrove Robin	
Gallinago stenura	Pin-tailed Snipe	
Gallirallus philippensis subsp. *mellori*		
Limnodromus semipalmatus	Asian Dowitcher	
Motacilla flava subsp. *simillima*		
Neochima ruficauda subsp. *subclarescens*	Star Finch (western)	Priority 4
Numenius madagascariensis	Eastern Curlew	Priority 4
Nycticorax caledonicus subsp. *hilli*		
Oceanites oceanicus	Wilson's Storm Petrel	
Pachycephala lanioides	White-breasted Whistler	
Passer montanus	Eurasian Tree Sparrow	
Ptilonorhynchus maculatus subsp. *guttatus*	Western Bowerbird	
Sterna caspia	Caspian Tern	
Sterna leucoptera	White-winged Black Tern	
Tringa brevipes	Grey-tailed Tattler	

Species	Common Name	Status
Tringa cinerea	Terek Sandpiper	
Turnix velox	Little Button-quail	
Tyto alba subsp. delicatula		
Mammals		
Antechinomys laniger	Kultarr	
Chaerephon jobensis	Northern Freetail-bat	
Dasycercus blythi	Brush-tailed Mulgara, Ampurta	Priority 4
Dasykaluta rosamondae	Little Red Kaluta	
Dasyurus hallucatus	Northern Quoll	Endangered
Dugong dugon	Dugong	Schedule 1
Lagostrophus fasciatus subsp. *fasciatus* Bernier Is.	Banded Hare-wallaby (name not current)	Vulnerable
Macropus robustus subsp. *erubescens*	Euro, Biggada	
Macrotis lagotis	Bilby, Dalgyte	Vulnerable
Mormopterus loriae subsp. *cobourgiana*	Little North-western Mastiff Bat	Priority 1
Nyctophilus arnhemensis	Arnhem Land Long-eared Bat	
Nyctophilus geoffroyi	Lesser Long-eared Bat	
Pseudomys hermannsburgensis	Sandy Inland Mouse	
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart	
Sousa chinensis	Indo-Pacific Humpback Dolphin	Priority 4
Vespadelus finlaysoni	Finlayson's Cave Bat	
Reptiles		
Acanthophis pyrrhus	Desert Death Adder	
Amphibolurus longirostris		
Antaresia perthensis	Pygmy Python	
Aspidites melanocephalus	Black-headed Python	
Aspidites ramsayi	Woma	Schedule 1
Chelonia mydas	Green Turtle	Vulnerable
Cryptoblepharus buchananii		
Ctenophorus caudicinctus subsp. *caudicinctus*		
Ctenophorus isolepis subsp. *isolepis*		
Ctenotus duricola		

Species	Common Name	Status
Ctenotus hanloni		
Ctenotus helenae		
Ctenotus pantherinus subsp. *ocellifer*		
Ctenotus rufescens		
Ctenotus saxatilis	Rock Ctenotus	
Ctenotus serventyi		
Delma haroldi		
Delma pax		
Delma tincta		
Demansia rufescens	Rufous Whipsnake	
Diplodactylus conspicillatus	Fat-tailed Gecko	
Diporiphora winneckei	Blue-lined Dragon	
Disteira stokesii		
Eremiascincus fasciolatus	Narrow-banded Sand Swimmer	
Eretmochelys imbricata subsp. *bissa*	Hawksbill Turtle (name not current)	
Fordonia leucobalia	White-bellied Mangrove Snake	
Furina ornata	Moon Snake	
Gehyra pilbara		
Gehyra punctata		
Gehyra purpurascens		
Gehyra variegata		
Hemidactylus frenatus	Asian House Gecko	
Hydrelaps darwiniensis		
Hydrophis elegans		
Lerista bipes		
Lerista clara		
Lialis burtonis		
Lucasium stenodactylum		
Menetia greyii		
Nephrurus levis subsp. *pilbarensis*		
Pogona minor subsp. *mitchelli*		
Pseudechis australis	Mulga Snake	
Pseudonaja modesta	Ringed Brown Snake	

Species	Common Name	Status
Pseudonaja nuchalis	Gwardar	
Pygopus nigriceps		
Ramphotyphlops ammodytes		
Ramphotyphlops braminus		
Ramphotyphlops grypus		
Ramphotyphlops pilbarensis		
Simoselaps anomalus	Desert Banded Snake	
Strophurus ciliaris subsp. *aberrans*		
Strophurus elderi		
Strophurus jeanae		
Suta punctata	Spotted Snake	
Tiliqua multifasciata	Central Blue-tongue	
Varanus acanthurus	Spiny-tailed Monitor	
Varanus brevicauda	Short-tailed Pygmy Monitor	
Varanus eremius	Pygmy Desert Monitor	
Varanus gouldii	Bungarra or Sand Monitor	

Table 17 Listing of Potentially Occurring Significant, Rare and Priority Fauna Species within 20 km of the Study Area, with Information Source

Genus	Species	Common Name	Listing under Wildlife Conservation Act 1950 or DEC Priority List	Listing under EPBC Act	Source of Information		
					DEC Database	EPBC Protected Matters Search Tool	NatureMap
Birds							
Macronectes	*giganteus*	Southern Giant-Petrel	Schedule 1	Endangered,		X	
Haliaeetus	*leucogaster*	White-bellied Sea-Eagle		Migratory, Listed, overfly marine areas		X	
Hirundo	*rustica*	Barn Swallow		Migratory, Listed, overfly marine areas		X	
Merops	*ornatus*	Rainbow Bee-eater		Migratory, Listed, overfly marine areas			
Ardea	*alba*	Great Egret, White Egret		Migratory, Listed, overfly marine areas		X	
Ardea	*ibis*	Cattle Egret		Migratory, Listed, overfly marine areas		X	
Charadrius	*veredus*	Oriental Plover, Oriental Dotterel		Migratory, Listed overfly marine areas		X	

Genus	Species	Common Name	Listing under Wildlife Conservation Act 1950 or DEC Priority List	Listing under EPBC Act	Source of Information		
					DEC Database	EPBC Protected Matters Search Tool	NatureMap
Glareola	*maldivarum*	Oriental Pratincole		Migratory, Listed, overfly marine areas		X	
Limicola	*falcinellus*	Broad-billed Sandpiper		Migratory, Marine		X	
Numenius	*minutus*	Little Curlew, Little Whimbrel		Migratory, Listed, overfly marine areas		X	
Tringa	*nebularia*	Common Greenshank, Greenshank		Migratory, Marine		X	
Calidris	*melanotos*	Pectoral Sandpiper		Marine		X	
Calidris	*subminuta*	Long-toed Stint		Marine		X	
Charadrius	*ruficapillus*	Red-capped Plover		Marine		X	
Himantopus	*himantopus*	Black-winged Stilt		Marine		X	
Ardeotis	*australis*	Australian Bustard	Priority 4		X		X
Numenius	*madagascariensis*	Eastern Curlew	Priority 4				X
Neochima	*ruficauda* subsp. *subclarescens*	Star Finch (western)	Priority 4		X		X
Apus	*pacificus*	Fork-tailed Swift		Migratory, Listed, overfly marine areas		X	

Genus	Species	Common Name	Listing under Wildlife Conservation Act 1950 or DEC Priority List	Listing under EPBC Act	Source of Information		
					DEC Database	EPBC Protected Matters Search Tool	NatureMap
Mammals							
Mormopterus	*loriae* subsp. *cobourgiana*	Little North-western Mastiff Bat	Priority 1		X		X
Macrotis	*lagotis*	Bilby, Dalgyte	Schedule 1	Vulnerable			X
Dasycercus	*blythi*	Brush-tailed Mulgara, Ampurta	Priority 4				X
Dasyurus	*hallucatus*	Northern Quoll	Schedule 1	Endangered	X	X	X
Lagostrophus	*fasciatus* subsp. *fasciatus* Bernier Is.	Banded Hare-wallaby	Schedule 1	Vulnerable	X		X
Rhinonicteris	*aurantius* (Pilbara form)	Pilbara Leaf-nosed Bat		Vulnerable		X	*
Reptiles							
Aspidites	*ramsayi*	Woma	Schedule 4				X

Table 18 Fauna Species Observed within the Study Area During the Field Survey

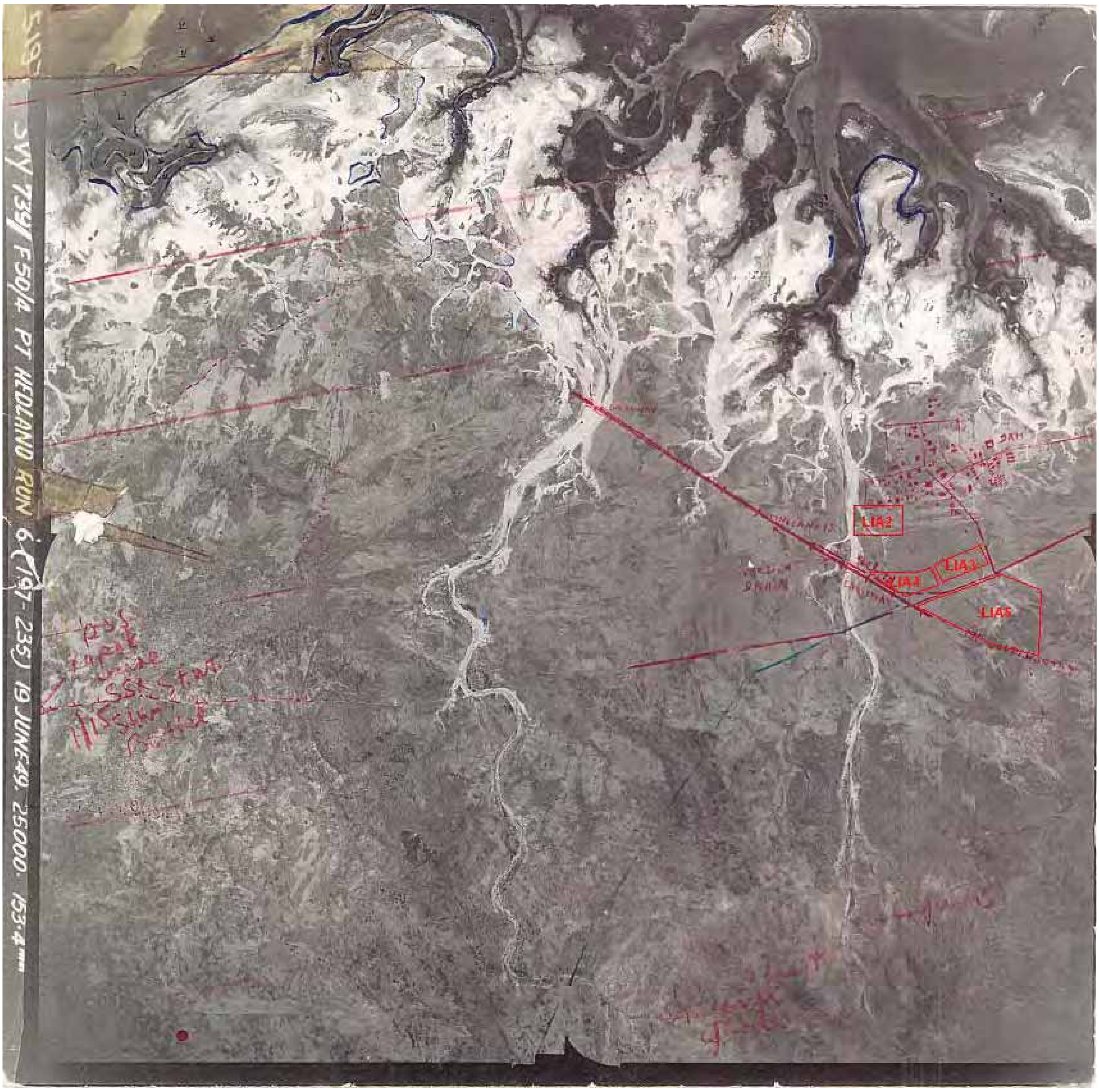
Family	Genus	Species	Common Name	Status
Birds				
Accipitridae	*Elanus*	*caeruleus*	Black-shouldered Kite	Mi
Accipitridae	*Milvus*	*migrans*	Black Kite	Mi
Alcedinidae	*Geopelia*	*humeralis*	Bar-shouldered Dove	
Artamidae	*Artamus*	*cinereus*	Black-faced Woodswallow	
Artamidae	*Artamus*	*leucorynchus*	White-breasted Woodswallow	
Campephagidae	*Coracina*	*novaehollandiae melanops*	Black-faced Cuckoo-Shrike	Ma
Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon	
Corvidae	*Corvus*	*orru*	Torresian Crow	
Dicruridae	*Rhipidura*	*leucophrys*	Willie Wagtail	
Dricruridae	*Grallina*	*cyanoleuca*	Magpie-Lark	
Falconidae	*Falco*	*cenchroides*	Nankeen Kestrel	Ma
Halcyonidae	*Todiramphus*	*pyrrhopygia*	Red-backed Kingfisher	
Maluridae	*Malurus*	*leucopterus*	White-winged Fairy Wren	
Meliphagidae	*Lichenostomus*	*virescens*	Singing Honeyeater	
Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner	
Meropidae	*Merops*	*ornatus*	Rainbow Bee-eater	Mi, Ma
Motacillidae	*Anthus*	*australis*	Australian Pipit	
Passeridae	*Taeniopygia*	*guttata*	Zebra Finch	
Psittacidae	*Cacatua*	*sanguinea*	Little Corella	
Psittacidae	*Eolophus*	*roseicapilla*	Galah	
Mammals				
Canidae	*Canus*	*domesticus*	Dog	*
Dasyuridae	*Dasycercus*	*cristicauda*	Mulgara	V, S1
Felidae	*Felis*	*catus*	Feral Cat	*
Macropodidae	*Macropus*	*rufus*	Red Kangaroo	
Reptiles				
Agamidae	*Ctenophorus*	*isolepis isolepis*	Central Military Dragon	
Scincidae	*Ctenotus*	*pantherinus ocellifer*	Leopard Ctenotus	
Varanidae	*Varanus*	*brevicauda*	Short-tailed Pygmy Monitor	

Appendix D

Contaminated Sites Desktop Review

Aerial Photographs

Certificate of Title



Legend

🟥 Approximate Site Boundary

N

Created By	Checked	Approved
GB	XX	XX

Date

01/10/08

File location

61/22635/Contaminated site/aerials.pdf

Revision

0

Source

Landgate

Light Industrial Areas
Preliminary Site Investigation
Aerial Photo
19 June 1949

1949

Legend ▯ Approximate Site Boundary N	Created By GB	Checked XX	Approved XX	Wedgefield Light Industrial Areas Preliminary Site Investigation Aerial Photo **13/09/1971**
	Date 01/10/08	File location 61/22635/contaminated sites/aerials.pdf		
	Revision 0	Source Landgate		**1971**

Legend

▭ Approximate Site Boundary

N

Created By GB	Checked XX	Approved XX

Date

01/10/08

File location

61/22635/Contaminated Sites/aerials.pdf

Revision

0

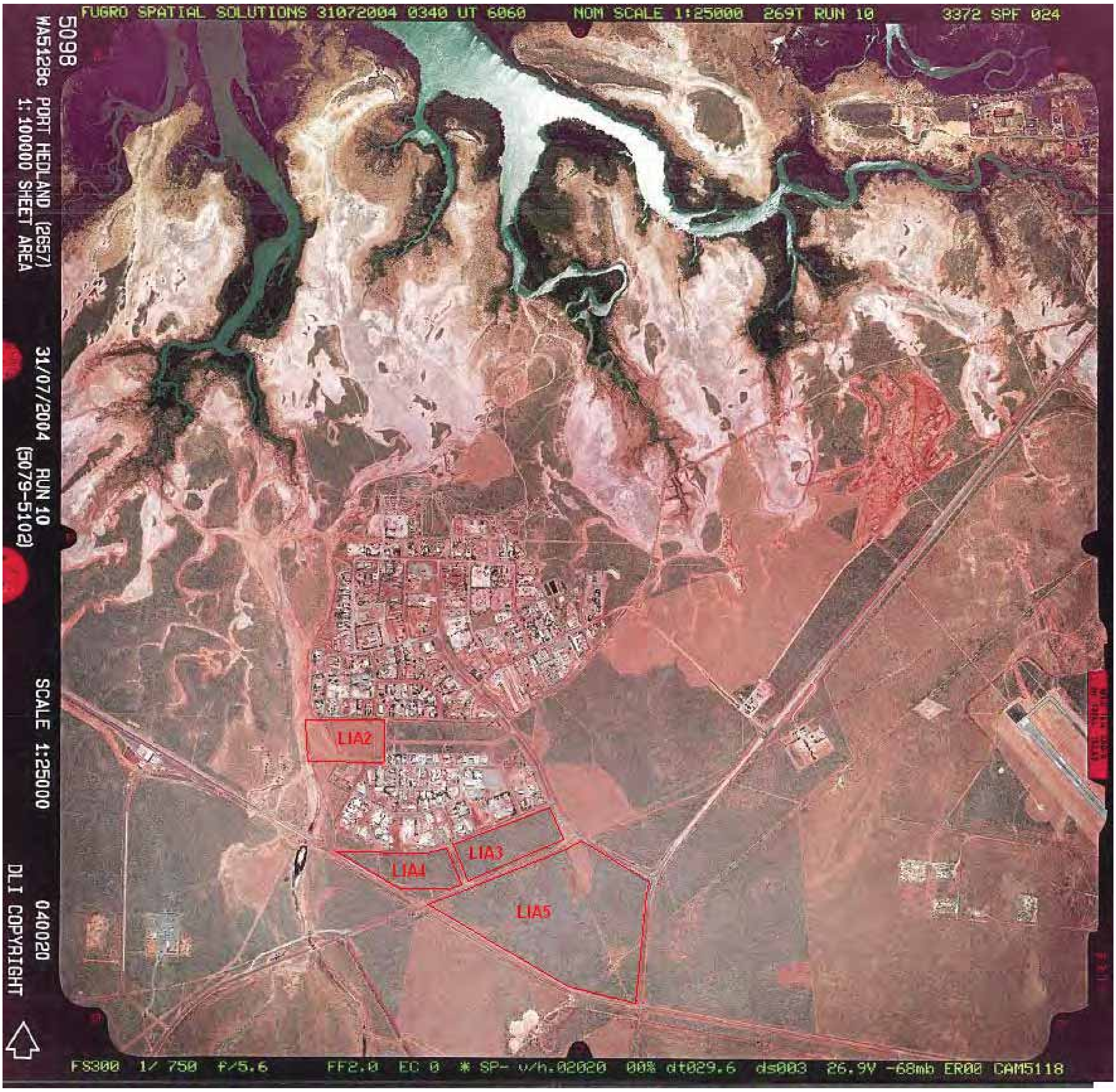
Source

Landgate

Wedgefield Light Industrial Area
Preliminary Site Investigation
Aerial Photo
04/08/1993

1993

GHD



Legend

▢ Approximate Site Boundary

N

Created By GB	Checked XX	Approved XX
Date 01/10/08	File location 61/226351/contaminated sites/aerials.pdf	
Revision 0	Source Landgate	

Wedgefield Light Industrial Area
Preliminary Site Investigation
Aerial Photo
31/07/2004

2004

GHD

REGISTER NUMBER	
6138/DP214753	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

VOLUME	FOLIO
LR3124	**271**

RECORD OF CERTIFICATE
OF
CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BG Roberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 6138 ON DEPOSITED PLAN 214753

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: UNALLOCATED CROWN LAND

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

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

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

--END OF CERTIFICATE OF CROWN LAND TITLE--

STATEMENTS:

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

SKETCH OF LAND:	DP214753 [SHEET 1].
PREVIOUS TITLE:	THIS TITLE.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	TOWN OF PORT HEDLAND.

NOTE 1:	J198435	CORRESPONDENCE FILE 01957-1975-03RO
NOTE 2:	K671562	DEPOSITED PLAN 41485 LODGED.
NOTE 3:	K671561	DEPOSITED PLAN 40616 LODGED.

REGISTER NUMBER	
5908/DP192295	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

WESTERN AUSTRALIA

VOLUME	FOLIO
LR3152	383

RECORD OF CERTIFICATE OF CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

BGRoberts
REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 5908 ON DEPOSITED PLAN 192295

STATUS ORDER AND PRIMARY INTEREST HOLDER:

(FIRST SCHEDULE)

STATUS ORDER/INTEREST: UNALLOCATED CROWN LAND

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:

(SECOND SCHEDULE)

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

---------------------------------------END OF CERTIFICATE OF CROWN LAND TITLE---------------------------------------

STATEMENTS:

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

SKETCH OF LAND:	DP192295 [SHEET 1].
PREVIOUS TITLE:	THIS TITLE.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	TOWN OF PORT HEDLAND.

NOTE 1: K551671 CORRESPONDENCE FILE 00264-2008-01RO

Appendix E

Potential Noise Impact Mitigation

Letter to DEC – September 2009

Your Ref:
Our Ref: A84350
Enquiries: Paul Schneider Ph 9482 7574

Mr Mike Pengelly
Environmental Officer
Environmental Impact Assessment Division
Department of Environment & Conservation
Locked Bag 33,
Cloisters Square,
PERTH WA 6850

Dear Mike

WEDGEFIELD TRANSPORT PRECINCT – NOISE MANAGEMENT MEASURES

I refer to our meeting on 29 July 2009 regarding the above.

Below is a summary of our understanding of the issues and the proposed management measures for consideration by the Department of Environment & Conservation (DEC).

ISSUE

The Transient Workforce Accommodation (TWA) facility is situated within the established industrial area of Wedgefield. The TWA site adjoins the 'Transport Development' area planned as part of the expansion of Wedgefield. The Transport Development area is intended to potentially operate as a 24 hour / 7 day a week estate for industries using oversized equipment and support servicing / maintenance activities. The proposed land uses are in accordance with the intentions of the Port Hedland Land Use Master Plan. The following information details the parameters to be incorporated into the Wedgefield Scheme Amendment, Development Plan and the land release strategy to address this short term land use interface issue.

TWA TENURE

State Land Services (SLS) of the Department of Regional Development and Lands administer the four ground leases occupied by the TWA. Some of these leases are due to expire shortly and the TWA is seeking to amalgamate the leases into a single agreement for a new term of 5 years. SLS has assured LandCorp that any new lease arrangement with the TWA operators will be in full consultation with LandCorp and will not exceed a maximum 5 year term from mid 2009 until mid 2014. The Town of Port Hedland (ToPH) administration may seek a shorter lease term in consideration of existing and potential land use conflicts and the potential availability of other suitable sites for the TWA. This matter will be resolved directly between SLS and ToPH administration after consultation with its Council.

The measures detailed below are therefore intended to address the potential land use conflicts during the initial business operations of Stages 1 & 2 of the Transport Precinct for a maximum period up to 30 June 2014. Thereafter the TWA will have ceased operations in this locality.

The new lease conditions will not permit the TWA operator to transfer or assign the lease to any other party, thereby negating the potential for future 3rd party involvement.

REZONING OF THE TWA SITE

The TWA site will be included into the Wedgefield Town Planning Scheme (TPS) amendment and rezoned to the 'Industrial' Zone. The TWA will then continue to enjoy non-conforming use rights during the remainder of its lease. No further lease will be issued and thereafter only industrial development will be permissible under Council's TPS.

TWA OPERATIONS

LandCorp's communications during July 2009 with the operator of the TWA indicate that they do not experience any significant noise issues from the established industrial activities and road train movements occurring in the immediate vicinity of the site. The 711 bed camp has an average occupancy of 550 workers, with night shift workers generally limited to around 50 workers (rarely more than 100). Night shift workers are located in the quieter areas of the camp, subject to internal and external activities at the time.

The proposed 5 year lease term from mid 2009 is adequate for the TWA commitments to accommodate workers on Rapid Growth Projects (RGP) 5 and 6. It also provides ample opportunity for the well planned and programmed relocation of the camp to an alternative site.

SUBDIVISION LAYOUT CHANGES

Attached are plans of the revised layout and staging. The main changes since our meeting of late July include:

1. No Transport Development lots will have vehicle access to Anthill Street, which will remain for light vehicle access to the TWA only.

2. The Transport Development area will be accessed from a single road off Pinga Street with the road pavement being located in excess of 250 metres from the TWA boundary.

3. Large lots adjoining the TWA, therefore allowing the purchaser / operator greater flexibility in how they utilise the site (ie: ability to implement noise mitigation measures and locate noisier activities further from the TWA). Larger sites are considered to be more manageable with fewer operators to control.

4. Stage 1 has been increased in area to provide a greater variety of lot sizes and provides flexibility to allocate land uses to the most appropriate location.

It should be noted that the revised layout is preliminary in nature. LandCorp reserves the right to refine this layout. LandCorp will consult with DEC on any substantial changes which impact the intentions / measures outlined in this letter.

PROPOSED STAGING OF TRANSPORT DEVELOPMENT AREA

Stage	Construction Commencement	Issue of Titles	Likely Operation of Businesses
1	October 2010	June 2011	June 2012
2	April 2012	December 2012	December 2013
3	April 2014	December 2014	December 2015

The above indicative time schedule was tabled at our meeting on 29 July 2009. The table identifies the targeted dates for commencement of construction, the issue of titles and the likely commencement of business operations for the first three stages of the Transport Development area. As noted earlier, the extent of Stage 1 has increased significantly in overall area (36 hectares), the number of lots (16) and the average lot size (1.87 hectares). The timing for Stage 2 will be subject to the take up of lots in Stage 1 and the anticipated future demand. Given the significant size of Stage 1, it is unlikely that Stage 2 will be developed in advance of the above timeline and is more likely to be pushed back 12 months. The TWA will therefore be relocated prior to the likely commencement of business operations on Stage 2.

NOISE INVESTIGATIONS TO DATE

The attached plans identify the extent of the anticipated noise affecting the transport precinct areas for daytime (L_{A10} of 49 dB) and night time (L_{A10} of 39 dB) environmental noise criteria, shown respectively on Attachments A & B. The noise levels apply to:

1. Road Truck (inner circle);

2. Industrial Truck (road train equivalent – mid circle); and

3. Front end loader (earth moving equipment – outer circle).

LAND USES

The table at Attachment C has been completed by our commercial sales agent, Hedland First National. It identifies likely land uses, approximate hours of operation and main noise generating activities based on their knowledge of parties who are interested in occupying the estate. Most of the identified uses operate predominantly during the daytime allocations. Generally, this is unlikely to change in the short term due to the high labour costs in the Pilbara making after hours operations more expensive and often uneconomical.

Individual interviews have also been recently undertaken by LandCorp with some of the main transport companies operating in Port Hedland with the following findings:

– Seeking a 20,000m^2 (2 hectare) site. 99% of their operations occur during daytime hours, in particular 6am to 4pm. No onsite after hours activity, except for emergency / break downs situations. No maintenance / workshop activities on site. Main noise emissions are from freezer trailers and this can be managed by locating the trailers away from sensitive uses.

– Interest in up to 6,000m^2. Single & B Double transports are the largest vehicles. Operate 7am to 5pm Monday to Friday and 8am to 5pm on Saturdays. Most noise is generated from fork lifts.

– Interest in up to 30,000m^2 (3 Hectares). Transport bulk ore and quarry products only. Operate 24 hours a day for truck movements and daytime hours for the on-site workshop. Propose to operate workshop on 24 hour basis in the future subject to workload. Main noise activities are from workshop operations, including grinders and sheet metal work (i.e. trailer body / panel repairs).

DEVELOPMENT PLAN CONTROLS

The proposed land uses on Lots 1 to 7 within Stages 1 & 2 (refer to Attachment A) of the 'Transport Development' zone will be subject to special limitations / conditions.

LandCorp will sell all lots via a tender process providing the opportunity to critically review the potential purchaser's proposed land use. In regard to Lots 1 to 7, specific tender conditions will apply and potential purchasers will need to demonstrate how they will meet the noise emission design criteria while the TWA continues to operate. DEC's input into the design criteria and possible mitigation strategies would be welcomed. The strategies by each successful purchaser (i.e. site utilisation layout, building envelopes, direction of building openings, etc) will become a condition of sale and part of their specific Design Guidelines.

All land use and development within the noise limitation area (Lots 1 to 7) as identified on the Development Plan shall comply with the following whilst the TWA site is being used for accommodation purposes:

- Any noise generating activities are to be, where practical, confined to an indoor area, with all buildings to be oriented to front the new internal road, with any major opening to be located on the southern portion of the building;

- Significant noise generating activities external to buildings should, where practical, be carried out at a location where the building acts as an acoustic barrier to the TWA site, or between the hours of 6am – 9am or 5pm – 8pm (being aligned to the change of shift hours for workers accommodated in the TWA);

- The site will be developed in accordance with the purchaser's strategy to address the noise emission design criteria as agreed to by LandCorp. This will be a condition of sale and part of that site's specific Design Guidelines;

- Hours are restricted to normal industrial operating hours, being 6am until 8pm, seven days a week (to avoid normal camp night sleeping hours in the TWA);

- Access to the proposed lots is restricted to the internal subdivision road, with no access from Anthill Street;

- Notwithstanding the permissibility of uses as per the Zoning Table in TPS No. 5, the use of the proposed lots within the noise limitation area shall be restricted to the following for as long as the nearby TWA remains in operation:

    - Infrastructure – AA
    - Office - IP
    - Carpark - AA
    - Public Utility – AA
    - Storage Facility / Depot / Laydown Area (excluding earth moving equipment yard) - P
    - Container Park - P
    - Distribution Centre - P
    - Transport Depot - P
    - Warehouse - P

- Sale contract conditions and LandCorp's standard certificate of title caveat will provide LandCorp with the option to repurchase any lots if they are not developed in accordance with the Design Guideline requirements and within a defined construction timeframe.

- The caveat will not be removed until practical completion of the site improvements / development is completed and transfer of ownership cannot occur until the caveat is lifted.

- Development Guidelines will be an enforceable item under the provisions of the Development Plan. Breach of conditions may result in actions utilising the normal town planning provisions.

Any 24 hours transport depots (i.e. similar to) will be situated on Lots A to J (refer to Attachment B). These lots are situated outside the industrial truck (road train equivalent) buffer for night time operation. It is not anticipated that any earth moving businesses generating noise equivalent to a front end loader will be operating on a 24 hour basis.

We believe the changes to the estate layout, proposed sale strategy, design guidelines, planning controls and other management measures outlined in this letter will adequately address any noise buffer issues associated with the remaining short term operation of the TWA. These measures were endorsed by the Wedgefield Technical Advisory Group (TAG) at our meeting on 21 August 2009. The Wedgefield TAG comprises representatives from the Town of Port Hedland, Main Roads WA, Department of Planning and Port Hedland Port Authority.

All of the measures outlined in this letter will be detailed in the relevant sections of our Rezoning and Development Plan applications. We look forward to DEC's favourable consideration of these soon to be lodged applications to achieve the timely release of Transport Development land.

Should you have any queries, please do not hesitate to contact me on
Ph 9482 7574.

Yours sincerely

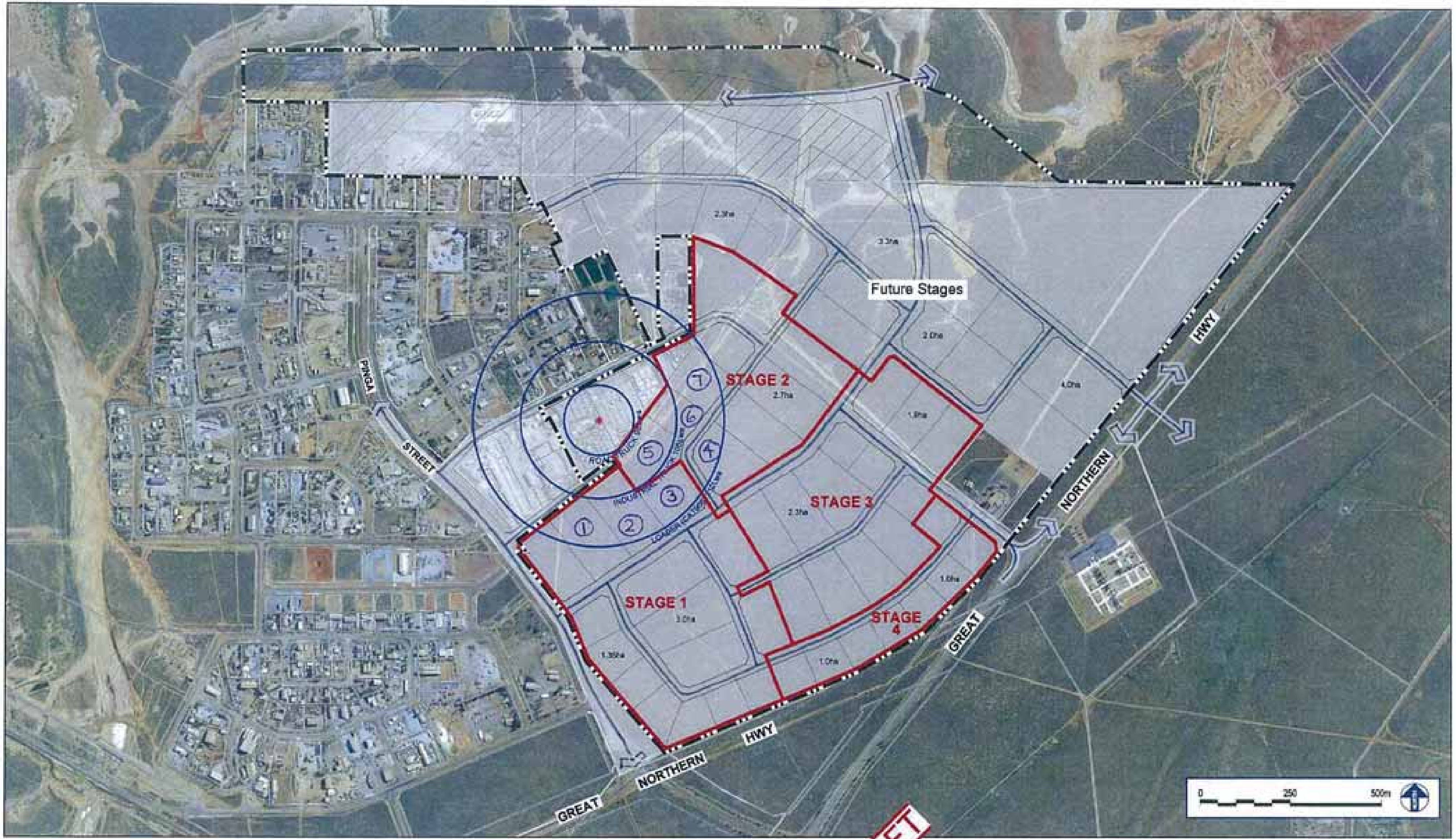
Paul Schneider
PROJECT MANAGER

9 September 2009

cc: Murray Raven, Regional Manager, State Land Services

Chris Adams, CEO, Town of Port Hedland

A.



DAYTIME BUFFER

DRAFT

TRANSPORT USE PRECINCT - *Indicative Staging Plan*

(With Daytime Noise Levels)

WEDGEFIELD INDUSTRIAL ESTATE

Base data supplied by Landgate & Main Roads

Aerial Photography dated October 2008, accuracy +/- 4m, Projection MGA Zone 50

Areas and dimensions shown are subject to final survey calculations. All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

LEGEND

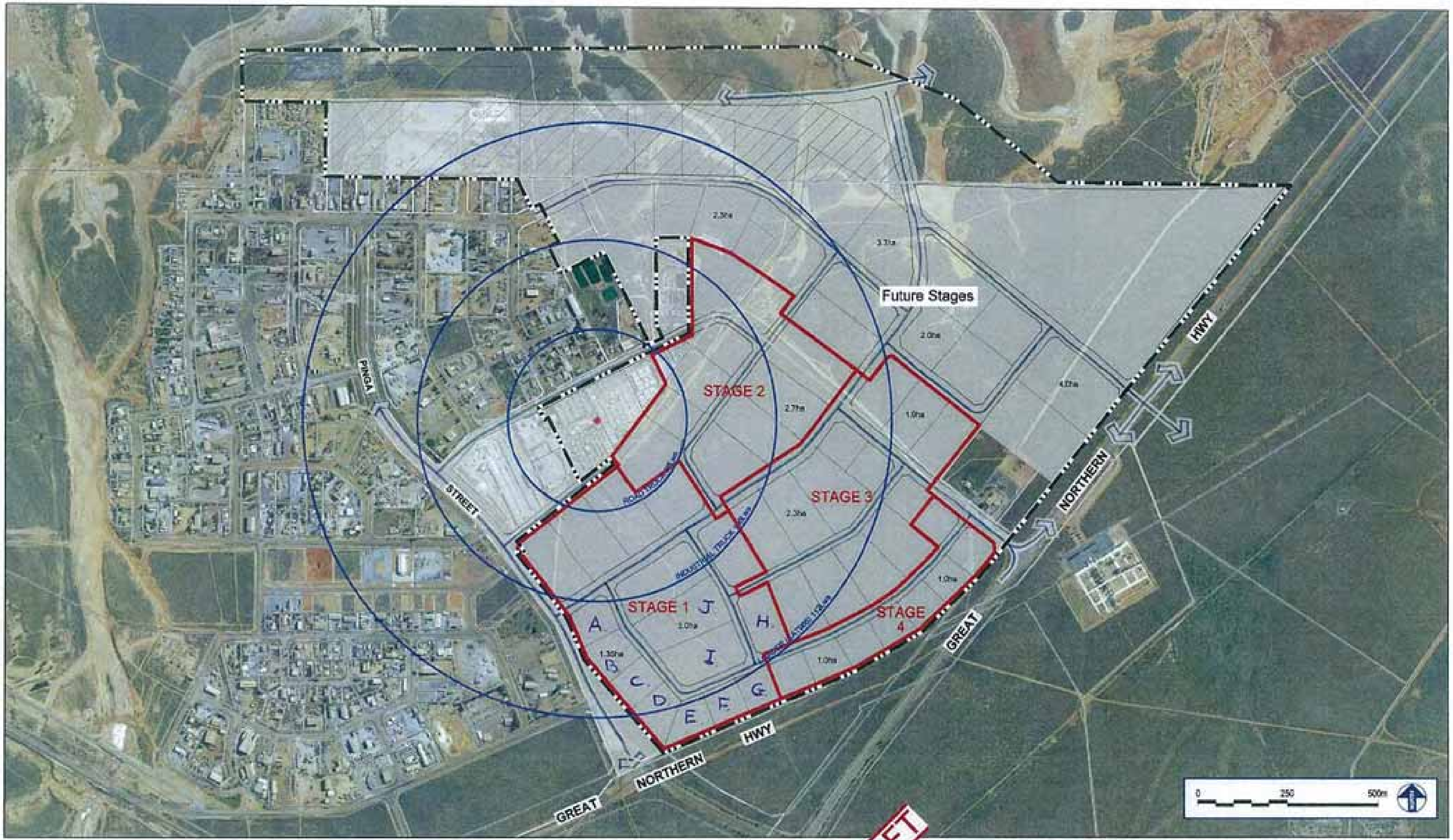
- Site Boundary
- Staging Boundary
- Daytime Noise level L_{A10} in db(A) = 49 (Source: Herring Storer)
- ▨ Port Hedland Port Authority Area
- ● Point Noise Source - Noise Sources (Inner to Outer Circles)
  - Road Truck (98L_{WA})
  - Industrial Truck (108L_{WA})
  - Loader (CAT 988) (112L_{WA})

CLIENT	Landcorp
SCALE	1:5,000@A1 / 1:10,000@A3
DATE	18 August 2009
PLAN No	3414_1-1-016.dgn
REVISION	-
PLANNER	T.C
DRAWN	R.F

RPS koltasz smith
TOWN PLANNING PROJECT MANAGEMENT URBAN DESIGN DEVELOPMENT CONSULTING
141 Burswood Road BURSWOOD WA 6100 Tel. (08) [illegible] Fax (08) [illegible]
PO Box 127 BURSWOOD WA 6100 Email:perth@[illegible]

A

B.



NIGHT-TIME BUFFER

TRANSPORT USE PRECINCT - Indicative Staging Plan

(With Night-time Noise Levels)

WEDGEFIELD INDUSTRIAL ESTATE

Base data supplied by Landgate & Main Roads

Aerial Photography dated October 2008, accuracy +/- 4m, Projection MGA Zone 50

Areas and dimensions shown are subject to final survey calculations.
All carriageways are shown for illustrative purposes only and are subject to detailed engineering design.

LEGEND

- ▬ ▪ ▪ ▬ Site Boundary
- ▬ Staging Boundary
- ▬ Night-time Noise level L_{A10} in db(A) = 39 (Source: Herring Storer)
- ▨ Port Hedland Port Authority Area
- ● Point Noise Source - Noise Sources (Inner to Outer Circles)

Road Truck (98L_{WA})
Industrial Truck (108L_{WA})
Loader (CAT 988) (112L_{WA})

Landcorp	:	CLIENT
1:5,000@A1 / 1:10,000@A3	:	SCALE
18 August 2009	:	DATE
3414_1-1-017.dgn	:	PLAN No
-	:	REVISION
T.C	:	PLANNER
R.F	:	DRAWN

RPS koltasz smith
TOWN PLANNING PROJECT MANAGEMENT URBAN DESIGN DEVELOPMENT CONSULTING
141 Burswood Road BURSWOOD WA 6100 Tel [illegible] Fax [illegible]
PO Box 127 BURSWOOD WA 6100 [illegible]

ATTACHMENT C

TRANSPORT DEVELOPMENT – LIKELY LAND USES

Completed by Hedland First National - 18 August 2009

Type of Operation	Size of Block (m2)	Expected Demand (high, med, low)	Hours of Operation	Major noise activities
Large Transport Depot	15,000 to 30,000	high	6am to 6pm	Access / egress of road trains, loading.
Small Transport Depot	10,000 to 15,000	Med	6am to 6pm	Semi load/unload forklift, reverse beeper
Vehicle Repair / Maintenance / Service	3-4000	High	6am to 6pm	Semi load/unload forklift, reverse beeper
Earthmoving Yard	4-6000	High	6am to 6pm	Semi/float load/unload forklift, reverse beeper
Industrial Hire Business	4-8000	Low	6am to 6pm	Semi load/unload forklift, reverse beeper
Container Park	4-8000	Med	6am to 6pm	Semi load/unload forklift, reverse beeper
Motor Vehicle Wash	Part of 3		6am to 6pm	Reverse beepers
Warehouse	2-8000	V High	6am to 6pm	Semi load/unload forklift, reverse beeper
Car Park	2-4000	V Low	6am to 6pm	Reverse beepers.

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box Y3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	L Marwick/A Napier/G Bishop	A Napier		A Napier		
1	E D'Raine	G. Nielssen	GNielsen	A Napier	C. Napier	6/11/09

APPENDIX C – LOCAL WATER MANAGEMENT STRATEGY

Prepared for:

DEVELOPMENT WA

Hedland Junction, Wedgefield Industrial Estate, Port Hedland

Local Water Management Strategy

February 2023

Report ref. J7157e

Suite 1/27 York St, Subiaco WA 6008 | PO Box 117, Subiaco WA 6904
T +61 (08) 9388 2436 **F** +61 (08) 9381 9279 **W** jdahydro.com.au

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CONTACT DETAILS

JDA Consultant Hydrologists
PO Box 117
Subiaco, WA, 6904
Australia

Phone: +61 (0) 8 9388 2436
Email: info@jdahydro.com.au
Website: www.jdahydro.com.au

Document Version No.	Issue Date
J7157a_DRAFT	18 February 2022
J7157b	14 April 2022
J7157c	31 May 2022
J7157e	16 February 2023

	Name	Signature	Date
Author	Michael Ioannidis		16 February 2023
Checked by	Alex Rogers		16 February 2023
Approved by	Jim Davies	JR. Davies	16 February 2023

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

EXECUTIVE SUMMARY

This Local Water Management Strategy [LWMS] has been prepared by JDA Consultant Hydrologists on behalf of Development WA for a 220.9 ha area of the Wedgefield Industrial Estate, referred to as 'Hedland Junction' and herein referenced as the Study Area, Figure 1. The proposed development of the Study Area is for General Industry.

The Study Area largely formed part of an approved LWMS previously prepared by JDA in 2011 (JDA, 2011a) which divided the Study Area into 4 Light Industrial Areas [LIAs]; LIA2 to LIA5; and a Transport Development Area [TDA]; areas shown on Figure 2. Subsequent Urban Water Management Plans [UWMPs] were prepared for LIA3 (JDA, 2011b), LIA5 (JDA, 2012b) and TDA Stages 1 and 2 (JDA, 2014a).

Since the original LWMS (JDA, 2011a), LIA2, LIA3 and TDA Stage 1 have been constructed with TDA Stage 2 to commence construction in the near future. This revised LWMS has been prepared in support of the Hedland Junction Structure Plan [SP] (URBIS, 2022), Appendix A, which removes areas from the original LWMS which have since been constructed or already zoned as industrial lots. The former LIA5 is now proposed as a General Industry area.

This LWMS provides the framework for the application of total water cycle management to the proposed industrial structure of the SP and develops on the principles within the Department of Water and Environmental Regulation’s principles on Water Sensitive Urban Design as described in the Stormwater Management Manual (DoW, 2004-2007) and Better Urban Water Management (WAPC, 2008).

A summary of the key principles and objectives of this LWMS, as previously agreed to by the then Department of Water [DoW], now Department of Water and Environmental Regulation [DWER], as applicable for the Study Area in the Pilbara region, is presented in Table 1.

TABLE 1: LWMS KEY PRINCIPLES AND OBJECTIVES

Key WSUD Guiding Principles		
• Facilitate implementation of sustainable best practice in water management in the Pilbara region. • Provide integration with planning processes and clarity for agencies involved with implementation. • To minimise public risk, including risk of injury or loss of life. • Protection of infrastructure from flooding and waterlogging. • Encourage environmentally responsible development.		
Category	**Principles**	**Design Objectives**
Water Supply and Conservation	• Consider all potential water sources in water supply planning. • Integration of water and land use planning. • Sustainable and equitable use of all water sources having consideration of the needs of all users, including community, industry and environment. • Maximise the re-use of stormwater.	• Minimise the use of potable water where drinking water quality is not essential, particularly ex-building use. • Apply water-wise landscaping measures to swales in road reserves to reduce and/or avoid irrigation.
Surface Water Flows	• Protect development from flooding • Implement economically viable stormwater systems. • Retain natural drainage systems and protect and/or improve ecosystem health – For the Pilbara, reduce the stormwater velocity to prevent export of sediments. • Ensure that stormwater management recognises and maintains social, aesthetic and cultural values.	• For ocean storm surge flood management, lot levels have minimum 2% AEP (50 year ARI) protection, with lots at minimum 6.0 mAHD and building floor levels at 6.3 mAHD. • For stormwater flood management, manage up to the 1% AEP (100yr ARI) event within the development. • Use swales through the development to disperse flow throughout the development with the aim to minimise velocity. Swales sized to minimum 10% AEP (10yr ARI), with larger events flowing over road reserve within safety criteria.
Water Quality	• Where development is associated with an ecosystem dependent upon a particular hydrological scheme, minimise discharge or pollutants to shallow groundwater and receiving waterways and maintain water quality in specified environments.	• No sensitive ecosystems in the immediate vicinity. The receiving environment is either directly to the supra-tidal zone or to South Creek which discharges to the supra-tidal zone prior to discharging to the ocean. • Follow Water Quality Protection Note [WQPN] 52 *Stormwater management at industrial sites*. Stormwater management should minimise the contamination risks which may arise as stored or split process chemicals are flushed offsite or into the ground following rainfall.
Groundwater Levels	• Protect development from water logging	• Protect development from water logging

The new edition of Australian Rainfall and Runoff (ARR) (Ball et al., 2019) adopts different probability terminology from that used in ARR 1987 (IEAust, 1987). In line with Ball et al. (2019), this report adopts new terminology Exceedances Per Year (EY) and Annual Exceedance Probability (AEP) instead of previous terminology, Average Recurrence Interval (ARI) used in ARR 1987, see conversions below.

- 1 EY is equivalent to 1 Year ARI
- 20% AEP equates to 4.49 Year ARI. (For simplicity, this report adopts 20% AEP as equivalent to 5 Year ARI)
- 10% AEP equates to 9.49 Year ARI. (For simplicity, this report adopts 10% AEP as equivalent to 10 Year ARI)
- 2% AEP equates to 49.5 Year ARI. (For simplicity, this report adopts 2% AEP as equivalent to 50 Year ARI)
- 1% AEP is equivalent to 100 Year ARI.

1. INTRODUCTION

The Study Area, comprising 220.9 ha, is an extension of the existing Wedgefield Industrial Area and is crown land, Figure 1. The Study Area is located within the Wedgefield locality in the Town of Port Hedland.

1.1 Planning Context

This Local Water Management Strategy [LWMS] has been prepared by JDA Consultant Hydrologists on behalf of Development WA for a 220.9 ha area of the Wedgefield Industrial Estate, referred to as 'Hedland Junction' and herein referenced as the Study Area, Figure 1. The proposed development of the Study Area comprises General Industry.

The Study Area largely formed part of an approved LWMS previously prepared by JDA in 2011 (JDA, 2011a). This revised LWMS has been prepared in support of the Hedland Junction Structure Plan [SP] for the Wedgefield Industrial Estate (URBIS, 2021), Appendix A, which mainly removes areas from the original LWMS which have since been constructed or zoned industrial lots.

To manage and protect Western Australia's water resources, the then Department of Water [DoW] and Western Australian Planning Commission [WAPC] produced *Better Urban Water Management* (WAPC, 2008) to guide urban development within Western Australia. Although not directly applicable to industrial land development, it provides a framework for land and water planning across Western Australia, as shown in Table 2.

WAPC (2008) documents focus on urban development, rather than industrial. Differentiating factors identified are as follows:

- Nutrients pose a low risk issue on industrial sites due to minimal fertiliser application compared with urban/rural land use.
- Specific management for liquid chemical waste such as greases, fuels and lubricants in industrial sites needs to be specifically addressed.

The water management strategy for Hedland Junction has been developed with the expertise and guidance of the then Department of Water [DoW], Water Corporation, Main Road Western Australia [MRWA] and Town of Port Hedland to achieve the best practice in water management and sustainable development within the context of the Pilbara region. As DoW had not published any guidelines to assist development of sites within the Pilbara region, discussions between JDA and DoW in 2010 lead to guidance requirements which are detailed in Section 1.3 and which in summary concluded that as Port Hedland has surface runoff issues due to erosion and sedimentation, post-development peak flow rates do not need to be detained to pre-development peak flow rates but post-development velocities should be minimised.

A copy of a complete WAPC (2008) LWMS checklist is contained as Appendix B to assist agency review of this document.

A summary of the key hydrological parameters used in this UWMP are summarised in Table 3.

TABLE 2: INTEGRATED PLANNING AND URBAN WATER MANAGEMENT PROCESS

Planning Phase	Planning Document	Water Management Document and Status
District	Port Hedland Land Use Master Plan; Port Hedland Planning Study Ultimate Development Plan	Flood Studies; detailed in Section 1.2
Local - Town Planning	Hedland Junction Structure Plan (URBIS, 2022)	Wedgefield Industrial Area Extension, Local Water Management Strategy (LWMS) THIS DOCUMENT
Subdivision	Subdivision Application	Urban Water Management Plan (required for individual stages of development) Approved: - LIA3 (JDA, 2011b) - TDA Stages 1 & 2 (JDA, 2014a) Future Preparation: - TDA (remaining stages) - LIA4 - LIA5 (JDA, 2012b but amendment required)

TABLE 3: KEY HYDROLOGICAL PARAMETER VALUES USED IN THIS REPORT

Parameters	Section	Value or Source
Design Rainfalls	4.2.3	Bureau of Meteorology [BoM] (2016)
Mannings Roughness, n	4.2.3	Chow (1959)

Note: If parameter values change from those assumed above, then the calculations and modelling which inform this report will need to be revised.

1.2 Previous Studies

1.2.1 State Planning Policy 2.9 – Water Resources (WAPC, 2006a)

The LWMS has been developed in accordance with regional and local principles and objectives of Integrated Urban Water Management [IUWM].

WAPC (2006a) defines IUWM, also known as *total water cycle management*, as:

> “ *Management of the urban water cycle as a single system in which all urban flows are recognised as a potential resource and where the interconnectedness of water supply, stormwater, wastewater, flooding, water quality, estuaries and coastal waters is recognised.* ”

IUWM promotes water conservation measures, re-use and recycling of water and best practice in stormwater management.

Note that a draft State Planning Policy [SPP] 2.9 was released for public comment in September 2021 which amalgamates and synthesises various SPPs into a single planning document including SPP 2.9 (WAPC, 2006a).

1.2.2 Stormwater Management Manual of WA (DoW, 2004-2007)

The Stormwater Management Manual for Western Australia was first published by the Waters and Rivers Commission in 1998 to define and describe in practical terms Best Management Practices (BMPs) to reduce pollutant and nutrient inputs to stormwater drainage systems as well as guidelines for the incorporation of water sensitive urban design principles. A major review of the Stormwater Management Manual was undertaken by DoW, with input from other State and Local Government agencies and sectors of the urban development industry. This revised version of the Stormwater Management Manual was released in 2007, though some chapters were published in 2004.

Principle objectives for managing urban water in Western Australia are:

- Water Quality: To main or improve the surface and groundwater quality within development areas relative to pre-development conditions.
- Water Quantity: To maintain the total water cycle balance within development areas relative to pre-development conditions.
- Water Conservation: To maximise the re-use of water.
- Ecosystem Health: To retain natural drainage systems and protect ecosystem health.
- Economic Viability: To implement stormwater systems that are economically viable in the long-term.
- Public Health: To minimise the public risk, including risk of injury or loss of life to the community.
- Protection of Property: To protect the built environment from flooding and waterlogging.
- Social Values: To ensure that social aesthetic and cultural values are recognised and maintain when managing stormwater.
- Development: To ensure the delivery of best practice stormwater management through planning and development of high quality developed areas in accordance with sustainability and precautionary principles.

The Decision Process for Stormwater Management (DWER, 2017) provides a decision framework for the planning and design of stormwater management systems and assists in meeting the objectives specified above.

1.2.3 Recorded Flood Levels on South Creek at Great Northern Highway

JDA (1994) indicates that MRWA records show the highest recorded flood levels on South Creek at Great Northern Highway of 7.58 mAHD (downstream) and 7.77 mAHD (upstream) were recorded in 1988.

1.2.4 MRWA Waterways Report RN 595 (MRWA, 2008)

MRWA conducted a study as part of the Port Hedland access corridor project for hydrological review of the then proposed Great Northern Highway alignment north of the Wedgefield Industrial Estate. The study assessed the combined tidal and cyclone wave height which could impact on proposed alignment of Great Northern Highway.

Estimated maximum tidal level based on DPI predicted tidal levels during 1998 to 2008 was 3.87 mAHD. Highest astronomical tide (HAT) was 3.67 mAHD and the highest recorded sea level was 5.7 mAHD in 1939.

The study also estimated maximum peak wave surge of 3.59 mAHD using the Jelesnianski (1972) procedure. Based on these estimations, combined tidal and cyclone wave height was estimated at 7.44 mAHD.

The study recommended a 7.0 mAHD combined HAT and wave surge be considered as a conservative estimate.

MRWA (2008) estimated peak flows for various Average Recurrence Intervals [ARIs] from South Creek catchment to the existing bridge on Great Northern Highway using Rational and Index Flood methods. The study adopted the Index Flood estimate of 269 m^3/s for the 100 year ARI design flow based on the assumption that the capacity of the existing bridge is 250 m^3/s and had never overtopped.

1.2.5 Summary of Flood Levels (JDA, 2009)

A JDA (2009) study for LandCorp, now Development WA, reviewed previous studies relating to storm surge levels and rainfall runoff levels in the area.

Most of the studies reviewed in JDA (2009) were conducted between 1975 and 2000 and included:

- *Town Planning Flood Study for South Hedland* (Wyche, 1975);
- *South Hedland Town Centre Stormwater Drainage* (Public Works Department of WA [PWDWA], 1976);

- *Port Hedland Storm Surge Inundation Study Preliminary Report* (Smith & Hubber, 1993);
- *Boodarie Resource Processing Estate Drainage and Flood Management* (JDA, 1995);
- *Port Hedland Stormwater Level Flood Study* (EGIS, 1999);
- *Greater Port Hedland Storm Surge Study* (GEMS, 2000);
- *Pilbara Iron Ore and Infrastructure Project – Flood Study Overview, Anderson Point to White Hills* (Fortescue Metals Group, 2004);
- *Flood Map Version 3.1* (2008); and
- MP Rogers and Associates [MRP] submission to Landcorp, 05 February 2009.

JDA (2009) concluded that the likely accuracy of the recent GEMS (2000) and Flood Map V3.1 (2008) studies was ± 0.05 m in the vicinity of Wedgefield. JDA (2009) noted that whichever hydraulic model is used, there would still be uncertainty combining the effects of storm surge on sea level, together with rainfall runoff from the land catchment and without calibration to historic events, any prediction of the 100 year ARI flood levels would not be reliable.

JDA (2009) recommended the adoption of the Floodmap V3.1 flood level estimate and MPR (2009) interpretation of design levels for Wedgefield. The study also recommended that due to significant infrastructure present and proposed for the Port Hedland district, the most reliable method of flood estimation should be a 2D hydraulic model such as MIKE 2, which had been used at other locations in Western Australia.

1.2.6 Wedgefield Industrial Area Geotechnical Investigation (GHD, 2009)

GHD (2009) assessed soil properties, infiltration rates, lot class site classification, acid sulphate soils (A.S.S.) and contaminated site aspects of the proposed development.

The investigation involved a site walkover, excavation of 52 shallow test pits and laboratory analysis for A.S.S. and contamination.

GHD (2009) concluded:

- The proposed development sites have uniform soil conditions and mostly clayey sand associated with the Pindan Sand Formation to the target depth of 3 m below existing natural surface.
- No groundwater was visually observed in any test pit however increased soil moisture content was observed, typically between 1 and 2 m below natural surface.
- Three infiltration tests conducted at 0.5 m below natural surface measured permeability in the order of 3 to 4 m/day. A permeability rate of 1 m/day was recommended for design.
- There was no evidence of A.S.S. materials being present at the sampling locations and confirmed the minimum risk of A.S.S materials. No further investigation prior to earthworks was recommended provided excavation works were limited to no deeper than 3 m below groundwater level and dewatering was not undertaken.
- Following contamination assessment, the site was deemed suitable for ongoing commercial/industrial land use. The waste stockpile situated in LIA2 showed elevated lead concentrations in the soil and further testing was recommended prior to any disposal of the material.

1.2.7 Port Hedland Access Corridor, Expert Review of Waterways Report RN 595 (MRWA, 2008), Tidal and Cyclone Surge Considerations (Damara, 2010)

Damara (2010) reviewed MRWA (2008) and suggested modification to the estimate of maximum surge level due to several minor flaws identified in the application of the Jelesnianski (1972) procedure in MRWA (2008). Damara (2010) revised the maximum tidal surge level estimate from 3.6 to 5.0 mAHD for the selected 'worst-case' storm scenario.

This revised estimated when added to the mean high spring water tide increased the combined total water levels from 7.1 to 7.7 mAHD.

Damara (2010) considered the likelihood of total water levels of 7.7 mAHD for the then new Great Northern Highway alignment to be a very rare event (approximately 1000 year ARI). This is outside of the range appropriate for design frequency which is generally 50 to 100 year ARI.

Application of the Jelesnianski (1972) procedure in Damara (2010) recommended design total water levels of 5.7 mAHD for the 50 year ARI and 6.8 mAHD for the 100 year ARI. This included an allowance for mean sea level rise of 0.2 m, however, the estimated design total water levels compared to the observed cyclone surges were ±20% for the cyclones passing close to Port Hedland.

1.2.8 Port Hedland Coastal Vulnerability Study (Cardno, 2011)

Cardno (2011) evaluated the combined effects of coastal inundation (flooding and storm surge) arising from cyclonic events for the Town of Port Hedland and surrounding areas and assessed shoreline stability over planning periods of up to 100 years (i.e. Year 2110). The study extended inland to cover major centres such as Wedgefield and South Hedland.

Cardno (2011) used a multi-domain wave model (SWAN) to simulate cyclone waves which are generated up to 2,000 km from Port Hedland and a 2D/3D hydrodynamic Delft3D model of the Pilbara coastline centred around Port Hedland to simulate tide and storm surge processes.

In the Port Hedland region, storm surge poses the greater risk and its severity is determined by:

- Magnitude of the tropical cyclone event;
- The proximity of the cyclone to the Town of Port Hedland (distance and heading); and
- The timing of the tidal cycle at the point of the cyclone approaching the coastline.

To model hydrological and hydraulic processes, 1D XPSWMM (hydrological) and 1D/2D SOBEK (hydraulic) models were used to determine design storms and flood extent for a range of ARIs. To address the joint occurrence of catchment flows (rainfall) and ocean wave levels, a 20 year ARI ocean water level was adopted in-conjunction with the 100 year ARI catchment flows. For design events less than 100 year ARI, the design ocean level had an ARI one-fifth of the catchment flows and for events greater than the 200 year ARI, the design ocean level had an ARI one-tenth of the catchment flows.

The modelling in Cardno (2011) showed that in the critical 100 year ARI event, the modelled inflow to South Creek was 666 m^3/s and to South West Creek was 212 m^3/s. The hydraulic modelling results indicated that the peak flow at the Greater Northern Highway at South Creek is in the order of 410 m^3/s and comprises 290 m^3/s through the bridge and 120 m^3/s over the highway. The modelled flow rate in Cardno (2011) was similar to the GEMS (2000) estimate of 383 m^3/s and accounted for the full range of cross catchment flows and floodplain storage.

Flood maps were produced for the Port Hedland (incl. Wedgefield and South Hedland) and Shellborough areas and show significant flooding across Wedgefield and South Hedland for the modelled 100 year ARI flood event. Modelling also showed significant cross catchment flows between South Creek and South West Creek in all modelled flood events. The flood map for the100 year ARI catchment flow and 20 year ARI ocean water level under existing shows the TDA, east of the existing Wedgefield Industrial Area, is largely unimpacted by flooding whilst the LIAs and existing Wedgefield Industrial Area, located adjacent to South Creek, are impacted by flooding.

Storm surge levels as modelled by Cardno (2011) impacting the Study Area have been summarised in previous JDA advice to Landcorp (JDA, 2012a), attached as Appendix C to this report.

One of the water level tag points in Cardno (2011) is located immediately adjacent to the northern boundary of the Study Area. Flood levels are provided at this location for the three climate scenarios modelled (2010, 2060, 2110), and include changes for sea level rise, cyclone intensity / frequency and rainfall intensities, Table 4. Plots showing flood data from Cardno (2011) are provided in Appendix C.

TABLE 4: FLOOD LEVELS FOR NORTHERN BOUNDARY OF STUDY AREA, BASED ON CARDNO (2011)

Climate Scenario	2 Year ARI (~40% AEP)	10 Year ARI (10% AEP)	100 Year ARI (1% AEP)	200 Year ARI (0.5% AEP)	500 Year ARI (0.2% AEP)
Storm Surge					
2010	3.18	3.70	4.72	4.95	5.13
2060	3.67		5.19		5.52
2110	4.22		5.65		6.13
Catchment Runoff					
2010	-	-	3.92	3.93	4.29
2060	3.22		5.25		5.62
2110	3.74		5.73		6.21

Appendix C Figure C8 shows storm surge levels for Tag Point 52 plotted on a Log-log scale against the return period (ARI). The 50 year ARI (2% AEP) storm surge and catchment runoff levels can be estimated from this plot. The storm surge levels are: 2010 – 4.40 mAHD; 2060 – 4.88 mAHD; and 2110 – 5.36 mAHD. The catchment runoff levels are: 2060 – 4.81 mAHD; and 2110 – 5.31 mAHD. A level was not estimated for the 2010 scenario as there was insufficient data to allow interpolation to the 50 year ARI event.

Levels for the catchment runoff are slightly lower than those estimated for storm surge.

The 2060 climate scenario allows for sea level rise predicted in 2060, with a 50 year ARI storm surge of 4.88 mAHD. Applying a 0.5 m freeboard, as with the Damara (2011) study, results in a minimum floor building floor level of 5.4 mAHD (compared to a level of 6.3 mAHD as above). This level is 0.9 m lower than the estimate from the Damara study.

1.2.9 Water Quality Protection Notes [WQPNs]

Specific to industrial sites, DoW released WQPN 52 *Stormwater Management at Industrial Sites* (DoW, 2010) which states that all industrial sites need to effectively manage stormwater runoff from roofs, pavements and material storage and processing areas to avoid flooding or contamination of water resources. The stormwater management should minimise the contamination risks which may arise as stored or split process chemicals are flushed offsite or into the ground following rainfall. Chemicals of concern include acids, alkalis, detergents, dyes, engine coolant, fertilisers, fuels, litter, lubricants, metal solution, poisons and solvents.

WQPN 93 *Light Industry Near Sensitive Waters* (DoW, 2009) provides a general guide on issues of environmental concern on light industry near sensitive waters, and offers potential solutions based on professional judgement and precedent.

WQPN 68 *Mechanical equipment wash down* (DoW, 2013a) provides guidance on small-scale (< 5 L wastewater/day) and non-automated wash down facilities. Large, automated wash down facilities that discharge wastewater to the receiving environment require individual assessment of water quality and community risks.

Chemical/General Industry land use is generally the most demanding in meeting WSUD design objectives as large areas of impervious surfaces (e.g. roofs, carparks, roads) are developed and create the potential for large volumes and peak flows of stormwater which must be catered for. It is common for light industrial/commercial business areas to comprise 70% impervious surface, however, in the Pilbara it is common to have a larger proportion of yard areas which are not fully sealed.

Industrial facilities should be constructed using weather-proof material with impervious flooring designed and graded to contain any spill material, washdown water or contaminated stormwater. This is to ensure that at no stage, i.e.

during normal operation or emergencies, is the surrounding environment at risk of contamination. The area could, if practical, have a graded floor or perimeter bund with speed humps to allow vehicles into the contained area if required.

If chemicals are stored on the premises, they should be kept within the contained compound on chemical resistant surfaces. The compound should have the capacity to store at least 110% of the volume of the largest container plus 25% of the volume of all other containers.

Any chemical bulk storage tanks that are 250 L or greater in capacity; permanent or temporary; above-ground and underground; or outside or within another structure (e.g. shipping container, shed, trailer), should follow the recommendations made in WQPN 56 *Tanks for fuel and chemical storage near sensitive water resources* (DWER, 2018). WQPN 56 (DWER, 2018) replaces the following WQPNs relevant to the Study Area:

- WQPN 56 *Tanks for elevated chemical storage* (DoW, 2006a);
- WQPN 58 *Tanks for temporary elevated fuel and chemical storage* (DoW, 2006b);
- WQPN 61 *Tanks for ground level chemical storage* (DoW, 2008a);
- WQPN 62 *Tanks for underground chemical storage* (DoW, 2008b); and
- WQPN 64 *Tanks – closure of underground chemical storage* (DoW, 2006c).

All toxic or hazardous chemicals, such as fuel, paint, solvents and pool chemicals, should be stored within contained compounds or chemically resistant surfaces and should follow the recommendations made in WQPN 65 *Toxic and hazardous substances – storage and use* (DoW, 2015).

All stormwater and runoff from roofs and pavements should be diverted away from where chemicals are stored, used or may be spilt. Where practical, employee training and signs erected adjacent to stormwater drainage gully grates should be used to inform all staff that disposal of chemicals and process wash-down water to drains will likely flow into natural water bodies causing environmental harm. The recommendations given in WQPN 52 (DoW, 2010) should be followed.

1.3 Key Design Principles and Objectives

A summary of the key principles and objectives applicable to the Study Area, based on previous studies and advice provided to JDA from DoW in 2010, are as follows:

- Towns in the Pilbara have been developed using open drains rather than piped drainage and this is appropriate due to the high rainfall intensities and runoff rates when compared with the Mediterranean climate of the south-west of Western Australia.
- Existing creeks and drains should be retained as far as possible and work with the existing drainage system rather than against it.
- Flood risk is the main risk from surface water however groundwater still needs to assessed.
- Management of erosion and sedimentation is important.
- As per DoW 2010 advice, 2 years pre-development monitoring is not required but groundwater monitoring bores should be installed across the Study Area to show the water table elevation relative to ground level and to indicate whether imported fill will be required.

2. PRE-DEVELOPMENT ENVIRONMENT

The environmental conditions of the pre-development Study Area provide an important context for planning future water management strategies.

2.1 Location and Land Use

The 220.9 ha Study Area is located adjacent to the existing Wedgefield Industrial Estate within the Town of Port Hedland, Figure 1. The Study Area is generally bound by the existing Industrial Estate to the west, the Port Hedland – Goldsworthy Railway to the south, Wallwork Road to the east, and native vegetation and supratidal flats to the north.

The pre-development land use is predominantly native vegetation with existing infrastructure limited to fences, tracks and access roads. Some of the supratidal flats to the north protrude into the Study Area, Figure 2. The term 'supratidal' is applied to the portion of a tidal flat which lies above the mean high water level for spring tides. It is inundated only occasionally by exceptional tides or by tides augmented by storm surge.

2.2 Topography

A feature survey of the Study Area and surrounds was conducted by Whelans in 2008 and 2009 and is shown on Figure 3. The southern and western sections of the Study Area generally fall from 9 mAHD north-westwards towards South Creek, invert of approximately 4 mAHD.

The northern section of the Study Area is flatter than the southern section at 6 to 7 mAHD, gently falling towards the northern interface of supratidal flats which is etched with small channels and ridges ranging from 3 to 5 mAHD.

In the north-eastern corner of the Study Area, a ridge at 8 to 8.6 mAHD divides the lot, resulting in a small section of the Study Area grading eastward, Figure 3.

2.3 Climate

Rainfall in the Pilbara region is derived from two types of meteorological events: rarer, high intensity rainfall resulting from tropical cyclonic activity, and more frequent, lower intensity rainfall resulting from low pressure systems, localised thunderstorms or tropical upper air disturbances.

Rainfall data is available from the Bureau of Meteorology's *Port Hedland Airport* (Site ID: 004032) rainfall gauging station, location shown on Figure 4 *top right*.

The long-term average annual rainfall, 1943 to 2020, is 317 mm. The annual and monthly data shows that there have been a number of years without significant rainfall. Most rainfall occurs in January to March from approximately 15 to 20 scattered thunderstorms and the occasional tropical cyclone (BoM, 2022). A secondary small peak in the monthly rainfall occurs in May and June from tropical cloud bands which intermittently affect the area.

The coast from Port Hedland to Exmouth Gulf is one of the most cyclone prone areas in Australia, averaging one every two years (BoM, 2022). The cyclone season runs from mid-December to April, peaking in February.

Average annual pan evaporation for Port Hedland is approximately 3,590 mm, with monthly averages shown in Figure 4.

2.4 Surface Geology & Geotechnical Investigations

The regional surface geology within the Study Area is a red sandy loam (GSWA, 1964), generally referred to as Pindan Sand. Pindan Sand has a small clay component and sands are generally fine to medium grained, sub-angular to sub-rounded quartz, which becomes sealed when dry and waterlogged during heavy rainfall.

Along the northern margin of the site, the Pindan Sand abuts supratidal deposits of calcareous sand, silt and clay. These superficial sediments overlie Archaean bedrock, probably of granite or possibly of metasediments, at an expected depth of between 10 to 20 m. The upper portion of bedrock is weathered (remaining as clayey soils) and fractured, grading downwards into fresh bedrock (GSWA, 1964).

Four geotechnical investigations have been conducted over parts of the Study Area: GHD (2009); GHD (2011); Douglas Partners (2021a) and Douglas Partners (2021b). The first study, GHD (2009), covered the then LIA2, LIA3 and eastern end of TDA and is further summarised in Section 1.2.6. A further study in May 2011 (GHD, 2011) covered a wider area in the centre of the Study Area which would later represent Stage 1 and 2 of the TDA (JDA, 2014a). The recent investigations by Douglas Partners (2021a & b) cover the likely next stage of development within the TDA.

The GHD (2009) included 52 test pits, shown on Figure 5, dug to a depth of 3 m depth in August 2009. The soil at all sites was described as clayey sand ("Pindan Sand"); with the sand containing local beds of laterite gravel. Grading of 8 samples showed the Pindan sand consists of 17 to 31% clay and silt sized particles, between 57 to 81% sand and up to 20% gravel.

The GHD (2011) and Douglas Partners (2021a & b) studies found similar soils, with 0.5 to 1.5 m of silty sand overlying clayey sand to the excavation depths of approximately 3 m.

2.5 Groundwater

2.5.1 Soil Permeability & Infiltration

GHD (2009) noted that whilst the upper Pindan Sand horizon was reasonably permeable, the underlying lower profile was relatively impermeable due to a greater proportion, 17 to 31%, of fine silt and clay material. Infiltration testing of the upper soil at 0.5 m depth gave results of 3 m/day, however permeability for design purposes was estimated at 1 m/day "based on correlation of the material classification with published data" (GHD, 2009).

Based on anecdotal evidence, a permeability of 1 m/d may be considered high. Infiltration rates can decrease with soil compaction, and a lower design infiltration rate may be more appropriate.

GHD (2009) recommended the following regarding site drainage:

> " *The Pindan Sand is known to be a collapsible soil that occurs extensively in the region, which can densify under load at high moisture content, leading to differential settlement, surface unevenness or even failure. Therefore, the development area should be well graded and well drained to prevent ponding of water and infiltration into the soils.* "

Douglas Partners (2021a & b) made similar recommendations. Infiltration testing gave indicative permeabilities of 1.9 m/day for the silty sand and 0.7 m/day for the clayey sand. However due to the nature of the soils and likely compaction post-development, a permeability in the order of 0.1 m/day for in-situ soils was suggested. Given the likely low infiltration capacity of the soils, Douglas Partners suggested that soakwells were not suitable, and that all lots should be graded to the roadside swales to minimise perching of water above the clayey sands.

2.5.2 Groundwater Levels

There are no long-term groundwater monitoring bores within the Wedgefield/South Hedland and Port Hedland Area.

No groundwater was encountered in the GHD (2009) 3 m deep test pits, however the soil was recorded as "moist" below 1 to 2 m depth, which may be due to a number of influences other than depth to groundwater. The geotechnical investigation was conducted in August, the first half of the dry season. Annual rainfall in 2009 was average.

Groundwater was not encountered by JDA during a site inspection in July 2010. There was no evidence of groundwater in any of the lowest points of the surface drainage pathways on or near the Study Area or in nearby creeks. For example, groundwater was not observed in the nearby Schillaman Road drainage, invert at 4.3 mAHD, or further north by the supratidal flats, elevations of 2.2 to 2.8 mAHD. Annual rainfall was below average in 2010.

In February and May 2012, twelve monitoring bores, W1 to W11, were installed by JDA across the TDA and LIA areas, locations shown on Figure 5, with W3 to W11 installed by JDA using hand auger. Water level capacitance loggers were installed in the monitoring bores from 25 May 2012 to 11 April 2013. There was no logger data available in 2013 for W1 and W9, which were destroyed, and W2 and W11, which had battery and/or recording issues.

Logged levels from December 2012 to April 2013 are shown on Figure 6 and represent a period where two significant rainfall events were recorded at the Port Hedland Airport rain gauge, 23-24 January 2013 and 28 February 2013.

There was a significant rise in groundwater in response to both rainfall events with most of the bores dry prior to 23-24 January 2013 rainfall. The groundwater response was greater following the 23-24 January rainfall event than the 28 February rainfall event. The groundwater level response was similar in bores W4, W8 and W10 which rose sharply following rainfall and then decline at similar rates over the following months. The response in bores W3, W5 and W12 was similar but more gradual. Peak groundwater levels in W7 and W8 could not be recorded as groundwater levels rose above the top of the data logger. Groundwater levels in bores W4, W7 and possibly W5 were likely influenced by pooling of surface water behind Great Northern Highway.

A summary of the groundwater monitoring, including bore lithological logs, is attached as Appendix D.

2.5.3 Groundwater Quality

The groundwater table is generally brackish to saline (1,150 to 30,000 mg/L) due to the proximity to the ocean and supratidal flats. Bores W8 to W12 recorded salinity concentrations generally in the range 23,000 to 29,000 mg/L approaching seawater during the 2012 and 2013 monitoring. Salinity in nearby W1 was slightly lower, with concentrations between 1,150 and 8,000 mg/L. The groundwater monitoring report, JDA (2014b), is attached as Appendix D.

Reduction in groundwater salinity can occur in a thin layer at the surface of the water table from freshwater recharge following significant rainfall events, and then increase during long dry periods. Groundwater is progressively more saline with depth.

2.5.4 Groundwater Supply

The Study Area forms part of the Pilbara Groundwater Allocation Plan area (DoW, 2013) with water supply for Port Hedland, Wedgefield, South Hedland, Nelson Point and Finucane Island sourced from existing borefields in the lower Yule and DeGrey alluvial aquifers. The Study Area is located more than 50 km from the lower Yule River wellfield and 75 km from the DeGrey River wellfield.

Recharge to the Yule alluvial aquifer is less reliable than the DeGrey River aquifer as the former is more reliant on recharge in the preceding wet season (DoW, 2013). Water supply from the Wallal aquifer in the West Canning Basin also has the potential to become a significant water source for the Port Hedland regional water supply scheme (DoW, 2013).

Opportunities for water abstraction from the superficial formation beneath the Study Area are very limited as groundwater is of poor quality due to high salinity (Section 2.5.3) with salinity also generally increasing with depth.

2.6 Surface Water

The pre-development surface water hydrology consists of natural features with some drainage swales which convey drainage from adjacent areas. Flows are generally northward towards the supratidal flats and creeks, which are occasionally influenced by storm and ocean surges.

2.6.1 Storm and Ocean Surges

Major flooding in Port Hedland is typically associated with storm surge rather than solely rain events causing the many creeks to flow. However, localised flooding can occur in susceptible areas along creeks and low-lying areas (Cardno, 2011).

Storm surges can occur during cyclones or tropical systems coinciding with near high tide levels. The flood water level, called the storm tide, is a combination of the storm surge and tidal variation (Cardno, 2011).

The flood potential of a system is not directly related to cyclone intensity but is associated with its track, speed and areal extent. Rainfall totals in excess of 100 mm are common with tropical lows that move over land. The worst case scenario is to have a severe cyclone pass near the Town near the time of high tide, but given the significant tidal variations, this is a rare occurrence. An example was the cyclone of 1939.

Estimated surge levels in previous studies are summarised in Section 1.2.

WAPC endorsed the 2% AEP (50 year ARI) flood protection criteria with 0.3 m freeboard for the Wedgefield Industrial Estate, setting a minimum lot fill level of 6.0 mAHD and minimum building floor level of 6.3 mAHD in a letter to the Town of Port Hedland dated 24 December 2009 (Appendix E).

The Cardno (2011) study resulted in lower storm surge level estimates, therefore the endorsed criteria can be regarded as conservative.

2.6.2 Existing Surface Drainage

Existing surface drainage is shown on Figure 7 and is discussed below with reference to the LIAs and TDA shown on Figure 2.

Surface water flow from LIA2 is to South Creek through open drains. Pre-development, a drain/creek passed through LIA2 carrying flow from the existing Wedgefield Industrial areas and the pre-development LIA3 area. An 3-barrel 1200 x 300 mm culvert at Hartwell Way conveys stormwater flow to the existing drain/creek in the LIA area, Figure 8. The external contributing catchment to LIA2 is based on the Whelen (2009) survey, Figure 3, and shows that stormwater flow in the existing Wedgefield areas bound by Pinga Street (east), Hartwell Way (north) and LIA3 (south), is conveyed through open swales and culverts within the road reserve to the existing drain/creek on LIA2 and thereafter outfall to South Creek, Figure 7.

Stormwater flow from LIA5 is north-west towards a low point at the junction of the Port Hedland Goldsworthy Railway line and Great Northern Highway, Figures 7 and 9.

Surface water drainage within the existing Industrial area is via open drains/swales within road reserves, often connected by culverts at road crossing or driveways. Existing open drain/swale widths vary from 2 to 12 m.

Existing drainage north of Powell Road is generally from south to north to the supratidal flats and then onto the estuary tributary system, shown on Figure 1.

2.6.3 Peak Flow Estimates

MRWA (2008) estimated the 100 year ARI peak flow for the 1,800 ha (18 km^2) South Creek catchment at the existing bridge on Great Northern Highway using the Rational Method (777 m^3/s) and Index Flood Method (269 m^3/s). The Index Flood Method was adopted as the capacity of the existing bridge was 250 m^3/s and there was no evidence or recorded of this bridge have been overtopped. Pro-rata, the adopted 269 m^3/s 100 year ARI peak flow equated to 0.14 $m^3/s/ha$.

MRWA (2008) had also estimated the 100 year ARI peak flow for the 3,350 ha (33.5 km^2) South Creek catchment to the then proposed bridge 1.4 km north of the existing bridge on the then proposed Great Northern Highway realignment around Wedgefield. The Index Flood Method produced a peak flow of 372 m^3/s, or 0.11 $m^3/s/ha$ pro-rata.

JDA estimated pre-development peak flows across various ARIs from the proposed development areas using the Index Flood Method, shown on Table 4. The areas of proposed development ranged from 8 to 194 ha with the 100 year ARI pre-development peak flow per hectare ranging from 0.15 to 0.18 $m^3/s/ha$, relatively similar to the MRWA (2008) estimates.

TABLE 5: ESTIMATED PRE-DEVELOPMENT PEAK FLOW RATES

		Peak Flow (m^3/s)			
Location (Figure 2)	Area (ha)	5 year ARI (20% AEP)	10 year ARI (10% AEP)	50 year ARI (2% AEP)	100 year ARI (1% AEP)
LIA5	65.32	2.4	3.8	9.4	11.8
TDA	194.1	5.9	9.4	23.7	28.1

2.7 Environmental Factors

There were no significant areas of flora and fauna, classified wetlands and buffers or contaminated sites within the Study Area or recorded sensitive receiving environments downstream of the Study Area, and at pre-development, the site was generally uncontaminated green title land.

2.8 Acid Sulphate Soils

Regional Acid Sulphate Soil (A.S.S.) risk mapping is absent across the Study Area and is indicative of no known risk of A.S.S. occurring within 3 m of the natural surface for the Study Area (DWER, 2016). To the north of the Study Area is low-lying supratidal soils where there is a high to moderate risk of A.S.S within 3 m of surface.

Field tests in GHD (2009) did not detect the presence of actual or potential acid sulphate soils within 3 m of the natural surface and concluded that no further A.S.S. investigations are likely to be required if excavation is less than 3 m (Section 1.2.6).

2.9 Aboriginal Heritage

There are no registered Aboriginal Heritage Sites within the Study Area, Figure 7, although there are numerous sites located west of the Study Area and associated with South Creek.

There are three 'Other heritage places', *LAN 08-02* (ID: 26699), *LAN 08-03* (ID: 26700), and *LAN 08-04* (ID: 26701), located within existing drains in the north of the Study Area.

DPLH (2022) denotes these areas as "*midden/scatter, shell*".

3. PROPOSED DEVELOPMENT

The Study Area, 220.9 ha and shown on Figure 1, is situated west and south of the existing Wedgefield Industrial Estate. The SP for the Study Area, URBIS (2022), proposes extension of the existing Wedgefield Industrial Estate eastward (‘Hedland Junction’), shown on Figure 10.

Key elements of the SP related to water management include:

- Proposed drainage swales within road reserves across the development;
- Relocation and formalisation of two existing drain outlets passing through the Study Area; and
- Conveyance of minor and major rainfall events within swales to the downstream outlets of the Study Area and thereafter into South Creek (southern area) and supratidal flats (northern area).

A breakdown of the land use within the Study Area is presented in Table 6 and shown on Figure 10.

TABLE 6: LAND USE BREAKDOWN

Land Use Description	Study Area (ha)
General Industry	158.9
Road Reserve	58.6
Public Open Space (POS)	3.4
Total	**220.9**

4. LOCAL WATER MANAGEMENT STRATEGY

4.1 Water Supply and Sustainability Initiatives

The supply and sustainable use of water within the proposed development are key components of the management strategy.

4.1.1 Water Balance

A water balance is generally required at the LWMS stage to support the identification and management of excess water generated by the development. Whilst development generally leads to an increase in surface water discharge and peak flow to the receiving environment, the limited infiltration and high runoff rates are similar for both the pre- and post-development condition. Consequently, change in land use will generate limited excess water post-development.

4.1.2 Water Supply and Wastewater

Scheme water is to service the potable water requirements of the industrial lots, and water efficient fixtures and fittings should be used. Groundwater across the Study Area is brackish to saline (Section 2.5.3) and due to the proximity of the Study Area to the estuary and ocean, there is no potential for a fresh groundwater supply (Section 2.5.4).

The Study Area is outside of Water Corporations septic service area. The wastewater strategy is consistent with the existing Wedgefield area of use of septic tanks with leach drains or alternative system (ATU's) approved by the Department of Health. Lot owners will have to make an *Application to Construct or Install an Apparatus for the Treatment of Sewerage* to the Town of Port Hedland. Permeability for design purposes was estimated at 1 m/day (GHD, 2009). Due to the density of the development lots, the total recharge to groundwater from septic systems is considered small.

4.1.3 Water Conservation

The State Planning Policy 2.9 regarding water resources (WAPC, 2006b) requires new developments to employ a total water cycle approach with consideration of water resources.

Water conservation strategies to be considered for adoption include:

- Promotion of use of waterwise practices including water efficient fixtures and fittings (WELD rated taps, toilets, appliances) and water-wise landscaping including native plant species; and
- Use of native vegetation requiring no/less irrigation in proposed drainage swales.

Specific measures to achieve water conservation will be further detailed in the UWMP.

4.2 Surface Water Management

4.2.1 Stormwater Design

Local stormwater is proposed consistent with water sensitive design practices and the key objectives and criteria detailed in Table 1 and Section 1.1.

The stormwater drainage system is designed to manage a range of rainfall events up to the 1% AEP (100 year ARI), using a small, minor and major design approach consistent with DWER (2017).

Small event management concentrates on the first 15 mm of rainfall; further detailed in DWER (2017). Town of Port Hedland industrial lot guidelines require the 5 year ARI 6 minute duration rainfall to be retained within lots. The IEAust (1987) 5 year ARI 6 minute duration rainfall intensity of 151 mm/hr equates to a rainfall depth of 15.1 mm and approximates the ‘small’ event rainfall and will be managed within landscape strips along street frontage boundaries within the industrial lots.

The minor drainage system is defined as the system of swales designed to convey frequent rainfall events, up to the 10% AEP (10 year ARI), to the downstream outlets of the Study Area.

The major drainage system is defined as the arrangement of roads and drainage reserves to provide safe passage of stormwater runoff from rarer rainfall events, up to the 1% AEP (100 year ARI). The major system uses the swale drainage system, culverts and flow spilling over the roads in key locations, generally at culverts.

General Industry lots are to be graded to drain towards the street front with stormwater runoff generated within lots to be collected via the swale system. Road reserves and the associated swales within the road reserve will be graded towards the downstream outflow locations of the Study Area.

Industrial lot levels are to be based on WAPC advice (Appendix E) with a minimum lot fill level of 6.0 mAHD and minimum building floor level of 6.3 mAHD.

Key elements of the drainage system are shown on Figures 11 and 14 for the southern and northern areas, respectively, of the Study Area which drain to South Creek (southern area) and the supratidal flats (northern area). Event Plans for the 10% AEP and 1% AEP are shown on Figures 12 and 13 for the southern area and Figures 15 and 16 for the northern area.

4.2.2 Upstream External Catchment Considerations

Main Roads WA installed a double Ø600 culvert in October 2014 under the existing Wallwork Road (previously Great Northern Highway) near a low point of the natural detention storage, Figure 17. To manage stormwater inflow from this culvert, a drain is proposed from that culvert which directs flow to Phosphorus Street which runs parallel to Wallwork Street, Figure 17). The upstream catchment has significant areas of existing natural storage, and these are assumed to be retained along with the existing cemetery lot, with the balance of the land assumed to be developed as business in the future. The external catchment also discharges by a drain to the north-east past the cemetery and Precinct 3 Kingsford Business Park (Figure 17 and Appendix G). The hydraulic analysis of the stormwater system, Section 4.2.3, has taken into consideration these natural storages, drains, surveyed Great Northern Highway road levels, proposed culverts and future development south of Wallwork Road, Figure 17.

4.2.3 Stormwater System Hydraulic Analysis

4.2.3.1 Design Rainfalls and Temporal Patterns

The previous approved LWMS (JDA, 2011a) used design rainfalls from the third edition of *Australian Rainfall and Runoff* (IEAust, 1987) which was current at the time. Design rainfalls are typically presented as Intensity-Frequency-Duration [IFD] curves. The fourth edition of *Australian Rainfall and Runoff* (Ball et al., 2019) was released in 2019 and included revised design rainfalls from the Bureau of Meteorology from 2016. These revised design rainfalls, BoM (2016), were based on nearly 30 years of additional rainfall data.

IFD values, expressed as rainfall intensities in mm/hr, from IEAust (1987) and BoM (2016) are shown in Tables 7 and 8, respectively.

Comparing the 2019 IFD data with the 1987 data indicates that there are significant changes in rainfall intensity. For the 1% AEP (100 year ARI), intensities have reduced for all durations, with reductions up to 30% for short durations up to 3 hours. For the 10% AEP (10 year ARI), intensities are lower for most durations, with reductions up to 25%. For the 1 EY (1 year ARI), intensities have reduced slightly for short durations (up to the 3 hour) and increased slightly for the longer durations. Due to a change in terminology, the 50% and 20% AEP events are now used, which are approximately equivalent to the 2 and 5 year ARI events from IEAust (1987).

In addition, the single temporal pattern in IEAust (1987) has been replaced with an ensemble of 10 temporal patterns, in Ball et al. (2019), with the mean of the ensemble selected as the design event.

This LWMS uses the design rainfalls and temporal patterns recommended in the latest *Australian Rainfall and Runoff* (Ball et al., 2019).

TABLE 7: IEAUST (1987) RAINFALL IFD INTENSITIES, IN MM/HR

Duration	1EY (1yr ARI)	0.5EY (2yr ARI)	18% AEP (5yr ARI)	10% AEP (10yr ARI)	5% AEP (20yr ARI)	2% AEP (50yr ARI)	1% AEP (100yr ARI)
5 min	83.4	112	162	194	234	290	334
6 min	77.7	104	151	181	219	272	314
30 min	38.7	52.7	78.5	95.6	117	148	172
1 hour	25.8	35.3	53.5	65.8	81.3	103	121
2 hour	15.9	22.0	34.1	42.5	53.0	68.0	80.3
3 hour	11.8	16.3	25.7	32.2	40.5	52.3	62.1
6 hour	6.91	9.66	15.6	19.9	25.3	33.1	39.6
12 hour	4.13	5.82	9.62	12.4	15.9	21.0	25.3
24 hour	2.56	3.63	6.06	7.85	10.1	13.5	16.3
48 hour	1.58	2.25	3.77	4.91	6.33	8.46	10.3
72 hour	1.14	1.62	2.74	3.57	4.63	6.20	7.53

TABLE 8: BALL ET AL. (2019) RAINFALL IFD INTENSITIES, IN MM/HR

Duration	1EY (1yr ARI)	50% AEP (1.44yr ARI)	20% AEP (4.48yr ARI)	10% AEP (10yr ARI)	5% AEP (20yr ARI)	2% AEP (50yr ARI)	1% AEP (100yr ARI)
5 min	69.6	81.3	119	145	171	208	238
6 min	67.3	78.7	115	141	166	202	230
30 min	36.3	42.4	61.8	75.4	89.0	107	121
1 hour	23.8	27.9	40.8	49.8	58.9	71.6	81.7
2 hour	15.1	17.8	26.4	32.6	38.8	47.9	55.1
3 hour	11.5	13.7	20.7	25.7	30.9	38.3	44.3
6 hour	7.34	8.82	13.8	17.5	21.4	26.8	31.2
12 hour	4.69	5.74	9.31	12.0	14.9	18.7	21.9
24 hour	2.95	3.65	6.06	7.90	9.86	12.4	14.6
48 hour	1.77	2.19	3.63	4.71	5.87	7.43	8.69
72 hour	1.27	1.56	2.56	3.29	4.08	5.18	6.05

4.2.3.2 Hydraulic Modelling

Modelling of the stormwater system was performed by JDA using an XP-Storm model to determine post-development peak flows and swale sizes to convey flow out of the Study Area. Modelling was based on the SP (URBIS, 2022) shown on Figure 10 and with the stormwater management system shown on Figures 11 to 16. A technical note detailing the XP-Storm drainage modelling is provided in Appendix H.

Swales are proposed to convey flows and provide some detention in minor rainfall events. This strategy of open swales/drains is consistent with the drainage systems in the existing Wedgefield Industrial Estate and South Hedland areas. Road drains are to convey a minimum of the 10% AEP (10 year ARI) minor event runoff with the Main Swales, shown in Figures 11 to 16, designed to convey the 1% AEP (100 year ARI) major event runoff. No stormwater detention basins are proposed for the Study Area.

The design storms modelled, the minor event (10% AEP) and major event (1% AEP), are calculated internally by the XP-Storm model with reference to the methodology in the most recent *Australian Rainfall and Runoff* (Ball et al., 2019). The ensemble of 10 rainfall temporal patterns is assumed to be spatially uniform across the catchment. Storm durations modelled range from 30 minutes to 72 hours, with peak flows and velocities reported the mean of the temporal pattern ensemble, consistent with Ball et al. (2019).

A 90% runoff coefficient is applied uniformly for both industrial lot areas and the road reserves, and upstream future business areas.

A Manning's roughness of 0.03 is used for the drainage swales, with roads assigned a value of 0.02 and lots 0.035 (Chow, 1959). The majority of internal road drains have side-slopes of 1:4, whilst the Main Swale drains and table drains along Quarry Road have side-slopes of 1:6. For the Hematite Drive Main Drain a base width of 10 m is adopted, consistent with the section built for Stage 1 of the TDA (JDA, 2014a). All other drains in the development are generally V-shaped drains.

The XP-Storm model was extended beyond the Study Area to simulate any backwater effects on the Main Swale drains, including the potential Port Authority future development between the Development WA managed land and the realigned Great Northern Highway (GNH). The GNH realignment has been designed for a minimum finished level of 4.7 mAHD, with culverts to the supra-tidal flats and ocean inlet creeks installed close to existing invert levels, ranging from 2.7 to 3.0 mAHD (see Appendix F for final design levels). For 1% AEP rainfall event modelling, a backwater of 4.4 mAHD was applied by JDA downstream of the GNH extension culverts across the supratidal flats. Approximately, 4.4 mAHD equates to a service level for Port Hedland tidal and storm surge of a 20 year ARI event. For the 10% AEP event modelling, the Highest Astronomical Tide (HAT) of 3.6 mAHD was applied as a backwater level.

For the southern area draining to South Creek, Figure 11, a water level of 5.4 mAHD in South Creek was applied in both minor and major events. The southern main swale is graded at up to 1:1000 from an invert of 5.6 mAHD near South Creek. The outlet point is approximately 200 m downstream of the railway bridge, and is also downstream of an old road crossing. Town of Port Hedland have advised that a number of culverts at this old road crossing have failed – however as this crossing is upstream of the swale outlet point, this will not affect discharge from the southern area.

For external upstream catchment storages, the stage-area-storage relationships were defined based on 2010 LiDAR topography and are shown on Figure 17 along with the 1% AEP extent. The Main Roads WA culvert under Wallwork Road was installed in October 2014 and has been surveyed. The Wallwork Road sag point near Quarry Road was included in the model as a cross-section based on survey levels, with invert of 7.267 mAHD, and spillway 80 m wide at peak depth of 0.088 m.

4.2.3.3 Modelling Results

A summary of peak flows and velocities at tag points along the Main Drainage Swale is given in Table 9 with further results shown on the event plans, Figures 12 & 13 (southern area) and Figures 15 & 16 (northern area), along with the location of indicative table drains. Event plans also show peak water levels at the tag points.

Swale velocities are less than the Town of Port Hedland (2019) recommendation of 1 m/s.

Drainage catchment and the final swale configuration, inverts and locations will be further refined and documented at the detailed design/UWMP and will depend on final earthworks, drainage and road design levels for the developments.

Indicative swale designs are shown on Figure 18 with full landscaping design to be undertaken during detailed design in conjunction with the UWMP.

Minimum lot finished levels are to be at a minimum of 6.0 mAHD and minimum building floor levels are to have a minimum clearance of 0.30 m above the estimated 2% AEP (50 year ARI) flood level in compliance with WAPC letter dated 17 December 2009, see Appendix E. Whilst this LWMS establishes criteria and the general approach for setting development levels, finished lot levels and fill requirements form part of detailed design and will be further addressed in the UWMPs.

TABLE 9: XP-STORM MODELLING RESULTS – MAIN SWALES

	South Swale (Outlet to South Creek)			Central Swale (Outlet F)				North Swale (Outlet G)		
Tag Points	Catch16b	Node124	S10	1Ab	d20	f4a	Fculv	Lot333	g5.3	Gculv
First 15 mm										
Peak Flow (m^3/s)	0.05	0.22	0.27	0.17	0.42	1.00	1.44	0.17	0.51	0.63
Peak Velocity (m/s)	0.16	0.28	0.22	0.21	0.27	0.36	0.32	0.29	0.19	0.40
Water Level (mAHD)	7.43	6.75	6.47	5.34	4.78	4.26	3.98	5.22	4.34	3.92
1 EY (1 year ARI)										
Peak Flow (m^3/s)	0.27	1.36	1.57	0.42	1.06	2.63	3.83	0.34	1.09	1.37
Peak Velocity (m/s)	0.28	0.49	0.46	0.28	0.38	0.42	0.42	0.37	0.19	0.48
Water Level (mAHD)	7.53	6.99	6.73	5.40	4.89	4.50	4.26	5.30	4.47	4.11
Critical Duration	3	3	3	3	3	3	3	2	2	2
10% AEP (10 year ARI)										
Peak Flow (m^3/s)	0.73	3.64	4.16	1.10	2.59	6.42	9.26	0.90	2.80	3.54
Peak Velocity (m/s)	0.35	0.61	0.73	0.35	0.50	0.46	0.50	0.51	0.21	0.55
Water Level (mAHD)	7.67	7.27	7.00	5.54	5.19	4.95	4.77	5.43	4.72	4.46
Critical Duration (hrs)	6	2	2	6	2	6	6	6	1	1
1% AEP (100 year ARI)										
Peak Flow (m^3/s)	1.33	6.38	7.30	1.74	3.71	9.83	14.57	1.58	4.64	5.86
Peak Velocity (m/s)	0.36	0.65	0.97	0.37	0.48	0.46	0.52	0.60	0.25	0.54
Water Level (mAHD)	7.88	7.55	7.25	5.85	5.68	5.40	5.21	5.57	5.00	4.85
Critical Duration (hrs)	3	2	2	6	3	3	3	2	2	2

4.3 Water Quality, Erosion and Scouring Management

The use of swales within this LWMS is appropriate for treatment of minor events in the Pilbara region.

The following non-structural controls are proposed:

- Planning practices – wide road reserves to accommodate dedicated drainage swales;
- Construction practices – construction management; use of appropriate native plantings; and
- Maintenance practices – maintenance of swale systems.

The following structural controls are proposed:

- Use of landscape strips in the fronts of lots for attenuation of the first 15 mm of rainfall (‘small’ event rainfall);
- Use of vegetated swales within road reserves; and
- Use of drop structures and road crossovers to reduce the longitudinal grade and peak channel velocities.

Indicative design concepts of the landscape strips and swales/drains are shown on Figure 18.

The erosion potential in channels by culverts and overland flow paths can be estimated based on the velocity of flow during storm events. The geotechnical investigation of the Study Area (GHD, 2009) found that the soils are classed as clayey sands with between 17 to 31% fine material (silt and clay). French (1986) indicates that for these soil types, erosion will start to commence at velocities greater than 0.8 to 1.1 m/s.

Maximum flow velocities can be used to identify areas where stabilization will be required. Higher flow velocities were primarily through some culvert structures as would be expected. These are areas where bank and channel stabilisation works, such as concrete wing walls and rock/concrete bedding, could be incorporated to minimise erosion and scour.

Other water quality parameters such as oils, grease and hydrocarbons from transport enterprises need to be treated by structural controls as specified by the Town of Port Hedland for the proposed industrial land use. For example, lot owners that require wash down bays for mechanical workshops or vehicles need to seek Town of Port Hedland approval, and the Town refers applicants to the appropriate guidelines for construction of wash down bays. The guidelines set out required treatment for waste wash water (i,e. oil & grease traps), disposal, and the maintenance of the treatment systems. Disposal of treated wash water can be via infiltration from appropriately sized soakwells or by runoff to drainage swales subject to Town of Port Hedland approval. The Town is responsible for approving the maintenance and monitoring of the treatment systems.

4.4 Groundwater Management

The stormwater drainage system is designed to grade to outlets to prevent ponding of water in drains and excessive infiltration into the soils. To reduce rainfall infiltration to groundwater, lots are graded towards the landscape strips along street frontage boundaries within the industrial lots and thereafter the roadside swales, to promote runoff from the low permeability soils. Subsoil drainage is not proposed and is not suitable in Pindan soils due to the high fines content.

5. IMPLEMENTATION

Implementation of the Local Water Management Strategy involves defining the roles and responsibilities of the developer and local authority, outlining future documentation required to support the development and defining operation, monitoring and maintenance of the stormwater system.

5.1 Roles and Responsibilities

Table 10 details the roles and responsibilities to undertake the implementation plan.

The operation and maintenance of the stormwater management system will be the responsibility of the developer within the Study Area and the parties responsible for the existing rural swale outside of the Study Area initially. Responsibly for all areas of the development will ultimately be reverted to the local authority. Preparation of UWMP(s) will be the responsibility of the developer.

TABLE 10: IMPLEMENTATION RESPONSIBILITIES

Implementation		Responsibility	
LWMS Section	Action	Developer	Town of Port Hedland
5.2	Preparation of Urban Water Management Plan(s) to support subdivision.	✓	
5.3	Construction of stormwater system and 12 months operation and maintenance post construction (defects period)	✓	
5.3	Long-term stormwater system operation and maintenance		✓

5.2 Subdivision Process

A UWMP forms part of the *Better Urban Water Management* (WAPC, 2008) process and is typically a condition of subdivision. UWMP(s) will be submitted by the developer to the Town of Port Hedland and Department of Water and Environmental Regulation as required under the relevant conditions of subdivision.

UWMPs should address:

- Detailed stormwater management design including the size, location and design of swales, integrating major and minor flood management capability, landscape plants for the swales as related to stormwater function, specific details of local geotechnical investigations and their impact on stormwater design;
- Detail measures to reduce stormwater discharge velocities and prevent erosion and sediment transportation;
- Detail groundwater level monitoring data, management of groundwater levels and if any dewatering is required;
- Agreed/approved measures to achieve water conservation and efficiencies of water use including sources of water for non-potable use, controls and management and operation of any proposed system; and
- Management of subdivisional works, including management of soil/sediment (dust).

5.3 Construction Management

5.3.1 Dewatering

Dewatering is unlikely to be required for subdivision construction unless deep excavation is required due to the depth to groundwater across the Study Area.

If excavation is such that dewatering is found to be required, prior to commencement of dewatering the construction contractor may need to apply for and obtain from DWER a “Licence to Take Water”. A licence is not required for dewatering if the pump rate does not exceed 10 L/s over a period of less than 30 days and the volume of water taken over the period does not exceed 25,000 kL. If required, dewatering is to be carried out in accordance with the licence conditions should a licence to take water be required. Where possible, construction will be timed to minimise impacts on groundwater and any dewatering requirement.

5.3.2 Acid Sulphate Soils

Section 2.8 shows no known risk of A.S.S. being present within 3 m of the natural surface of the Study Area, and no known potential or actual A.S.S was detected in test pits across the Study Area (GHD, 2009). Therefore, there is no foreseeable management required for A.S.S. However, if A.S.S. is encountered, a Dewatering and Management Plan will be required to demonstrate the measures that will be taken to minimise the risk from disturbance of A.S.S. If A.S.S. is encountered, it will be investigated and managed in accordance with the applicable DWER Acid Sulphate Guidelines for Identification and Investigation (DER, 2015a) and Treatment and Management (DER, 2015b) of Disturbed Acid Sulphate Soils. Specific methods for treatment and holding times of A.S.S. are specified in these guidelines.

5.4 Stormwater System Operation and Maintenance

Long-term operation and maintenance of the drainage system will be the responsibility of the Town of Port Hedland. The surface drainage system will require routine maintenance to ensure its efficient operation. A summary of the proposed maintenance schedule is presented in Table 11 below.

TABLE 11: MAINTENANCE SCHEDULE FOR DRAINAGE INFRASTRUCTURE

Item	Maintenance Interval	
	Biannually	As Required
Swales		
Inspect for erosion + sediment accumulation.	✓	
Assess vegetation, slash if needed, where necessary remove and replace dead plants.		✓
Removal of sediment and litter layer build up.		✓

5.5 Monitoring

The stormwater management system outlined in this LWMS focuses on implementation of current known best management practice and as applicable to the Pilbara region, a minimisation of infiltration to groundwater and a maximisation of stormwater runoff to the swale drainage system.

Therefore, no post-development groundwater or surface water monitoring program is required.

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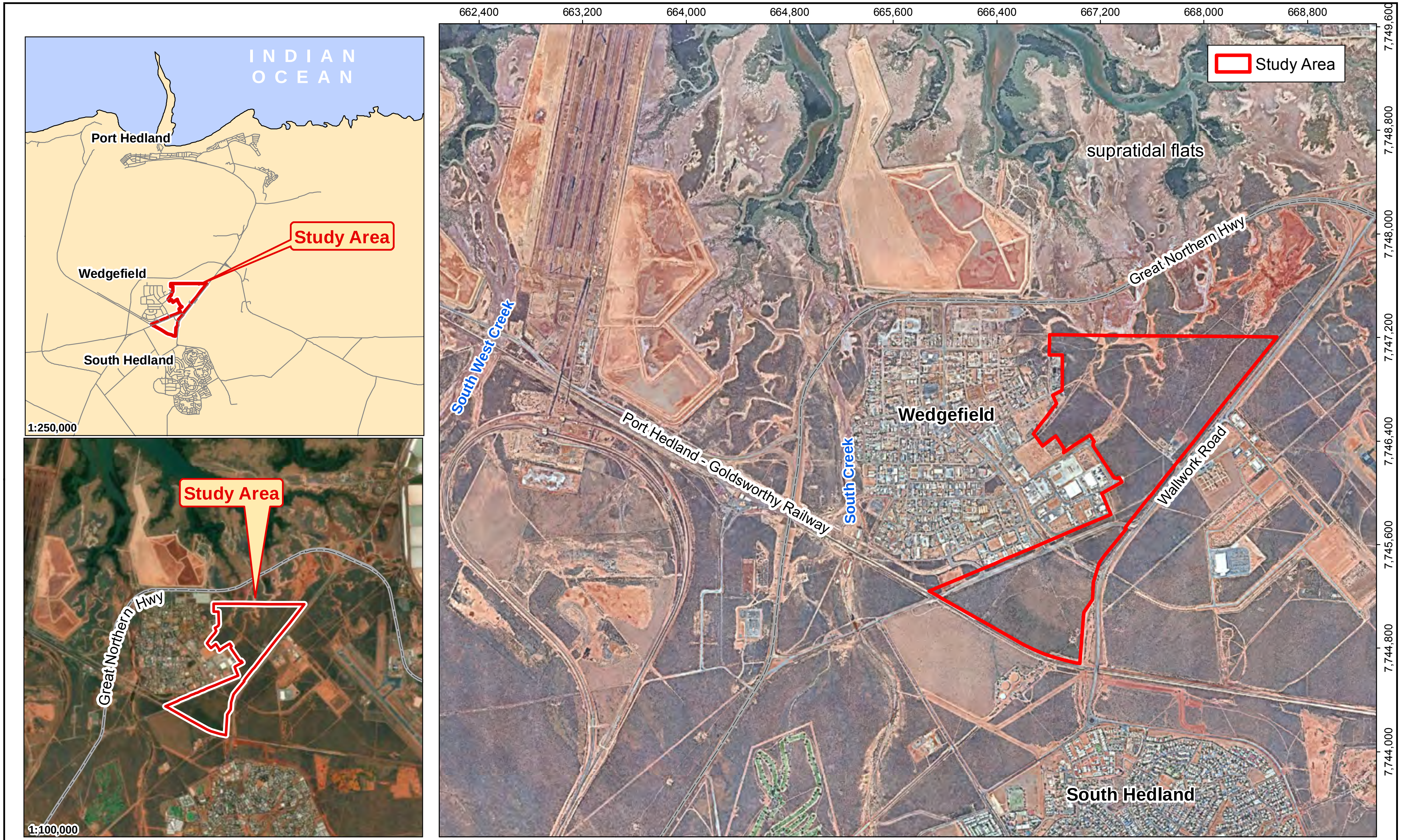
FIGURES



Data Source: Nearmap Digital Imagery (2021), 30 September 2020.

Coordinate System: GDA 94, Zone 50

JDA

Job No. J7157
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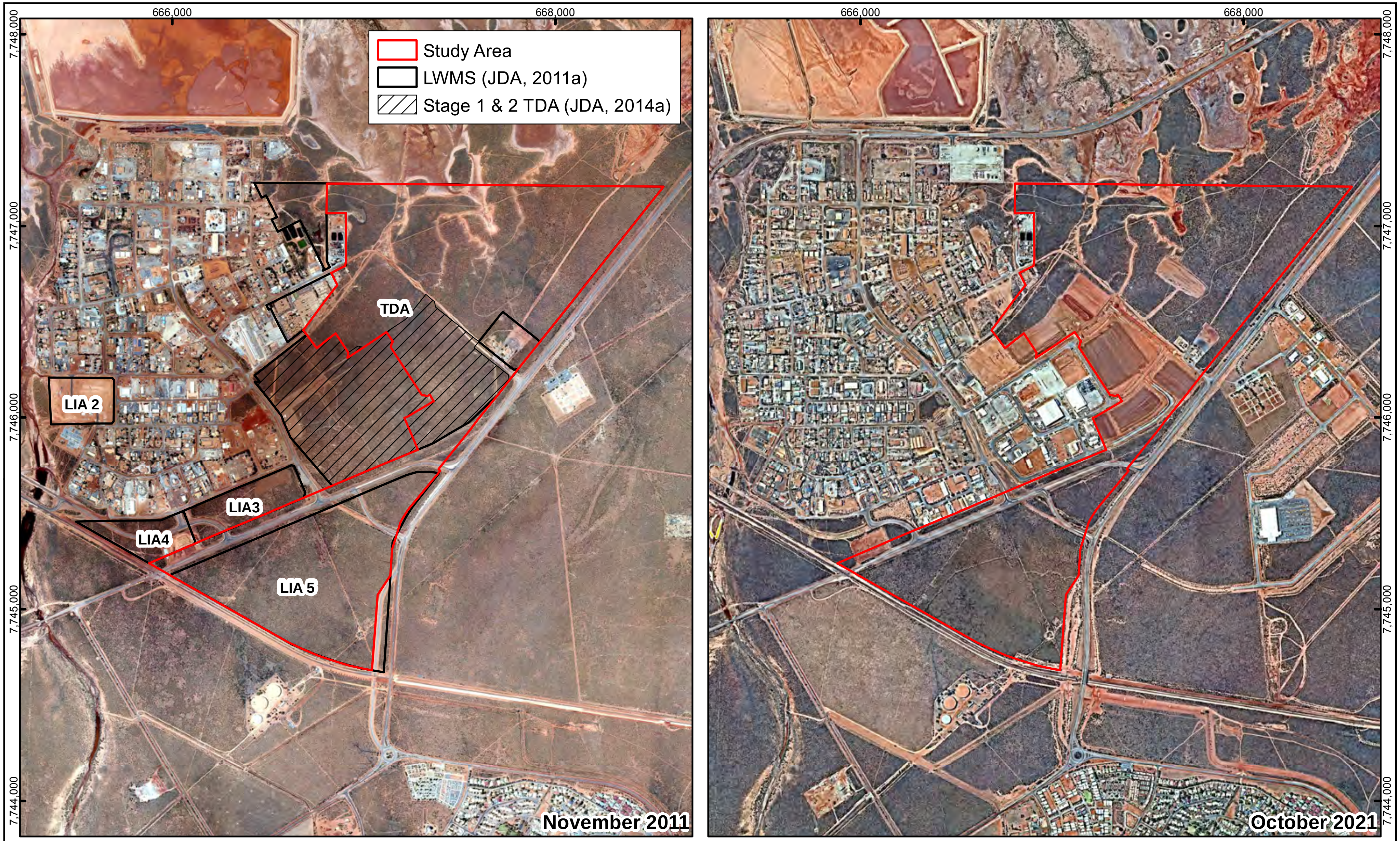
0 500 1,000 1,500 2,000
Metres

N

Development WA
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy
Figure 1: Location Plan



Data Source: NearMaps (2022) *05 November 2011 and 04 October 2021*.

Coordinate System: GDA 94, Zone 50

Job No. J7157
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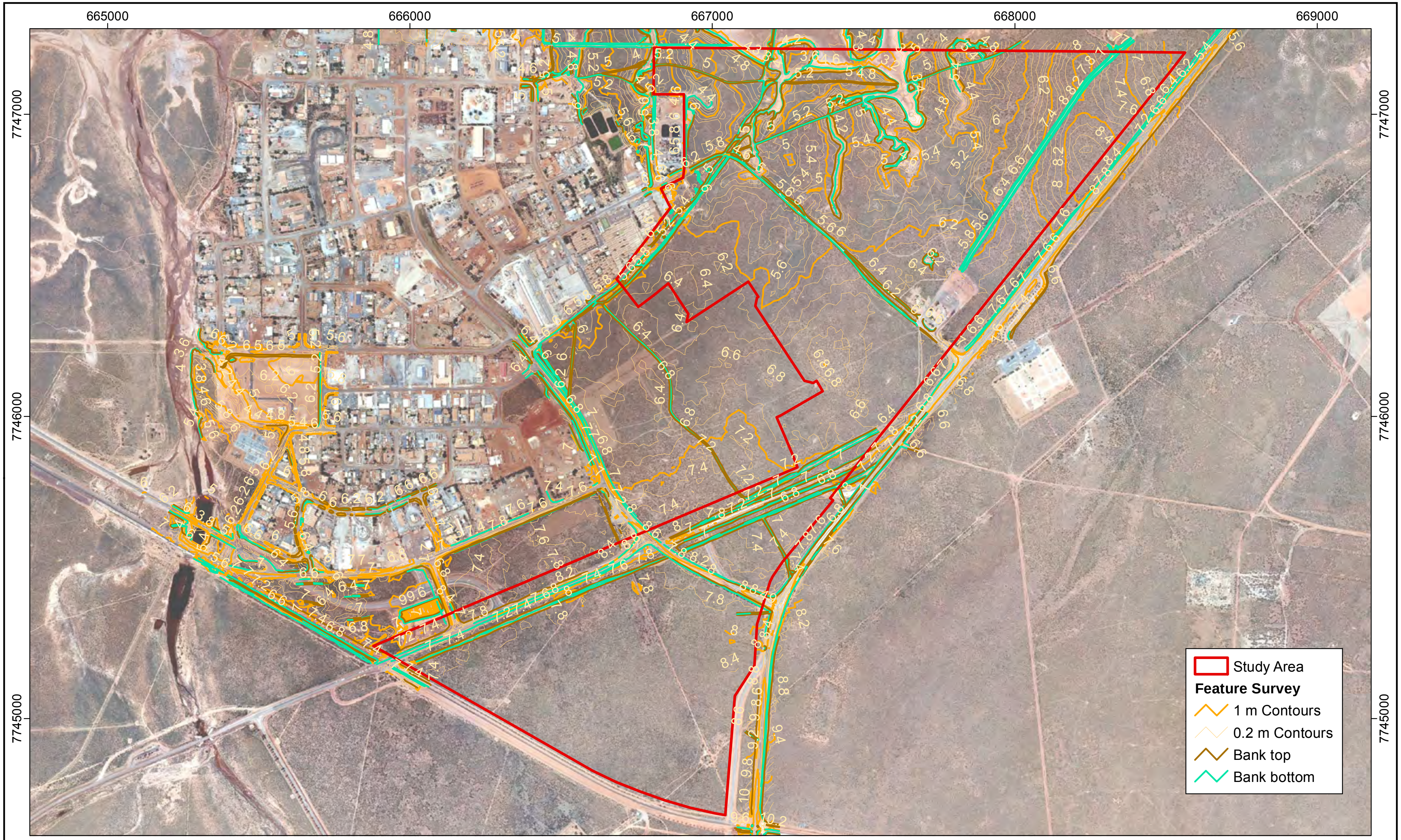
N

Development WA
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 2: Aerial Photographs, 2011 and 2021



Data Source: Whelans (2009) *Feature Survey*; NearMaps (2022) *05 November 2011*.

Coordinate System: GDA 94, Zone 50

Job No. J7157

Scale:1:17,000 @A4

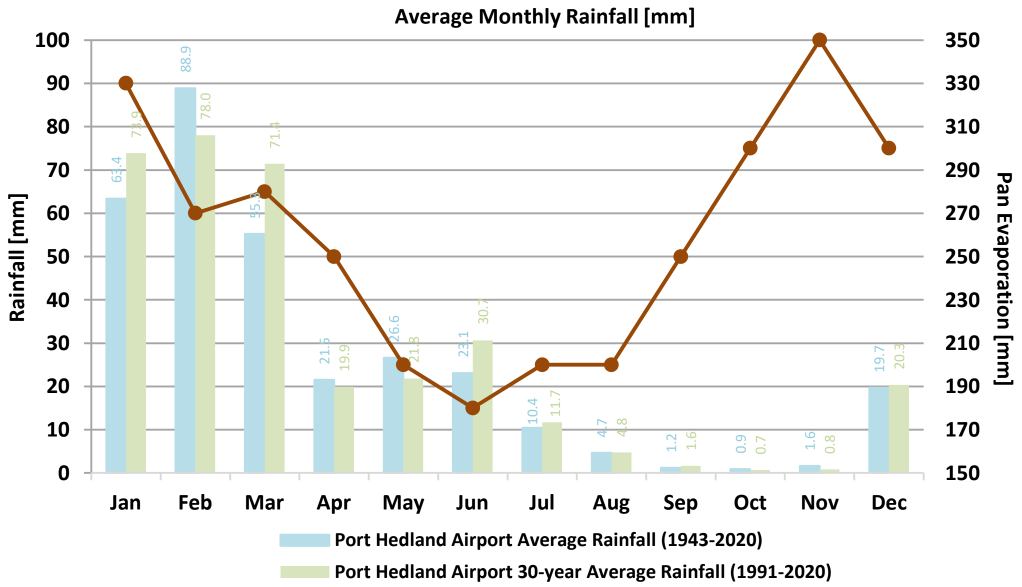
0 250 500 750 1,000 Metres

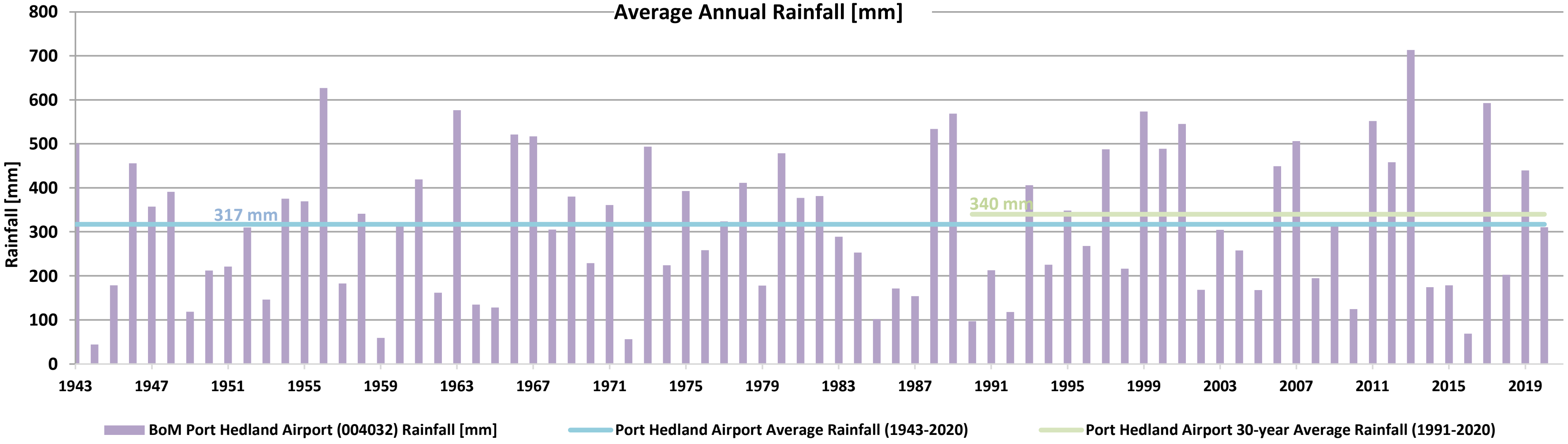
N

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 3: Topography





Data Source: Bureau of Meteorology (2021) *Port Hedland Airport (004032) Rainfall Gauging Stations.*

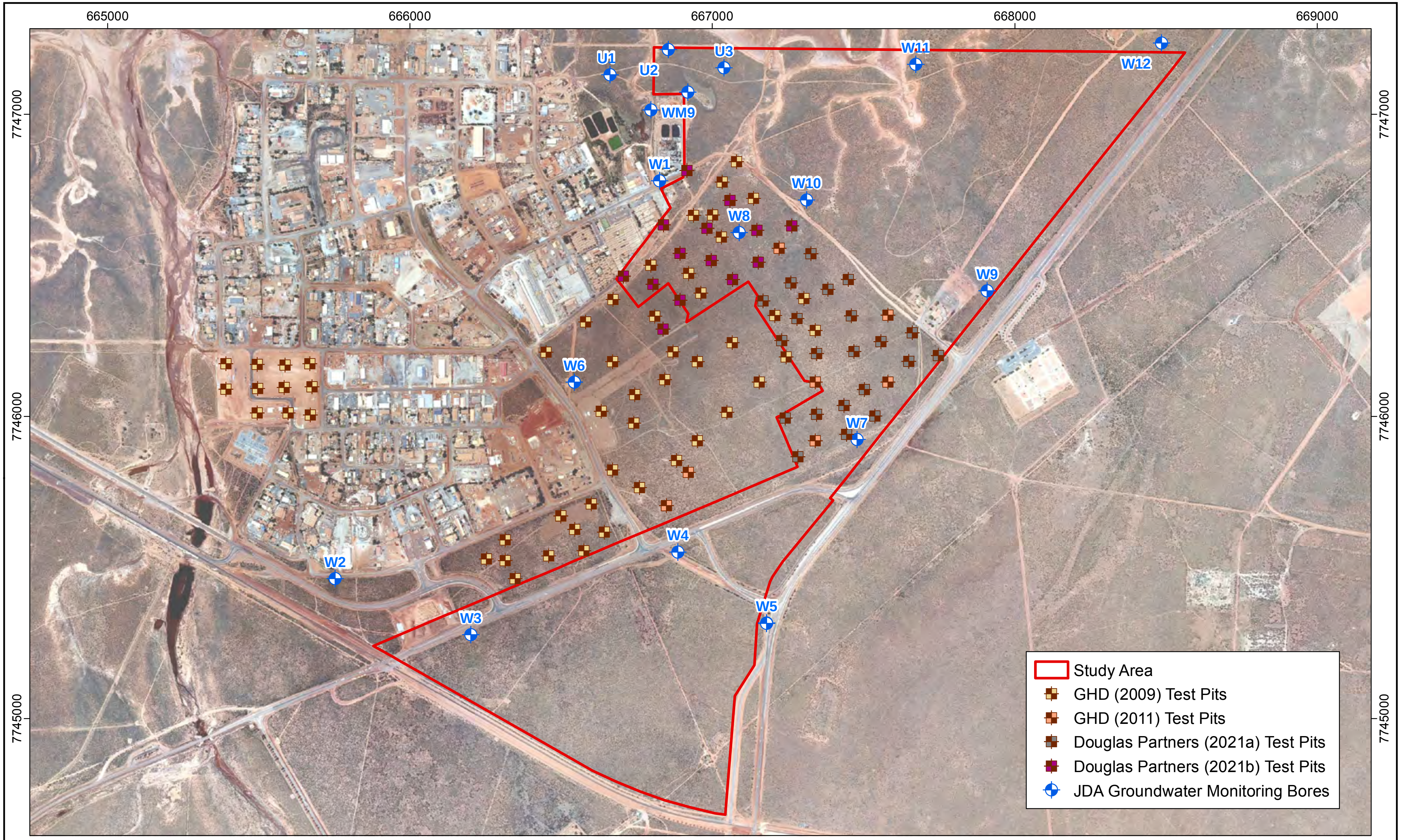
JDA Consultant Hydrologists

Job No. J7157

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 4: Rainfall and Evaporation Data



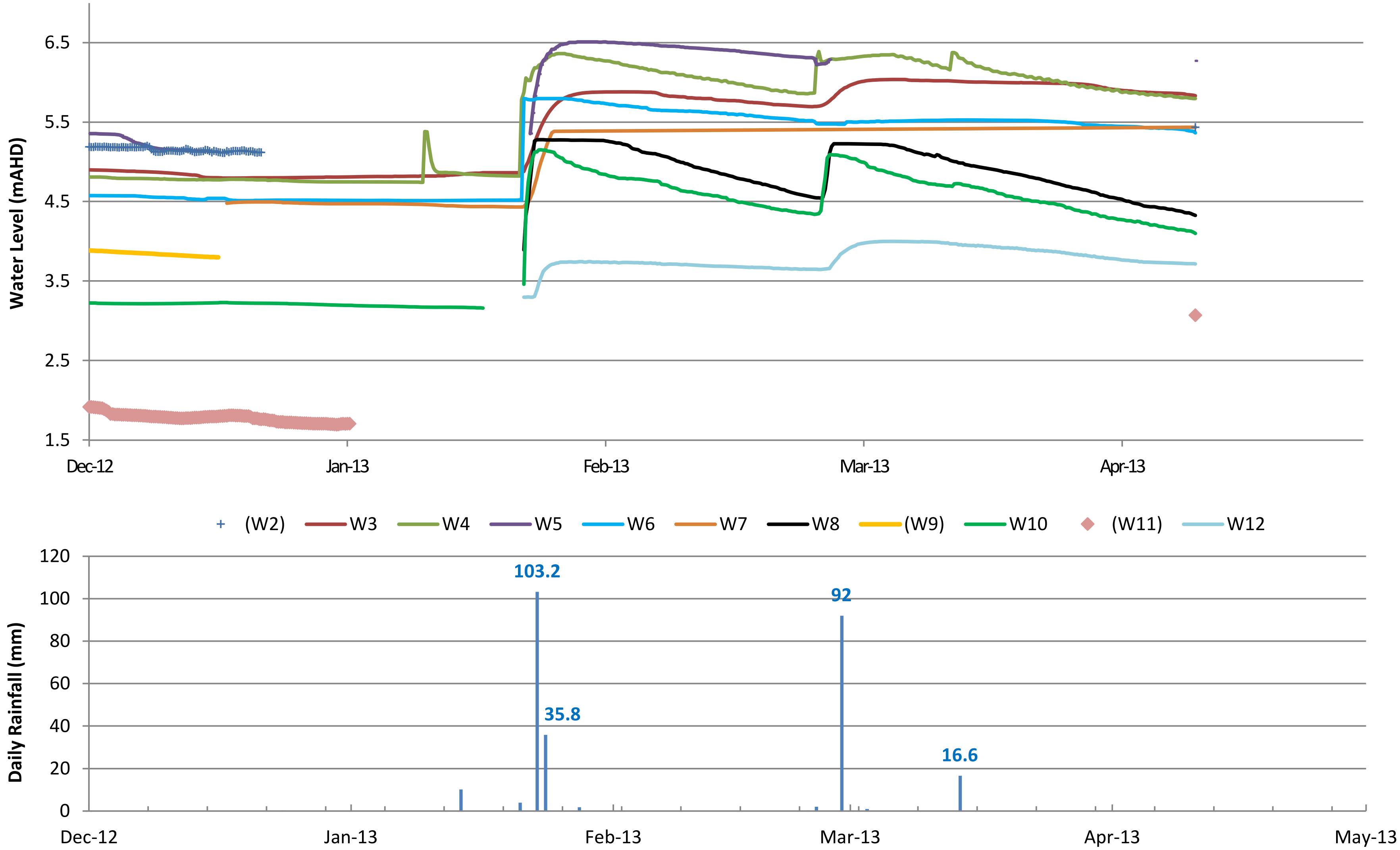
Data Source: GHD (2009); GHD (2011); JDA (2014b); Douglas Partners (2021a; 2021b).

Coordinate System: GDA 94, Zone 50

Job No. J7157
Scale: 1:17,000 @A4

Development WA
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 5: Geotechnical Investigations and Groundwater Monitoring Bores



Note: W11 by intratidal flats; logger/battery fault.
Measured levels: 2.65 and 3.06 mAHD on 19/12/12 & 11/4/13.
1.8mAHD on 22/05/12 prior to downstream works.
W9 was destroyed.

Data Source: Climate Data Online (2021) Port Hedland Airport (004032) Rain Gauge; JDA (2014b)

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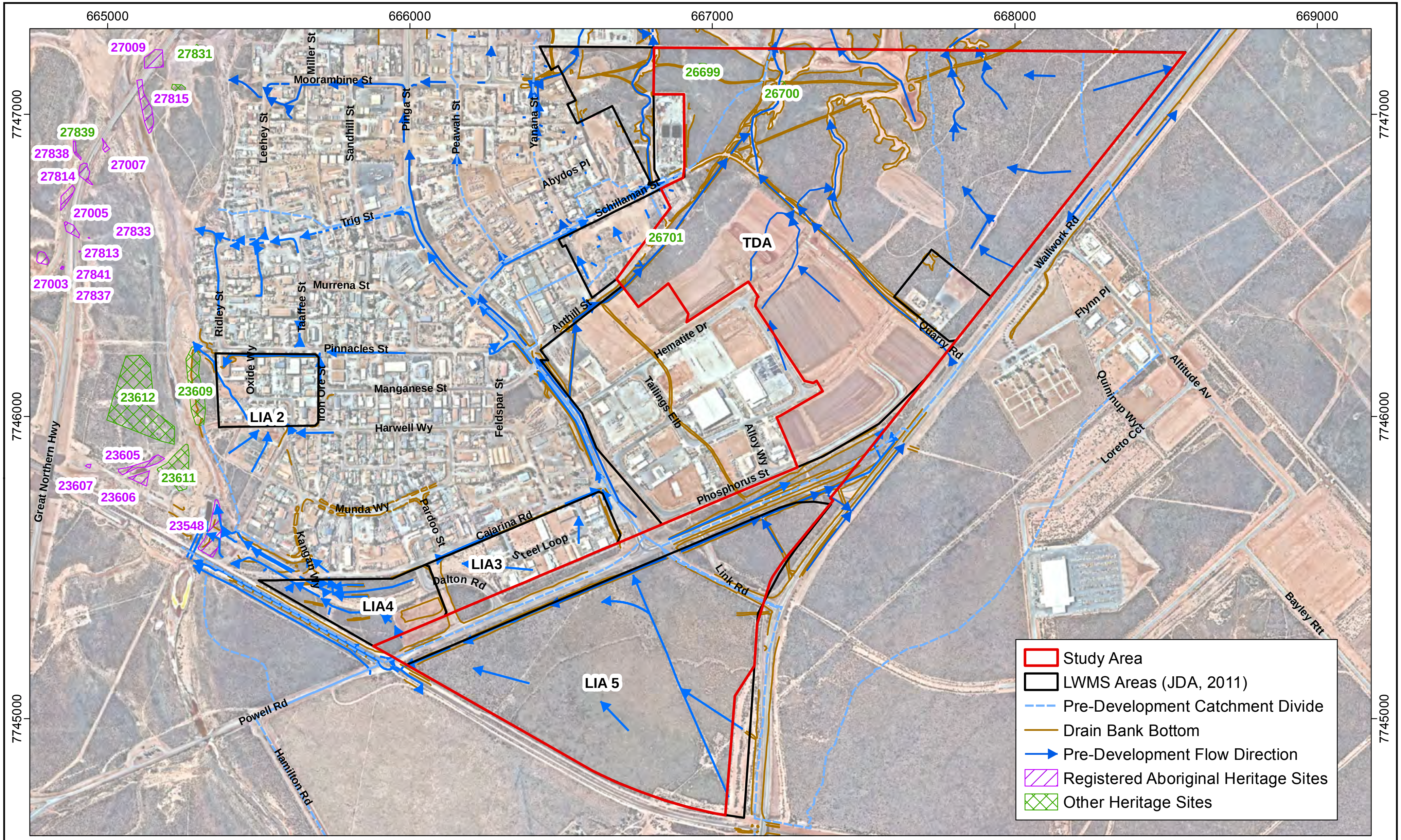
Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 6: Recorded Groundwater Levels, Wet Season 2012/2013



Data Source: Whelans (2009) *Feature Survey*; NearMaps (2021) *04 October 2021*; DPLH (2022).

Coordinate System: GDA 94, Zone 50

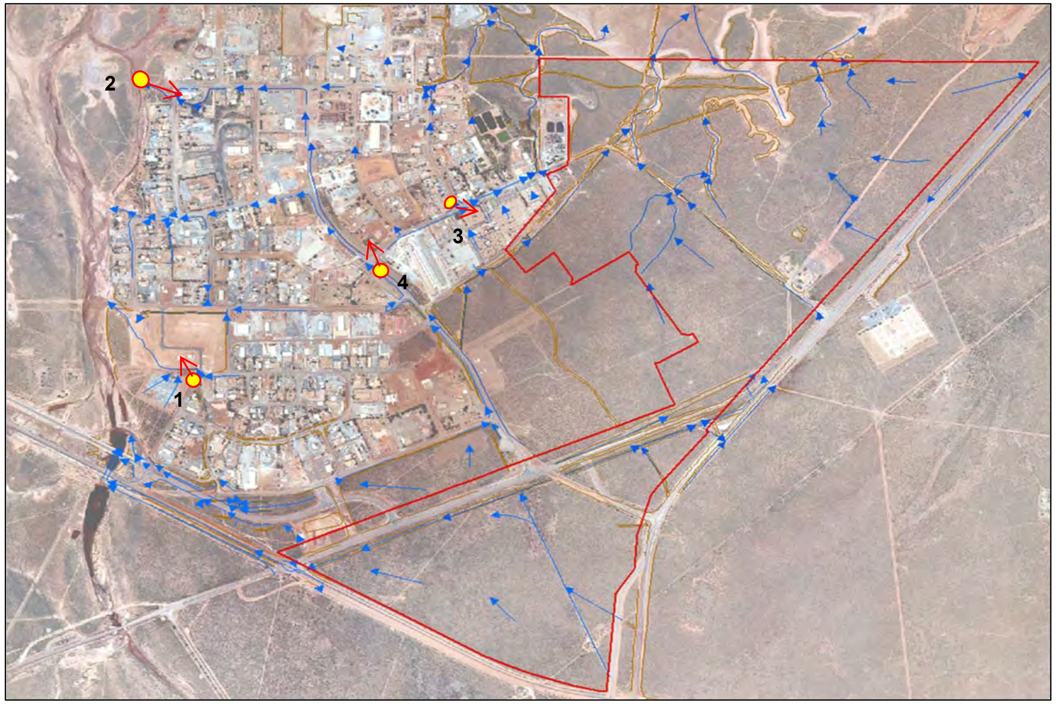
Job No. J7157
Scale: 1:17,000 @A4

0 250 500 750 1,000 Metres

N

Development WA
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy
Figure 7: Surface Water Drainage and Aboriginal Heritage

1 3 x 1200 x 300 mm culverts at Hartwell Way



2 Outflow culverts to South Creek at Moorambine St

3 Culverts and Swale at Schillaman Street

4 Swale along Pinga street

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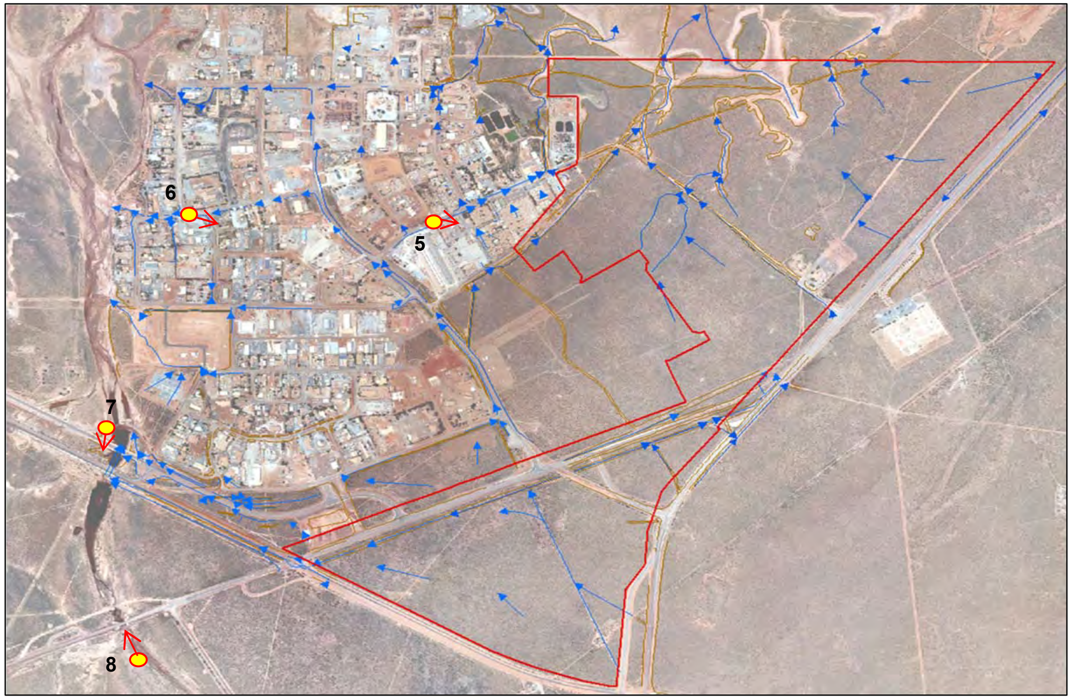
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 8: Existing Culverts and Swales, Photos 1 to 4

5 Culverts at Schillaman Street



6 Swale at Trig Street

7 South Creek culvert adjacent to railway

8 Great Northern Highway Bridge at South Creek

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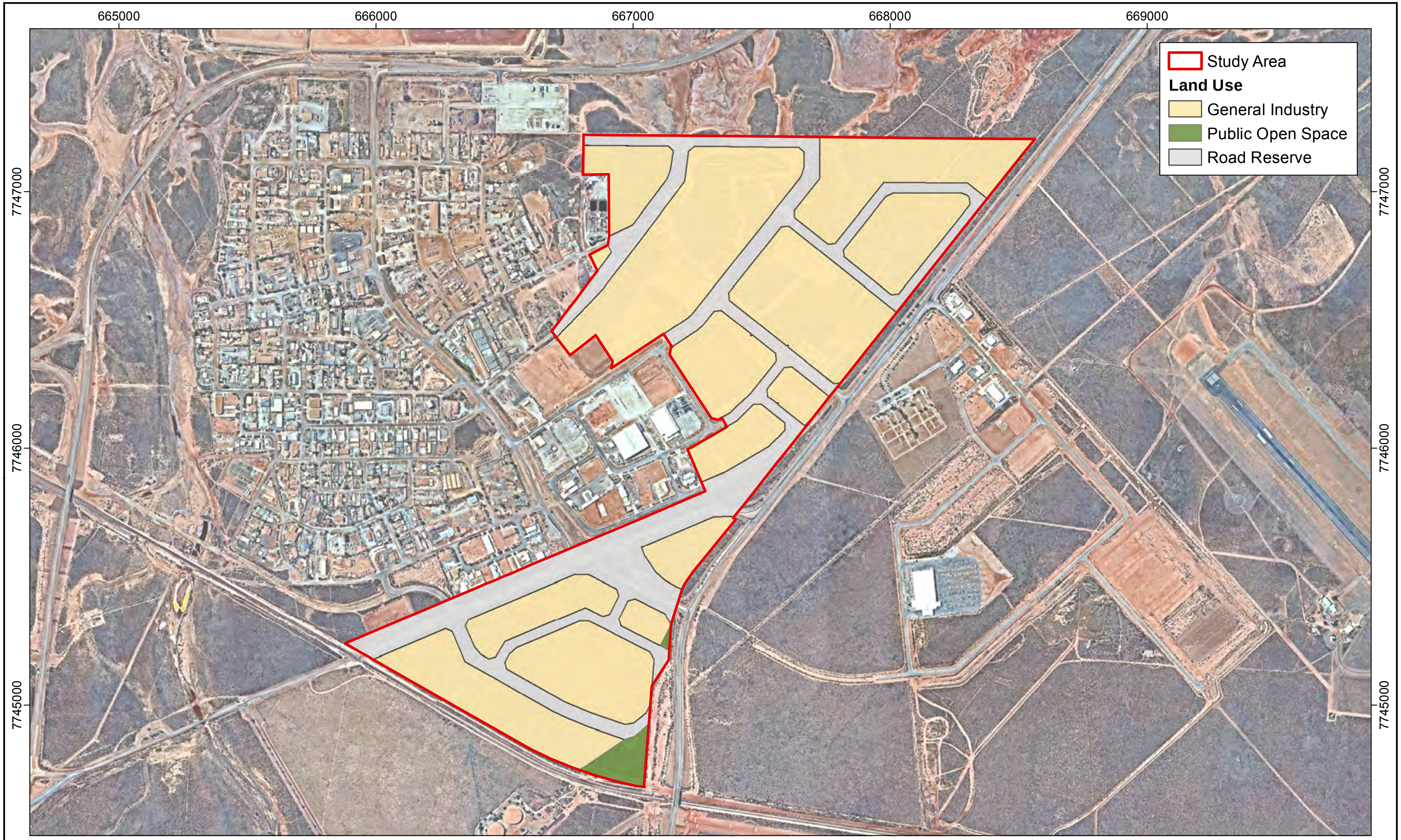
Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 9: Existing Culverts and Swales, Photos 5 to 8



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

JDA

Job No. J7157

Scale:1:20,000 @A4

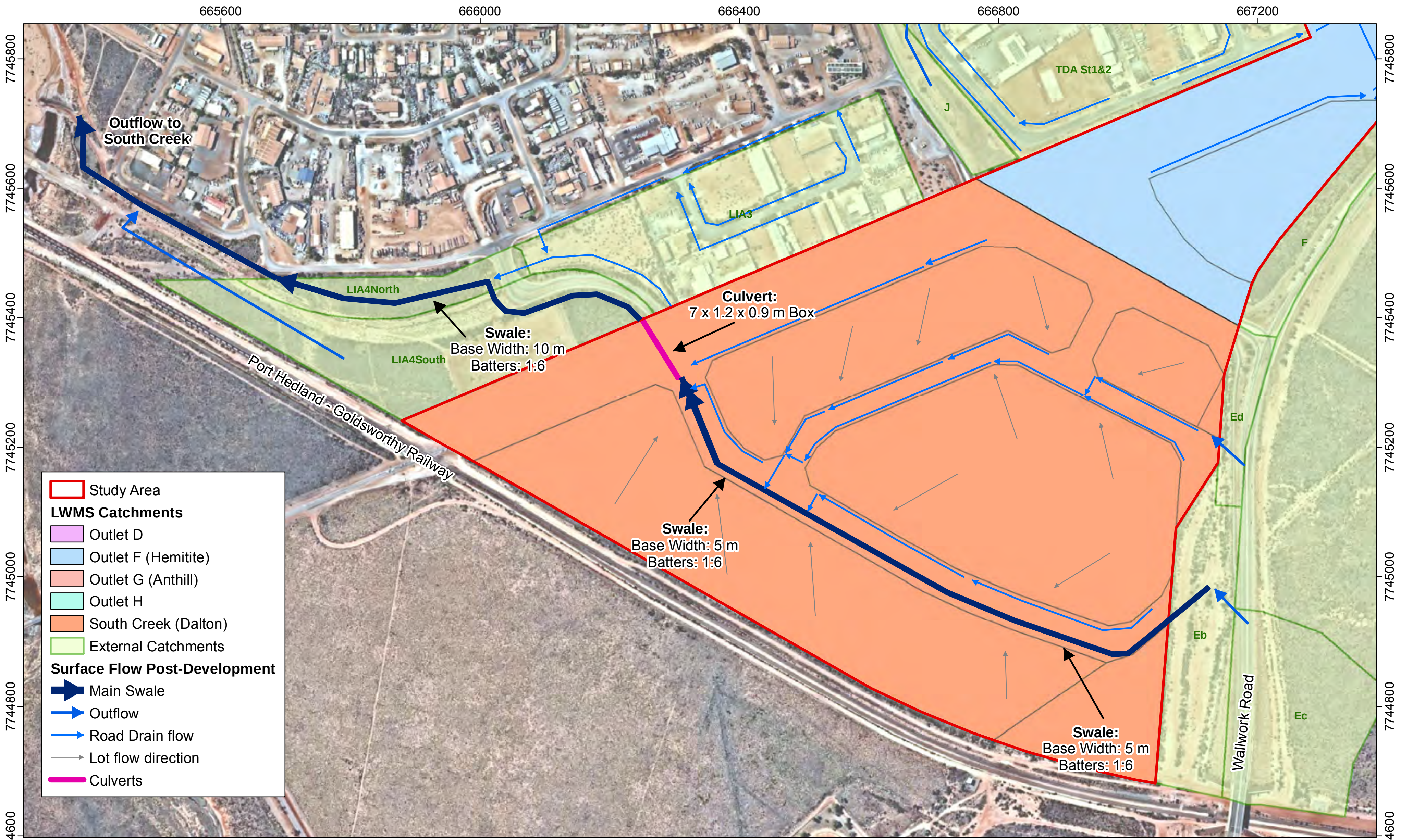
0 500 1,000 1,500 2,000 Metres

N

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 10: Structure Plan



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

JDA

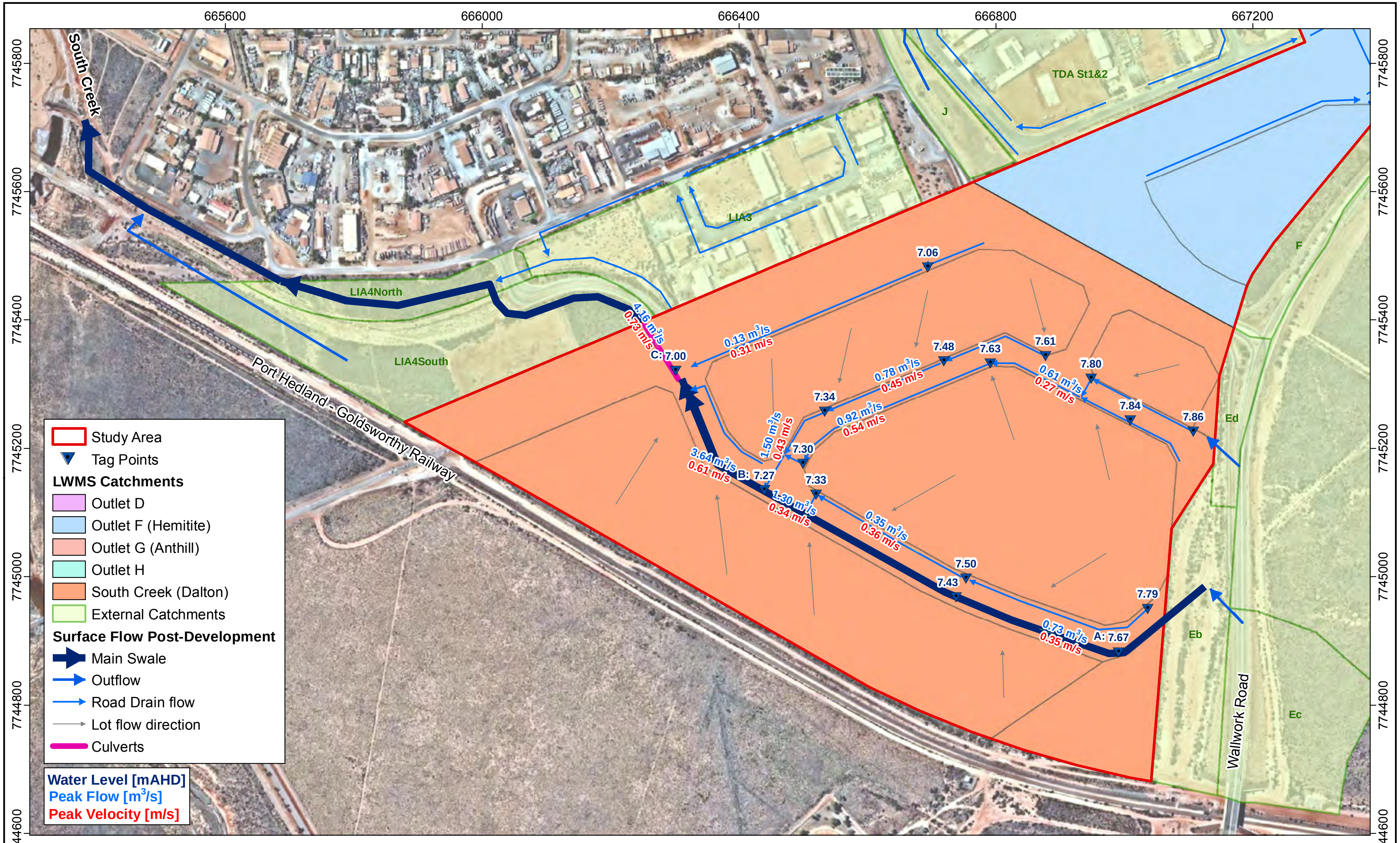
Job No. J7157

Scale: 1:8,000 @A4

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 11: Stormwater Management System, Southern Area



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

JDA

Job No. J7157

Scale: 1:8,000 @A4

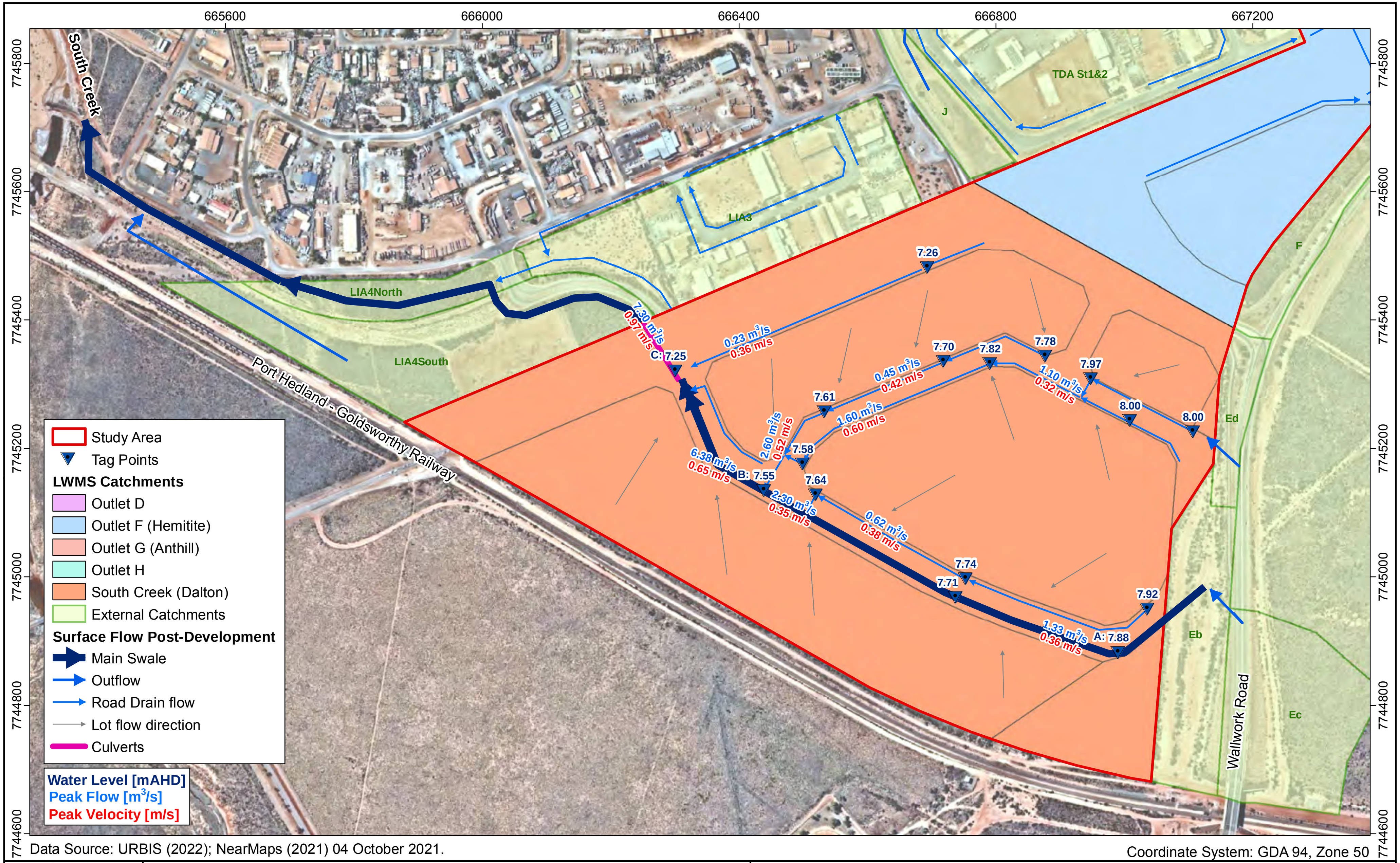
0 100 200 300 400 Metres

N

Development WA

Hedland Junction, Wedgefield LWMS: Technical Note

Figure 12: South Area (Dalton) 10% AEP Event Plan



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

JDA

Job No. J7157

Scale: 1:8,000 @A4

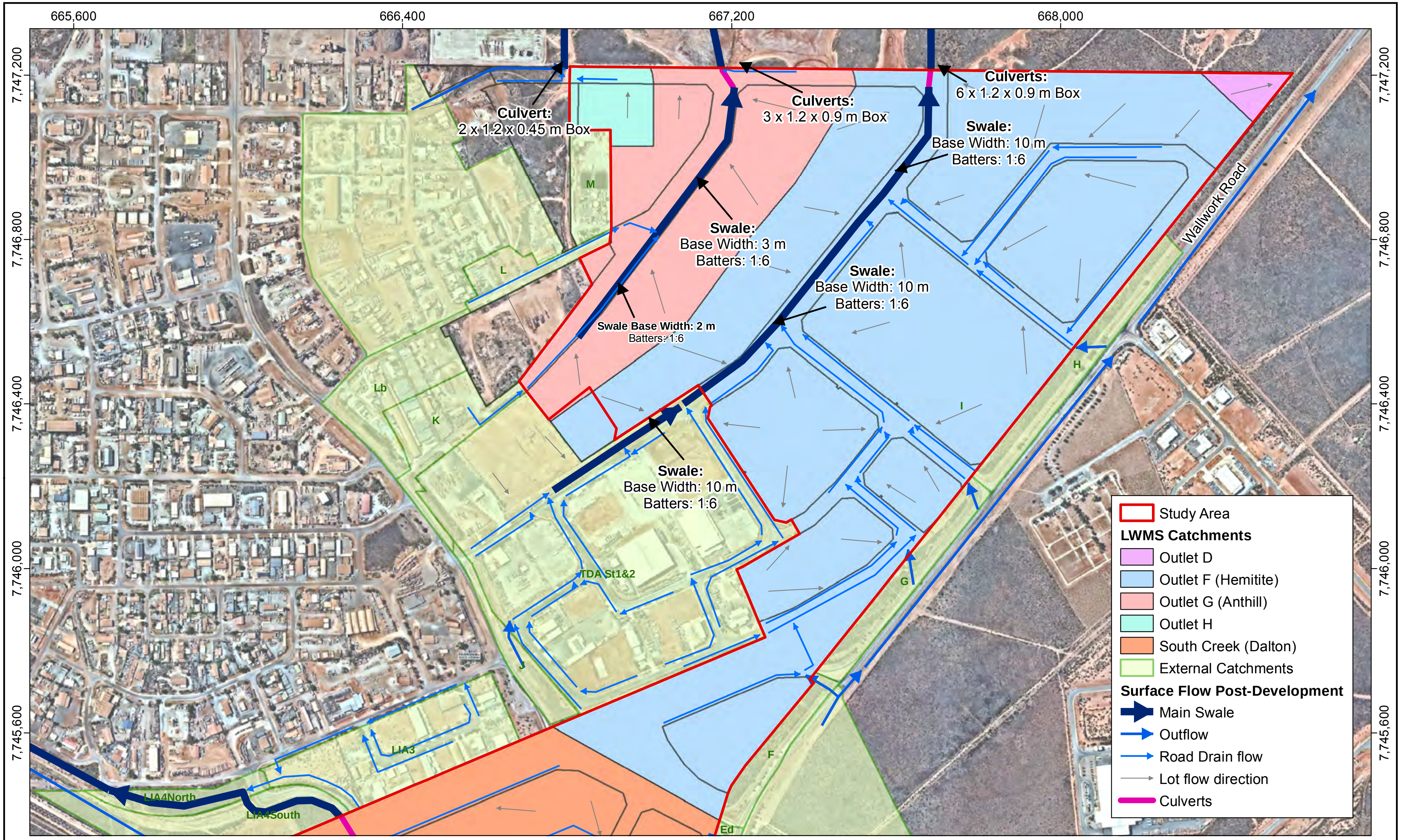
0 100 200 300 400 Metres

N

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 13: South Area (Dalton) 1% AEP Event Plan



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

JDA

Job No. J7157

Scale:1:12,500 @A4

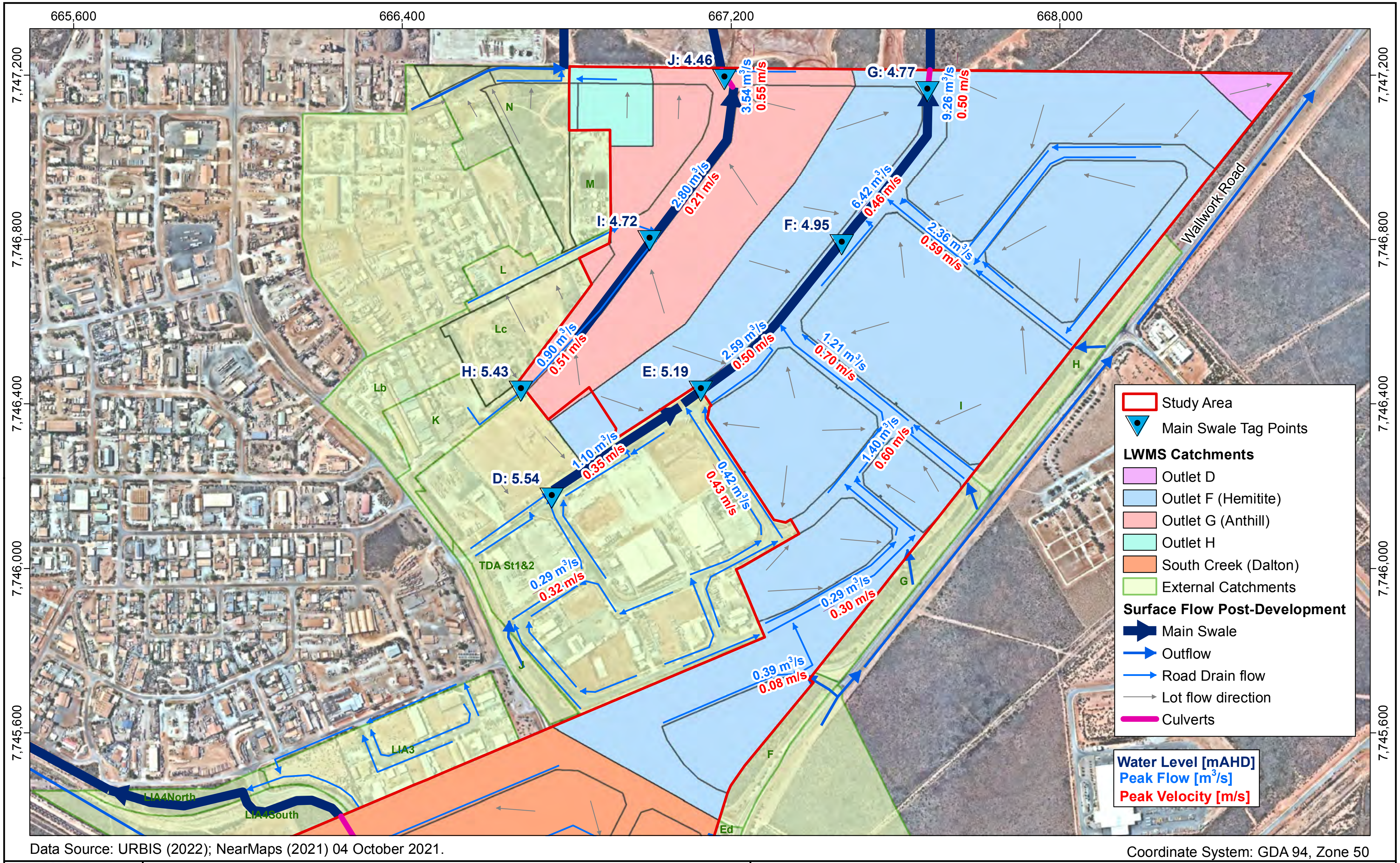
0 200 400 600 800 Metres

N

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 14: Stormwater Management System, Northern Area



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

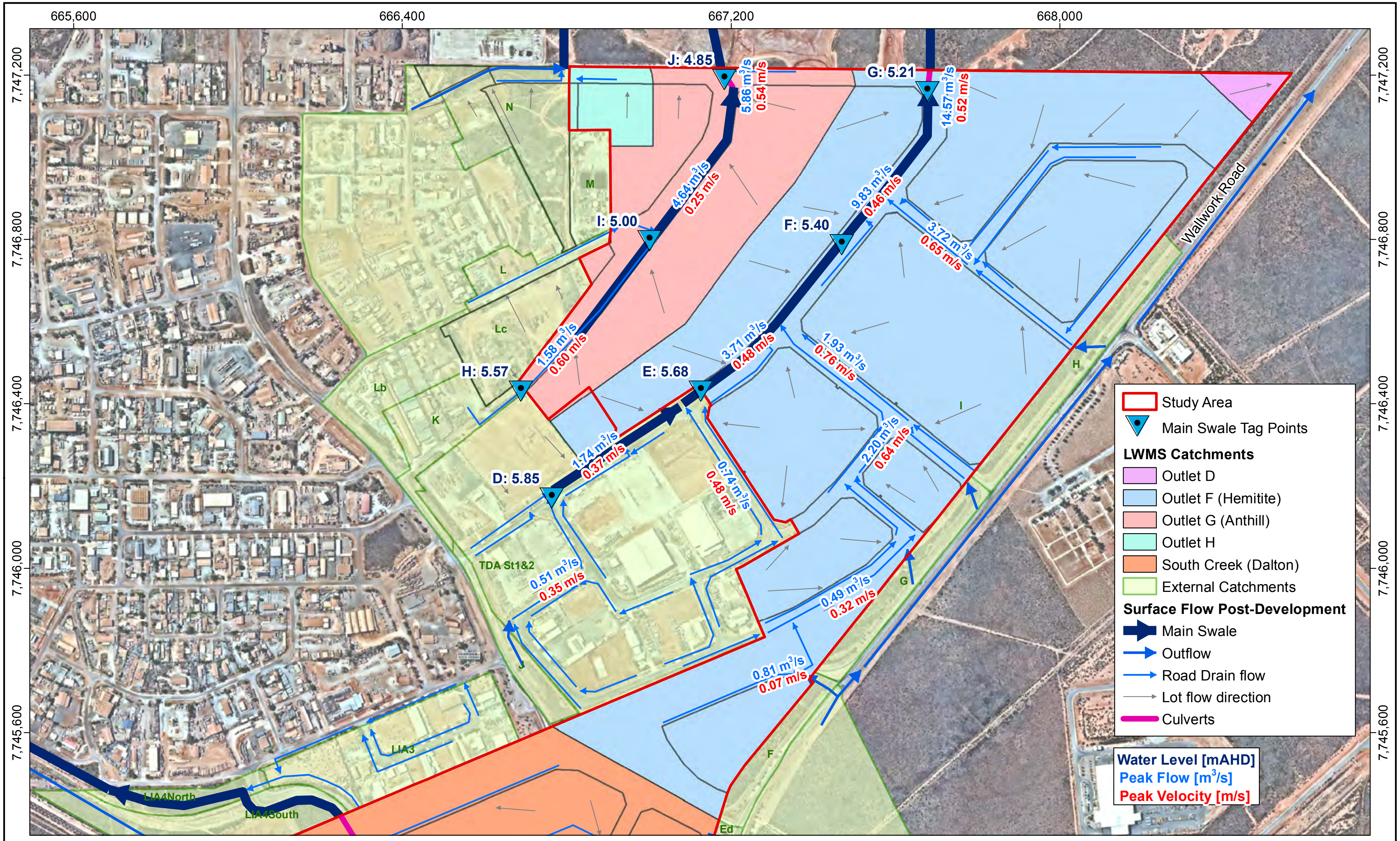
Job No. J7157

Scale:1:12,500 @A4

Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 15: Northern Area – 10% AEP (Minor) Event Plan



Data Source: URBIS (2022); NearMaps (2021) 04 October 2021.

Coordinate System: GDA 94, Zone 50

JDA

Job No. J7157

Scale: 1:12,500 @A4

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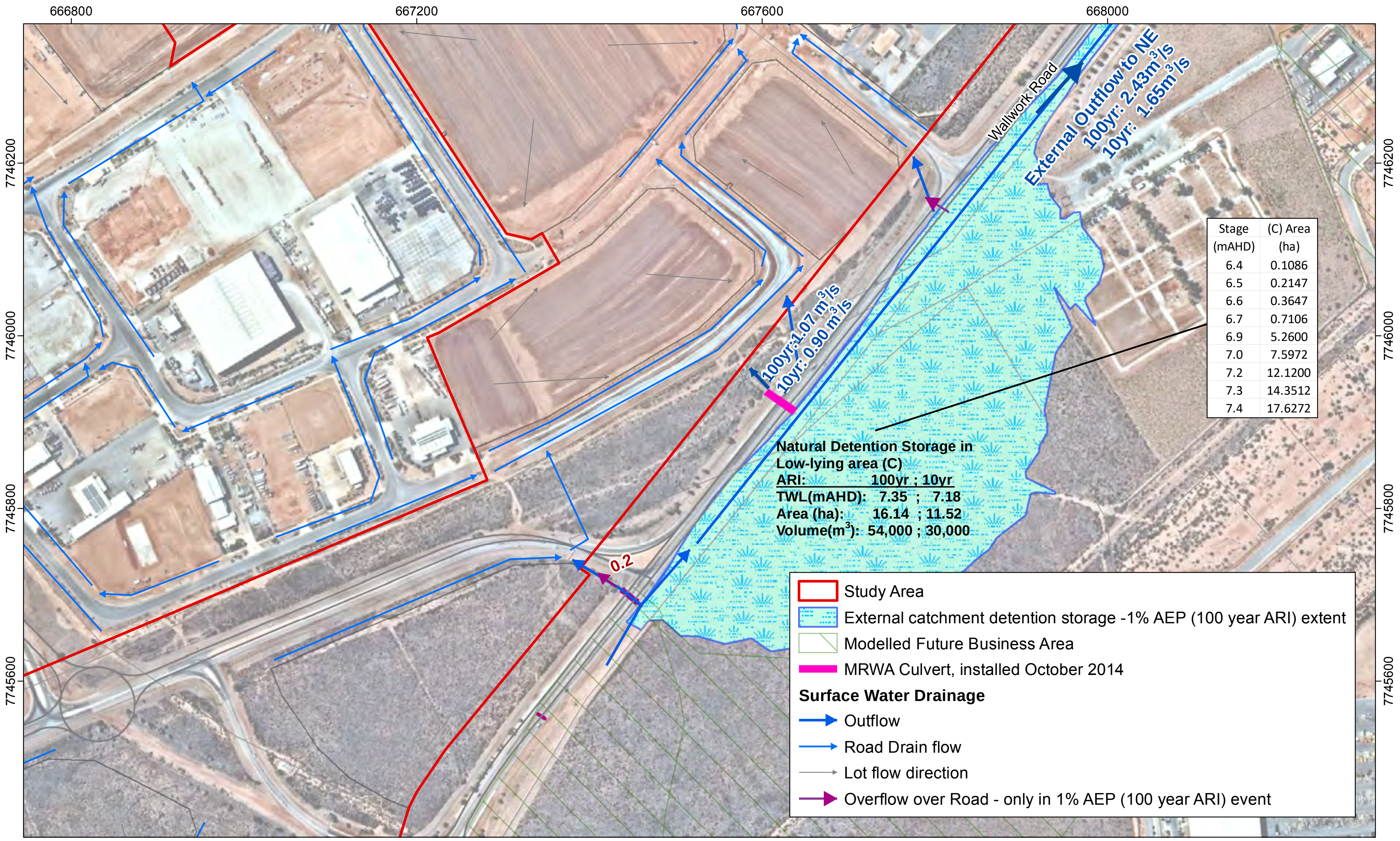
Development WA

Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 16: Northern Area – 1% AEP (Major) Event Plan



Stage (mAHD)	(C) Area (ha)
6.4	0.1086
6.5	0.2147
6.6	0.3647
6.7	0.7106
6.9	5.2600
7.0	7.5972
7.2	12.1200
7.3	14.3512
7.4	17.6272

LiDAR (2010) Topography; Main Roads WA (2014) Culvert survey; Pritchard Francis (2014) Precinct 3 Business Park GNH Intersection Plan & Drain cross-sections.

Coordinate System: GDA 94, Zone 50

Job No. J7157
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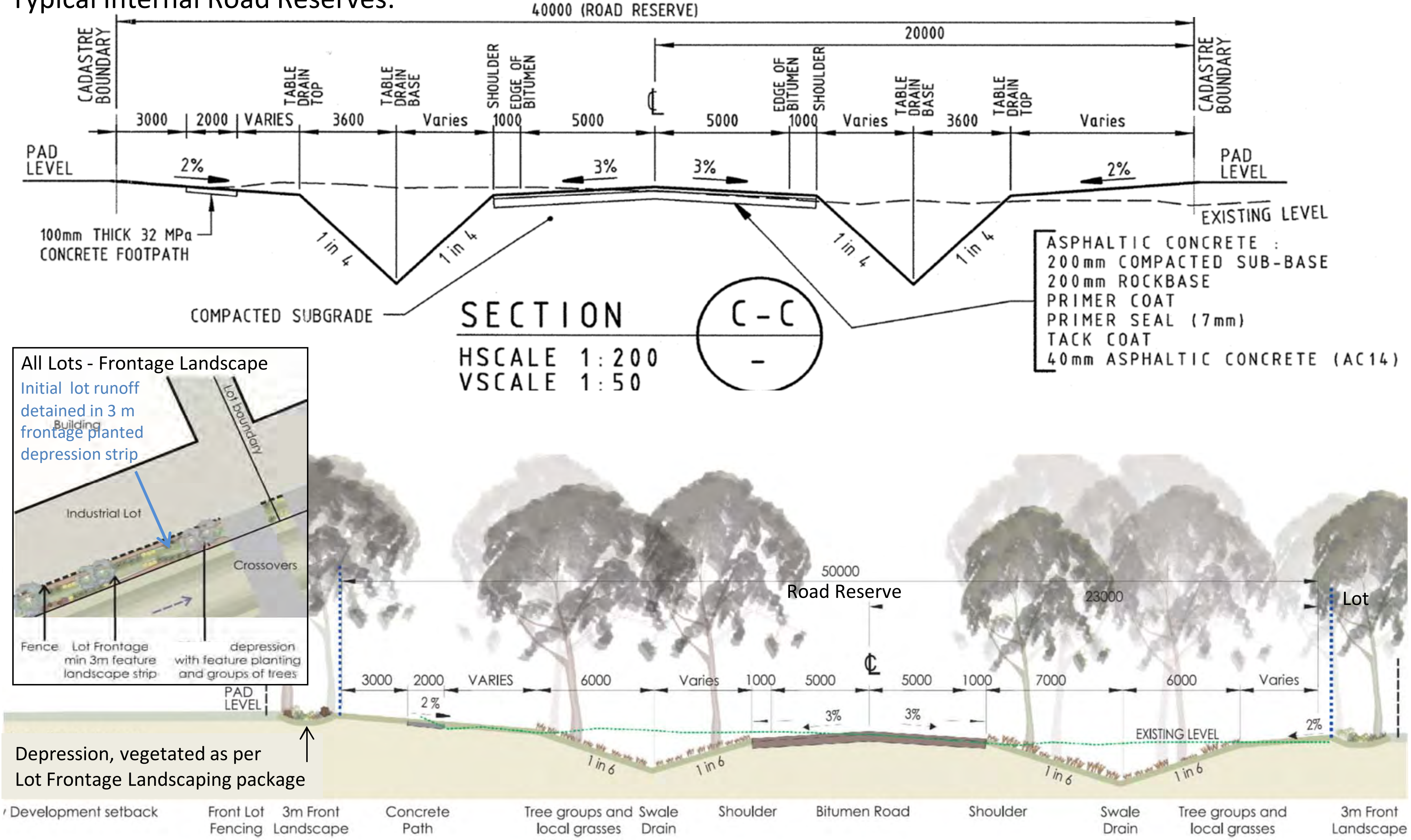
Development WA
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy
Figure 17: Upstream Storage Details and Flood Results

Typical Internal Road Reserves:



All Lots - Frontage Landscape

Initial lot runoff detained in 3 m frontage planted depression strip

Depression, vegetated as per Lot Frontage Landscaping package

Data source: UDLA (2011) Landscape extracts, based on Engineering Earthworks plan.

Job No: J7157

Development WA

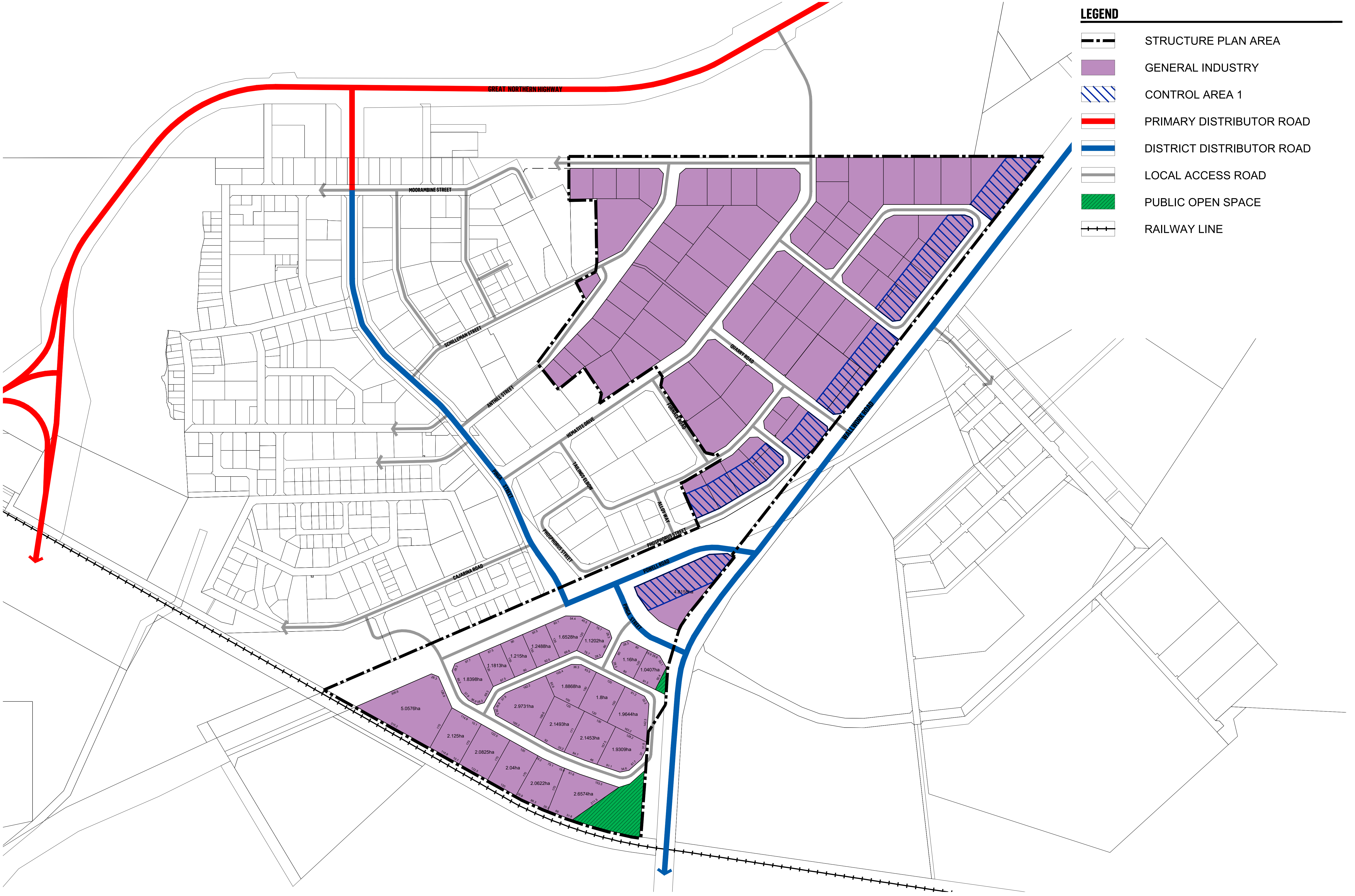
Hedland Junction, Wedgefield Industrial Estate: Local Water Management Strategy

Figure 18: Swale Cross-Sections & Landscape Extracts

APPENDICES

APPENDIX A

Hedland Junction Structure Plan (URBIS, 2022)



URBIS

Hedland Junction - Structure Plan

Wedgefield Industrial Estate

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DISCLAIMER

CLIENT

Development WA

1:12,500 @ A3

0 50 100 250m

PROJECT NO.	DATE
P0006040	03.03.22
DRAWING NO.	REVISION
20	b

APPENDIX B

Local Water Management Strategy Checklist for Developers

Checklist for integrated water cycle management assessment of local structure plan or local planning scheme amendment

1. Tick the status column for items for which information is provided.
2. Enter N/A in the status column if the item is not appropriate and enter the reason in the comments column.
3. Provide brief comments on any relevant issues.
4. Provide brief description of any proposed best management practices, eg. multi-use corridors, community based-social marketing, water re-use proposals.

Local water management strategy item	Deliverable	☑	Comments
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements & requirements for BMPs and critical control points	☑	
Introduction			
Total water cycle management – principles & objectives Planning background Previous studies		☑	Section 1
Proposed development			
Structure plan, zoning and land use. Key landscape features Previous land use	Site context plan Structure plan	☑ ☑	Figures 1 and 2 Figure 10
Landscape - proposed POS areas, POS credits, water source, bore(s), lake details (if applicable), irrigation areas	Landscape Plan	☑	No POS Swale Concepts on Figure 18
Design criteria			
Agreed design objectives and source of objective		☑	Table 1 Section 1.3
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☑	Section 2
Site Conditions - existing topography/ contours, aerial photo underlay, major physical features	Site condition plan	☑	Figures 2 and 3
Geotechnical - topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	☑	Figure 5
Environmental - areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental Plan plus supporting data where appropriate	☑	Figures 3 and 7
Surface Water – topography, 100 year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface Water Plan	☑	Figures 7 to 9; Appendix C
Groundwater – topography, pre development groundwater levels and water quality, test bore locations	Groundwater Plan plus details of groundwater monitoring and testing	☑	Figures 5 and 6; Appendix D
Water use sustainability initiatives			
Water efficiency measures – private and public open spaces including method of enforcement		☑	Section 4.1.3
Water supply (fit-for-purpose strategy), agreed actions and implementation. If non-potable supply, support with water balance		☑	Section 4.1.2
Wastewater management		☑	Section 4.1.2
Stormwater management strategy			
Flood protection - peak flow rates, volumes and top water levels at control points,100 year flow paths and 100 year detentions storage areas	100yr event Plan Long section of critical points	☑ ☑	Figures 13 and 16 Figures 11 to 16
Manage serviceability - storage and retention required for the critical 5 year ARI storm events Minor roads should be passable in the 5 year ARI event	5yr event Plan	☑	Figures 12 and 15 10 yr ARI applicable for industrial area

Local water management strategy item	Deliverable	☑	Comments
Protect ecology – detention areas for the 1 yr 1 hr ARI event, areas for water quality treatment and types of (including indicative locations for) agreed structural and non-structural best management practices and treatment trains. Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1yr event plan Typical cross sections	☑ ☑	Figure 18
Groundwater management strategy			
Post development groundwater levels, fill requirements (including existing and likely final surface levels), outlet controls, and subsoils areas/exclusion zones	Groundwater/subsoil Plan	☐	Not Applicable
Actions to address acid sulfate soils or contamination		☑	Section 5.3.2
The next stage – subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required prior to detailed design.		☑	Section 5.2
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☑	Section 5.5
Implementation			
Developer commitments		☑	Section 5.1
Roles, responsibilities, funding for implementation		☑	Section 5.1
Review		☑	Section 5

APPENDIX C

Wedgefield TDA Storm Surge Levels (JDA, 2012a)

Jim Davies & Associates Pty Ltd
ACN 067 295 569

Suite 1, 27 York Street, Subiaco
PO Box 117, Subiaco WA 6008
Telephone (08) 9388 2436
Facsimile (08) 9381 9279
Email info@jdahydro.com.au
www.jdahydro.com.au

JDA CONSULTANT HYDROLOGISTS

Your Ref:
Our Ref: J5205a

15 May 2012

Steve Kelly
LandCorp
Locked Bag 5
Perth Business Centre
Perth WA 6849

Dear Steve,

WEDGEFIELD EXPANSION TRANSPORT DEVELOPMENT AREA (TDA) STORM SURGE LEVELS

Please find below advice regarding storm surge levels impacting the Transport Development Area (TDA) in Wedgefield (see Figure 1 for location plan). This advice does not refer areas shown as LIA which are influenced by South Creek.

Background

In 2009, JDA investigated flood levels impacting upon the Wedgefield Industrial Site (JDA, 2009). This was a desktop review of previous studies, addressing both flooding from catchment runoff and storm surge.

Reports reviewed included the Greater Port Hedland Storm Surge Study (GEMS, 2000) and the Pilbara Iron Ore and Infrastructure Project (FMG, 2004), both of which used 2 dimensional modelling to assess flood levels.

Also included was advice from coastal engineers MP Rogers & Associates (MRA, 2009) which provided estimates of storm surge for the 25, 50 and 100 year ARI events. MRA recommended that the 50 year ARI event should be used for the basis of development levels at Wedgefield given the site was industrial rather than residential, with no accommodation onsite.

JDA agreed with the MRA recommendation regarding design levels, based on understanding and studies available at that time.

Recent Studies

In late 2010, Cardno were appointed to provide a coastal vulnerability study for Port and South Hedland, assessing storm surge and catchment runoff. This report was finalised in 2011 (Cardno, 2011). This study provides a detailed assessment of the combined impacts of the two flooding mechanisms for the 2, 10, 100, 200 and 500 year ARI events.

The study utilised topographic Lidar data flown in November 2010 with a vertical accuracy of +/- 0.10m for 0.5m interval contours (Cardno, 2011). This is significantly more accurate than used in previous studies. For example, GEMS (2000) study used 1:50,000 national topographic 10m contour interval maps and topography derived from 1:10,000 scale photographs available at the time.

One of the tag points for the Cardno study is located immediately adjacent to the Wedgefield TDA. For this location the report provides flood levels for the three climate scenarios (2010, 2060 and 2110). These climate scenarios allow for changes such as sea level rise, cyclone intensity/frequency and changes to rainfall intensities. The data for this location is shown in Table 1 below. For the 10 and 200 year ARI event, data was not provided for the 2060 and 2110 climate scenarios. Figures 2 to 7 show the 100 year ARI storm surge and catchment runoff mapping for the 2010, 2060 and 2110 climate scenarios.

TABLE 1: FLOOD LEVELS FOR TAG POINT 52 (FROM CARDNO, 2011)

Climate Scenario	2 Year ARI	10 Year ARI	100 Year ARI	200 Year ARI	500 Year ARI
Storm Surge					
2010	3.18	3.70	4.72	4.95	5.13
2060	3.67		5.19		5.52
2110	4.22		5.65		6.13
Catchment Runoff					
2010	-	-	3.92	3.93	4.29
2060	3.22		5.25		5.62
2110	3.74		5.73		6.21

Reassessment of Design Levels for Wedgefield TDA

In November 2009, LandCorp made a submission to the Western Australian Planning Commission regarding the application of State Planning Policy 2.6 (SPP2.6) to the expansion of the Wedgefield Industrial Estate. The submission proposed setting a minimum development fill level of 6.0 m AHD with building floor heights at a minimum level of 6.3 m AHD. This was based on the 50 year ARI storm surge level, with an allowance for sea level rise in 50 years and a safety factor (freeboard) of 0.5 m. The 50 year ARI event was proposed in the context of the relatively low risk of inundation, application of management measures, setback from the coastline, less sensitive and consolidated land use and significance of the cost factor to fill the land. The application also noted there were negligible impacts on coastal processes from the development and relatively low impacts on the development from coastal processes.

This proposal was accepted by WAPC on 17 December 2009 (see attached).

The same argument can be applied to the results from the Cardno (2011) study. Figure 8 shows the Cardno (2011) storm surge levels for tag point 52 plotted on a log-log scale against the return period (ARI). It can be seen that for the 2010 data, between the 2 year and 100 year ARI, the lines are approximately linear. This allows an estimation of the 50 year ARI storm surge levels.

Using this methodology, the 50 year ARI storm surge levels are:

- 2010 – 4.40 m AHD
- 2060 – 4.88 m AHD
- 2110 – 5.36 m AHD

Similarly for the catchment runoff, the 50 year ARI levels are:

- 2060 – 4.81 m AHD
- 2110 – 5.31 m AHD

A level was not estimated for the 2010 scenario as there was insufficient data to allow an interpolation to the 50 year ARI.

It can be seen that the 50 year ARI levels for catchment runoff are lower than those for storm surge. Therefore the storm surge results should be used.

The 2060 climate scenario allows for the sea level rise in 50 years' time for the 50 year ARI event (4.88 m AHD). Making an allowance for 0.5 m freeboard results in a design development minimum building floor level of 5.4 m AHD.

This level is 0.9 m lower than the previous estimate of the 50 year ARI in 50 years' time (4.9 m AHD compared to 5.8 m AHD).

The current minimum building level provides clearance above the 2110 500 year ARI storm surge event. This could be considered excessive given the low risk associated with the proposed land use, particularly given the cost factor of fill required to provide this protection.

Conclusions and Recommendations

The analysis of data from the recently completed Port Hedland Coastal Vulnerability Study (Cardno, 2011) shows that the estimated flood level for the 50 year ARI event in 50 years time has reduced from previous study estimates referred to by JDA (2009) and MRA (2009). This current assessment indicates a 50 year ARI flood level in 2060 of 4.88 m AHD for the Wedgefield Transport Development Area. It was noted that the Cardno (2011) study utilised recent topographic Lidar data accurate to +/- 0.10 m, significantly more accurate than utilised for previous estimates.

Consistent with previous design methodology applied to Wedgefield accepted by WAPC, allowance of 0.5m safety factor (freeboard) above 50 yr ARI flood level would results in a required minimum building floor level of 5.4 m AHD, and minimum lot level of 5.1 mAHD.

It is therefore recommended WAPC consider revising previously issued advice for Wedgefield based on applying the same design criteria and safety factors to the latest coastal vulnerability study results for the TDA site as outlined. That is, a minimum building level of 5.4 m AHD, and finish lot level of 5.1 mAHD be adopted for development of the proposed Wedgefield Transport Development Area (TDA) site.

References

Cardno (2011) Port Hedland Coastal Vulnerability Study, prepared for LandCorp, August 2011.

Fortescue Metals Group Ltd (2004) Pilbara Iron Ore and Infrastructure Project: Flood Study Overview – Anderson Point to White Hills, October 2004.

Global Environmental Modelling Systems (2000) Greater Port Hedland Storm Surge Study, Final Report to WA Ministry for Planning and Port Hedland Town Council, October 2000.

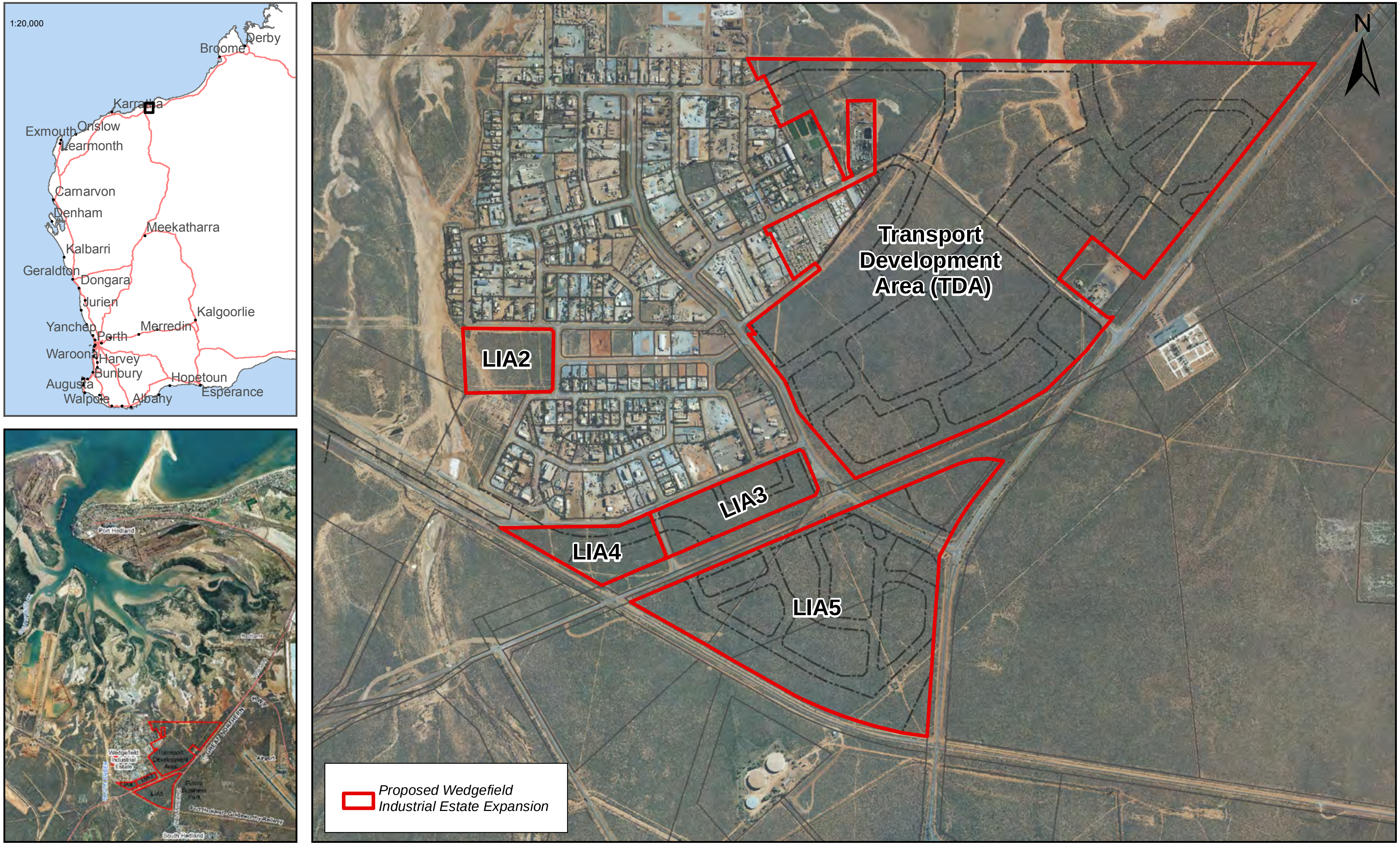
JDA (2009) Wedgefield Industrial Estate, Port Hedland – Flood Levels, prepared for LandCorp, October 2009.

MP Rogers & Associates (2009) Wedgefield Storm Surge and Development Levels, email advice to LandCorp, February 2009.

If you have any queries, please do not hesitate to contact Alex Rogers or Wendy Green.

Yours sincerely,

JDA Consultant Hydrologists



Job No. J5205

Scale:1:20,000

0 100 200 300 400 Meters

LandCorp

Wedgefield TDA Storm Surge Levels

Figure 1: Location Plan

Data Source: Cardno (2012)

Job No. J5205

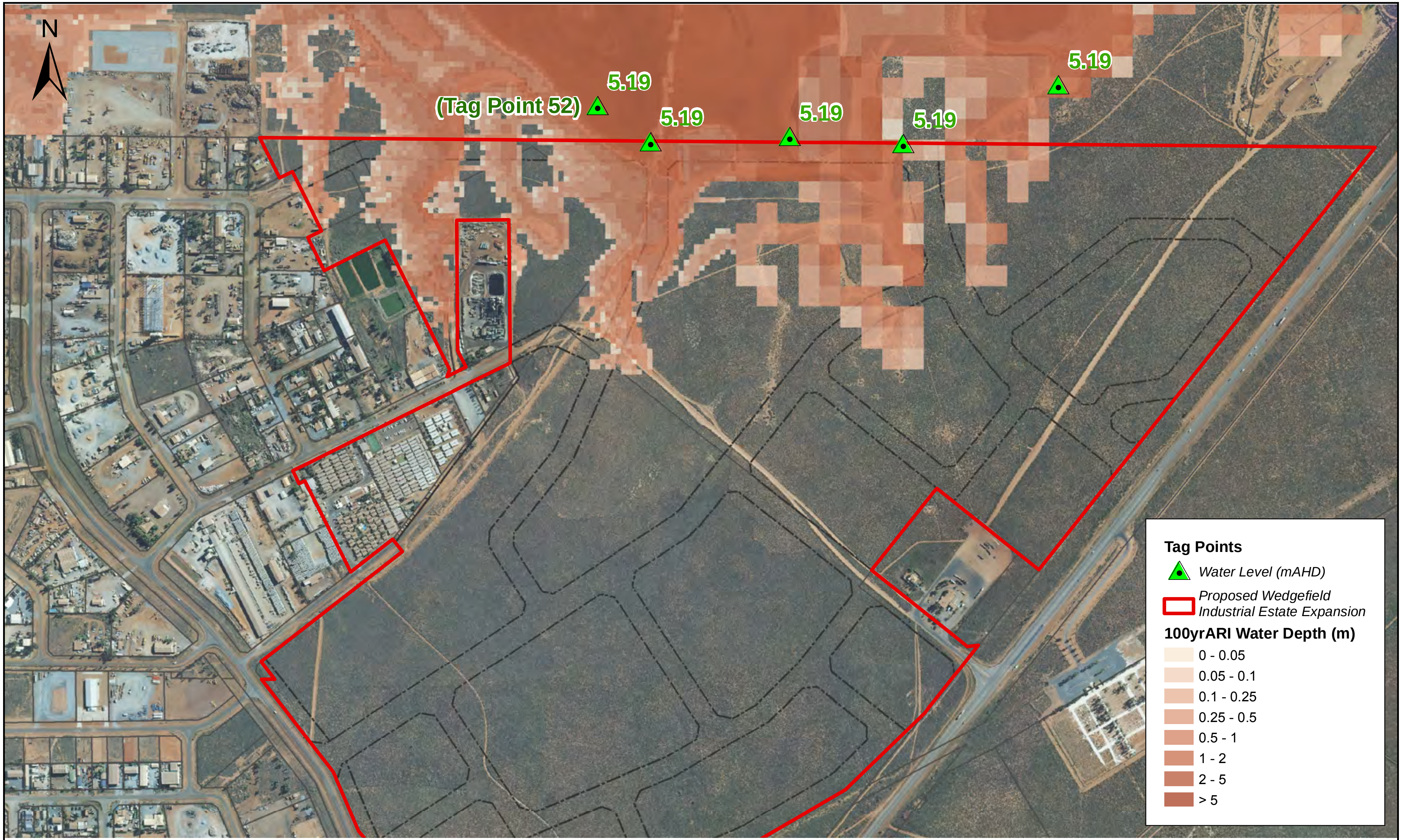
Scale:1:10,000

0 100 200 300 400 Meters

LandCorp

Wedgefield TDA Storm Surge Levels

Figure 2: Existing Climate 100yr ARI Storm Surge Water Depth & Level



Data Source: Cardno (2012)

Job No. J5205
Scale:1:10,000

LandCorp
Wedgefield TDA Storm Surge Levels

Figure 3: 2060 Climate Change 100yr ARI Storm Surge Water Depth & Level

Data Source: Cardno (2012)

Job No. J5205

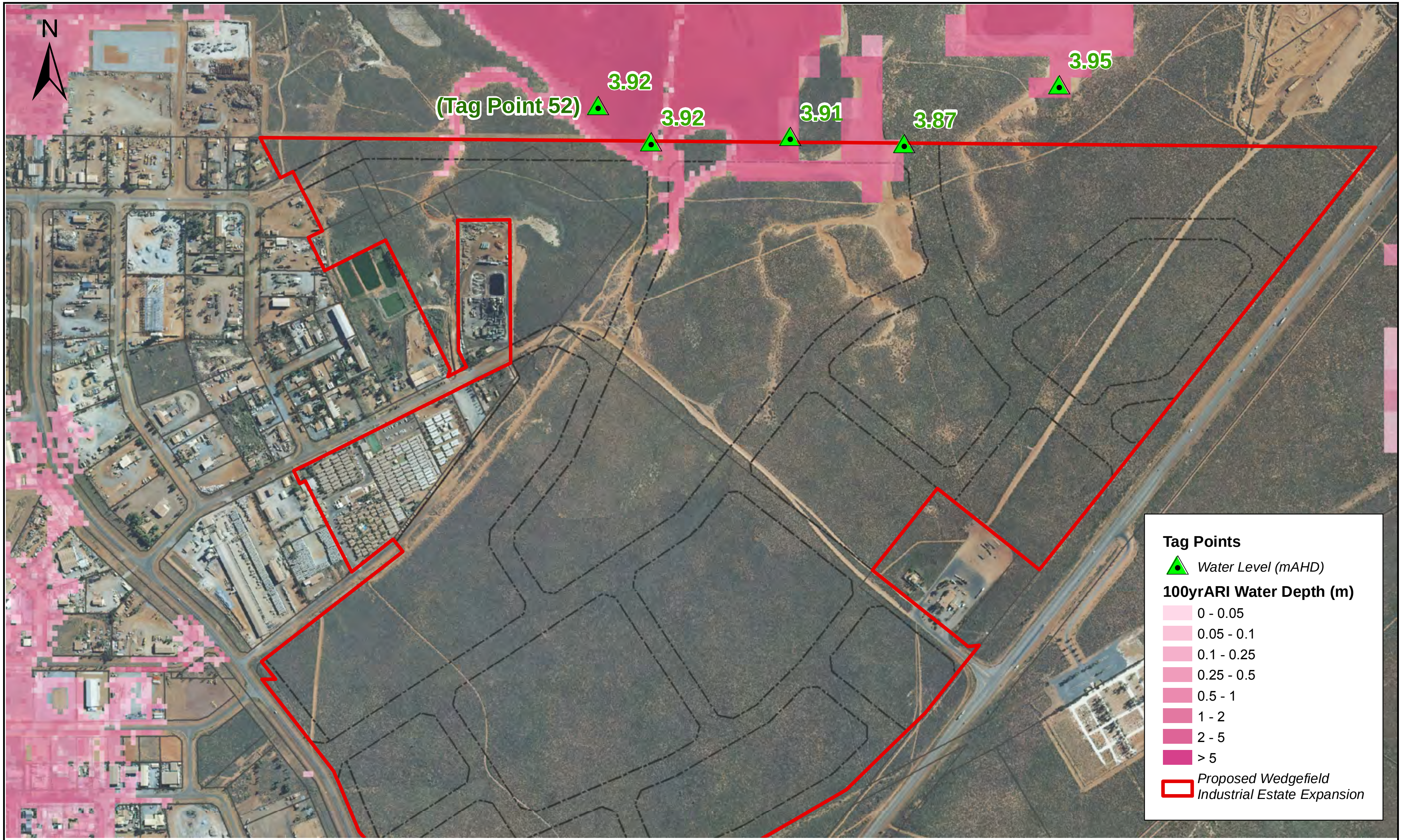
Scale:1:10,000

0 100 200 300 400 Meters

LandCorp

Wedgefield TDA Storm Surge Levels

Figure 4: 2110 Climate Change 100yr ARI Storm Surge Water Depth & Levels

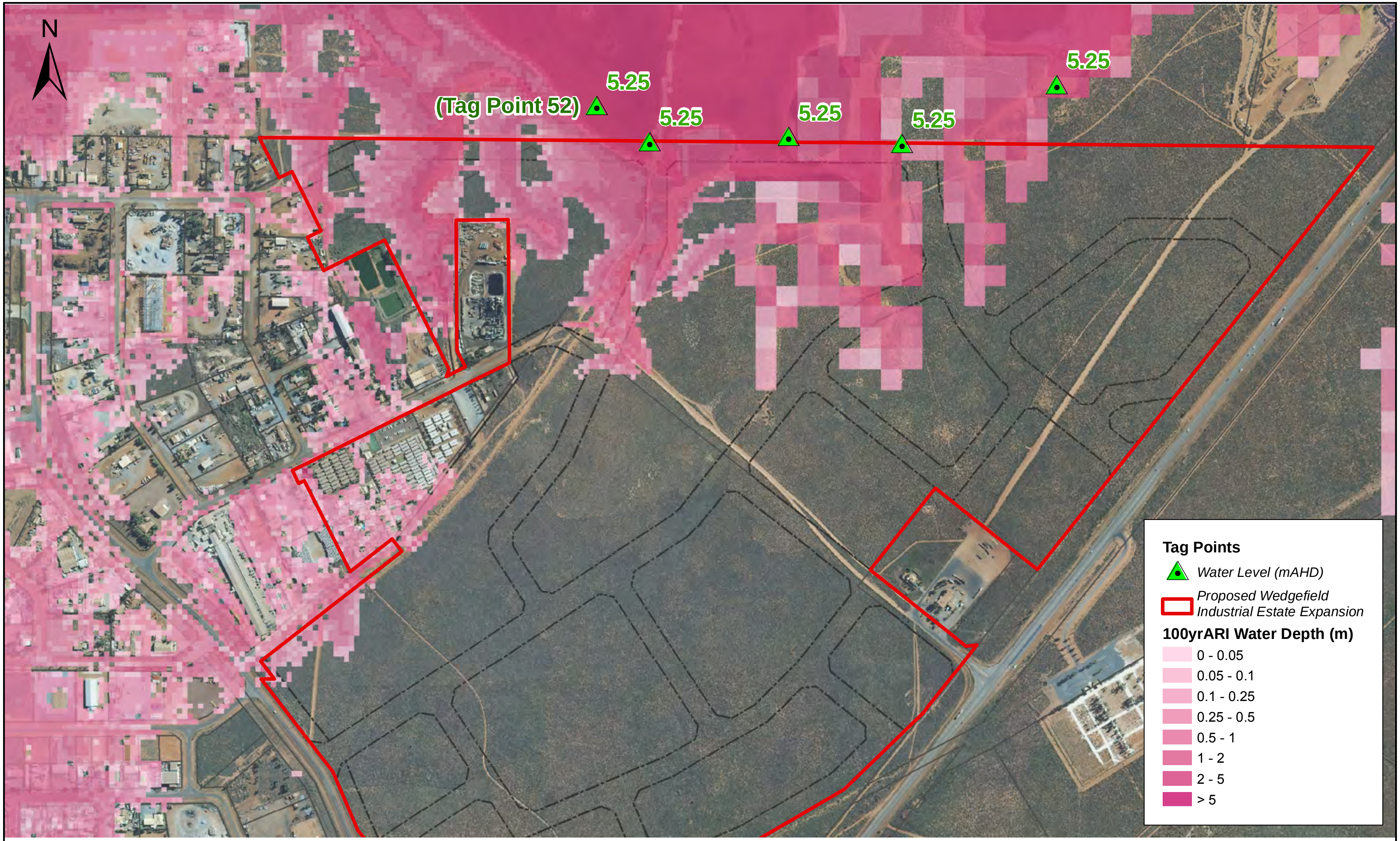


Data Source: Cardno (2012)

Job No. J5205
Scale: 1:10,000
0 100 200 300 400 Meters

LandCorp
Wedgefield TDA Storm Surge Levels

Figure 5: Existing Climate 100yr ARI Storm Catchment Runoff Flood Depth & Level



Data Source: Cardno (2012)

JDA

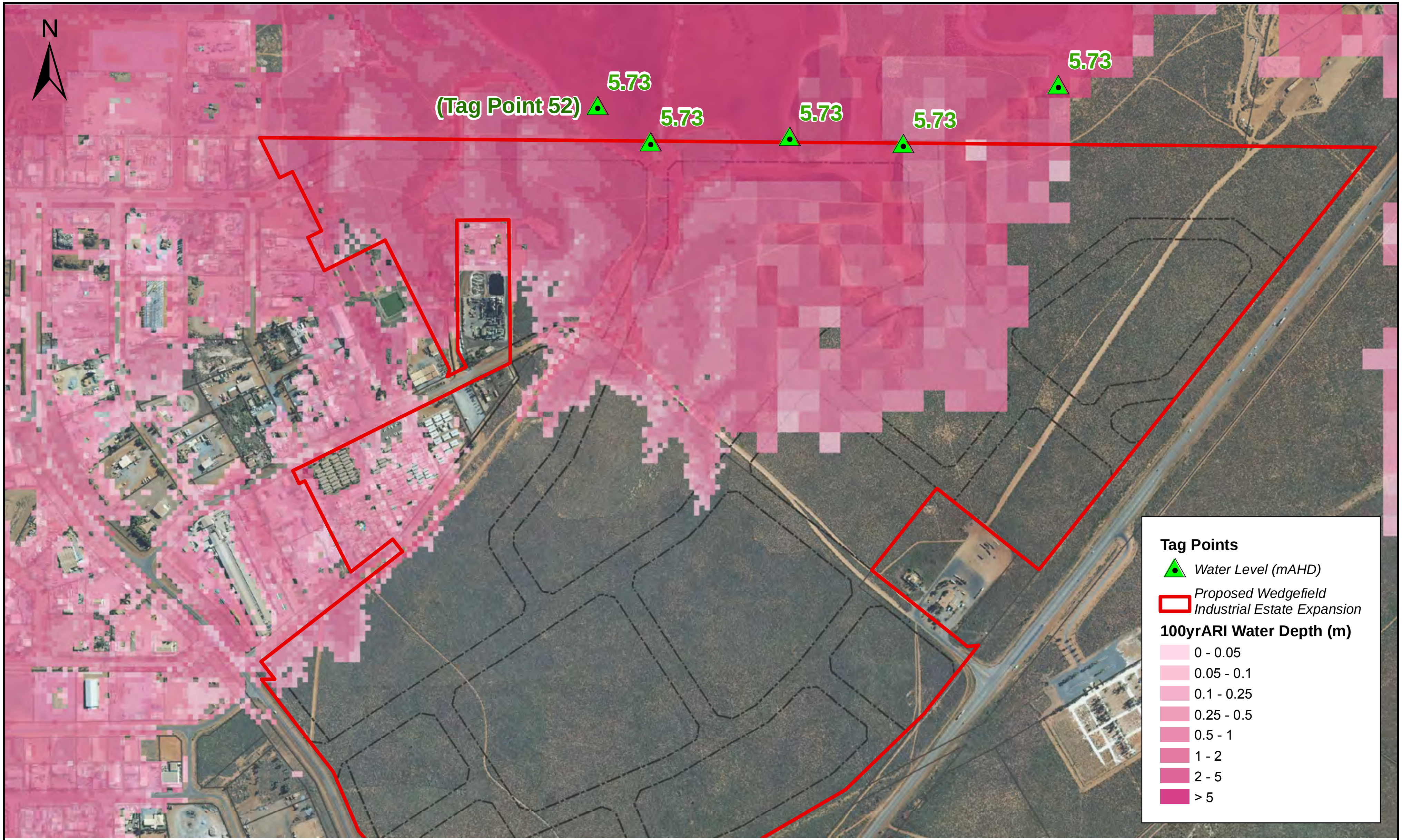
Job No. J5205

Scale:1:10,000

LandCorp

Wedgefield TDA Storm Surge Levels

Figure 6: 2060 Climate Change 100yr ARI Storm Catchment Runoff Flood Depth & Level

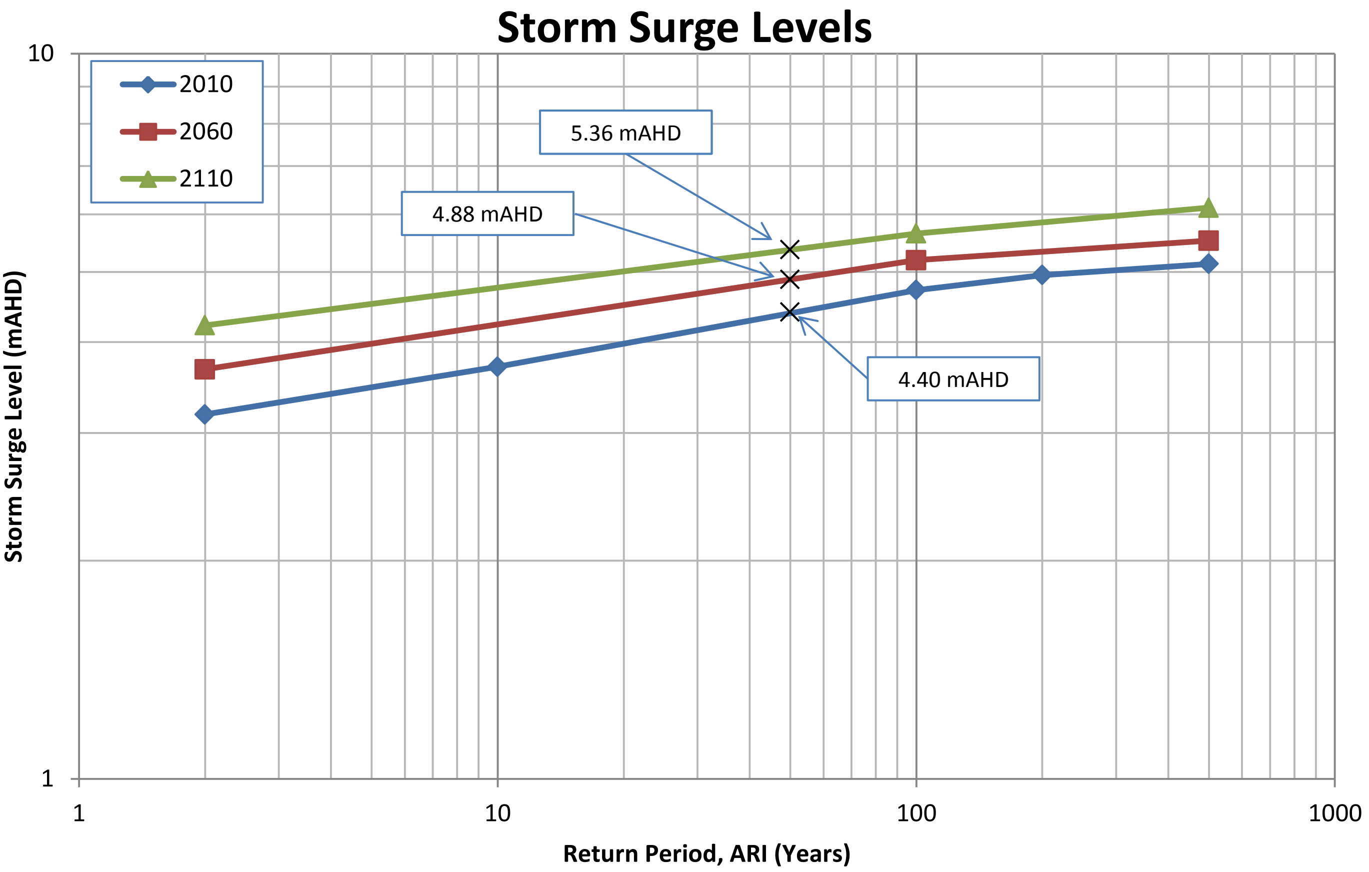


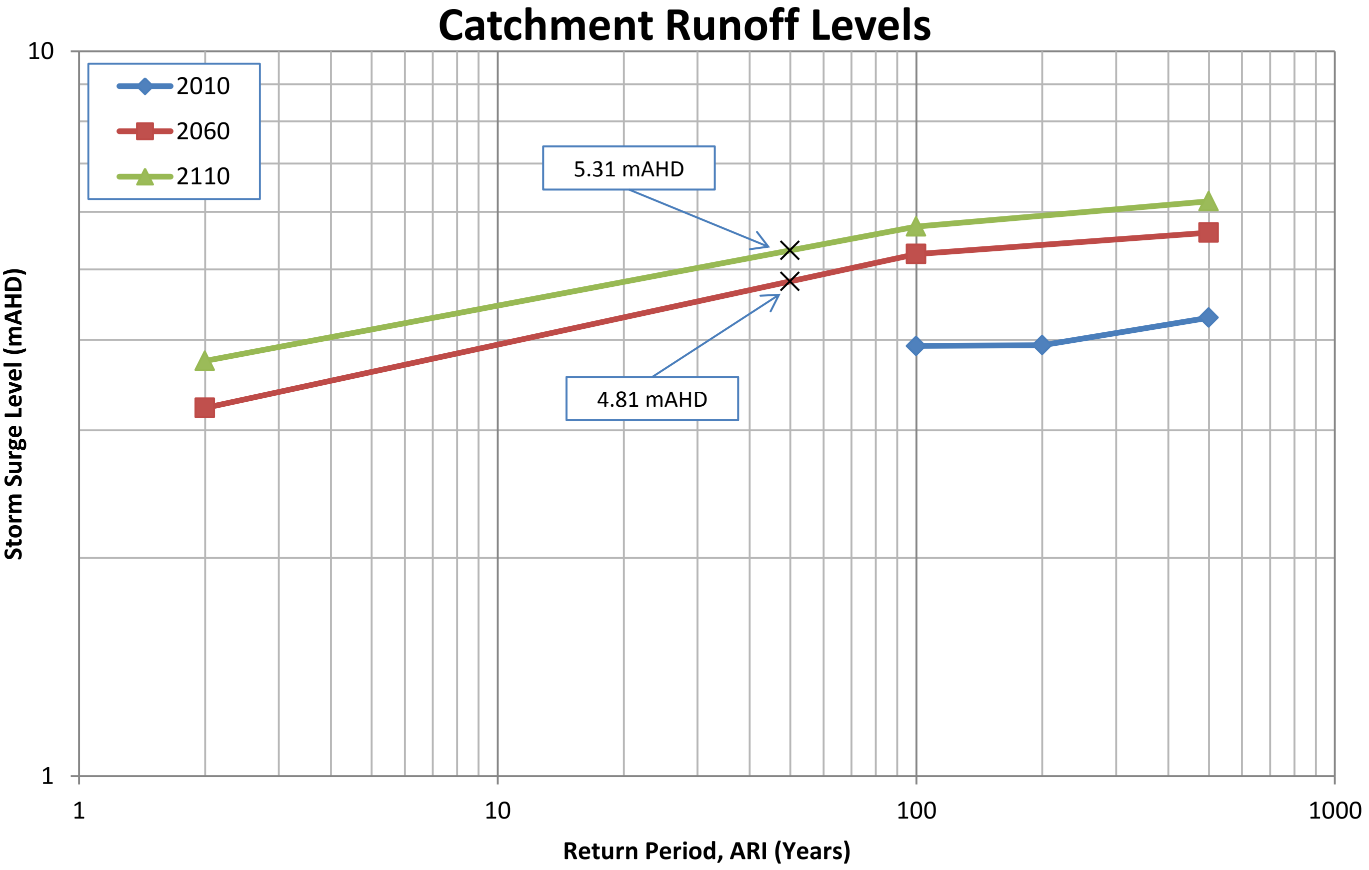
Data Source: Cardno (2012)

Job No. J5205
Scale:1:10,000
0 100 200 300 400 Meters

LandCorp
Wedgefield TDA Storm Surge Levels

Figure 7: 2110 Climate Change 100yr ARI Storm Catchment Runoff Flood Depth & Level





Data Source: Cardno (2011)

JDA Consultant Hydrologists

Job No. J5205

LandCorp
Wedgefield TDA Storm Surge Levels
Figure 8: Flood Levels at Cardno (2011) Tag Point 52 adjacent to Wedgefield

IPA1987

Western
Australian
Planning
Commission

Our Ref: DPI/07/0841
Enquiries: Ken Dawson (9264 7575)

Document #: IPA1987
Date: 24.12.2009
Officer: RICHARD DEREK JOHN BAIRSTOW
File: 18/08/0005

+ WOODWARD
[illegible]

Chief Executive Officer
Town of Port Hedland
PO BoX 41
PORT HEDLAND WA 6721

ATTENTION: Richard Bairstow

Dear Sir/Madam

INDUSTRIAL AND RESIDENTIAL DEVELOPMENT IN PORT HEDLAND AND APPLICATION OF STATE PLANNING POLICY 2.6 - STATE COASTAL PLANNING POLICY (SPP 2.6)

I refer to correspondence regarding the above matter. In this regard, the Western Australian Planning Commission has resolved to

1. Note progress on the review of State Coastal Planning Policy SPP 2.6 and that an increase in the projected sea level rise figures from the current policy (0.38 m) is anticipated.

2. Note the matters raised by LandCorp regarding the proposed Wedgefield Industrial Expansion, Port Hedland and the matters raised by Satterley regarding the Styles Road, Port Hedland proposal.

3. Adopt, with regard to the LandCorp "Wedgefield Transport Industrial Estate" proposal, a minimum fill level of 6.0m AHD and a minimum building floor level of 6.3m AHD.

4. Adopt, with regard to the Satterley Syles Road proposal, a minimum fill level of 7.5m AHD consistent with the adjacent Pretty Pool development by LandCorp.

Yours faithfully

For Tony Evans
Secretary
Western Australian Planning Commission

17 December 2009

cc. Landcorp; Satterley

Albert Facey House, 469 Wellington Street (cnr Forrest Place), Perth, Western Australia 6000
Tel: (08) 9264 7777; Fax: (08) 9264 7566; TTY: (08) 9264 7535; Infoline: 1800 626 477
e-mail: corporate@wapc.wa.gov.au; web address: http://www.wapc.wa.gov.au
ABN 35 482 341 493

wa.gov.au

APPENDIX D

Groundwater Monitoring (JDA, 2014b)

Jim Davies & Associates Pty Ltd
ABN 24 067 295 569
Suite 1, 27 York Street, Subiaco
PO Box 117, Subiaco WA 6008
Ph: (08) 9388 2436
Fx: (08) 9381 9279
info@jdahydro.com.au
www.jdahydro.com.au

To :	Landcorp	Date :	20/11/2014
Attention :	David Cooper	Our Ref :	J4956a
Email :		Pages :	19

WEDGEFIELD INDUSTRIAL ESTATE, PORT HEDLAND
ADDITIONAL GROUNDWATER MONITORING SUMMARY

1.0 Introduction

Two monitoring bores to measure groundwater levels and salinity were required as part of the Wedgefield Expansion LWMS approvals, and Bores W1-W2 were installed in February 2012 at locations shown in Figure 1.

Additional bores (W3-W12) were installed at the end of the wet season in May 2012 due to above average rainfall in early 2012 during construction of TDA Stage 1 (see Figure 1). Bores were installed both near TDA Stage 1, and in future Wedgefield expansion areas that were uncleared by LIA5 and TDA future stages (Figure 1).

Monitoring included water levels and salinity in all bores on three occasions (end of 2012 wet season, beginning and end of 2013 wet season), plus logging of water levels in bores up to the end of the 2013 wet season.

Annual rainfall in 2013 was the highest on record with a total of 713 mm (Figure 2). Daily rainfall during the wet season in 2013 is shown on Figure 3, and included several large rainfall events, including a 5yr ARI event of 116.6 mm on 22-23 January 2013 (Figure 4).

The data collected is suitable to understand the groundwater rise and recession in Pindan soils of various clay contents. The monitoring programme also aimed to understand salinity concentrations in groundwater in the Wedgefield Expansion Area.

The data is useful for future Wedgfield Expansion Area UWMP's.

2.0 Method

This monitoring programme included installation of 10 bores (W3 to W12) in the Transport Development Area (TDA) and the Light Industrial Area 5 (LIA5) as shown on Figure 1. JDA installed Bores W3 to W12 by hand auger between 22 May and 24 May 2012. Two existing pre-development monitoring bores (W1 and W2) installed by JDA on 20/2/2012 were also monitored (Figure 1).

Bore lithological and construction logs are attached. All bores were equipped with Odyssey data loggers.

Water level data loggers measured groundwater levels in the monitoring bores from 25 May 2012 to 11 April 2013 and were processed using a HYDSTRA system, with calibration to water levels measured by hand-held probe on three occasions (25 May 2012, 19 February 2012, 11 April 2013). No logger results for 2013 are available for bores W1, W9 as they were built over or destroyed during the monitoring period (Schillaman Street was widened). The logger in W2 and W11 had battery or recording issues during 2013.

Bores were sampled for electrical conductivity at site visits on 25/5/2012, 19/12/2012, and 11/4/52013. Bore W1 and W2 were previously sampled on

20/2/2012. To estimate the salinity in mg/L, a conversion factor of 560 has been applied to the measured electrical conductivity unit mS/cm.

3.0 Development work in the Area during monitoring

The Transport Development Area Stage 1 works occurred during 2012, and were completed late 2012.

The proposed Light Industrial Area 5 is undeveloped to date and has existing natural vegetation. Bore W4 is to the north-western side of the existing Pinga link Street alignment, and is part of the catchment with no outlet where water pools in the nearby drain and the extensive area shown on Figure 1.

The adjacent Wallwork Road near Bore W5 was being upgraded as part of railway bridge works during the period of monitoring.

4.0 Water Level Results & Discussion

Figure 3 shows logged water levels in bores graphed from the wet season in 2013 (from 19/12/2012 to 11/4/2013, along with daily rainfall from the Port Hedland Bureau of Meteorology station. The results from the 2013 wet season are examined here as the LIA3 and TDA Stage1 works had been completed and the results were more reliable.

During the 2013 wet season monitoring period, two significant rainfall events occurred (23-24/1/2013 and 28/2/2013) totalling 139 mm and 92 mm respectively. The rainfall of 23 January 2013 was the first significant rainfall for the wet season and was a 5yr ARI event (Figure 4).

Figure 2 clearly shows the significant groundwater rise in response to both of these rainfall events. Most bores were dry prior to the rainfall on 23/1/13, and so the total magnitude of the water level rise from 23/1/13 could not be captured for all bores. Despite this, the groundwater level increase detected following 23/1/2013 rainfall event was greater than following 28/2/2013 rainfall. This indicates a greater groundwater level change in response to the first significant rains after the lows of the dry season, compared to later events in the wet season.

The water level response in Bores W4, 8 and 10 were similar as they rose sharply following rainfall, plus water levels declined at similar rates over many months. The water level rise and decline in bores W3, W5 and W12 were similar, and more gradual in comparison to other bores. This indicated a lower hydraulic conductivity (K) from a higher clay content for the screened section of the soil profile, and/or slower infiltration of rainfall to the screened soil profile in the vicinity of these bores.

Peak water levels in bores W7 and W8 were above the data logger.

Levels in W4, W7 and possibly W5 were influenced by pooling of surface water behind the old Great Northern Hwy for area shown on Figure 3.

It is unknown if additional runoff from the Wallwork Rd upgrade influenced W5 peak levels.

5.0 Salinity Results & Discussion

Salinity of bores for the 3 sampling occasions between 2011 and 2013 is reported on Figure 3. Salinity for the broader Wedgefield Expansion area was highly variable from 450 to 29,100 mg/L. As expected, the groundwater near the water table surface is brackish to saline due to the proximity to the ocean and supratidal flats.

All bores detected lower salinities at the end of the wet seasons compare to their start. For example, the salinity at the water table in bore W2 became fresher between 20 Feb 2012 (11,088 mg/L) and 24 May 2012 (7,728), and similarly between December 2012 and April 2013, due to the wet season fresh rainfall recharging to top of the groundwater table. The variation in the drop of salinity could be been due to a combination of the bore screen depth in the water table and additional infiltration of fresh water at certain locations.

The drop was greatest in Bores W4 and W6. Salinity in Bore W4 dropped from 24,808 mg/L to 450 mg/L probably because of the ponding of surface water in the vicinity (Figure 3). Bore W6 salinity dropped from 20,104 mg/L to 1,904 mg/L, probably due to the nearby Stage 1 Main drain.

Bore W1 also had low salinities in 2012, and was situated 30 m west of a surface water drain. In February 2012 the salinity was the same in the drain and the W1 bore.

Note that the groundwater is progressively more saline with depth. A deep groundwater bore shown on Figure 1 screened below clay layers at depths between 16-34 m (not at the water table surface), was reported to measure 53,900 mg/L at hyper-saline concentrations (Drilling and Grouting Services, 2011).

6.0 Conclusions

A sharp rise in groundwater levels after rainfall events has been measured, and groundwater level decline is a slow process over many months. The gradual decline curves are characteristic of the high clay content of the Pindan soils in the area. A more gradual decline indicates a higher clay content of the soil profile and/or perching upon a clay layer with very low hydraulic conductivities.

Bore data near TDA Stage 1 and LIA3 in 2012 and possibly also 2013 does not reflect pre-development or post-development conditions as the outlet drain had not been completed during the 2012 rains and thus water pooled for months and additional infiltration could have occurred. Construction water was also applied to TDA Stage 1 and LIA3 areas during 2012.

Rainfall runoff has been pooling east of the Great Northern Hwy since the Hwy was built, and this will change for the post-development scenario with Main Roads installation of a culvert in October 2014 that will drain water through the TDA Stage 2 area. Reduction in pooling of water east of the existing Great Northern Hwy could reduce W4, W5, and W7 levels in the future.

The new Great Northern Hwy Realignment construction to the north of Wedgefield (north of Bore W11) could have affected Bore W11 measurements. It is unknown if the Wallwork Rd-Railway overpass construction works affected levels in Bores W5 and W4. The remainder of bore data over future Wedgefield Expansion Areas (W8, W10, W12) could be reflective of pre-development highest-on-record rainfall conditions (i.e. above average rainfall).

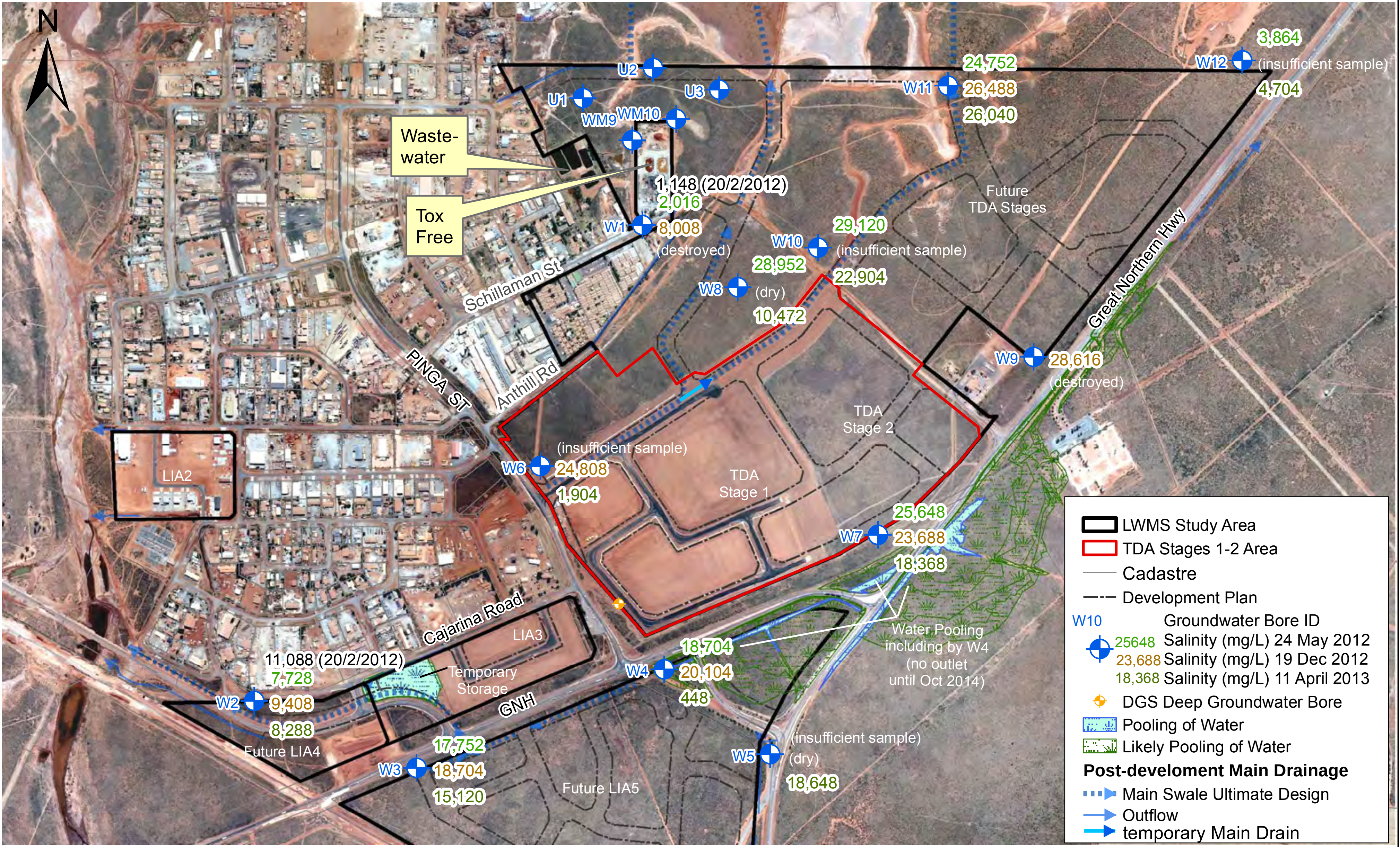
The salinity of the water table is generally brackish to saline, and freshens slightly after heavy wet season rainfall. The only measured marked drop in salinity was by Bores W6 and W4 which were both near surface water drains.

7.0 Recommendations

Future Wedgefield Industrial Expansion Area UWMP's consider this report.

JDA CONSULTANT HYDROLOGISTS

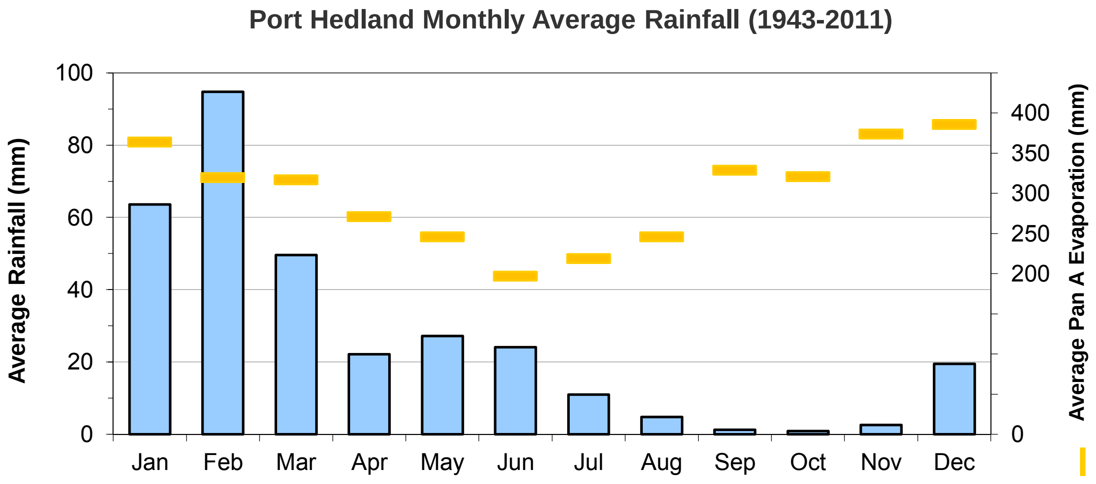
Attached
Figures 1-4
Bore logs W1-W12.



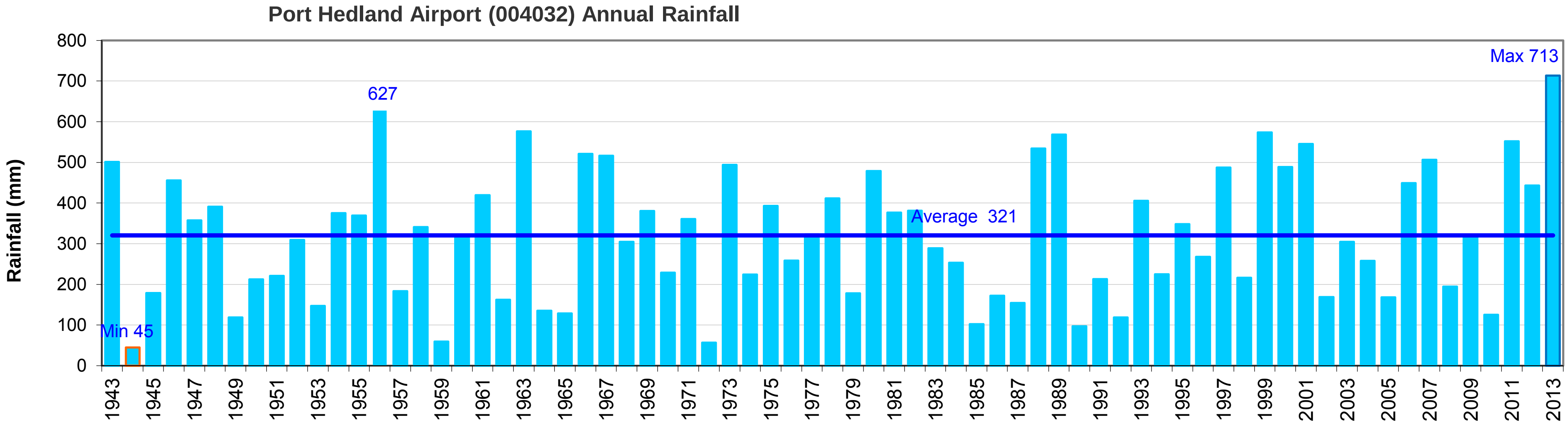
Data Source: Near Map (2012) Aerial Photograph 6/8/12; Vekta (2012) Bore Survey Details; JDA (2012) Salinity converted from measured Electrical Conductivity by factor of 560.

Job No. J4956
Scale: 1:14,500
0 100 200 300 400 Meters

Landcorp
Wedgefield Industrial Area Expansion Groundwater Monitoring 2011-2013
Figure 1: Groundwater Bores and Salinity



Port Hedland Monthly Average Rainfall (1943-2011)

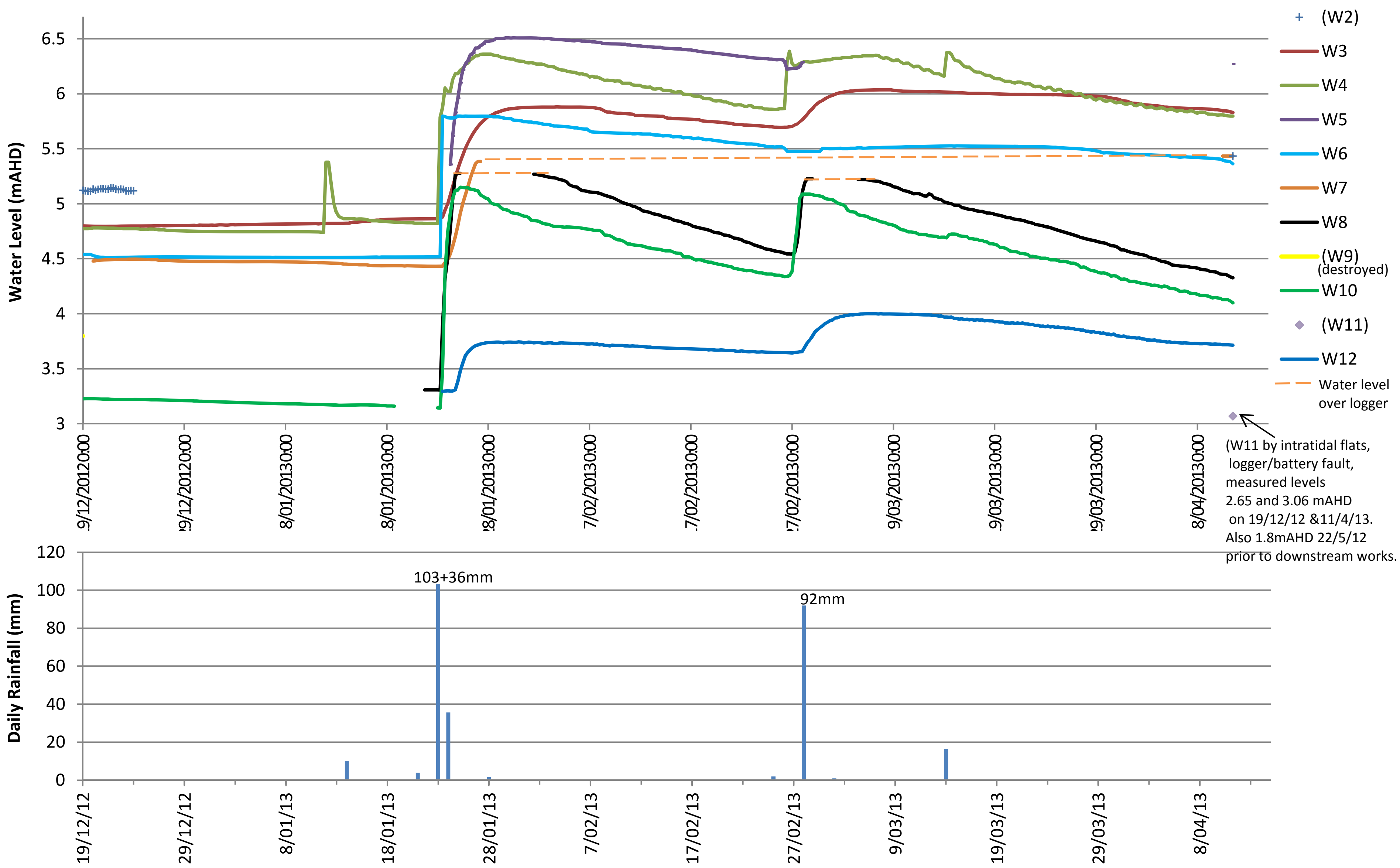


Port Hedland Airport (004032) Annual Rainfall

Data Source: Bureau of Meterorology (2014) Climate Data Online. Luke et al (2003) Average monthly Pan A Evaporaiton.

Job No. J4956

LandCorp
Wedgefield Industrial Area Expansion Groundwater Monitoring 2011-2013
Figure 2: Port Hedland Airport Rainfall Data



(W11 by intratidal flats, logger/battery fault, measured levels 2.65 and 3.06 mAHD on 19/12/12 &11/4/13. Also 1.8mAHD 22/5/12 prior to downstream works.

Data Source: JDA Water Level Data Loggers; Bureau of Meterorology (2014) Online daily rainfall, Port Hedland Aiport Station.

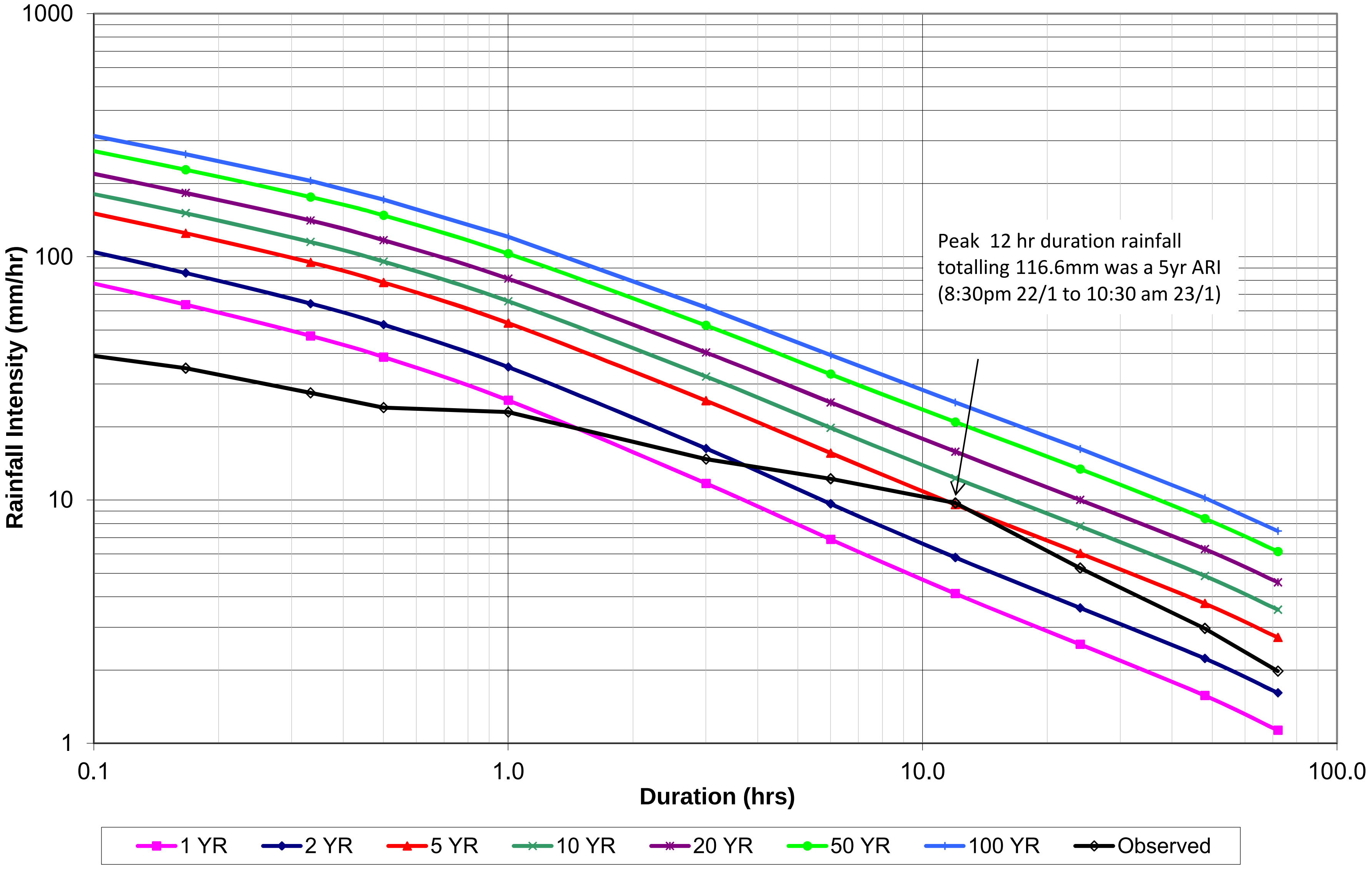
JDA Consultant Hydrologists

Job No. J4956

LandCorp

Wedgefield Industrial Area Expansion Groundwater Monitoring 2011-2013

Figure 3: Recorded Water Levels Wet season 2013 and Daily Rainfall (19/12/2012 to 11/4/2013)



Data Source: Bureau of Meteorology (2013) Minute interval rainfall data. Bureau of Meteorology (2013) IFD values, based on IEAust (1987) Australian Rainfall and Runoff (ARR)

JDA Consultant Hydrologists

Job No. J4956

LandCorp

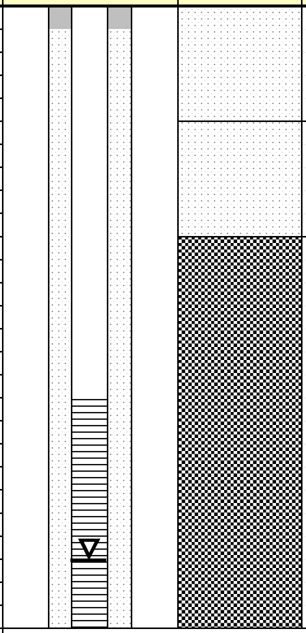
Wedgefield Industrial Estate Expansion Groundwater Monitoring 2011-2013

Figure 4: Rainfall on 22-23 January 2013 compared to IFD at Port Hedland Airport

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	20/02/2012
Bore location:	666825E, 7746780N	Hole completed:	20/02/2012
Datum:	GDA94 MGA Zone 50	Logged by:	WG/BZ
Bore Name:	W1	Total Depth:	2.7m
Drill type:	Hand Auger	R.L. TOC:	6.01 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



Depth (m)	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
	Sand	Brown	Medium	m	Suba	"Pindan Sand" Dry
0.5m	Sand	Red-brown	Medium	w	Subr	moist
1.0m	Sandy Clay	Red-brown	Medium	w	Subr	moist "Pindan Sand" (able to form 40mm ribbon strip)
1.5m						
2.0m						soil saturated at 1.8mbNS
2.5m						*End of Hole*
3.0m						
3.5m						
4.0m						
4.5m						
5.0m						

░	Sand
░	Loamy sand
▒	Sandy Loam
▒	Clayey Sand
▓	Sandy Clay Loam
▦	Clay Loam
▦	Sandy Clay
■	Clay

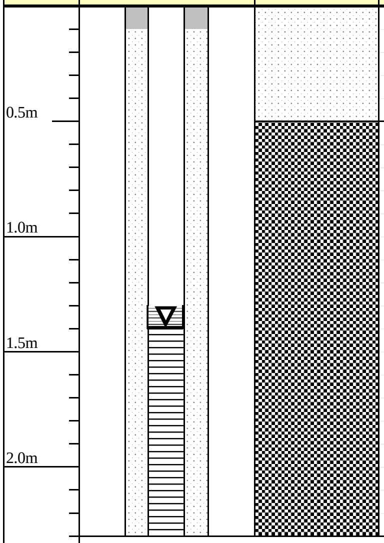
Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 20/02/2012: 2.05 mS/cm
(Approx 1,150 mg/L)
Water Level: measured on 20/02/2012 (2.4mbNS, level likely to still be recovering)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	20/02/2012
Bore location:	665750E, 7745464N	Hole completed:	20/02/2012
Datum:	GDA94 MGA Zone 50	Logged by:	WG/BZ
Bore Name:	W2	Total Depth:	2.3m
Drill type:	Hand Auger	R.L. TOC:	6.27 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



Depth (m)	BORE CONSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
0.0m			Sand	Brown	Medium	m	Suba	"Pindan Sand" Dry
0.5m			Sandy Clay	Red-brown	Medium	w	Subr	"Pindan Sand"
1.5m								Soil Saturated at 1.4m
2.3m								*End of Hole*

2.5m
3.0m
3.5m
4.0m
4.5m
5.0m

░ Sand
░ Loamy sand
░ Sandy Loam
▒ Clayey Sand
▓ Sandy Clay Loam
▩ Clay Loam
▩ Sandy Clay
■ Clay

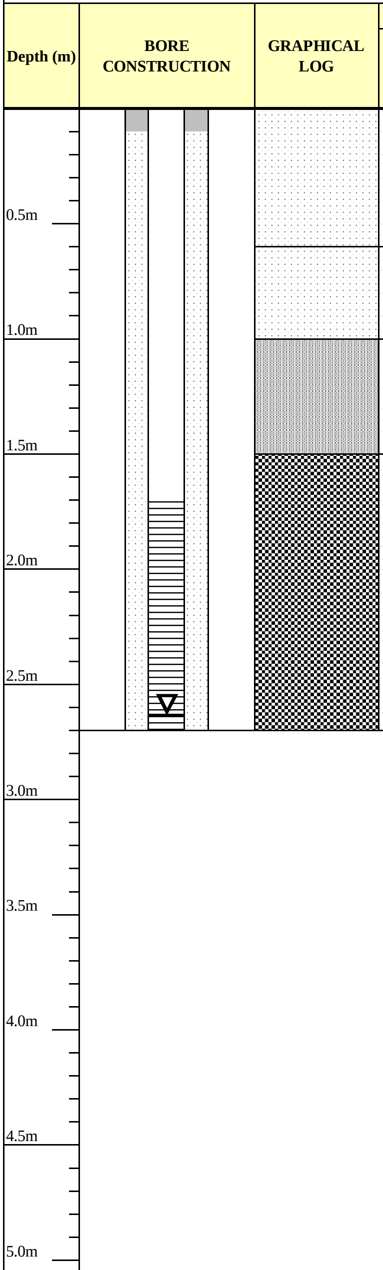
Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 20/02/2012: 19.8 mS/cm
(Approx 11080 mg/L) Measured twice confirming high reading
(Water in South Creek 500 m WNW-salinity greater than meter upper limit)
Water Level: measured on 20/02/2012 at 1.4 m below NS

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	22/05/2012
Bore location:	666200E, 7745278N	Hole completed:	22/05/2012
Datum:	GDA94 MGA Zone 50	Logged by:	SN/BZ
Bore Name:	W3	Total Depth:	3m
Drill type:	Hand Auger	R.L. TOC:	7.45 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



LITHOLOGICAL LOG

LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
Sand	Brown	Medium	m	suba	"Pindan Sand" Dry
Sand	Brown	Medium	m	suba	slightly moist
Clayey Sand	Dark Brown	Medium	m	suba	moist "Pindan Sand"
Sandy Clay	Dark Brown	Medium	m	suba	very moist rock in clay soil saturated at 2mbNS *End of Hole*

░ Sand
░ Loamy sand
░ Sandy Loam
▒ Clayey Sand
▓ Sandy Clay Loam
▩ Clay Loam
▩ Sandy Clay
■ Clay

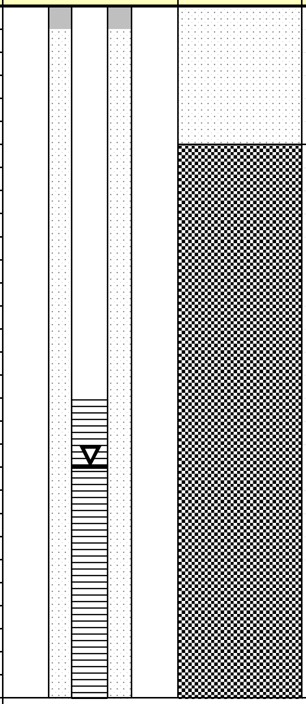
Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 31.7 mS/cm
(Approx 17,752 mg/L)
Water Level: measured on 24/05/2012 (2.65 mbNS, corresponding to 4.8 mAHD)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	22/05/2012
Bore location:	666885E, 7745551N	Hole completed:	22/05/2012
Datum:	GDA94 MGA Zone 50	Logged by:	SN/BZ
Bore Name:	W4	Total Depth:	3m
Drill type:	Hand Auger	R.L. TOC:	7.32 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



LITHOLOGICAL LOG

Depth (m)	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
0.5m	Sand	Light Brown	Medium	m	Suba	"Pindan Sand" Dry
1.0m	Sandy Clay	Brown	Medium	m	suba	slightly moist (able to form 40mm ribbon strip)
1.5m 2.0m						very moist rock in clay
2.5m 3.0m						soil saturated at 2mbNS *End of Hole*

3.5m
4.0m
4.5m
5.0m

░	Sand
░	Loamy sand
░	Sandy Loam
▒	Clayey Sand
▓	Sandy Clay Loam
▦	Clay Loam
▦	Sandy Clay
■	Clay

Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 33.4 mS/cm
(Approx 18,704 mg/L)
Water Level: measured on 24/05/2012 (1.97 mbNS,corresponding to 5.35 mAHD)

JDA Consultant Hydrologists
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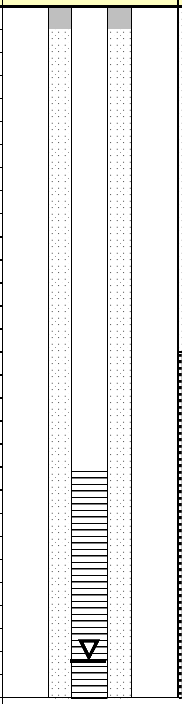
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	24/05/2012
Bore location:	667179E, 7745316N	Hole completed:	24/05/2012
Datum:	GDA94 MGA Zone 50	Logged by:	SN/BZ
Bore Name:	W5	Total Depth:	3m
Drill type:	Hand Auger	R.L. TOC:	8.13 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



Depth (m)	BORE CONSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
0.0–1.5m (0.5m, 1.0m, 1.5m)		░	Sand	Light Brown	Medium	m	suba	"Pindan Sand" Dry Slightly moist rock fragments
1.5–3.0m (2.0m, 2.5m, 3.0m)	∇	▩	Sandy Clay	Brown	Medium	m	suba	very moist rock in clay soil saturated at 2.7mbNS *End of Hole*

3.5m
4.0m
4.5m
5.0m

░ Sand
░ Loamy sand
░ Sandy Loam
▒ Clayey Sand
▓ Sandy Clay Loam
▩ Clay Loam
▩ Sandy Clay
■ Clay

Grain Size
f - fine
m - medium
c course
v.c - very course
g - gravel

Sorting
p - poorly
m - moderately
w - well

Grain
a - angular
suba - subangular
subr - subrounded
r - rounded
wr - well rounded

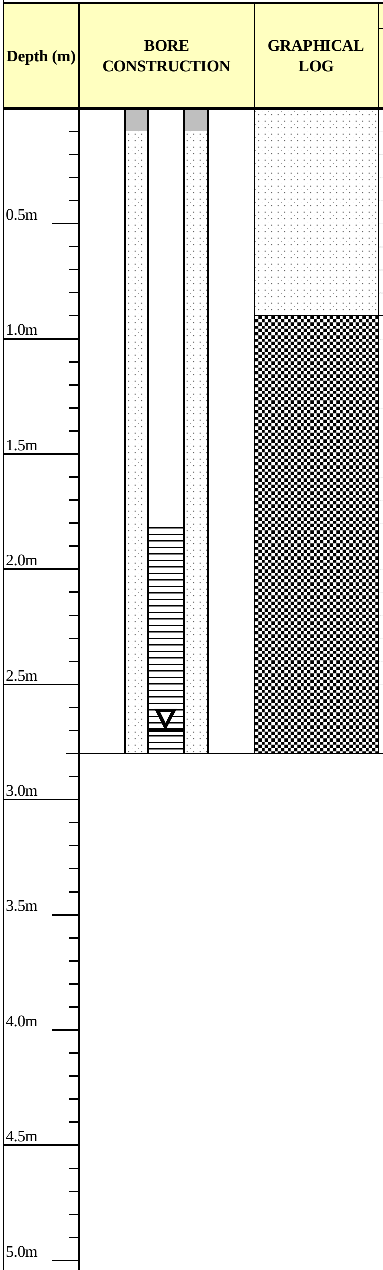
Water quality could not be measured due to insufficient flow for sampling
Water Level: measured on 24/05/2012 (2.83 mbNS, corresponding to 5.30 mAHD)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client: Landcorp
Project: Wedgefield Industrial Estate Groundwater Monitoring
Bore location: 666543E,77461133N
Datum: GDA94 MGA Zone 50
Job No: J4956
Hole commenced: 23/05/2012
Hole completed: 23/05/2012
Logged by: SN/BZ

Bore Name: W6
Drill type: Hand Auger
Hole diameter: 50mm
Total Depth: 2.8 m
R.L. TOC: 6.53 mAHD
Natural Surface: Same as TOC



LITHOLOGICAL LOG

LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
Sand	Light Brown	Medium	m	suba	"Pindan Sand" Dry Slightly moist
Sandy Clay	Brown	Medium	m	suba	Moist Very moist Very clayey White rock in clay Saturated *End of Hole*

░ Sand
░ Loamy sand
░ Sandy Loam
▒ Clayey Sand
▓ Sandy Clay Loam
▩ Clay Loam
▩ Sandy Clay
■ Clay

Grain Size
f - fine
m - medium
c course
v.c - very course
g - gravel

Sorting
p - poorly
m - moderately
w - well

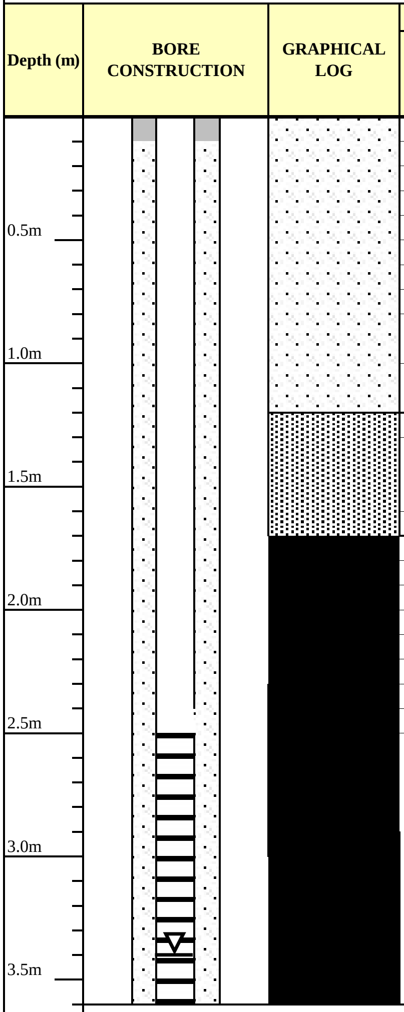
Grain
a - angular
suba - subangular
subr - subrounded
r - rounded
wr - well rounded

Water quality could not be measured due to insufficient flow for sampling
Water Level: measured on 24/05/2012 (2.71 mbNS, corresponding to 3.82 mAHD)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client: Landcorp
Project: Wedgefield Industrial Estate Groundwater Monitoring
Bore location: 667478E, 7745923N
Datum: GDA94 MGA Zone 50
Job No: J4956
Hole commenced: 22/05/2012
Hole completed: 22/05/2012
Logged by: SN/BK
Bore Name: W7
Drill type: Hand Auger
Hole diameter: 50mm
Total Depth: 3.6 m
R.L. TOC: 6.43 mAHD
Natural Surface: Same as TOC



LITHOLOGICAL LOG

LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
Sand	Light Brown	Medium	m	suba	"Pindan Sand"
					Dry
Clayey Sand	Brown	Medium	m	suba	
Clay	Dark brown	Medium	m	suba	very moist
					White rock in clay
					Saturated
					End of Hole

4.0m
4.5m
5.0m

▨ Sand
▨ Loamy sand
▨ Sandy Loam
▨ Clayey Sand
▨ Sandy Clay Loam
▨ Clay Loam
▨ Sandy Clay
■ Clay

Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 45.8 mS/cm
(Approx 25,648 mg/L)
Water Level: measured on 24/05/2012 (3.42 mbNS, corresponding to 3.01 mAHD)

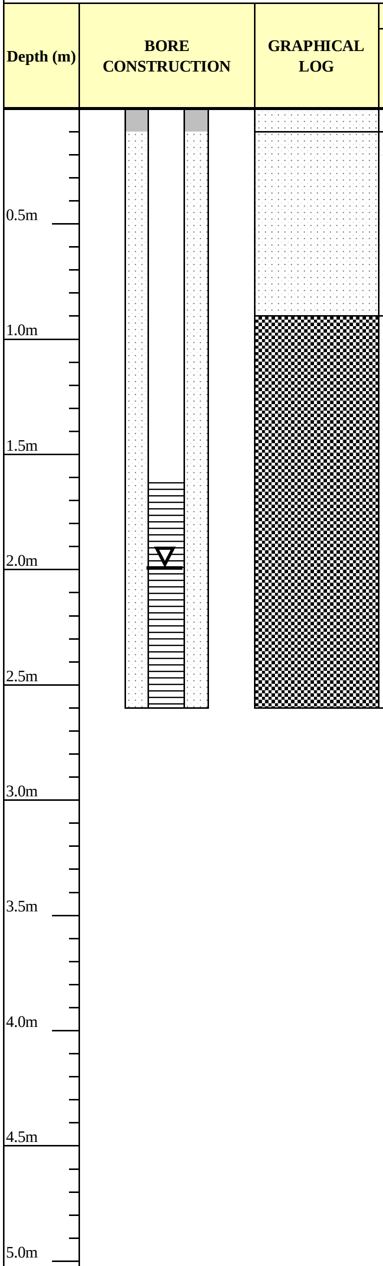
JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client: Landcorp
Project: Wedgefield Industrial Estate Groundwater Monitoring
Bore location: 667089E, 7746608N
Datum: GDA94 MGA Zone 50
Job No: J4956
Hole commenced: 23/05/2012
Hole completed: 23/05/2012
Logged by: SN/BK

Bore Name: W8 (previously known as W8b)
Drill type: Hand Auger
Hole diameter: 50mm
Total Depth: 2.63m
R.L. TOC: 6.01 mAHD
Natural Surface: Same as TOC

LITHOLOGICAL LOG



LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
Sand	Light Brown	Medium	m	suba	Dry
Sand	Brown	Medium	m	suba	
					Slightly moist
Sand Clay	Brown				Moist
					rock fragments
					Saturated

End of Hole

could not break through rock

▨ Sand
▨ Loamy sand
▨ Sandy Loam
▨ Clayey Sand
▨ Sandy Clay Loam
▨ Clay Loam
▨ Sandy Clay
■ Clay

Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 51.7 mS/cm (Approx 28,950mg/L)
Water Level: measured on 24/05/2012 (1.97 mbNS, corresponding to 4.04 mAHD)

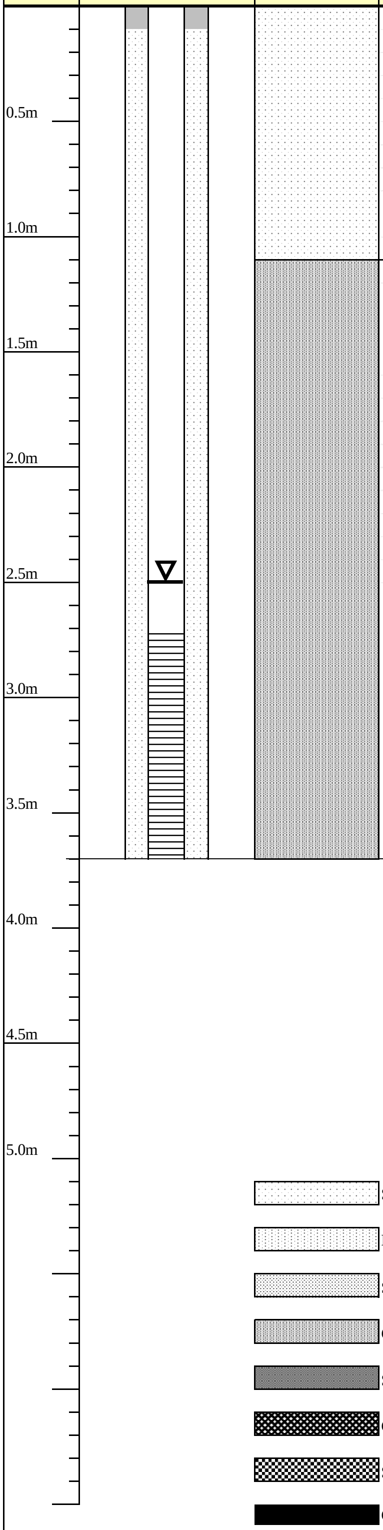
JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client: Landcorp
Project: Wedgefield Industrial Estate Groundwater Monitoring
Bore location: 667909E, 7746415N
Datum: GDA94 MGA Zone 50
Job No: J4956
Hole commenced: 24/05/2012
Hole completed: 24/05/2012
Logged by: SN/BK

Bore Name: W9
Drill type: Hand Auger
Hole diameter: 50mm
Total Depth: 3.7 m
R.L. TOC: 6.43 mAHD
Natural Surface: Same as TOC

LITHOLOGICAL LOG



LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
Sand	Light Brown	Medium	m	suba	"Pindan Sand" Dry
					Moist
Clayey Sand	Brown	Medium	m	suba	Moist
					Saturated
					End of Hole

▨ Sand
▨ Loamy sand
▨ Sandy Loam
▨ Clayey Sand
▨ Sandy Clay Loam
▨ Clay Loam
▨ Sandy Clay
■ Clay

Grain Size
- f - fine
- m - medium
- c course
- v.c - very course
- g - gravel

Sorting
- p - poorly
- m - moderately
- w - well

Grain
- a - angular
- suba - subangular
- subr - subrounded
- r - rounded
- wr - well rounded

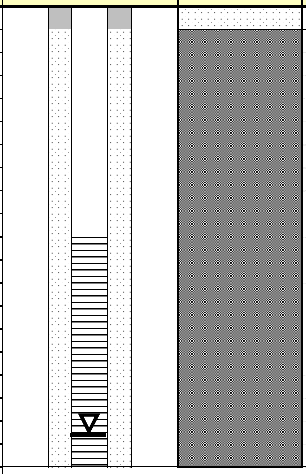
Water quality could not be measured due to insufficient flow for sampling
Water Level: measured on 24/05/2012 (2.5 mbNS, corresponding to 3.93 mAHD)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	23/05/2012
Bore location:	667312E, 7746717N	Hole completed:	23/05/2012
Datum:	GDA94 MGA Zone 50	Logged by:	SN/BK
Bore Name:	W10	Total Depth:	2.0 m
Drill type:	Hand Auger	R.L. TOC:	5.13 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC

BORE CONSTRUCTION / **GRAPHICAL LOG**



LITHOLOGICAL LOG

Depth (m)	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
	Sand	Light Brown	Medium	m	suba	"Pindan Sand"
	Sandy Clay	Brown	Medium	m	suba	Slightly moist
0.5m						
						Very moist, fragmented rocks
1.0m						
1.5m						Saturated
2.0m						*End of Hole*
2.5m						
3.0m						
3.5m						
4.0m						
4.5m						
5.0m						

░	Sand
░	Loamy sand
▒	Sandy Loam
▒	Clayey Sand
▓	Sandy Clay Loam
▓	Clay Loam
▩	Sandy Clay
■	Clay

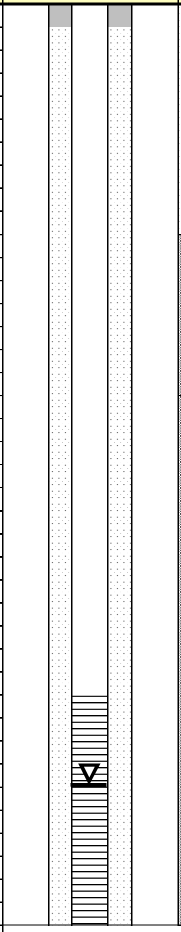
Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 52 mS/cm
(Approx 29,120 mg/L)
Water Level: measured on 24/05/2012 (1.74 mbNS, corresponding to 3.39 mAHD)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	23/05/2012
Bore location:	667672E, 7747166N	Hole completed:	23/05/2012
Datum:	GDA94 MGA Zone 50	Logged by:	SN/BK
Bore Name:	W11	Total Depth:	4.0 m
Drill type:	Hand Auger	R.L. TOC:	5.19 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



Depth (m)	BORE CONSTRUCTION	GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
		░	Sand	Light Brown	Medium	m	suba	"Pindan Sand" Dry
0.5m		░						
		░						Slightly moist
1.0m		▨	Clayey Sand	Brown	Medium	m	suba	Moist
1.5m		▨						
		▨	Clayey Sand	Dark brown	Medium	m	suba	
2.0m		▨						
		▨						Very moist
2.5m		▨						
3.0m		▨						
		▨						Fragmented rocks
3.5m		▨						
		▨						Saturated *End of Hole*
4.0m								
4.5m								
5.0m								

- ░ Sand
- ░ Loamy sand
- ░ Sandy Loam
- ▨ Clayey Sand
- ▩ Sandy Clay Loam
- ▩ Clay Loam
- ▩ Sandy Clay
- ■ Clay

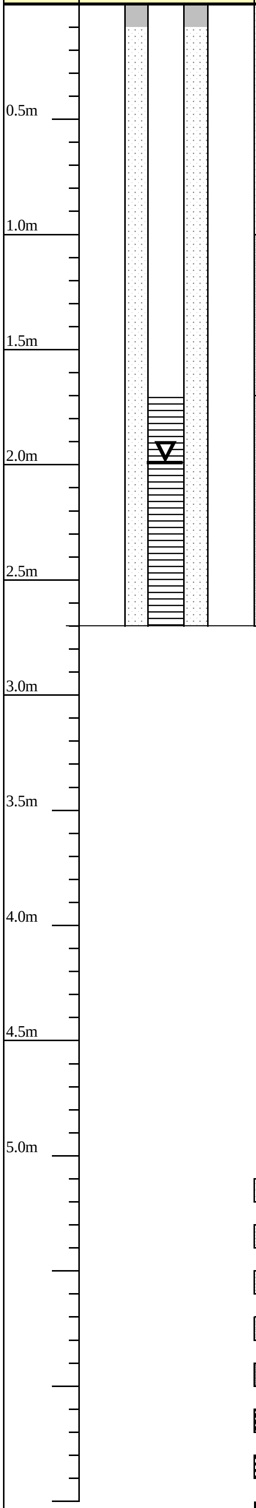
Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 44.2 mS/cm
(Approx 24,752 mg/L)
Water Level: measured on 24/05/2012 (3.39 mbNS, corresponding to 1.80 mAHD)

JDA Consultant Hydrologists
Suite 1, 27 York Street
Subiaco WA 6008
Tel: 9388 2436
Fax: 9381 9279

LITHOLOGICAL LOG

Client:	Landcorp	Job No:	J4956
Project:	Wedgefield Industrial Estate Groundwater Monitoring	Hole commenced:	22/05/2012
Bore location:	668485E, 7747236N	Hole completed:	22/05/2012
Datum:	GDA94 MGA Zone 50	Logged by:	SN/BK
Bore Name: W12		Total Depth:	2.7 m
Drill type:	Hand Auger	R.L. TOC:	5.96 mAHD
Hole diameter:	50mm	Natural Surface:	Same as TOC



GRAPHICAL LOG	LITHOLOGY	COLOUR	GRAIN SIZE	SORTING	GRAIN SHAPE	OTHER
░	Sand	Light Brown	Medium	m	suba	"Pindan Sand" Dry Slightly moist
▒	Clayey Sand	Brown	Medium	m	suba	Slightly moist
▒	Clayey Sand	Dark brown	Medium	m	suba	Very moist Fragmented rocks *End of Hole*

- ░ Sand
- ░ Loamy sand
- ░ Sandy Loam
- ▒ Clayey Sand
- ▓ Sandy Clay Loam
- ▓ Clay Loam
- ▓ Sandy Clay
- ■ Clay

Grain Size	Sorting	Grain
f - fine	p - poorly	a - angular
m - medium	m - moderately	suba - subangular
c course	w - well	subr - subrounded
v.c - very course		r - rounded
g - gravel		wr - well rounded

Salinity indicator: EC measured on 24/05/2012: 6.9 mS/cm
(Approx 3,864 mg/L)
Water Level: measured on 24/05/2012 (1.95 mbNS, corresponding to 4.01 mAHD)

APPENDIX E

WAPC letter, dated 15 December 2009, regarding fill and lot levels.

Western
Australian
Planning
Commission

IPA1987

Our Ref: DPI/07/0841
Enquiries: Ken Dawson (9264 7575)

Document #: IPA1987
Date: 24.12.2009
Officer: RICHARD DEREK JOHN BAIRSTOW
File: 18/08/0005

+ LEONARD LONG

Chief Executive Officer
Town of Port Hedland
PO BoX 41
PORT HEDLAND WA 6721

ATTENTION: Richard Bairstow

Dear Sir/Madam

INDUSTRIAL AND RESIDENTIAL DEVELOPMENT IN PORT HEDLAND AND APPLICATION OF STATE PLANNING POLICY 2.6 - STATE COASTAL PLANNING POLICY (SPP 2.6)

I refer to correspondence regarding the above matter. In this regard, the Western Australian Planning Commission has resolved to

1. Note progress on the review of State Coastal Planning Policy SPP 2.6 and that an increase in the projected sea level rise figures from the current policy (0.38 m) is anticipated.
2. Note the matters raised by LandCorp regarding the proposed Wedgefield Industrial Expansion, Port Hedland and the matters raised by Satterley regarding the Styles Road, Port Hedland proposal.
3. Adopt, with regard to the LandCorp "Wedgefield Transport Industrial Estate" proposal, a minimum fill level of 6.0m AHD and a minimum building floor level of 6.3m AHD.
4. Adopt, with regard to the Satterley Syles Road proposal, a minimum fill level of 7.5m AHD consistent with the adjacent Pretty Pool development by LandCorp.

Yours faithfully

For Tony Evans
Secretary
Western Australian Planning Commission

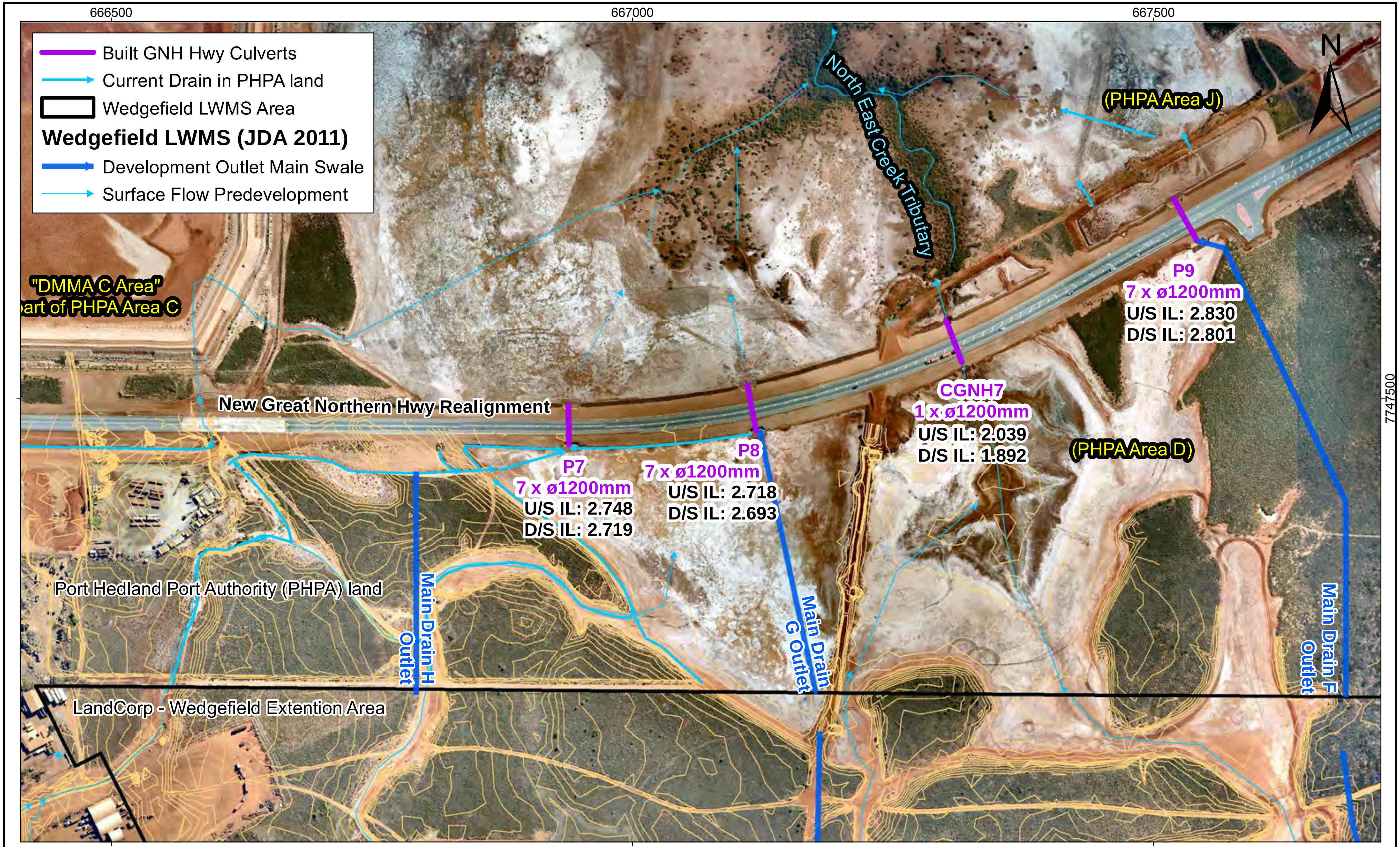
17 December 2009

cc. Landcorp; Satterley

Albert Facey House, 469 Wellington Street (cnr Forrest Place), Perth, Western Australia 6000
Tel: (08) 9264 7777; Fax: (08) 9264 7566; TTY: (08) 9264 7535; Infoline: 1800 626 477
e-mail: corporate@wapc.wa.gov.au; web address: http://www.wapc.wa.gov.au
ABN 35 482 341 493

APPENDIX F

MRWA Great Northern Hwy Realignment Culverts (Constructed); and BGE (2013) Great Northern Hwy Realignment Port Hedland - Drainage Plans



Data Source: Nearmap (2014) Aerial 11 July 2014; BGE (2013) GNH Drainage Plans & Culvert Schedule (RD15); JDA (2011) Wedgefield IE Expansion LWMS; JDA (2011) Advice Letter to Main Roads and PHPA

JDA

Job No. J5837

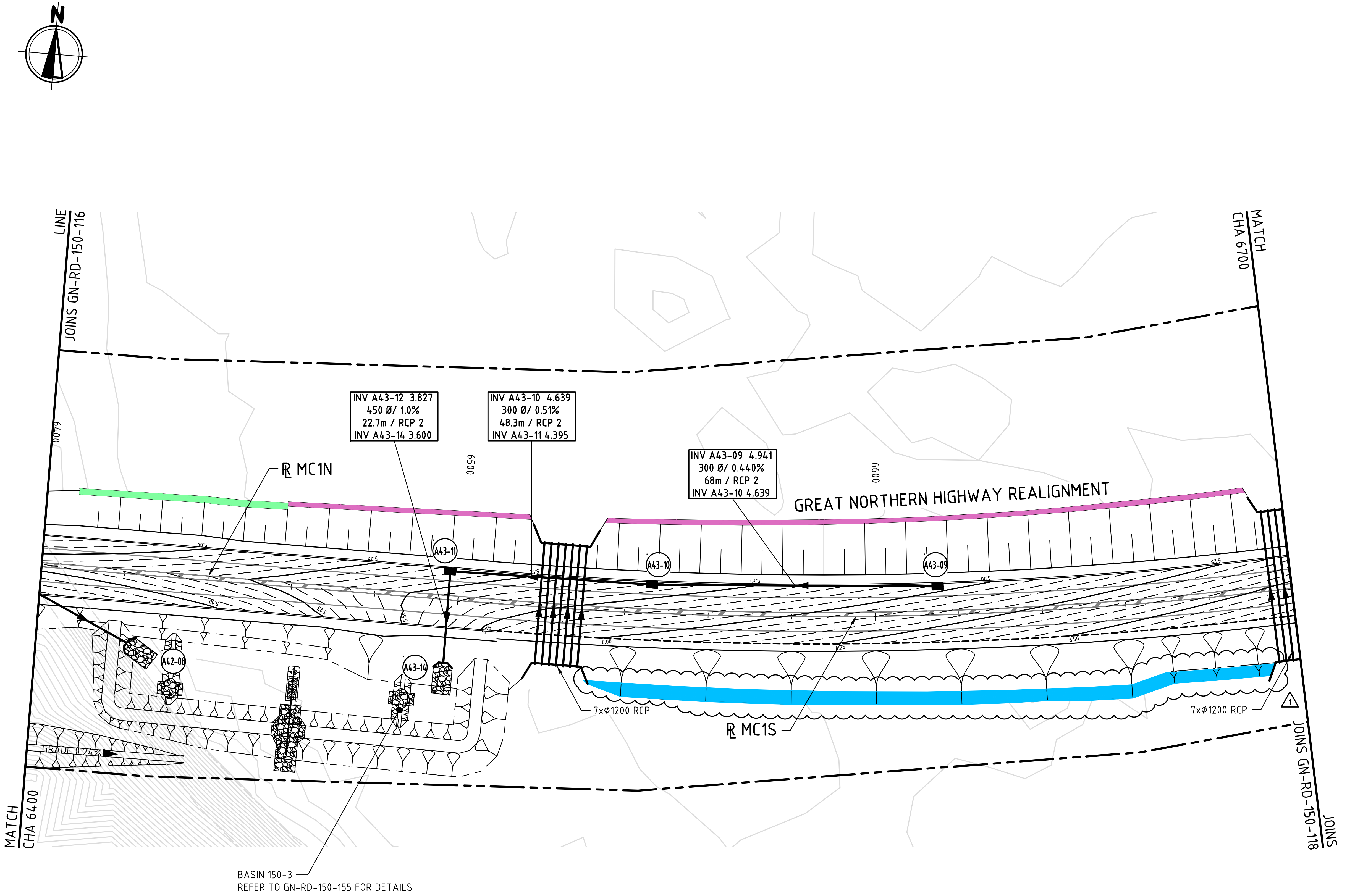
Scale: 1:5,000

0 100 200 300 400 Meters

Landcorp

Wedgefield Industrial Area Expansion TDA1&2: UWMP

Figure F1: MRWA New Great Northern Hwy Realignment Culverts (Constructed)



LEGEND:

— — —	SITE BOUNDARY
——▶——	PROPOSED STORMWATER DRAINAGE PIPE
)——▶——(	PROPOSED CULVERT
●	PROPOSED MANHOLE
▬	PROPOSED SIDE ENTRY GULLY OR GRATED GULLY
⌋ ⌊	PROPOSED KERB OPENING
▨	PROPOSED CATCHPIT (WITH ROCK PITCHING)
(	PROPOSED HEADWALL (H/W)
⊓	PROPOSED DRAINAGE CAP
▨	ROCK PROTECTION (THICKNESS VARIES)
(C1-01)	STRUCTURE NUMBER
— — > — —	EXISTING OPEN DRAIN
🟩	ROCK PROTECTION TYPE 1
🟪	ROCK PROTECTION TYPE 2
🟦	RIPRAP BALLAST ARMOURING

INV A-3-2 15.03 300 Ø / 9.45% 8.55m / RCP 2 INV A-3-1 14.22	UPSTREAM INVERT DIAMETER (mm)/SLOPE LENGTH/CLASS DOWNSTREAM INVERT

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY. BOUNDARIES TO BE VERIFIED BY SURVEY.
3. EXTENT AND TYPE OF ROCK PROTECTION AT HEADWALL OUTLETS SHALL BE AS DETAILED ON DRAWINGS GN-RD-150-135 AND GN-RD-150-151.
4. DRAINAGE INLETS, PITS AND PIPE SHALL BE INSTALLED IN ACCORDANCE WITH MAIN ROADS SPECIFICATIONS 404, 405 AND STANDARD DRAWINGS
5. FOR CULVERT DETAILS REFER TO DRAWING GN-RD-150-135.
6. REDUNDANT PAVEMENTS SHALL BE REMOVED AND REHABILITATED IN ACCORDANCE WITH SPECIFICATIONS.
7. FOR DETAILS ON ULTIMATE STAGE DRAINAGE WORKS REFER TO REPORT RD-150-REP-001.
8. AREAS BOUNDED BY ROADS AND RAMPS SHALL BE REGRADED TOWARDS CULVERTS OR PROPOSED OPEN DRAINS TO ENSURE NO STANDING WATER.
9. EXISTING DRAINAGE SHALL BE REMOVED UNLESS NOTED OTHERWISE.
10. EXISTING DRAINS HIGHLIGHTED ON THE DRAWINGS SHALL BE RECONDITIONED UNLESS NOTED OTHERWISE.
11. EXISTING SERVICES SHOWN ARE INDICATIVE AND SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
12. DEPTH TO SERVICES AT ALL CROSSING POINTS SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
13. FOR SETOUT DETAILS OF MODELLED OPEN DRAINS REFER TO DESIGN MODEL.
14. MODELLED OPEN DRAINS SHALL BE TYPE 'F' DRAINS IN ACCORDANCE WITH MAIN ROADS DRAWING 9831-5498 UNLESS NOTED OTHERWISE.

1:1000

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)
MRWA RESPONSIBILITY AREA PILBARA
MRWA DRAWING No. -
MRWA CONTRACT No. 183/10
MRWA SLK GREAT NORTHERN HWY (H006) - 1602.58 SLK TO 1612.53 SLK

No.	DATE	DESCRIPTION	APPROVED
1	30.08.13	RE-ISSUED FOR CONSTRUCTION	C.S
0	24.05.13	ISSUED FOR CONSTRUCTION	C.S

VERIFIER:
Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
256 St George's Terrace
Perth, Western Australia 6000
VERIFIED DATE

CO-ORDINATOR & DESIGNER:
Perth Office—
484 Murray St Perth WA 6000
P/ +61 8 6364 3300
E/ info@bgeeng.com
bgeeng.com—
BG&E
APPROVED DATE

DRAWN DM
DESIGNED TM/TT
CHECKED SM
DESIGNER PROJECT No P11120
GRID PHG94
DATUM AHD
SCALE 1:1000
SCALE 1:1000 0 10m 20 30

CONTRACTOR:
John Holland
PROJECT MANAGER DATE

CLIENT:
Government of Western Australia
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
PROJECT DIRECTOR CK. DATE 2013-11-08

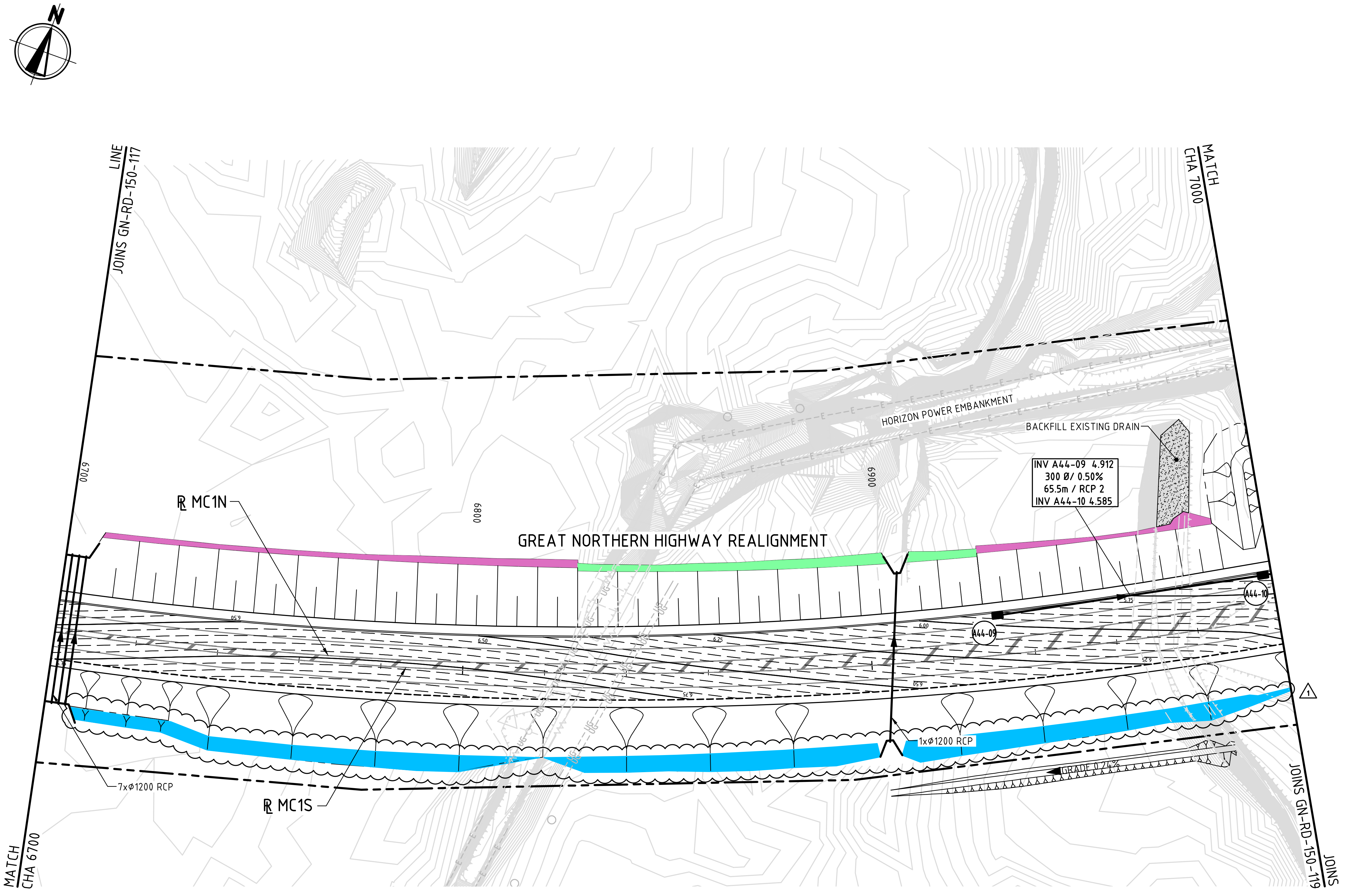
PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
DRAINAGE PLAN (RD150)
SHEET 18

SHEET SIZE A3

PROJECT GN DESIGN LOT RD150 DRAWING No. 117 REV 1

P:\P11120 GREAT NORTHERN HWAY - MACMAHON\100 DRAWINGS\RD150\AutoCad\GN-RD-150-100 to 126.dwg, 30/08/2013 1:55:20 PM



LEGEND:

- — — — SITE BOUNDARY
- ➞ PROPOSED STORMWATER DRAINAGE PIPE
-)➞(PROPOSED CULVERT
- ● PROPOSED MANHOLE
- ▬ PROPOSED SIDE ENTRY GULLY OR GRATED GULLY
- ⅃ L PROPOSED KERB OPENING
- ▨ PROPOSED CATCHPIT (WITH ROCK PITCHING)
- (PROPOSED HEADWALL (H/W)
- ╕ PROPOSED DRAINAGE CAP
- ▨ ROCK PROTECTION (THICKNESS VARIES)
- (E1-01) STRUCTURE NUMBER
- - - -> - - EXISTING OPEN DRAIN
- 🟩 ROCK PROTECTION TYPE 1
- 🟪 ROCK PROTECTION TYPE 2
- 🟦 RIPRAP BALLAST ARMOURING

INV A-3-2 15.03 300 Ø / 9.45% 8.55m / RCP 2 INV A-3-1 14.22	UPSTREAM INVERT DIAMETER (mm)/SLOPE LENGTH/CLASS DOWNSTREAM INVERT

1

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY. BOUNDARIES TO BE VERIFIED BY SURVEY.
3. EXTENT AND TYPE OF ROCK PROTECTION AT HEADWALL OUTLETS SHALL BE AS DETAILED ON DRAWINGS GN-RD-150-135 AND GN-RD-150-151.
4. DRAINAGE INLETS, PITS AND PIPE SHALL BE INSTALLED IN ACCORDANCE WITH MAIN ROADS SPECIFICATIONS 404, 405 AND STANDARD DRAWINGS
5. FOR CULVERT DETAILS REFER TO DRAWING GN-RD-150-135.
6. REDUNDANT PAVEMENTS SHALL BE REMOVED AND REHABILITATED IN ACCORDANCE WITH SPECIFICATIONS.
7. FOR DETAILS ON ULTIMATE STAGE DRAINAGE WORKS REFER TO REPORT RD-150-REP-001.
8. AREAS BOUNDED BY ROADS AND RAMPS SHALL BE REGRADED TOWARDS CULVERTS OR PROPOSED OPEN DRAINS TO ENSURE NO STANDING WATER.
9. EXISTING DRAINAGE SHALL BE REMOVED UNLESS NOTED OTHERWISE.
10. EXISTING DRAINS HIGHLIGHTED ON THE DRAWINGS SHALL BE RECONDITIONED UNLESS NOTED OTHERWISE.
11. EXISTING SERVICES SHOWN ARE INDICATIVE AND SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
12. DEPTH TO SERVICES AT ALL CROSSING POINTS SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
13. FOR SETOUT DETAILS OF MODELLED OPEN DRAINS REFER TO DESIGN MODEL.
14. MODELLED OPEN DRAINS SHALL BE TYPE 'F' DRAINS IN ACCORDANCE WITH MAIN ROADS DRAWING 9831-5498 UNLESS NOTED OTHERWISE.

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0 5m 10 15 20 25 30 35 40 45 50 55 60 65 70 75

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)	MRWA RESPONSIBILITY AREA PILBARA
MRWA DRAWING No. -	MRWA CONTRACT No. 183/10
MRWA SLK GREAT NORTHERN HWY (H006) - 1602.58 SLK TO 1612.53 SLK	

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APPROVED DATE

DRAWN	DM	DESIGNED	TM/TT
CHECKED	SM		
DESIGNER PROJECT No	P11120		
GRID	PHG94	DATUM	AHD
SCALE	1:1000		
SCALE 1:1000	0 10m 20 30		

CONTRACTOR:
John Holland
PROJECT MANAGER DATE

CLIENT:
Government of Western Australia
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
PROJECT DIRECTOR CR. DATE 2013-11-08

PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
DRAINAGE PLAN (RD150)
SHEET 19

SHEET SIZE A3

PROJECT GN | DESIGN LOT RD150 | DRAWING No. 118 | REV 1

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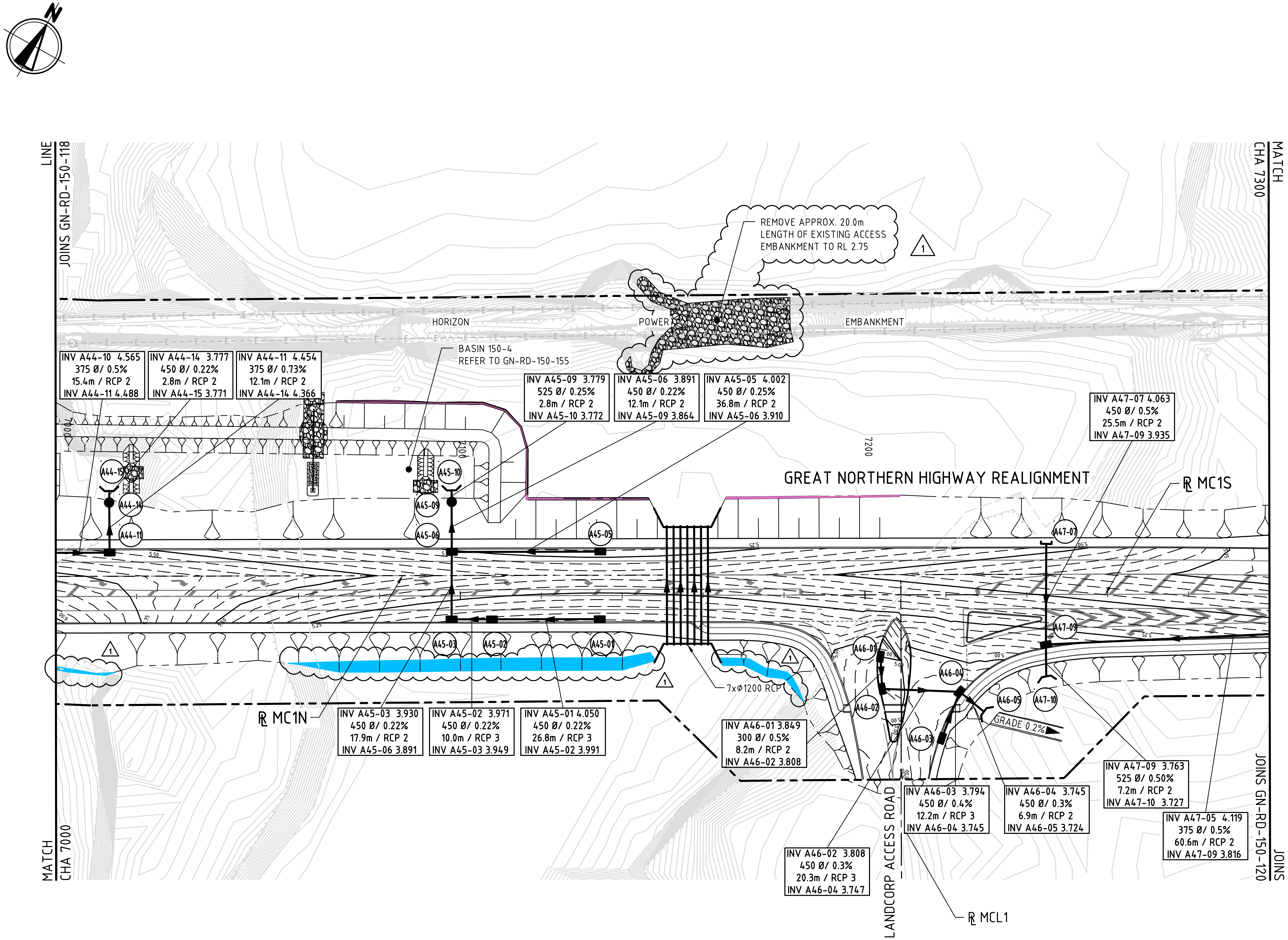

LEGEND:

- – – – SITE BOUNDARY
- ──▶── PROPOSED STORMWATER DRAINAGE PIPE
-)──▶──(PROPOSED CULVERT
- ● PROPOSED MANHOLE
- ▬ PROPOSED SIDE ENTRY GULLY OR GRATED GULLY
- ⌋ ⌊ PROPOSED KERB OPENING
- ▨ PROPOSED CATCHPIT (WITH ROCK PITCHING)
- (PROPOSED HEADWALL (H/W)
- ⌐ PROPOSED DRAINAGE CAP
- ▨ ROCK PROTECTION (THICKNESS VARIES)
- (E1-01) STRUCTURE NUMBER
- – – –>– – EXISTING OPEN DRAIN
- 🟩 ROCK PROTECTION TYPE 1
- 🟪 ROCK PROTECTION TYPE 2
- 🟦 RIPRAP BALLAST ARMOURING

1

INV A-3-2 15.03	UPSTREAM INVERT
300 Ø / 9.45%	DIAMETER (mm)/SLOPE
8.55m / RCP 2	LENGTH/CLASS
INV A-3-1 14.22	DOWNSTREAM INVERT

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
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13. FOR SETOUT DETAILS OF MODELLED OPEN DRAINS REFER TO DESIGN MODEL.
14. MODELLED OPEN DRAINS SHALL BE TYPE 'F' DRAINS IN ACCORDANCE WITH MAIN ROADS DRAWING 9831-5498 UNLESS NOTED OTHERWISE.

0 5m 10 15 20 25 30 35 40 45 50 55 60 65 70 75
1:1000

LOCAL AUTHORITY
TOWN OF PORT HEDLAND (813)
MRWA RESPONSIBILITY AREA
PILBARA
MRWA DRAWING No.
-
MRWA CONTRACT No.
183/10
MRWA SLK
GREAT NORTHERN HWY (H006) - 1602.58 SLK TO 1612.53 SLK

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DESIGNER PROJECT No P11120
GRID PHG94
DATUM AHD
SCALE 1:1000
SCALE 1:1000 0 10m 20 30

CONTRACTOR:
John Holland
PROJECT MANAGER DATE

CLIENT:
Government of Western Australia
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
PROJECT DIRECTOR DATE 2013-11-08

PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
DRAINAGE PLAN (RD150)
SHEET 20

SHEET SIZE A3

PROJECT GN
DESIGN LOT RD150
DRAWING No. 119
REV 1

P:\P11120 GREAT NORTHERN HWAY - MACMAHON\100 DRAWINGS\RD150\AutoCad\GN-RD-150-100 to 126.dwg, 30/08/2013 1:55:41 PM

CULVERT DETAILS								CULVERT INLET										CULVERT OUTLET									GROUND CONDITIONS REFER TO NOTES	COMMENTS
STRUCTURE NUMBER	REF. LINE	CHA	PIPE DIA. (mm) AND CLASS	NUMBER OF BARRELS	PIPE TYPE	SKEW (DEGREES)	OVERALL LENGTH OF CULVERT (m)	SIDE L = LEFT R = RIGHT	OFFSET FROM CENTRE LINE (m)	INVERT LEVEL (m)	HEADWALL HEIGHT (m)	APRON LENGTH (m)	REFERENCE POINT		TRAVERSABLE END TREATMENT	OIL SPILL STOP BOARD	ROCK PROTECTION REFER TABLE	SIDE L = LEFT R = RIGHT	OFFSET FROM CENTRE LINE (m)	INVERT LEVEL (m)	HEADWALL HEIGHT (m)	APRON LENGTH (m)	REFERENCE POINT		TRAVERSABLE END TREATMENT	ROCK PROTECTION REFER TABLE		
													EASTING	NORTHING									EASTING	NORTHING				
CBHP	MCF1	30	450-2	1	RCP	0	39.040	L	16.7214	8.348	0.600	2.223	47521.436	144355.503	NO	NO	NONE	R	22.319	8.185	0.450	1.823	47542.183	144388.579	NO	LIGHT		△1
CGNH2	MC1N	1915	600-2	1	RCP	-10	56.120	L	13.4664	7.888	0.563	2.617	47600.360	144461.282	NO	NO	NONE	R	42.652	7.766	0.577	2.664	47650.134	144435.362	YES	FACING	AGGRESSIVE	
CGNHE - 1	MCR1	79	450-2	1	RCP	22	31.720	L	13.317	8.000	0.440	1.791	47763.952	144630.803	NO	YES	NONE	R	18.403	7.900	0.541	2.093	47775.546	144601.278	NO	NONE		
CGNHE - 2	MCW2	1669	450-2	1	RCP	38	21.960	L	10.727	7.746	0.600	2.265	47816.554	144592.669	NO	YES	NONE	R	11.233	7.564	0.552	2.132	47837.116	144585.068	NO	NONE		
CGNH3	MC1N	2461	450 - 2	1	RCP	0	36.600	R	26.270	7.700	0.300	1.371	47744.375	144983.204	YES	NO	NONE	L	10.330	7.531	0.354	1.535	47708.146	144988.400	YES	FACING		
CGNH4	MC1N	3655	600-2	1	RCP	10	70.760	L	29.220	4.763	0.342	1.957	47850.108	146165.976	NO	YES	NONE	R	41.540	4.460	0.321	1.893	47920.446	146173.692	NO	FACING	AGGRESSIVE	
CUROF	MC21	459	450-2	1	RCP	15	34.160	L	14.663	5.048	0.565	2.166	47764.336	146173.051	NO	NO	NONE	R	19.497	4.900	0.510	2.002	47790.874	146194.515	NO	NONE	AGGRESSIVE	
CURON	MC41	445	450-2	1	RCP	30	26.840	R	14.722	3.750	0.471	1.884	47864.655	146420.490	YES	YES	NONE	L	12.118	3.620	0.569	2.177	47840.544	146432.352	NO	FACING		
P3	MC1N	3983	1050-3	2	RCP	23	61.000	R	29.122	3.427	0.300	3.202	47913.236	146484.915	NO	NO	NONE	L	31.878	3.330	0.375	3.426	47858.120	146511.055	NO	FACING	AGGRESSIVE	
P4	MC1N	4132	1050-2	1	RCP	10	48.800	R	23.516	3.400	0.304	3.212	47932.493	146633.414	NO	NO	NONE	L	25.284	3.350	0.300	3.201	47888.907	146655.362	NO	FACING	AGGRESSIVE	REFER TO NOTE 7.
Bridge 1707	MC1N	TBC	3.0 x 1.5	33	RCBC	REFER TO BRIDGE 1707 DRAWINGS																						
Bridge 1708	MC1N	TBC	3.0 x 1.5	17	RCBC	REFER TO BRIDGE 1708 DRAWINGS																						
CAH	MCH1	45	450-2	1	RCP	0	48.800	R	23.451	2.783	0.362	1.523	48760.716	147436.198	NO	NO	NONE	L	25.349	2.653	0.352	1.516	48711.923	147436.198	NO	NONE	AGGRESSIVE	
CGNH6	MC1N	6178	600-2	1	RCP	20	26.840	R	13.428	3.400	0.361	2.323	49599.603	147366.345	-	-	NONE	L	13.412	3.327	0.556	2.598	49590.218	147391.490	NO	FACING	AGGRESSIVE	
CGNH6A	MC1N	6185	600-2	4	RCP	0	24.400	R	11.950	3.400	0.438	2.472	49607.147	147366.979	NO	NO	NONE	L	12.220	3.327	0.600	2.960	49607.144	147391.149	NO	FACING	AGGRESSIVE	△1
P7	MC1N	6527	1200-2	7	RCP	0	29.280	R	14.795	2.748	0.359	3.833	49943.938	147364.352	NO	NO	NONE	L	14.485	2.719	0.385	3.911	49943.930	147393.632	NO	FACING	AGGRESSIVE	REFER TO NOTE 7.
P8	MC1N	6702	1200-2	7	RCP	0	36.600	R	18.465	2.718	0.448	4.102	50121.455	147380.164	NO	NO	NONE	L	18.135	2.693	0.300	3.658	50113.977	147415.992	NO	1/4 Tonne	AGGRESSIVE	
CGNH7	MC1N	6907	1200-2	1	RCP	6	41.480	R	22.436	2.039	0.376	3,885	50318.878	147441.150	NO	NO	NONE	L	19.044	1.892	0.300	3.656	50306.294	147480.675	NO	FACING	AGGRESSIVE	
P9	MC1N	7157	1200-2	7	RCP	0	29.280	R	17.202	2.830	0.577	4.719	50539.510	147568.488	NO	NO	NONE	L	12.078	2.801	0.579	4.494	50525.031	147593.937	NO	1/4 Tonne	AGGRESSIVE	REFER TO NOTE 7.
P10	MC1N	7515	1200-2	2	RCP	30	46.360	R	25.023	2.632	0.440	4.076	50843.152	147732.263	NO	NO	NONE	L	21.338	2.589	0.476	4.186	50844.229	147777.593	NO	1/4 Tonne	AGGRESSIVE	REFER TO NOTE 7.
CUR	MC31	1613	600-2	1	RCP	50	68.320	R	34.660	3.800	0.417	2.180	47400.095	146124.695	NO	NO	NONE	L	33.659	3.450	0.478	2.362	47446.667	146174.680	NO	NONE	AGGRESSIVE	
CPB	MCV1	29	450-2	1	RCP	-7	31.720	R	14.312	2.750	0.566	2.168	50936.260	147837.122	NO	YES	NONE	L	17.408	2.460	0.455	1.837	50904.988	147831.811	NO	FACING	AGGRESSIVE	
CPS	MCP1	124	450-3	1	RCP	0	21.960	L	10.045	4.200	0.467	1.872	49004.680	147257.409	NO	YES	NONE	R	11.915	4.140	0.300	1.371	48982.720	147257.409	NO	FACING	AGGRESSIVE	REFER TO NOTE 7.
CPSE	MCP1	394	375-3	2	RCP	0	36.600	R	19.169	4.921	0.437	1.518	48977.699	146992.292	NO	NO	NONE	L	17.431	4.804	0.549	1.855	49014.294	146991.673	NO	NONE	AGGRESSIVE	
CPS2	MCP1	315	450-3	1	RCP	0	19.520	R	9.780	5.171	0.300	1.371	49006.483	147066.301	NO	NO	NONE	L	9.740	5.120	0.300	1.371	48986.964	147066.297	NO	NONE	AGGRESSIVE	REFER TO NOTE 7.
CGNH1	MC1N	1340	450-3	1	RCP	0	19.520	L	9.760	8.408	0.300	1.371	47312.670	143964.845	YES	NO	NONE	R	9.760	8.357	0.300	1.371	47329.146	143954.378	YES	NONE	AGGRESSIVE	REFER TO NOTE 7

ROCK CLASS	ROCK THICKNESS	LENGTH OF ROCK
NONE	-	-
FACING	500	3000
LIGHT	750	3000
¼ TONNE	1000	5000

△1

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. FOR ROCK PROTECTION TYPE DETAILS REFER TO TECHNICAL SPECIFICATION 406.
3. FOR BEDDING AND BACKFILL REFER TO SPECIFICATION 404 MRWA STANDARD DRAWING 200131-062 AND MANUFACTURERS INSTRUCTIONS.
4. FOR DETAILS ON OPEN DRAINS REFER TO MAIN ROADS GUIDELINE DRAWING 9831-5498.
5. OPEN DRAINS WITHIN THIS SCHEDULE MAY BE OMITTED WHERE THE CONTRACTOR HAS SUITABLY REGRADED QUADRANTS TO FLOW TOWARDS OUTLET CULVERTS.
6. AGGRESSIVE GROUND CONDITIONS HAVE BEEN SPECIFIED FOR THOSE PIPES ANTICIPATED TO BE SUBJECTED TO FREQUENT INUNDATION. MARINE GRADE PIPE TO BE USED IN THESE INSTANCES. REFER TO REPORT RD-150-REP-001 FOR FURTHER DETAILS.
7. CULVERTS P4, P7, P9, P10, CPS, CGNH1 AND CPS2 SHALL HAVE VERTICAL CONSTRUCTION TOLERANCE OF +10/-0 MM AT THE INLET AND +0/-10 MM AT THE OUTLET.

LOCAL AUTHORITY
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INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
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PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
CULVERT SCHEDULE (RD150)

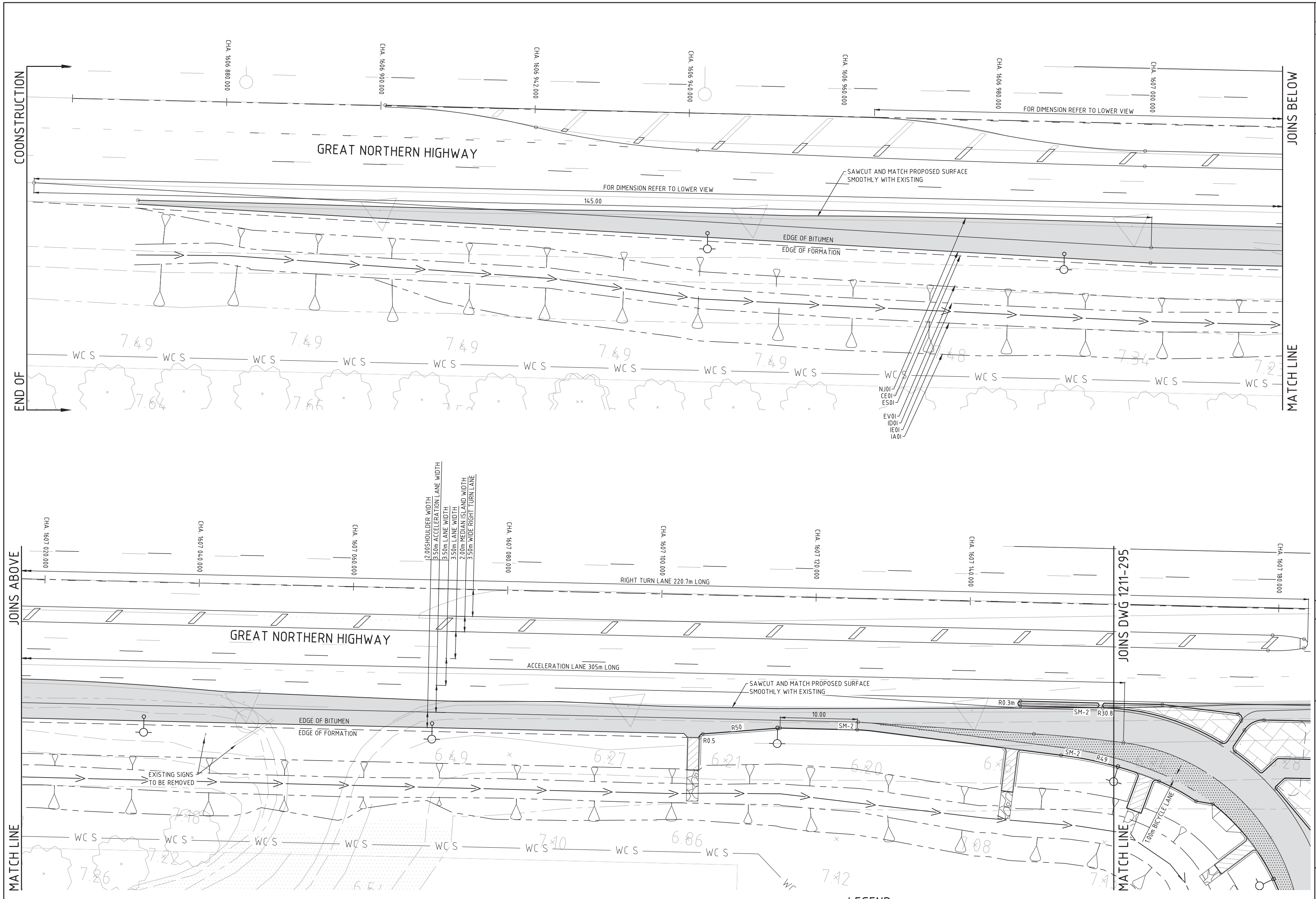
SHEET SIZE A3

PROJECT GN
DESIGN LOT RD150
DRAWING No. 135
REV 1

P:\P11120 GREAT NORTHERN HWAY - MACMAHON\100 DRAWINGS\RD150\AutoCad\GN-RD-150-135.dwg, 30/08/2013 1:57:12 PM

APPENDIX G

Pritchard Francis (2014) Precinct 3 Business Park GNH Intersection Plan & Drain cross-sections



LEGEND

EXISTING CENTRELINE OF GREAT NORTHERN HWY

SEALED ROAD EDGE

SEMI-MOUNTABLE KERB SM-2(40) AND TANGENT POINT

NEW CULVERT

OPEN DRAIN

PEDESTRIAN RAMP TYPE 'A'

WC S PROPOSED SEWER PRESSURE MAIN

KERB BREAK

ROCK PROTECTION

BRICK PAVING

40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX

40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX WITH 2% RED OXIDE

EXISTING ROAD TO BE REHABILITATED

DIAL 1100 DIAL BEFORE YOU DIG PERTH ONE CALL SYSTEM

E:\WORKING\2011\11-125\CIVIL

AMENDMENTS

No.	DESCRIPTION	APPROVED & DATE
B	ISSUED FOR FINAL REVIEW	31/07/12
C	REVISED TO INCLUDE ACCELERATION LANE AND TRAFFIC ISLANDS	11/02/13
D	MODIFIED GNH RAISED MEDIAN, ADDED STREET LIGHTING & DIMENSIONS; MODIFIED OPEN DRAIN	4/07/13
E	ISSUED FOR FINAL REVIEW	19/08/13
F	REVISED ACCELERATION LANE	13/09/13
0	ISSUED FOR CONSTRUCTION	16/10/13
1	REVISED OPEN DRAIN	16/04/14
2	REVISED LIGHTING AND OPEN DRAIN	13/05/14

NOTES

1. REFER TO 3D MODEL OUTPUT AND REPORTS FOR SETOUT DETAILS
2. DESIGN BASED UPON :
   REFERENCE: "96976T - 96976de-010H"
   BY "McMULLEN NOLAN"
3. HORIZONTAL DATUM: PHG94
   MAP PROJECTION ZONE 50
   VERTICAL DATUM AHDM
4. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE NOTED
5. ALL LEVELS ARE DESIGNED TO THE TOP OF PAVEMENT
6. ALL BATTERS ARE TO BE 1 IN 4 UNLESS NOTED OTHERWISE
7. ANY GUIDEPOSTS AFFECTED BY WORKS TO BE RELOCATED TO EDGE OF NEW SHOULDER.
8. ALL SERVICES TO BE VERIFIED USING 'POT HOLING' AND RELEVANT SERVICE PROVIDERS NOTIFIED PRIOR TO CONSTRUCTION.
9. DESIGN VEHICLE IS A 27.5m B-DOUBLE TRUCK WITH A 20m TURNING TEMPLATE RADII
10. FOR TYPICAL CROSS SECTIONS AND DETAILS REFER TO DRG No 1211-0302
11. FOR CULVERT AND DRAINAGE INFORMATION REFER TO DRG No's 1211-301 AND 1211-303
12. FOR HIGHWAY INFORMATION REFER TO DRG No 1211-293
13. FOR CROSS SECTIONS REFER TO DRG No's 1211-297 AND 1211-298
14. FOR SIDE ROAD INFORMATION REFER TO DRG No's 1211-294 AND 1211-299
15. FOR SIGNS AND PAVEMENT MARKING INFORMATION REFER TO DRG No 1211-300
16. FOR STREET LIGHT INFORMATION REFER TO DRG No's 1311-1406 TO 1311-1409

METADATA

GROUND SURVEY STANDARD: PHG94
DATE OF CAPTURE:
MAPPING SURVEY STANDARD:
DATE OF CAPTURE:
MAIN ROADS PROJECT ZONE: Z50
HEIGHT DATUM: AHD

pritchard francis
civil and structural
engineering consultants

Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au
ACN: 008 891 094

DRAWING NUMBER/DOCUMENT ID
DESIGNED / DRAWN MJC
VERIFIED RF
DIRECTOR CJ

Government of
Western Australia

mainroads
WESTERN AUSTRALIA

PLANNING AND TECHNICAL SERVICES DIRECTORATE
REGIONAL SERVICES DIRECTORATE
ROAD AND TRAFFIC ENGINEERING BRANCH
PILBARA REGION
WATERLOO CRESCENT
BRAND ST, SOUTH HEDLAND
Telephone (08) [illegible]
Fax (08) [illegible]

SCALES 1:250
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A1

MRWA FILE NUMBER

APPROVED (MRWA)

GREAT NORTHERN HIGHWAY (H006)

PRECINCT 3 - ROAD 1 INTERSECTION
SLK 1607.2

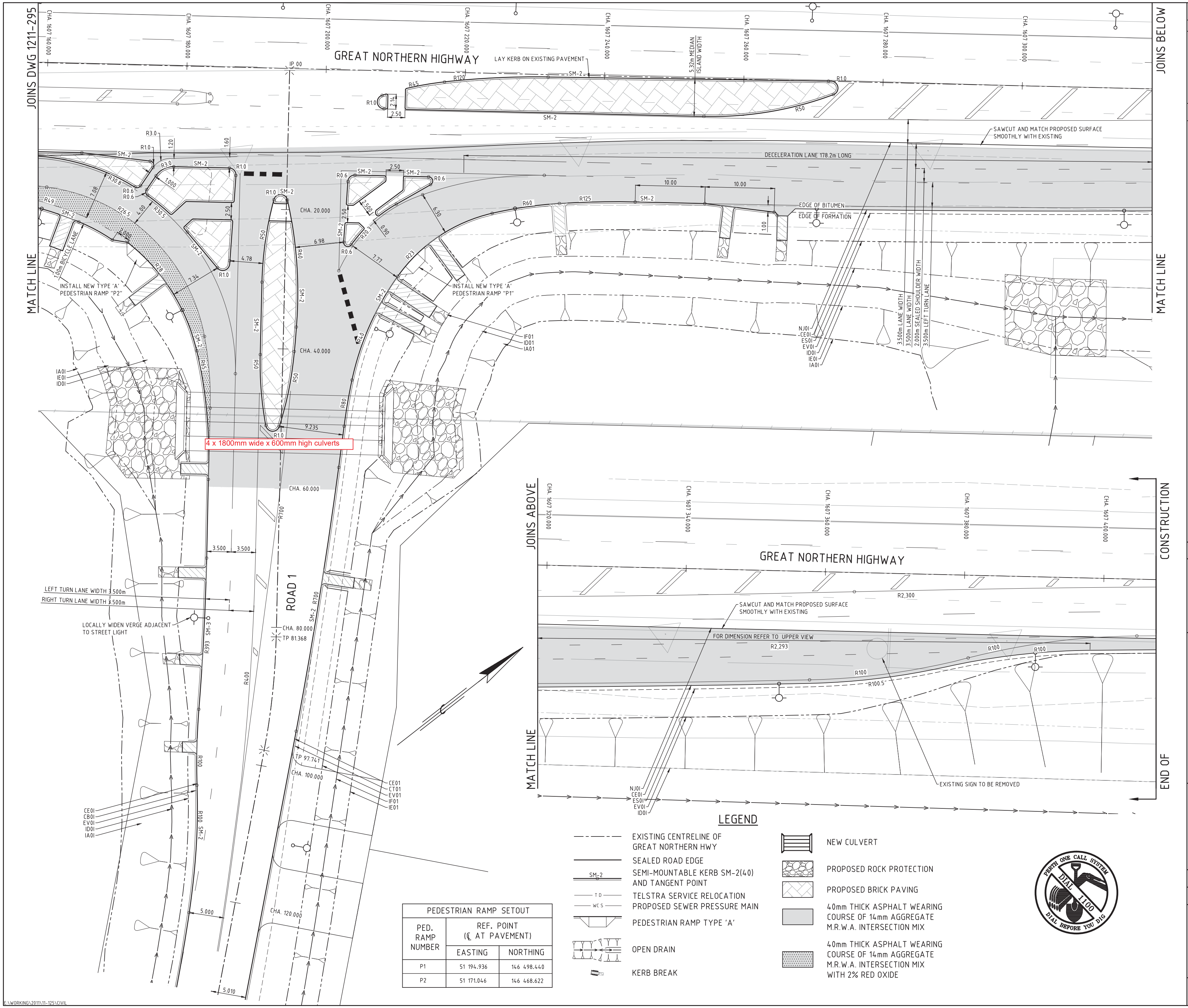
INTERSECTION PLAN - GNH

SHEET 1 OF 2

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)

MRWA DRAWING NUMBER
1211-295

2



LEGEND

— · — · —	EXISTING CENTRELINE OF GREAT NORTHERN HWY
———	SEALED ROAD EDGE
SM-2	SEMI-MOUNTABLE KERB SM-2(40) AND TANGENT POINT
— T D —	TELSTRA SERVICE RELOCATION
— WC S —	PROPOSED SEWER PRESSURE MAIN
	PEDESTRIAN RAMP TYPE 'A'
	OPEN DRAIN
	KERB BREAK
	NEW CULVERT
	PROPOSED ROCK PROTECTION
▨	PROPOSED BRICK PAVING
▒	40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX
░	40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX WITH 2% RED OXIDE

PEDESTRIAN RAMP SETOUT

PED. RAMP NUMBER	REF. POINT (℄ AT PAVEMENT)	
	EASTING	NORTHING
P1	51 194.936	146 498.440
P2	51 171.046	146 468.622

AMENDMENTS

No.	DESCRIPTION	APPROVED & DATE
C	REVISED TO INCLUDE ACCELERATION LANE AND TRAFFIC ISLANDS	11/02/13
D	MODIFIED GNH RAISED MEDIAN, ADDED STREET LIGHTING & DIMENSIONS; MODIFIED OPEN DRAIN	04/07/13
E	ISSUED FOR FINAL REVIEW	19/08/13
F	REVISED ACCELERATION LANE	13/09/13
G	ADDED KERB OPENINGS	24/09/13
0	ISSUED FOR CONSTRUCTION	16/10/13
1	REVISED OPEN DRAIN	16/04/14
2	REVISED LIGHTING AND OPEN DRAIN	13/05/14

NOTES

1. REFER TO 3D MODEL OUTPUT AND REPORTS FOR SETOUT DETAILS
2. DESIGN BASED UPON :
   REFERENCE: "96976T - 96976de-010H"
   BY "McMULLEN NOLAN"
3. HORIZONTAL DATUM: PHG94
   MAP PROJECTION ZONE 50
   VERTICAL DATUM AHDM
4. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE NOTED
5. ALL LEVELS ARE DESIGNED TO THE TOP OF PAVEMENT
6. ALL BATTERS ARE TO BE 1 IN 4 UNLESS NOTED OTHERWISE
7. ANY GUIDEPOSTS AFFECTED BY WORKS TO BE RELOCATED TO EDGE OF NEW SHOULDER.
8. ALL SERVICES TO BE VERIFIED USING 'POT HOLING' AND RELEVANT SERVICE PROVIDERS NOTIFIED PRIOR TO CONSTRUCTION.
9. DESIGN VEHICLE IS A 27.5m B-DOUBLE TRUCK WITH A 20m TURNING TEMPLATE RADII
10. FOR TYPICAL CROSS SECTIONS AND DETAILS REFER TO DRG No 1211-0302
11. FOR CULVERT AND DRAINAGE INFORMATION REFER TO DRG No's 1211-301 AND 1211-303
12. FOR HIGHWAY INFORMATION REFER TO DRG No 1211-293
13. FOR CROSS SECTIONS REFER TO DRG No's 1211-297 AND 1211-298
14. FOR SIDE ROAD INFORMATION REFER TO DRG No's 1211-294 AND 1211-299
15. FOR SIGNS AND PAVEMENT MARKING INFORMATION REFER TO DRG No 1211-300
16. FOR STREET LIGHT INFORMATION REFER TO DRG No's 1311-1406 TO 1311-1409

METADATA

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DATE OF CAPTURE:
MAPPING SURVEY STANDARD:
DATE OF CAPTURE:
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HEIGHT DATUM: AHD

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SCALES 1:250
0 2.5m 5 7.5 10 12.5 15 17.5 20 22.5 25 27.5 30 32.5 35 37.5
A1

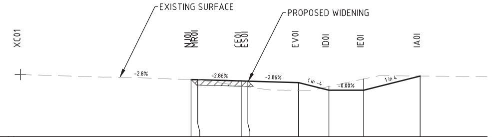
MRWA FILE NUMBER
APPROVED (MRWA)

GREAT NORTHERN HIGHWAY (H006)

PRECINCT 3 - ROAD 1 INTERSECTION
SLK 1607.2

INTERSECTION PLAN - GNH

SHEET 2 OF 2
LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)
MRWA DRAWING NUMBER
1211-296 2



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PROPOSED		7.299 7.285	7.192 7.177	7.069	6.500	6.500	7.557
EXISTING SURFACE	7.673	7.299 7.285	6.824 6.753	6.499	6.780	7.342	7.562
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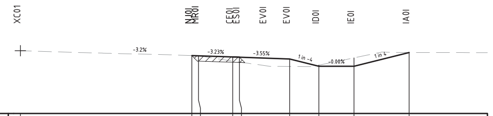
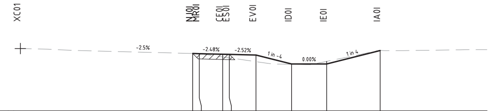
CHAINAGE 1606 960.0



DATUM 3

PROPOSED		7.318 7.300	7.217 7.200	7.066	6.520	6.520	7.549
EXISTING SURFACE	7.681	7.318 7.300	6.912 6.839	6.506	6.603	7.147	7.550
OFFSET	0.000	12.844 13.344	15.912 16.413	20.179	22.369	24.996	29.127

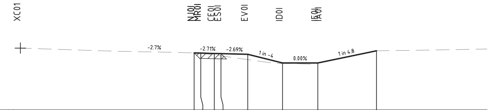
CHAINAGE 1606 940.0



DATUM 3

PROPOSED		7.326 7.313	7.270 7.257	7.207	6.540	6.540	7.543
EXISTING SURFACE	7.693	7.326 7.313	7.067 6.997	6.712	6.520	6.735	7.543
OFFSET	0.000	12.924 13.424	15.176 15.677	17.678	20.343	22.977	26.987

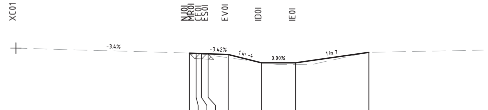
CHAINAGE 1606 920.0



DATUM 3

PROPOSED		7.319 7.305	7.277 7.264	7.213	6.560	6.560	7.475
EXISTING SURFACE	7.682	7.319 7.307	7.163 7.094	6.817	6.521	6.572	7.475
OFFSET	0.000	13.035 13.535	14.552 15.052	17.054	19.663	22.313	26.709

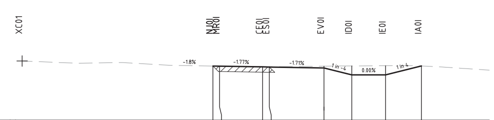
CHAINAGE 1606 900.0



DATUM 3

PROPOSED		7.297 7.280 7.267 7.249	7.198	6.580	6.580	7.360
EXISTING SURFACE	7.675	7.297 7.280 7.226 7.158	6.953	6.612	6.450	7.360
OFFSET	0.000	12.992 13.492 13.892 14.392	15.898	18.38	20.931	26.417

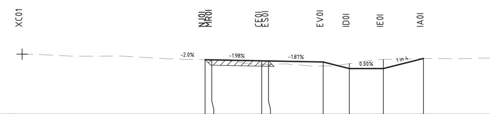
CHAINAGE 1606 880.0



DATUM 3

PROPOSED		7.071 7.063	7.005 6.997	6.926	6.404	6.404	7.074
EXISTING SURFACE	7.444	7.071 7.063	7.029 7.029	7.062	7.078	7.098	7.074
OFFSET	0.000	14.288 14.788	18.014 18.514	22.614	24.701	27.234	29.916

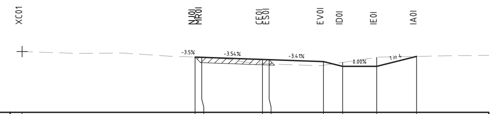
CHAINAGE 1607 060.0



DATUM 3

PROPOSED		7.086 7.074	7.000 6.990	6.913	6.424	6.424	7.176
EXISTING SURFACE	7.498	7.084 7.074	6.743 6.731	6.620	6.795	7.105	7.176
OFFSET	0.000	13.708 14.209	17.954 18.454	22.554	24.51	27.057	30.066

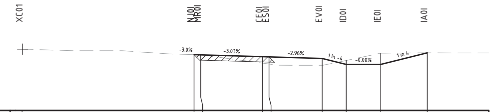
CHAINAGE 1607 040.0



DATUM 3

PROPOSED		7.136 7.119	6.958 6.941	6.802	6.443	6.443	7.191
EXISTING SURFACE	7.553	7.136 7.119	6.675 6.646	6.522	6.736	7.121	7.191
OFFSET	0.000	12.974 13.474	18.022 18.522	22.599	24.034	26.595	29.586

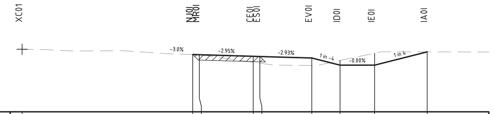
CHAINAGE 1607 020.0



DATUM 3

PROPOSED		7.201 7.186	7.046 7.031	6.913	6.461	6.461	7.335
EXISTING SURFACE	7.613	7.202 7.186	6.563 6.495	6.400	6.760	7.309	7.335
OFFSET	0.000	12.891 13.391	18.018 18.519	22.506	24.311	26.888	30.385

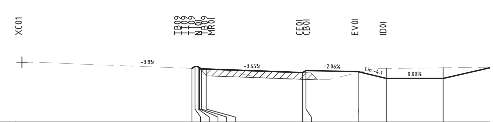
CHAINAGE 1607 000.0



DATUM 3

PROPOSED		7.271 7.256	7.137 7.123	7.009	6.480	6.480	7.467
EXISTING SURFACE	7.660	7.271 7.256	6.692 6.622	6.455	6.824	7.368	7.467
OFFSET	0.000	12.792 13.292	17.331 17.831	21.726	23.841	26.432	30.383

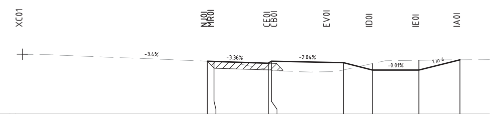
CHAINAGE 1606 980.0



DATUM 3

PROPOSED		7.062 7.212 7.175 7.040 7.025 7.021	6.747 6.897	6.816	6.303	6.303
EXISTING SURFACE	7.539	7.063 7.055 7.042 7.040 7.028 7.009	6.235 6.235	6.774	7.057	7.111
OFFSET	0.000	12.719 12.949 13.191 13.293 13.422 13.793	21.015 21.253	25.17	27.273	31.529

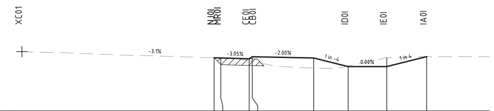
CHAINAGE 1607 160.0



DATUM 3

PROPOSED		6.981 6.961	6.832 6.982	6.872	6.324	6.323	7.084
EXISTING SURFACE	7.501	6.981 6.950	6.352 6.306	6.329	6.804	7.052	7.084
OFFSET	0.000	13.871 14.372	18.437 18.669	24.069	26.232	29.706	32.781

CHAINAGE 1607 140.0



DATUM 3

PROPOSED		7.004 6.988	6.925 7.075	6.983	6.339	6.339	7.086
EXISTING SURFACE	7.458	7.004 6.982	6.768 6.724	6.247	6.379	7.002	7.086
OFFSET	0.000	14.38 14.88	17.003 17.233	21.837	24.411	27.3	30.288

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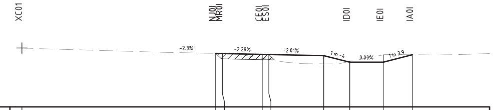

DATUM 3

PROPOSED		7.025 7.015	6.947 6.936	6.854	6.366	6.366	6.924
EXISTING SURFACE	7.428	7.025 7.015	6.651 6.567	6.231	6.423	6.912	6.925
OFFSET	0.000	14.502 15.002	17.984 18.484	22.584	24.537	27.04	29.212

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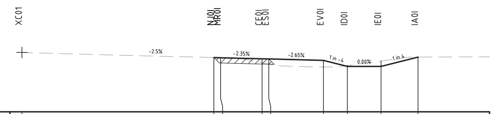

DATUM 3

PROPOSED		7.042 7.027	6.954 6.941	6.833	6.385	6.385	7.078
EXISTING SURFACE	7.421	7.045 7.028	6.653 6.551	6.342	6.446	6.788	7.078
OFFSET	0.000	14.366 14.866	17.969 18.469	22.569	24.359	26.877	29.649

CHAINAGE 1607 080.0

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AMENDMENTS

No.	DESCRIPTION	APPROVED & DATE
B	AECOM: ISSUED FOR FINAL REVIEW	31/07/12
C	ISSUED FOR MRWA REVIEW	30/10/12
D	REVISED TO INCLUDE ACCELERATION LANE AND TRAFFIC ISLANDS	11/02/13
E	REVISED DESIGN	04/07/13
F	ISSUED FOR FINAL REVIEW	19/08/13
G	AMENDED CHAINAGES	13/09/13
0	ISSUED FOR CONSTRUCTION	16/10/13
1	REVISED OPEN DRAINAGE	16/04/14
2	REVISED OPEN DRAIN ADJACENT CH. 6940	13/05/14

NOTES

METADATA

GROUND SURVEY STANDARD:
DATE OF CAPTURE:
MAPPING SURVEY STANDARD:
DATE OF CAPTURE:
MAIN ROADS PROJECT ZONE:
HEIGHT DATUM: AHD

pritchard francis
civil and structural
engineering consultants
Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
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Telephone (08) 9172 8877
BRAND ST, STH HEDLAND
Fax (08) 9140 1076

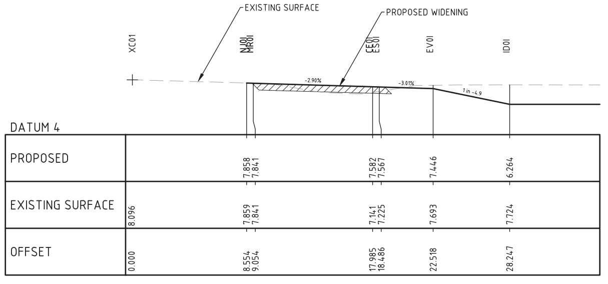
SCALES 1:200
A
1

MRWA FILE NUMBER

APPROVED (MRWA)

GREAT NORTHERN HIGHWAY (H006)
PRECINCT 3 - ROAD 1 INTERSECTION
SLK 6880 - SLK 7160
CROSS SECTIONS - GNH
SHEET 1 OF 2

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)
MRWA DRAWING NUMBER
1211-297 2



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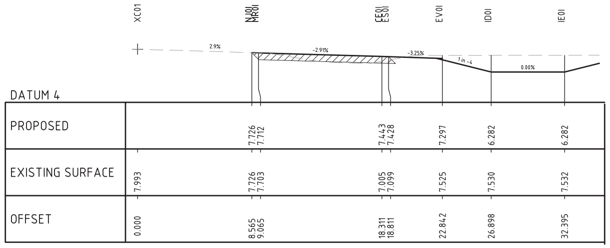

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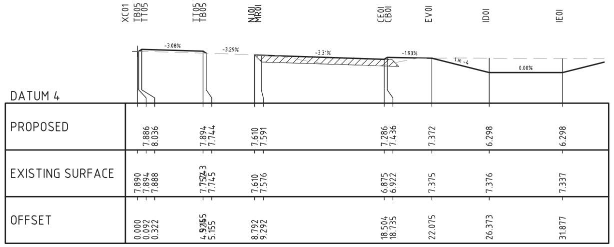

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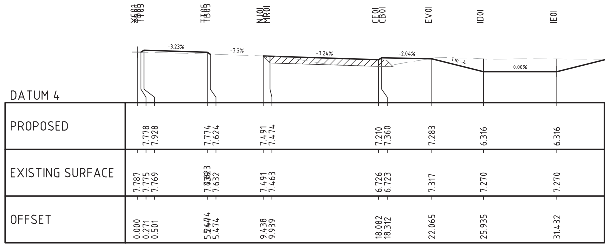

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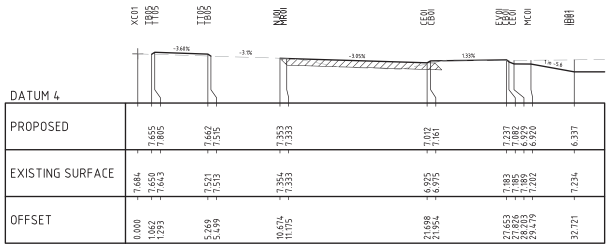

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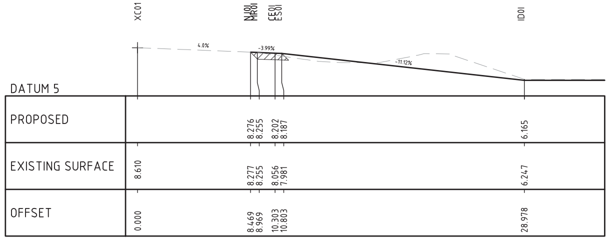

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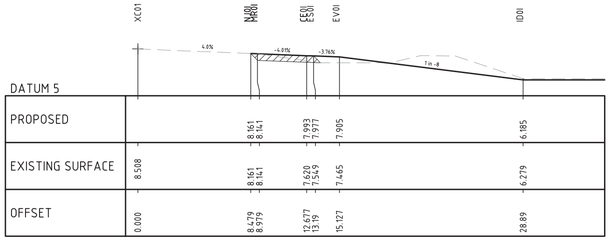

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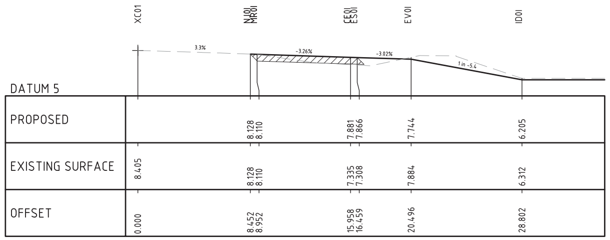

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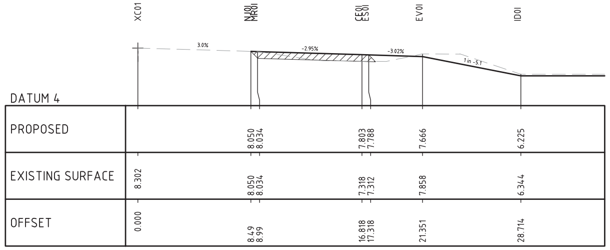

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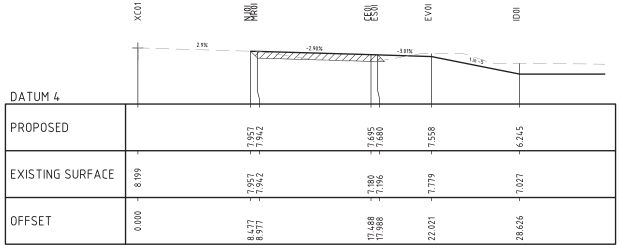

CHAINAGE 1607 320.0

AMENDMENTS

No.	DESCRIPTION	APPROVED & DATE
A	AECOM: ISSUED FOR MRWA REVIEW	21/06/12
B	AECOM: ISSUED FOR FINAL REVIEW	31/07/12
C	ISSUED FOR MRWA REVIEW	30/10/12
D	REVISED TO INCLUDE ACCELERATION LANE AND TRAFFIC ISLANDS	11/02/13
E	REVISED DESIGN	04/07/13
F	ISSUED FOR FINAL REVIEW	19/08/13
G	AMENDED CHAINAGES	13/09/13
0	ISSUED FOR CONSTRUCTION	16/10/13
1	REVISED OPEN DRAINAGE	16/04/14

NOTES

METADATA

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DATE OF CAPTURE:
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HEIGHT DATUM: AHD

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civil and structural engineering consultants

Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
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DIRECTOR CJ

Government of Western Australia
mainroads WESTERN AUSTRALIA
[illegible]
ROAD AND TRAFFIC ENGINEERING BRANCH
[illegible]

SCALES 1:200
A1

MRWA FILE NUMBER
APPROVED (MRWA)

GREAT NORTHERN HIGHWAY (H006)
PRECINCT 3 - ROAD 1 INTERSECTION
SLK 7220 - SLK 7400
CROSS SECTIONS - GNH
SHEET 2 OF 2

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)

MRWA DRAWING NUMBER
1211-298 1

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APPENDIX H

Technical Note:
Post Development XP-Storm Stormwater Modelling (JDA, 2023)

Hedland Junction, Wedgefield LWMS

Post Development XP-Storm Stormwater Modelling

Prepared for Development WA

TECHNICAL NOTE

(24 January 2023)

1 INTRODUCTION

As part of the works for the LWMS and UWMPs for Hedland Junction, Wedgefield, Figure 1, JDA developed a XP-Storm hydraulic model for the simulation of stormwater runoff.

1.1 BACKGROUND

A hydraulic model to simulate post development flow conditions at Wedgefield Transport Development Area (TDA) and Light Industrial Areas (LIAs) was first developed in 2010 as part of the original LWMS for the Study Area (JDA, 2011).

Stages 1, 2 and 3 of the TDA has since been constructed. LIA2 and LIA3 have been constructed.

The hydraulic model has been updated to include as constructed drainage infrastructure, as well as incorporate the revised Structure Plan. This Technical Note describes the updated hydraulic model.

1.2 MODEL PURPOSE

The main purpose of the stormwater hydraulic model is to allow design of the stormwater drainage infrastructure required to convey flows up to the 1% AEP event. The modelling also provides 1% AEP event flood elevations, used to set finished floor levels (FFLs) for lots. In addition to the 1% AEP event (for flood protection), the modelling includes the 10% AEP event (for minor flow conveyance) and the 1EY / first 15 mm rainfall (small event management).

1.3 MODEL DEFINITION

The model extent, Figure 5, includes the whole of the LWMS area, taking into account any upstream catchment areas and the downstream flowpaths. The TDA northeast of Pinga St drains to the northern tidal flats of Taylor Inlet via culverts under the Great Northern Hwy. The LIA south of Powell Rd and south west of Pinga St drains north westerly, north of the railway line, to South Creek. These flowpaths are included in the stormwater model.

2 MODEL CONCEPTUALISATION

The hydraulic model is primarily defined by the surface water catchments, endeavouring to maintain existing flow paths and discharge points. External, upstream catchments are included in the model definition, with connection points via existing culverts or floodways. Flow conveyance is via overland flow in swale drains, with primary objectives of flow discharge to minimise flood levels, minimise flow velocity to lower risk of erosion, and retention of the first 15mm for water quality objectives.

2.1 CONSTRAINTS

2.1.1 Topography

The pre development natural surface was mapped initially by feature survey (by Whelans in 2008 and 2009) and then by LiDAR (commissioned for the Port Hedland Coastal Vulnerability Study (Cardno, 2011)). Topography is shown in Figure 2.

The southern and western sections of the Study Area generally fall from 9 mAHD north-westwards towards South Creek invert of approximately 4 mAHD.

The northern section of the Study Area is flatter than the southern section at 6 to 7 mAHD, gently falling towards the northern interface of supratidal flats which is etched with small channels and ridges ranging from 3 to 5 mAHD.

In the north-eastern corner of the Study Area, a ridge at 8 to 8.6 mAHD divides the lot, resulting in a small section of the Study Area grading eastward, Figure 2.

Topography determines catchments and subcatchment areas to a degree, to minimise changes in flow direction and fill.

2.1.2 Surface Geology

Regional surface geology within the Study Area is red sandy loam (GSWA, 1964), generally referred to as Pindan Sand. This has a clay component and sands are generally fine to medium grained, sub-angular to sub-rounded quartz, which becomes sealed when dry and waterlogged during heavy rainfall. Geotechnical studies (GHD, 2009) found the Pindan Sands has a fines content of between 17 and 31%. Along the northern margin of the site, the Pindan Sand abuts supratidal deposits of calcareous sand, silt and clay.

Surface geology impacts upon the ability of the native soil to infiltrate rainfall. The high fines content of the Pindan Sand results in a very low infiltration capacity, and hence a high runoff coefficient.

2.1.3 Groundwater

Whilst groundwater is present at the site and may intercept the invert of the drainage swales in the later stages of the wet season, the low hydraulic conductivity of the soil means that seepage of groundwater into the swales will be negligible compared to surface water runoff volumes. Groundwater flows have therefore not been included in modelling.

2.2 MODEL OUTLINE

Based on the above constraints and the design objectives, the model considers the Study Area as two separate catchments, with most of the south western area discharging to the north west to South Creek, with the remainder of the area discharging north east towards the supratidal flats.

Due to the soil type, a large percentage of rainfall would become runoff, requiring conveyance towards the outlets. Volume of runoff would be incompatible for a pit and pipe system, and open swales are preferred, with flatter gradients to reduce flow velocities and risk of erosion.

3 DATA FOR MODEL

3.1 RAINFALL IFD DATA

The fourth edition of *Australian Rainfall and Runoff* (Ball et al., 2019) includes revised design rainfalls from the Bureau of Meteorology from 2016. These revised design rainfalls, BoM (2016), are based on nearly 30 years of additional rainfall data. Data from the ARR Datahub is presented in Table 1 below.

TABLE 1: RAINFALL IFD INTENSITIES, IN MM/HR

Duration	1EY	50% AEP	20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
5 min	69.6	81.3	119	145	171	208	238
6 min	67.3	78.7	115	141	166	202	230
30 min	36.3	42.4	61.8	75.4	89.0	107	121
1 hour	23.8	27.9	40.8	49.8	58.9	71.6	81.7
2 hour	15.1	17.8	26.4	32.6	38.8	47.9	55.1
3 hour	11.5	13.7	20.7	25.7	30.9	38.3	44.3
6 hour	7.34	8.82	13.8	17.5	21.4	26.8	31.2
12 hour	4.69	5.74	9.31	12.0	14.9	18.7	21.9
24 hour	2.95	3.65	6.06	7.90	9.86	12.4	14.6
48 hour	1.77	2.19	3.63	4.71	5.87	7.43	8.69
72 hour	1.27	1.56	2.56	3.29	4.08	5.18	6.05

3.2 SURVEY DATA

Apart from topographic data, there is little additional survey data. There is limited survey of culverts under existing roads, and while there is design data for culverts for Stage 1 of the TDA, JDA has not been provided with as-con survey for all constructed infrastructure. Available data is included as Appendix A.

3.3 AVAILABLE FLOOD DATA

There is no recorded flow or water level data for drainage swales within the Wedgefield area. There are some anecdotal photographs from storm events early in 2022, but the drainage swales were not completely constructed with a functional outlet, and observed water levels were probably higher than they will be after construction.

4 MODEL DEVELOPMENT

4.1 POST DEVELOPMENT HYDROLOGY MODEL

Post development rainfall runoff is modelled using the runoff module in XP-STORM. Runoff is dependent on catchment areas, slope and roughness, with the loss model associated with each land-use type, and routing method.

4.1.1 Catchments

Internal and external stormwater catchments and land-use are shown in Figure 3, with subcatchments shown in Figure 4. Catchment areas for each land use are presented in Appendix B. The different land uses are entered as separate sub-catchments in each model node.

The Laurenson routing method was used for all catchments and land uses within the runoff module of the model. This is a non-linear runoff routing method used to simulate runoff from catchments resulting from each time step of applied rainfall.

Catchment slopes of between 0.002 and 0.005 were used for the catchments, based on estimated slopes within the earthworks model.

4.1.2 Runoff – Loss Model

The loss model applied is consistent with that used in the previously approved LWMS (JDA, 2011), and shown in Table 2, and applied to the rainfall input in the runoff module of the model. The loss model takes into account the nature of the Pindan Sands.

Industrial lots are primarily a combination of roof area and paved or impervious areas (including driveways). Pervious areas are likely to be minimised and left as existing vegetation. Due to the low permeability of the soil type, runoff from pervious areas is also likely to be high. The loss model therefore included 15 mm initial loss, with a proportional loss of 10% (i.e., 90% runoff).

Impervious surfaces (roofs and paved areas) flow to swales within the front of each lot, sized to store the first 15 mm of rainfall. Any overflow from the lot swale will occur as overland flow.

Road reserves are a combination of impervious road surface (~50-70%) and pervious soil verges (~30-50%), often with footpaths. Road reserve verges are unlikely to be landscaped. With the relative impermeability of the soil on site, a proportional loss of 10% (ie 90% runoff coefficient) has been used, with a minimal initial loss of 2 mm (for minor loss in pervious verges).

For the swale drain, a large proportion of the area will function as drainage during storm events and will therefore have some level of inundation. Therefore, a runoff coefficient of 90% (10% proportional loss) has been applied, with no initial loss.

TABLE 2: RUNOFF LOSS MODEL

Land Use	Initial Loss (mm)	Proportional Loss (%)	Manning's Roughness
Industrial Lots	15	10	0.03
Road Reserve	2	10	0.02
Drainage Swales	-	10	0.03

4.2 POST DEVELOPMENT HYDRAULIC MODEL

A post development 1D model was developed using XP-STORM for simulation of the drainage swales and culverts. Figure 5 shows the nodes and links of the model overlaying the subdivision plan. This model covers the stormwater system for the LWMS area.

4.2.1 Tailwater Conditions

The downstream boundary conditions in the supra-tidal flats of Taylor Inlet north of the Great Northern Highway (GNH) and in South Creek have been modelled at constant flood levels, based on regional modelling (Cardno, 2011).

For the Hematite and Anthill Main Swales, the XP-Storm model was extended beyond the Study Area to simulate backwater effects on the Main Swale drains, including the potential Port Authority future development between the Development WA managed land and the realigned Great Northern Highway (GNH). The GNH realignment has a minimum finished level of 4.7 mAHD, with culverts to the supra-tidal flats and ocean inlet creeks installed close to existing invert levels, ranging from 2.7 to 3.0 mAHD (see Appendix B for final design levels).

For 1% AEP rainfall event modelling, a backwater of 4.0 mAHD was applied downstream of the GNH extension culverts across the supra-tidal flats, equating to a service level for Port Hedland tidal and storm surge of a 20 year ARI event in 2010 (see Table 3 below). For the 10% AEP event modelling, the Highest Astronomical Tide (HAT) of 3.6 mAHD was applied as a backwater level.

For the southern Dalton area draining to South Creek, Figure 6, a water level of 5.4 mAHD in South Creek was applied in both minor and major events.

TABLE 3: SUPRA-TIDAL STORM SURGE LEVELS (FROM CARDNO, 2011) TAG POINT 52 (mAHD)

Event AEP	Modelling Horizon		
	2010	2060	2110
2 year ARI (0.5 EY)	3.18	3.67	4.22
10 year ARI (10% AEP)	3.70	4.45 [1]	4.95 [1]
20 year ARI (5% AEP)	4.00 [1]	4.70 [1]	5.20 [1]
50 year ARI (2% AEP)	4.40 [1]	5.00 [1]	5.45 [1]
100 year ARI (1% AEP)	4.72	5.19	5.65
200 year ARI (0.5% AEP)	4.95	5.35 [1]	5.85 [1]
500 year ARI (0.2% AEP)	5.13	5.52	6.13

Note: 1. Value interpolated

4.2.2 External Catchments

For external catchments, there is effective storage on the upstream (south eastern) side of Wallwork Road, with the stage-area-storage relationship defined based on 2010 LiDAR topography. The Main Roads WA culvert under Wallwork Road was installed in October 2014 and has been surveyed. The Wallwork Road sag point near Quarry Road was included in the model as a cross-section based on available survey levels.

4.2.3 Main Swale Design

The main swale drains are the primary conveyors of flow to the downstream outlet, with other drains discharging flow into these swales:

- the drain along Hematite Road,
- the smaller drain along and downstream of Anthill Road, and
- Dalton Rd in the south western catchment (which conveys flow from external catchment to the east).

These drains generally have a base width of between 3 m and 10 m, with 1 in 6 side slopes, and are several metres deep (at downstream outlet points). A Manning's roughness of 0.03 has been applied to the swales, on the assumption that there may be light vegetation on the slopes, with maintenance to ensure no build up of shrubs or dense vegetation.

Longitudinal gradients are generally 1 in 700 to 1 in 1,000 (0.0014 to 0.001 m/m) to ensure flow velocities are less than 1 m/s, to minimise risk of erosion.

Drain crossings result in afflux across each culvert crossing, and therefore dimensions of any crossovers can be quite critical in the impact on upstream flood levels, and therefore needs to be modelled accurately. Crossovers have therefore been modelled for these drains, with a summary of sizing provided later in this document.

A summary of culverts is presented in Tables 4, 6, 7 & 8. A summary of parameters is provided in Table 9.

4.2.4 Minor Swale Design

Many of the swales within the Study Area are classed as minor – these may be conveying flow from upstream swales and catchments, but flows are generally less than 1 m^3/s and flow depths less than 1 m.

Minor swales have either minimal base widths <1 m or are "V" drains, with generally 1 in 6 side slopes. A Manning's roughness coefficient of 0.03 is used for minor swales, on the assumption that there may be light vegetation on the slopes, with maintenance to ensure no build up of shrubs or dense vegetation.

Longitudinal gradients are generally 1 in 700 to 1 in 1,000 (0.0014 to 0.001 m/m) to ensure flow velocities are less than 1 m/s, to minimise risk of erosion.

Minor swales that convey larger flows (1 – 2 m^3/s) may be impacted by crossover sizing, and are modelled. Crossovers in the south western catchment (Dalton) have been modelled, as have crossovers in TDA Stages 2 and 3. Details of installed crossovers in Stage 1 have not been supplied or are not available and have not been modelled. As Stage 1 is at the upstream extent of the TDA catchment, most drains are minor or roadside, and so have only small flow rates. TDA Stages 4 and 5 are north of Quarry Rd and a separate subcatchment to Stages 1 to 3. Crossovers in Stages 4 and 5 will be modelled the UWMP for these stages.

A summary of culverts used is presented in Table 4, 6 and 7 below. A summary of parameters is provided in Table 9.

4.2.5 Roadside Swale Design

Roadside swales are small, located at the top of each subcatchment and have no upstream contributing swales or catchments. Flow in these drains is generally less than 0.5 m depth.

Roadside swale drains are shallow "V" drains, with 1 in 4 side slopes, modelled with a Manning's roughness coefficient of 0.03, and should be maintained to minimise vegetation build up.

4.2.6 Crossovers

Crossovers provide access from the road to a lot, while maintaining stormwater flow in the swales. Crossover culverts in the main swale are included in the hydraulic model and crossover sizes have also been included in the minor swales where the 1% AEP flow is greater than 0.7 m^3/s. Crossover culvert length can greatly impact on the hydraulic grade-line across a culvert. A 30 m wide crossover was assumed sufficient to allow access of traffic to lots. Crossover culverts were therefore modelled with a 30 m length. Culvert sizes were adjusted as part of the modelling process to minimise flood elevation gain across culverts (afflux) to minimise impact on upstream flood elevations. Final crossover culvert sizes are detailed in Tables 5, 6 and 8 below. If lot purchasers require multiple crossovers, or culvert lengths longer than 30 m, these will need to be modelled to assess upstream impact on flood levels. Crossovers for TDA Stages 4 and 5 and Anthill Swale will be detailed in future UWMPS for these areas.

TABLE 4: MODELLED CULVERT DETAILS – HEMATITE MAIN SWALE CATCHMENT CULVERTS

Location	Link ID	Upstream Node ID	Culvert Size (mm)	Length (m)	Upstream Invert (mAHD)	Downstream Invert (mAHD)
Phosphorus Rd Culvert	Link92	1Cd	1 x 600 x 1200	16.8	5.79	5.70
Tailings Elbow Culvert 1	Link87	d5	3 x 450 x 1200	27.0	5.38	5.28
Tailings Elbow Culvert 2	Link111	d24	1 x 450 x 1200	43.2	5.94	5.92
Tailings Elbow Culvert 3	Link121	d28	1 x 375 x 1200	46.8	5.59	5.17
Tailings Elbow Culvert 4	Link147	2Hc	1 x 375 x 1200	19.2	5.45	5.30
Tailings Elbow Culvert 5	Link129	d33	1 x 375 x 1200	45.6	5.40	5.30
Tailings Elbow Culvert 6	Link135	2Hf	4 x 375 x 1200	16.8	5.11	4.96
Furnace Road Culvert 1	Link113	Fa	3 x 450 x 1200	48.0	4.78	4.72
Quarry Road Culvert 1	Link138	2Jb	3 x 600 x 1200	20.4	5.14	5.00
Quarry Road Culvert 2	Link140	d40	3 x 600 x 1200	40.2	4.54	4.43
Quarry Road Culvert 3	Link132	d30	3 x 750 x 1200	50.4	4.50	4.42
Quarry Road Culvert 4	Link318	d40	3 x 600 x 1200	51.6	4.41	4.38
Future Road Culvert 1	Link170	f6d	3 x 450 x 1200	30.0	4.79	4.76
Future Road Culvert 2	Link181	d80	3 x 450 x 1200	30.0	4.52	4.49
Future Road Culvert 3	rd	f7b	3 x 450 x 1200	30.0	4.49	4.46
Future Road Culvert 4	Link296	Node262	2 x 600 x 1200	20.0	4.27	4.25
Future Road Culvert 5	fL6.1	d60	5 x 750 x 1200	30.0	4.25	4.00
Pinga Street Culvert 1	culvLinkRd	td6.2	1 x 450	24.9	6.90	6.85
Powell Road Culvert 1	GNHcul3	fext3fLIA	1 x 450	30.0	6.69	6.68
Wallwork Road Culvert 1	Link247	MROut	2 x 600	30.0	6.41	6.32
Wallwork Road Culvert 2	cGNH1b	Culv1DS	2 x 300 x 1200	10.1	6.44	6.44
Hematite Road Culvert 1	Link98	1Bb	1 x 450 x 1200	16.8	5.62	5.58
Hematite Road Culvert 2	Link99	1Ba	1 x 600	19.2	5.45	5.40
Hematite Road Culvert 3	Link82	1Da	1 x 450 x 1200	19.2	5.03	5.02
Hematite Road Culvert 4	Link125	2Ga	1 x 375 x 1200	19.2	4.60	4.50
Hematite Road Culvert 5	Link300	Node265	3 x 600 x 1200	20.0	3.93	3.91
Hematite Road Culvert 6	Fcul	Fculv	6 x 900 x 1200	40.0	3.54	3.50

TABLE 5: MODELLED CULVERT DETAILS – HEMATITE MAIN SWALE CATCHMENT CROSSOVERS

Location	Link ID	Upstream Node ID	Culvert Size (mm)	Length (m)	Upstream Invert (mAHD)	Downstream Invert (mAHD)
Phosphorus Way Crossover 1 (Lot 319)	Link342	Node304	4 x 600 x 1200	30.0	5.33	5.30
Tailings Elbow Crossover 1 (Lot 320)	Link338	Node303	4 x 600 x 1200	30.0	5.20	5.175
Tailings Elbow Crossover 2 (Lot 321)	Link340	Node301	4 x 600 x 1200	30.0	5.155	5.13
Tailings Elbow Crossover 4 (Lot 324)	Link325	Node287	3 x 450 x 1200	9.0	5.01	5.00
Furnace Road Crossover 1 (Lot 325)	Link343	Node305	2 x 600 x 1200	30.0	5.07	5.04
Furnace Road Crossover 2 (Lot 322)	Link345	2Gb	2 x 600 x 1200	30.0	5.02	4.99
Quarry Road Crossover 1 (Lot 319)	Link346	Node309	3 x 600 x 1200	30.0	5.23	5.19
Quarry Road Crossover 2 (Lot 324)	Link328	Node289	5 x 750 x 1200	18.0	4.885	4.865
Quarry Road Crossover 3 (Lot 324)	Link330	Node291	5 x 750 x 1200	18.0	4.84	4.82
Quarry Road Crossover 4 (Lot 323)	Link337	2Ha	3 x 900 x 1200	30.0	4.74	4.665
Quarry Road Crossover 5 (Lot 352)	Link332	Node293	3 x 600 x 1200	30.0	4.88	4.85
Quarry Road Crossover 6 (Lot 351)	Link334	Node295	3 x 600 x 1200	30.0	4.83	4.80
Quarry Road Crossover 7 (Lot 350)	Link336	Node297	3 x 600 x 1200	30.0	4.71	4.65
Hematite Road Crossover 1 (Lot 332)	Link100	d2	3 x 450 x 1200	23.0	5.40	5.29
Hematite Road Crossover 2 (Lot 333)	Link304	Node268	4 x 600 x 1200	30.0	5.17	5.14
Hematite Road Crossover 3 (Lot 340)	Link306	Node270	4 x 600 x 1200	30.0	5.11	5.08
Hematite Road Crossover 4 (Lot 349)	Link 309	Node272	5 x 600 x 1200	30.0	4.92	4.87
Hematite Road Crossover 5 (Lot 348)	Link114.2	d21u.1	6 x 750 x 1200	30.0	4.67	4.65
Hematite Road Crossover 6 (Lot 347)	Link311	Node274	6 x 900 x 1200	30.0	4.57	4.54
Hematite Road Crossover 7 (Lot 346)	Link116.1	d38	6 x 900 x 1200	30.0	4.40	4.35
Hematite Road Crossover 8	Link313	Node276	8 x 900 x 1200	30.0	4.17	4.13
Hematite Road Crossover 9	Link315	Node278	8 x 900 x 1200	30.0	4.10	4.06
Hematite Road Crossover 10	Link317	Node264	8 x 900 x 1200	30.0	3.91	3.88

TABLE 6: MODELLED CULVERT DETAILS – ANTHILL MAIN SWALE CATCHMENT CULVERTS

Location	Link ID	Upstream Node ID	Culvert Size (mm)	Length (m)	Upstream Invert (mAHD)	Downstream Invert (mAHD)
Schillaman St Culvert 1	culSch	g4g5.4	3 x 450 x 1200	14.0	4.45	4.40
Schillaman St Culvert 2	Link322	g5.1	2 x 600 x 1200	50.0	4.31	4.18
Anthill St Culvert 1	Gcul	Gculv	3 x 900 x 1200	25.0	3.61	3.60
Anthill St Crossover 1	AntHill1	Lot332	2 x 450 x 1200	12.0	5.10	5.09

TABLE 7: MODELLED CULVERT DETAILS – DALTON MAIN SWALE CATCHMENT CULVERTS

Location	Link ID	Upstream Node ID	Culvert Size (mm)	Length (m)	Upstream Invert (mAHD)	Downstream Invert (mAHD)
Future Road 1 Culvert 1	Link158	Catch13	2 x 900 x 1200	30.0	7.366	7.328
Future Road 1 Culvert 2	Link218	Node187	4 x 900 x 1200	30.0	6.726	6.689
Future Road 1 Culvert 3	Link209	Node170	5 x 900 x 1200	50.0	6.689	6.614
Wallwork Road Culvert 1	WallwCulv	d59	2 x 300 x 1200	20.0	8.98	8.95
Powell Road Culvert 1	Link195	Node156	2 x 900 x 1200	60.0	6.395	6.32
Future Dalton Road Culvert 1	Link212	CM8	3 x 900 x 1200	50.0	6.777	6.714
Future Dalton Road Culvert 2	Link194	Node155	2 x 900 x 1200	30.0	6.382	6.345
Future Dalton Road Culvert 3	Link197	S10	7 x 900 x 1200	50.0	6.32	6.30

TABLE 8: MODELLED CULVERT DETAILS – DALTON MAIN SWALE CATCHMENT CROSSOVERS

Location	Link ID	Upstream Node ID	Culvert Size (mm)	Length (m)	Upstream Invert (mAHD)	Downstream Invert (mAHD)
Future Road 1 Crossover 1	Link154	Node146	2 x 600 x 1200	30.0	7.516	7.478
Future Road 1 Crossover 2	Link156	Node148	2 x 600 x 1200	30.0	7.453	7.416
Future Road 1 Crossover 3	Link161	Catch14	2 x 600 x 1200	30.0	7.428	7.39
Future Road 1 Crossover 4	Link219	Node189	3 x 600 x 1200	30.0	7.365	7.328
Future Road 1 Crossover 5	Link199	Catch6	1 x 600 x 1200	30.0	7.258	7.22
Future Road 1 Crossover 6	Link210	Node180	2 x 600 x 1200	30.0	7.183	7.145
Future Road 1 Crossover 7	Link202	Catch5	2 x 600 x 1200	30.0	7.048	7.011
Future Road 1 Crossover 8	Link204	Node176	2 x 600 x 1200	30.0	6.986	6.948
Future Road 1 Crossover 9	Link206	Catch4	3 x 750 x 1200	30.0	6.833	6.795
Future Road 1 Crossover 10	Link207	Node171	3 x 900 x 1200	30.0	6.758	6.722
Future Road 1 Crossover 11	Link214	Catch11	3 x 600 x 1200	30.0	7.096	7.058
Future Road 1 Crossover 12	Link216	Node184	3 x 900 x 1200	30.0	6.933	6.896
Powell Road Crossover 1	Link140	Node162	2 x 900 x 900	30.0	6.855	6.818
Powell Road Crossover 2	Link142	Node160	2 x 900 x 1200	30.0	6.792	6.755
Powell Road Crossover 3	Link144	Catch2a	2 x 900 x 1200	30.0	6.605	6.567
Future Dalton Road Crossover 1	Link180	Catch15	2 x 600 x 1200	30.0	7.389	7.352
Future Dalton Road Crossover 2	Link182	Node134	2 x 600 x 1200	30.0	7.189	7.152
Future Dalton Road Crossover 3	Link184	Node129	2 x 600 x 1200	30.0	7.126	7.089
Future Dalton Road Crossover 4	Link186	Catch9	3 x 900 x 1200	30.0	6.938	6.895
Future Dalton Road Crossover 5	Link167	Catch16a	3 x 600 x 1200	30.0	7.211	7.174
Future Dalton Road Crossover 6	Link169	Node117	4 x 600 x 1200	30.0	7.055	7.018
Future Dalton Road Crossover 7	Link171	Node119	5 x 600 x 1200	30.0	6.955	6.917
Future Dalton Road Crossover 8	Link173	Node121	5 x 900 x 1200	30.0	6.714	6.676
Future Dalton Road Crossover 9	Link175	Node123	5 x 900 x 1200	30.0	6.651	6.614
Future Dalton Road Crossover 10	Link177	CM1	5 x 900 x 1200	30.0	6.47	6.432

4.3 MODEL SUMMARY

Table 9 provides a summary of the hydrologic and hydraulic modelling parameters used in the XP-Storm model.

TABLE 9: SUMMARY OF XP-STORM MODELLING ASSUMPTIONS

Key Elements	Parameter			Values
IFD Data	BoM IFD Calculator			See Table 1
Runoff Assumptions	Land Use	Lots	Initial Loss (mm)	15
			Continuing Loss (mm/hr)	1.8
			Manning's n	0.03
		Road Reserves	Initial Loss (mm)	0
			Runoff Coefficient (%)	80
			Manning's n	0.02
		Drainage Swales	Initial Loss (mm)	0
			Runoff Coefficient (%)	95
			Manning's n	0.03
	Catchment Grade			0.002 – 0.005
	Runoff routing method			Laurenson's Method
	Evaporation			None assumed
Simulation Parameters	Dry time step			86400 seconds
	Transition time step			30 seconds
	Wet time step			30 seconds
	Simulation Period			3 days
Hydraulics	Culverts		Manning's n	0.013
			Headwall type	45 degree wingwall
			Entrance loss coefficient	0.5
			Exit loss coefficient	0.5
	Main Swales		Channel Manning's n	0.03
			Assumed infiltration	0
			Side Slopes	1:6
	Minor Swales		Manning's n	0.03
			Assumed infiltration	0
			Side Slopes	1:6
	Roadside Swales		Assumed infiltration	0
			Side Slopes	1:4
Tailwater Condition	Hematite Main Swale – Supra-tidal - constant level			1% AEP – 4.0 mAHD
	Anthill Main Swale – Supra-tidal - constant level			1% AEP – 4.0 mAHD
	Dalton Main Swale – South Creek - constant level			1% AEP – 5.4 mAHD

5 MODEL CALIBRATION / VALIDATION

As discussed in Section 3.2, there is no flow or water level data available for model calibration or validation. Model sensitivity analysis therefore informs the variability of the model outputs to input parameters such as the loss model used, Manning's roughness coefficients, as well as assessing the impact that blockage of culverts has on flood levels and the ability of the system to convey flood flows.

6 RAINFALL TEMPORAL PATTERNS

The rainfall temporal patterns applied to the catchments were assumed to be spatially uniform across the catchment. Ensemble temporal patterns were used, with the mean of the ten patterns reported for design. Storms modelled range from 30 minutes to 72 hours duration.

7 MODEL RESULTS

The stormwater management system as described above was modelled using XP-Storm based on the methodology in Australian Rainfall and Runoff (Ball et al., 2019).

Modelling results are summarised in Table 10.

TABLE 10: MODEL RESULTS FOR MAIN SWALES

	Dalton Main Swale (Outlet to South Creek)			Hematite Main Swale (Outlet F)				Anthill Main Swale (Outlet G)		
Tag Points	Catch16b	Node124	S10	1Ab	d20	f4a	Fculv	Lot333	g5.3	Gculv
First 15 mm										
Peak Flow (m^3/s) [1]	0.05	0.22	0.27	0.17	0.42	1.00	1.44	0.17	0.51	0.63
Peak Velocity (m/s) [1]	0.16	0.28	0.22	0.21	0.27	0.36	0.32	0.29	0.19	0.40
Water Level (mAHD)	7.43	6.75	6.47	5.34	4.78	4.26	3.98	5.22	4.34	3.92
1 EY (1 year ARI)										
Peak Flow (m^3/s) [1]	0.27	1.36	1.57	0.42	1.06	2.63	3.83	0.34	1.09	1.37
Peak Velocity (m/s) [1]	0.28	0.49	0.46	0.28	0.38	0.42	0.42	0.37	0.19	0.48
Water Level (mAHD)	7.53	6.99	6.73	5.40	4.89	4.50	4.26	5.30	4.47	4.11
Critical Duration	3	3	3	3	3	3	3	2	2	2
10% AEP (10 year ARI)										
Peak Flow (m^3/s) [1]	0.73	3.64	4.16	1.10	2.59	6.42	9.26	0.90	2.80	3.54
Peak Velocity (m/s) [1]	0.35	0.61	0.73	0.35	0.50	0.46	0.50	0.51	0.21	0.55
Water Level (mAHD)	7.67	7.27	7.00	5.54	5.19	4.95	4.77	5.43	4.72	4.46
Critical Duration (hrs)	6	2	2	6	2	6	6	6	1	1
1% AEP (100 year ARI)										
Peak Flow (m^3/s) [1]	1.33	6.38	7.30	1.74	3.71	9.83	14.57	1.58	4.64	5.86
Peak Velocity (m/s) [1]	0.36	0.65	0.97	0.37	0.48	0.46	0.52	0.60	0.25	0.54
Water Level (mAHD)	7.88	7.55	7.25	5.85	5.68	5.40	5.21	5.57	5.00	4.85
Critical Duration (hrs)	3	2	2	6	3	3	3	2	2	2

Note: 1. Flow and velocity in adjacent swale.

Results of the modelling are shown in Figures 8 to 39.

For the north and south areas, Figures 8 and 11 show the stormwater management systems while Figures 9, 10, 12 and 13 show the 10% and 1% AEP event plans.

Figures 14 and 15 shows hydrographs of flood levels at the upstream and downstream extent of the Dalton Main Swale, with Figure 16 showing the flow hydrograph at the point of discharge from the Study Area. Figures 17 to 19 show the same for Hematite Main Swale, and Figures 20 to 22 for the Anthill Main Swale.

Figures 23 to 25 show longsections for the Dalton Main Swale and other swales within that catchment.

Figures 26 to 37 show longsections for the Hematite Main Swale and the other swales within the catchment.

Figures 38 and 39 show longsections for the Anthill Main Swale and the other minor swale within that catchment.

The 1% AEP flood levels are used, with 300 mm freeboard, to set lot finished floor levels. For areas already constructed within Stages 1 and 2 of the TDA, earthwork levels are at least 300 mm above flood levels .

8 MODEL SENSITIVITY ANALYSIS

The modelling results presented in Section 6 above represent a best estimate of flood characteristics based on the information available. However, there is always some uncertainty in modelling parameters. Where calibration data is not available (as in the current study), sensitivity analysis is important to gain an understanding of the impact on flood levels and flows of parameter values.

Data critical to flow hydraulics such as topography, channel geometry or structures are reasonably straightforward to quantify, being part of the design process, subject only to construction tolerances. Topography accuracy depends on survey accuracy.

Other parameters critical to flow hydraulics such as catchment roughness, channel roughness, losses and structure blockage are difficult to quantify. A sensitivity analysis of these parameters assists in determining the possible range of flood levels at a particular location.

Crossover length is a factor of interest to the Town of Port Hedland for assessment of proposed lot developments, as different lot lengths are often requested by lot purchasers. An assessment of 50 m cross over lengths (as opposed to the 30 m lengths used in the modelling reported above) is documented in Section 7.4 below.

8.1 SENSITIVITY TO MANNING'S ROUGHNESS COEFFICIENT

To assess the impact of Manning's roughness coefficient on model results, the model was rerun increasing the coefficient by 33%. For the swales, Manning's n was increased from 0.03 to 0.04, and for the culverts from 0.013 to 0.017.

Results for the 1% AEP are reported in Table 11, for the same model nodes as in Table 10. Only the 1% AEP event was assessed, to identify the potential impact on finished floor levels.

The 33% increase in roughness coefficient results in an increase in flood levels by up to 0.09 m, which is well within the 0.3 m freeboard to finished floor levels.

TABLE 11: IMPACT OF CHANNEL MANNINGS ROUGHNESS ON MAIN SWALE FLOOD LEVELS

	Dalton Main Swale (Outlet to South Creek)			Hematite Main Swale (Outlet F)				Anthill Main Swale (Outlet G)		
Tag Points	Catch16b	Node124	S10	1Ab	d20	f4a	Fculv	Lot333	g5.3	Gculv
Water Level (n=n x 1.0) (mAHD)	7.88	7.55	7.25	5.85	5.68	5.40	5.21	5.57	5.00	4.85
Water Level (n= x 1.33) (mAHD)	7.96	7.64	7.33	5.93	5.77	5.49	5.26	5.63	5.07	4.88
Increase (m)	0.08	0.09	0.08	0.08	0.09	0.09	0.05	0.06	0.07	0.03

8.2 SENSITIVITY TO LOSS MODEL

To assess the impact of the adopted loss model on model results, the model was rerun increasing the runoff coefficient from 0.9 to 1.0 for lots, road reserves and drainage swales.

Results of this scenario are reported in Table 12, for the same model nodes used in Table 10. Only the 1% AEP event was assessed, to identify the potential impact on finished floor levels.

The increase in runoff coefficient results in an increase in flood levels by up to 0.12 m (for the Hematite Main Swale), which is well within the 0.3 m freeboard to finished floor levels.

TABLE 12: IMPACT OF CATCHMENT LOSS MODEL PARAMETERS ON MAIN SWALE FLOOD LEVELS

	Dalton Main Swale (Outlet to South Creek)			Hematite Main Swale (Outlet F)				Anthill Main Swale (Outlet G)		
Tag Points	Catch16b	Node124	S10	1Ab	d20	f4a	Fculv	Lot333	g5.3	Gculv
Water Level (RC = 0.9) (mAHD)	7.88	7.55	7.25	5.85	5.68	5.40	5.21	5.57	5.00	4.85
Water Level (RC = 1.0) (mAHD)	7.97	7.62	7.31	5.97	5.79	5.48	5.27	5.59	5.08	4.95
Increase (m)	0.09	0.07	0.06	0.12	0.11	0.08	0.06	0.02	0.08	0.10

8.3 SENSITIVITY TO BLOCKAGE FACTOR

To assess the impact of blockage at the inlets to the culvert structures, a blockage factor of 50% was applied to the model. A 50% blockage factor was applied at all culvert inlets for the 1% AEP event, by assuming a sediment depth equivalent to the radius of the culvert pipe.

Table 13 presents the results of the modelling. Flood levels are compared against the results of the unblocked system from Table 10. It can be seen that for the Dalton and Hematite Main Swales, the highest increase in flood level occurs at the upstream extent (nodes “Catch16b” and “1Ab” respectively) with blockage from downstream culverts accumulating upstream. For the Anthill Main Swale, the only culvert on the main section is the downstream culvert at the outlet. Blockage at this culvert is sufficient to pond stormwater back to node “g5.3”. Due to the change in flow characteristics, there is a slight decrease in levels at node “Lot333”.

The increase in flood level due to blockage is generally less than the 300 mm freeboard required above the 1% AEP flood level to finished flood levels. The downstream section of the Anthill Main Swale has between a 0.35 and 0.5 m increase in levels, however in this location FFL is determined by storm surge constraints rather than stormwater levels. The upstream section of the Dalton Main Swale has an increase of 0.37 m, primarily due to the number of crossovers on this section. It is recommended that the future UWMP considers the design of this section, with either an increase in culvert sizes along this swale, or an increase in the freeboard for the lots in this upstream section.

TABLE 13: IMPACT OF CULVERT BLOCKAGE (50%) ON MAIN SWALE FLOOD LEVELS

	Dalton Main Swale (Outlet to South Creek)			Hematite Main Swale (Outlet F)				Anthill Main Swale (Outlet G)		
Tag Points	Catch16b	Node124	S10	1Ab	d20	f4a	Fculv	Lot333	g5.3	Gculv
Water Level (unblocked) (mAHD)	7.88	7.55	7.25	5.85	5.68	5.40	5.21	5.57	5.00	4.85
Water Level (50% blockage) (mAHD)	8.25	7.72	7.37	6.08	5.90	5.56	5.32	5.55	5.35	5.33
Increase (m)	0.37	0.17	0.12	0.23	0.22	0.16	0.11	-0.02	0.35	0.48

8.4 SENSITIVITY TO CROSSOVER LENGTH

The crossovers included in the LWMS have been modelled with a length of 30 m, with one crossover per lot. JDA understands that during development of lots, owners may require a longer crossover than 30 m, or multiple crossovers. Each crossover has an afflux which will increase with increasing culvert length. Therefore, longer, or multiple crossovers per lot will result in increased flood levels upstream, unless culvert capacity is increased.

Modelling of 50 m long crossover culverts was performed for a number of crossovers on the major swales. To maintain afflux as for the 30 m crossovers, modelling results show that (on average), the cross-sectional area of the culvert bank needs to be increased by 20%. For example, if 4 x 1200mm x 600mm culverts are required for a 30 m long crossover culvert, 5 x 1200mm x 600mm culverts are required for a 50 m long crossover culvert to maintain the same afflux.

8.5 MODEL LIMITATIONS

The modelling undertaken as part of this Study uses the best information currently available. However, the following limitations apply.

- There is uncertainty regarding the transformation of rainfall to runoff rates, that is, with respect to loss rates. This uncertainty has been addressed using sensitivity analysis above.
- The lack of historical flood data available for the calibration of the models. Model parameters were based on professional experience and are consistent with values from the literature.
- Assumed culvert blockage conditions.

9 REFERENCES

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10 FIGURES

35. Hematite Longsection 10: Minor Swale #9 (Quarry Rd)
36. Hematite Longsection 11: Minor Swale #10 (Tailings Elbow)
37. Hematite Longsection 12: Minor Swale #11 (Tailings Elbow, Phosphorus St, Powell Rd)
38. Anthill Longsection 1: Anthill Main Swale
39. Anthill Longsection 2: Main Swale + Minor Swale (Schillaman St)

11 APPENDICIES

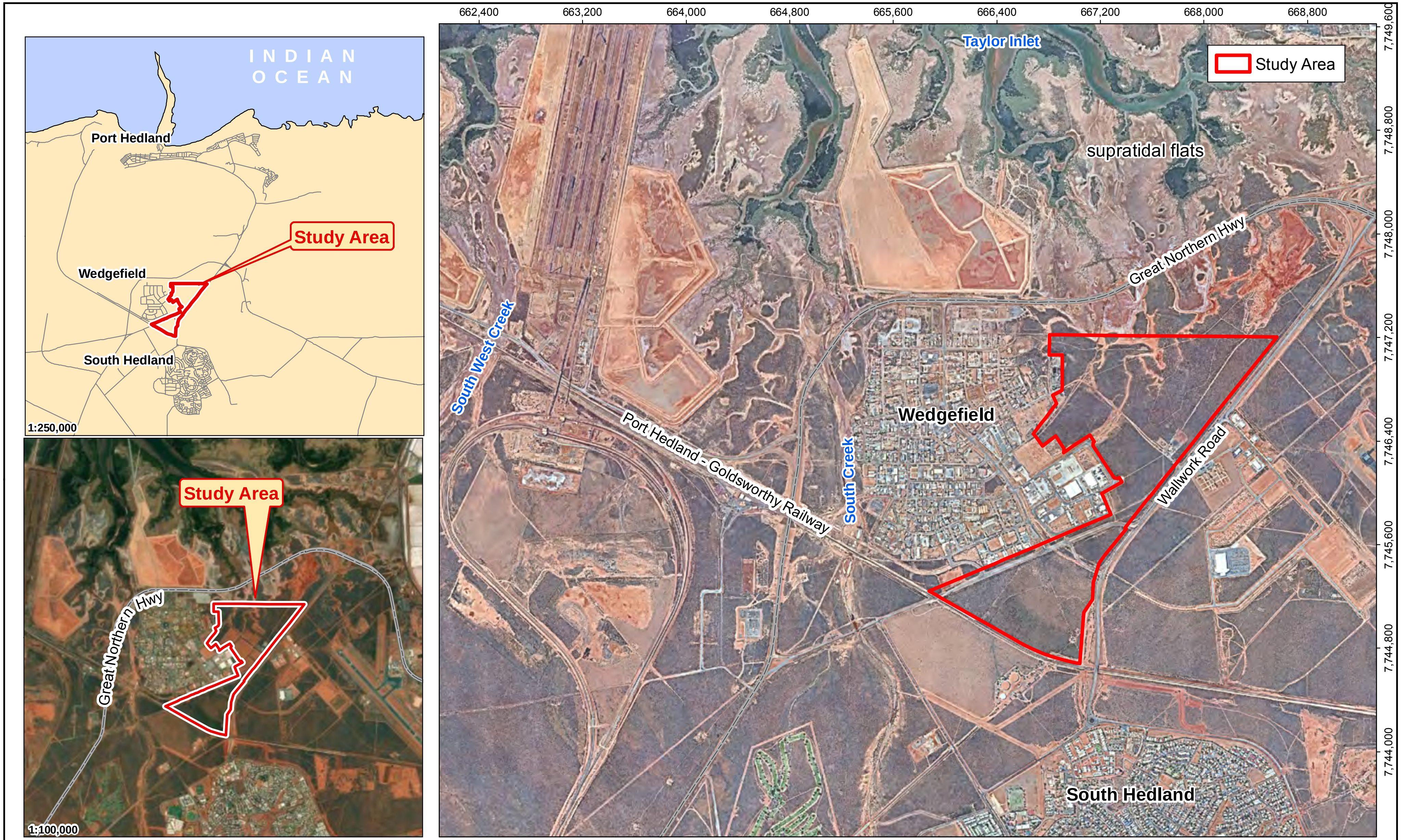
A. Available Survey and Engineering Drawings
B. Catchment Data

Author:

Alex Rogers
Principal Engineering Hydrologist

Reviewed and Approved by:

Jim Davies
Senior Principal Hydrologist



Data Source: Nearmap Digital Imagery (2021), 30 September 2020.

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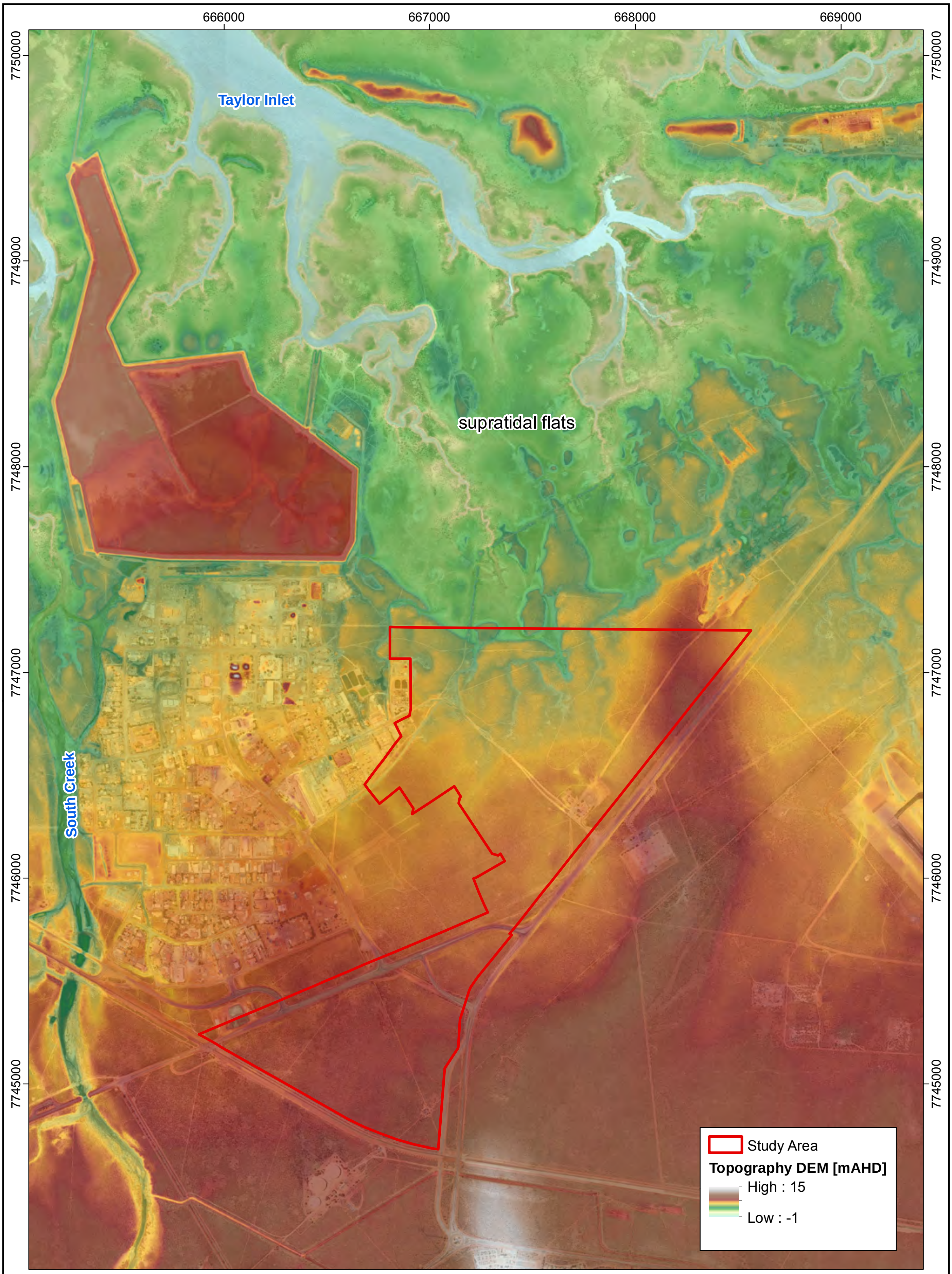
Figure 1: Site Location



Data Source: Topography DEM derived from 0.5 m LiDAR (2010) Contours.

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Figure 2: Topography 2010

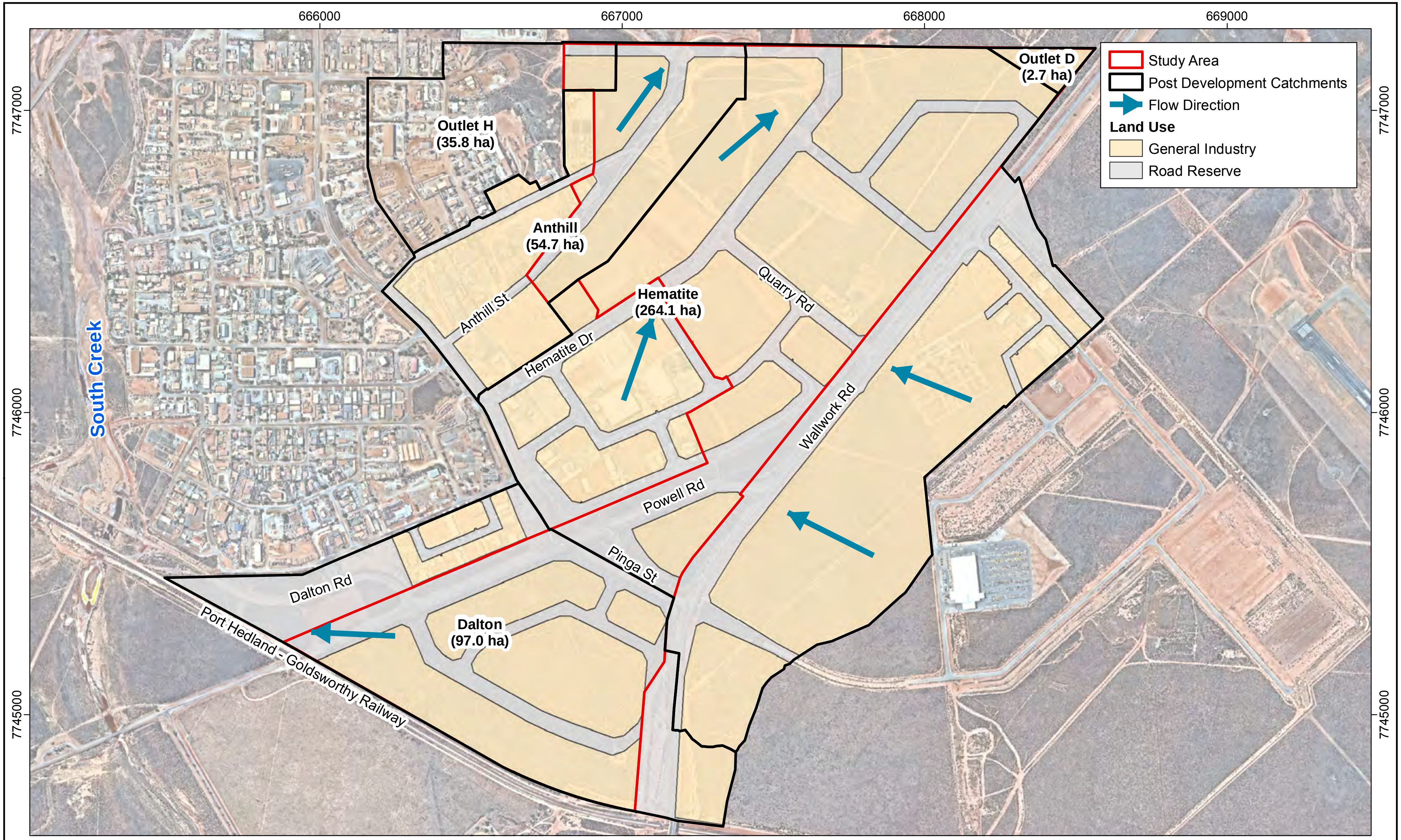

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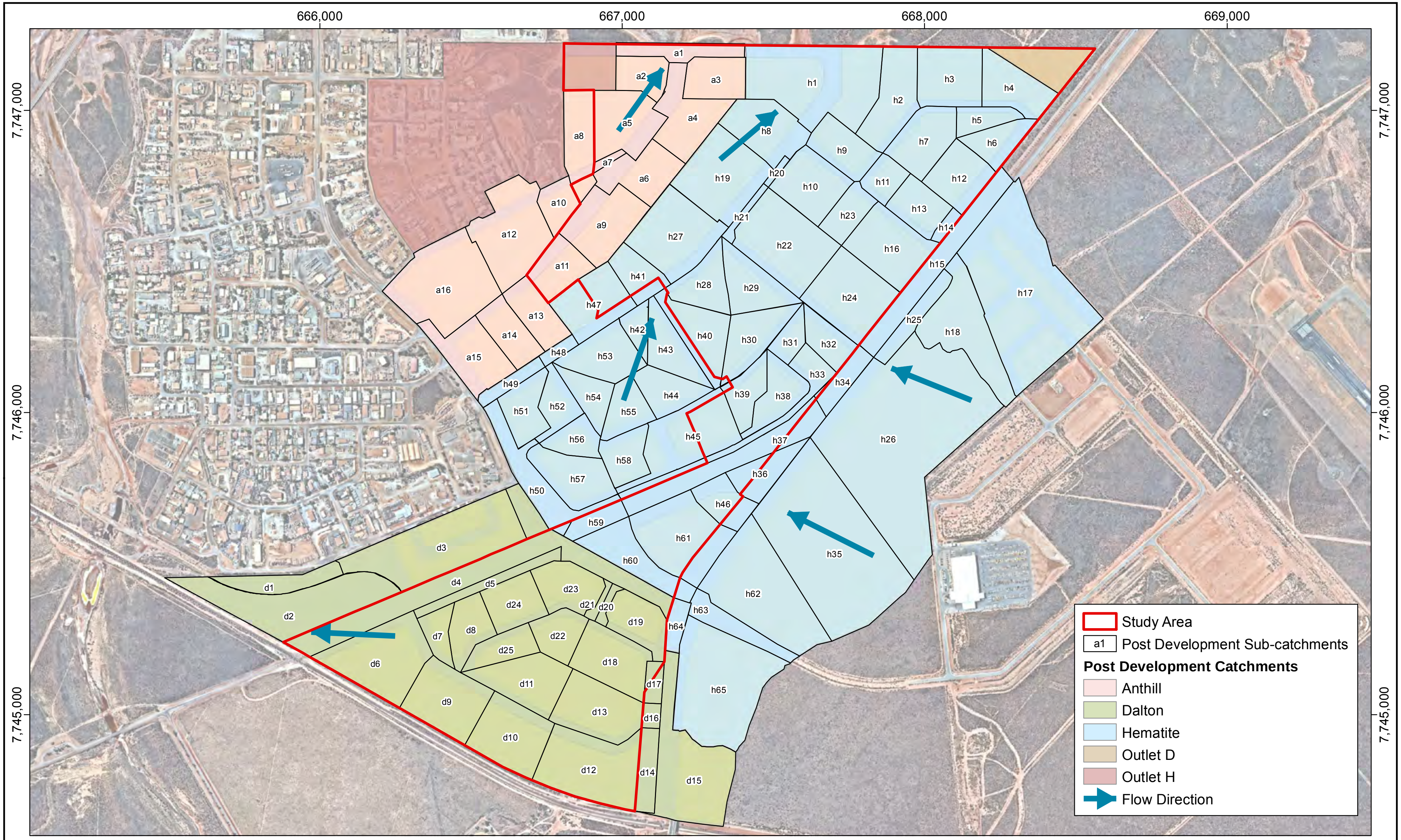
Figure 3: Post Development Catchments and Land Use



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Job No. J7157

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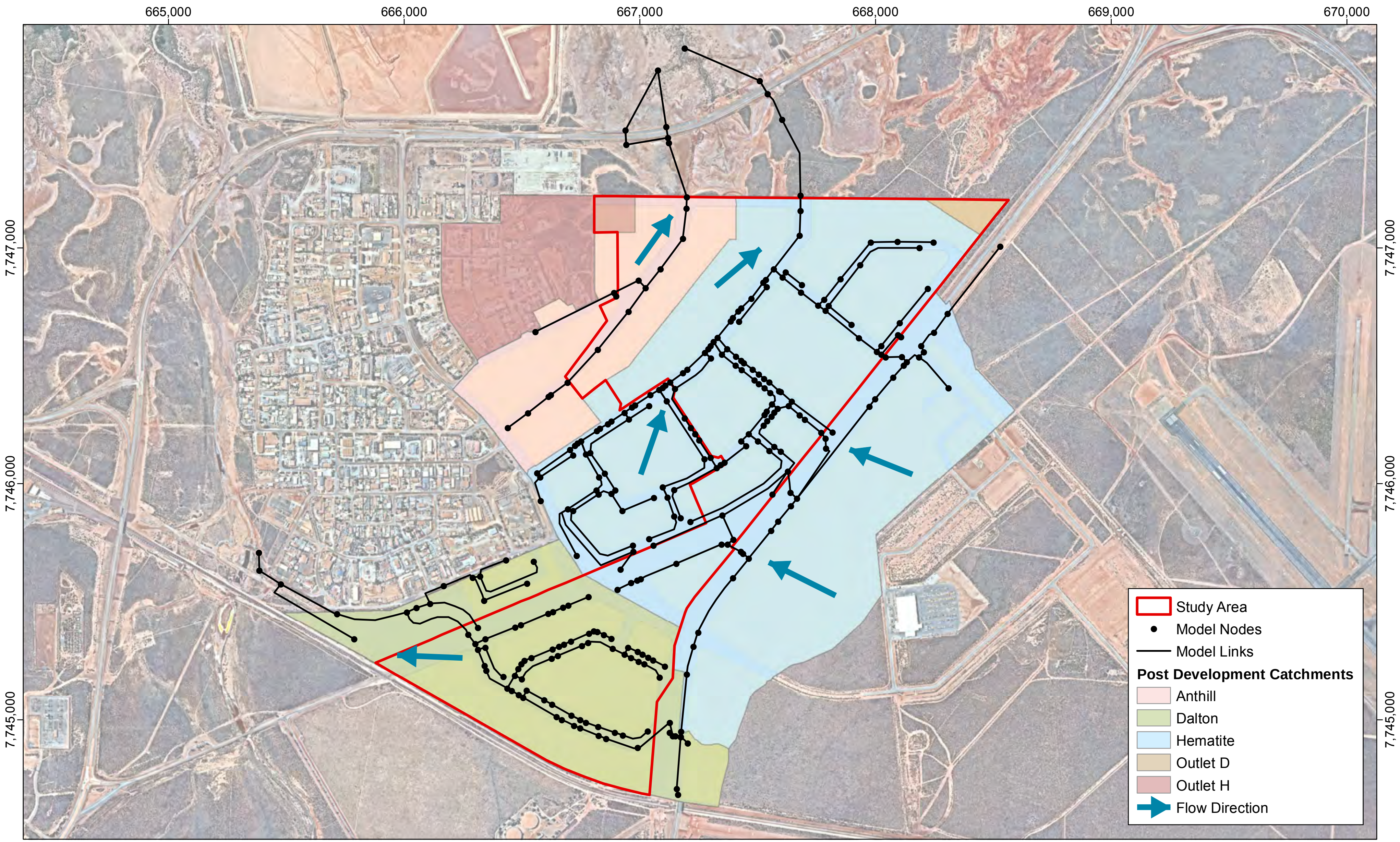
Figure 4: Post Development Sub-catchments



Data Source: XP-Storm Model

Coordinate System: GDA 94, Zone 50

Job No. J7157

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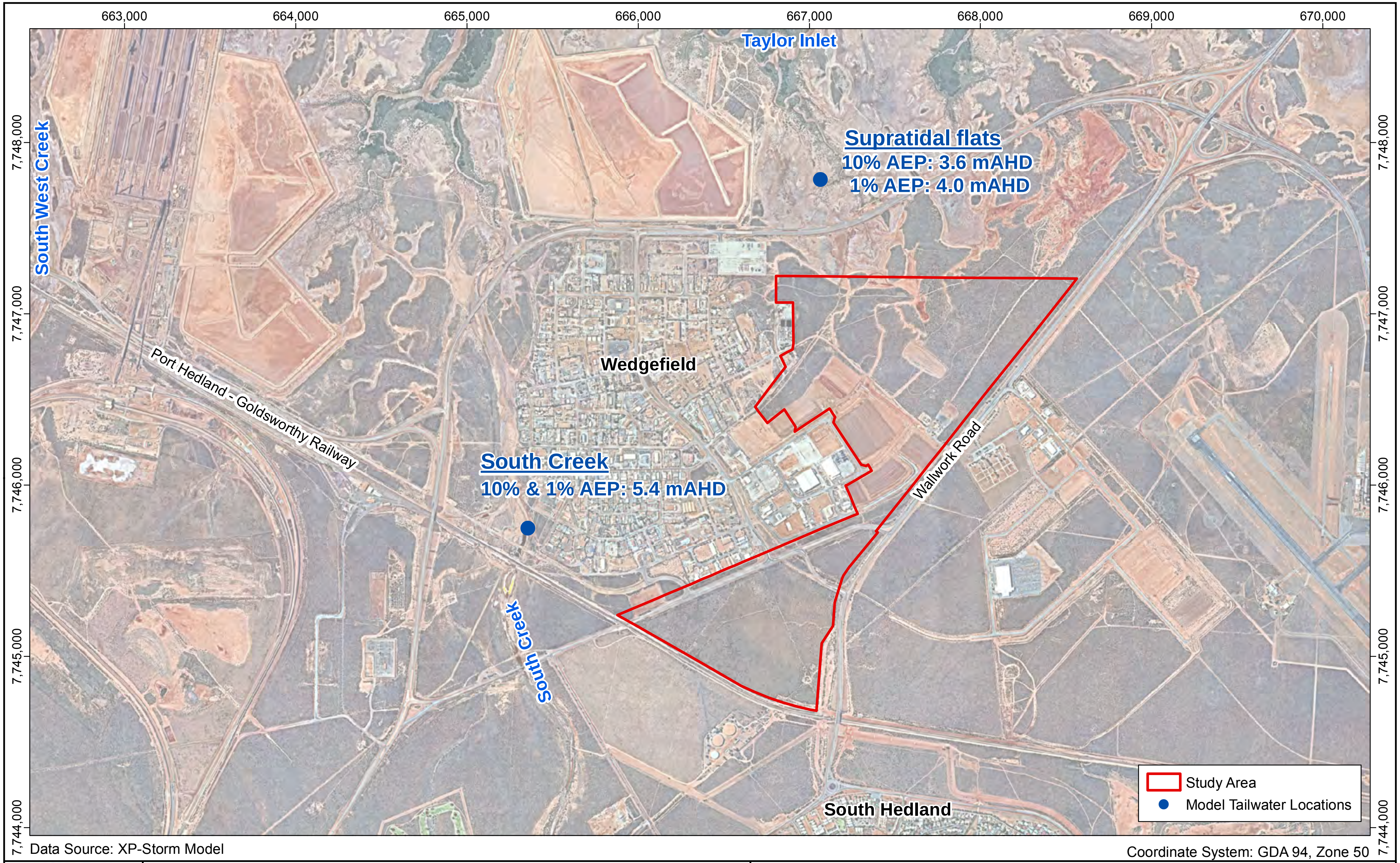
Figure 5: Hydraulic Model Network



Data Source: XP-Storm Model

Coordinate System: GDA 94, Zone 50

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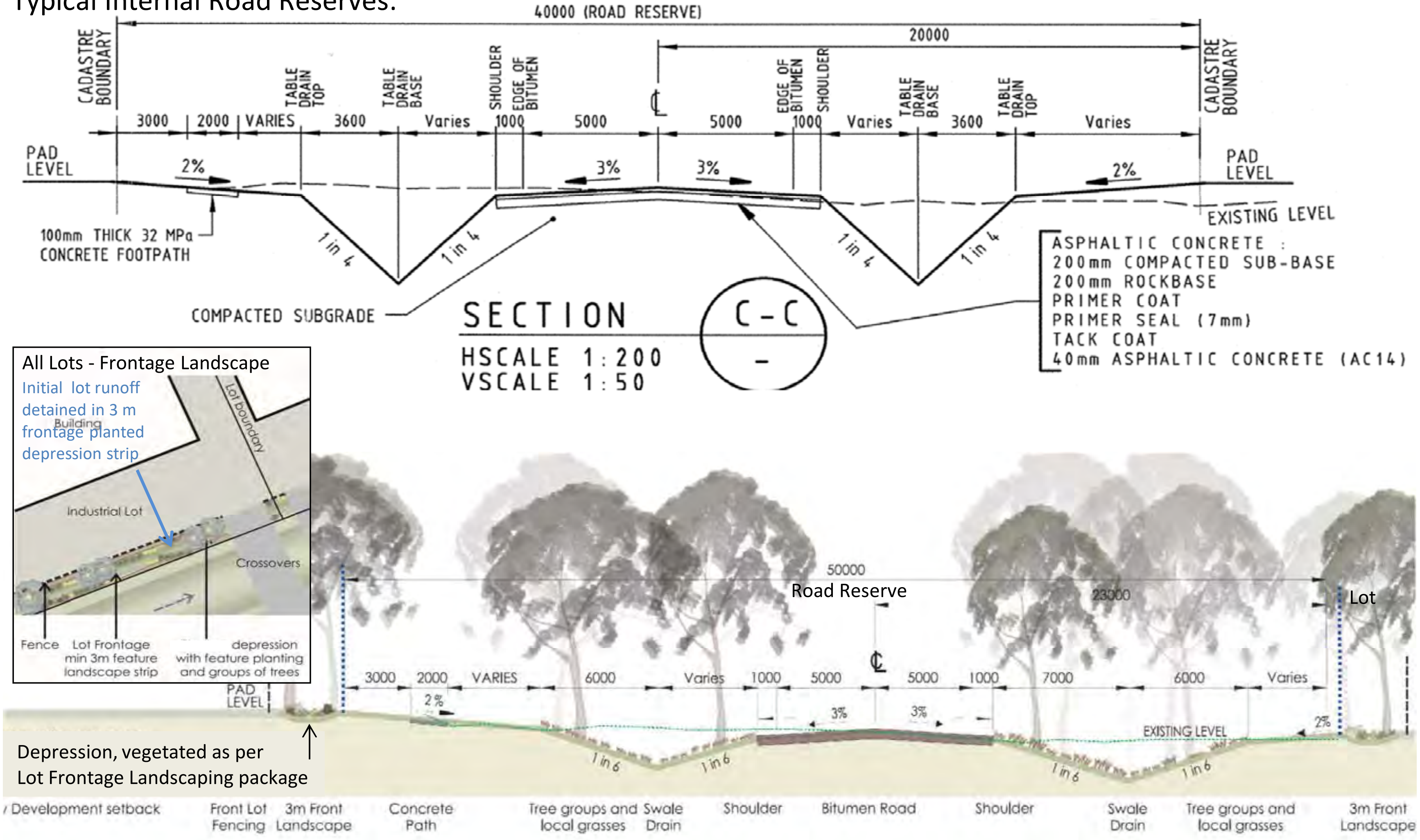
Figure 6: Wedgefield Tailwater Conditions

Typical Internal Road Reserves:



Initial lot runoff detained in 3 m frontage planted depression strip

Depression, vegetated as per Lot Frontage Landscaping package

Data source: UDLA (2011) Landscape extracts, based on Engineering Earthworks plan.

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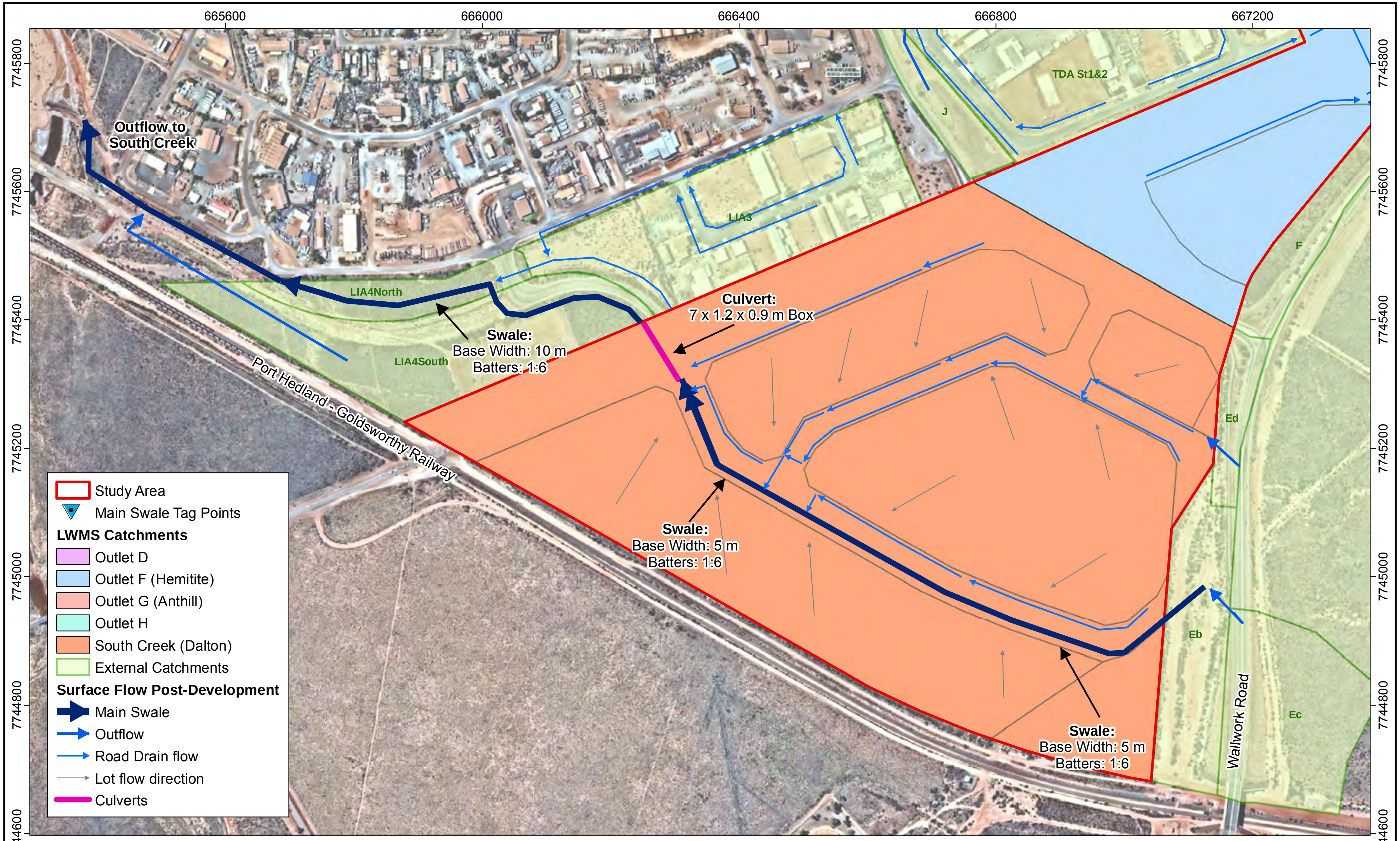
Figure 7: Drainage Swale Cross Sections



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0 100 200 300 400 Metres

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Figure 8: South Area (Dalton) Stormwater Management System

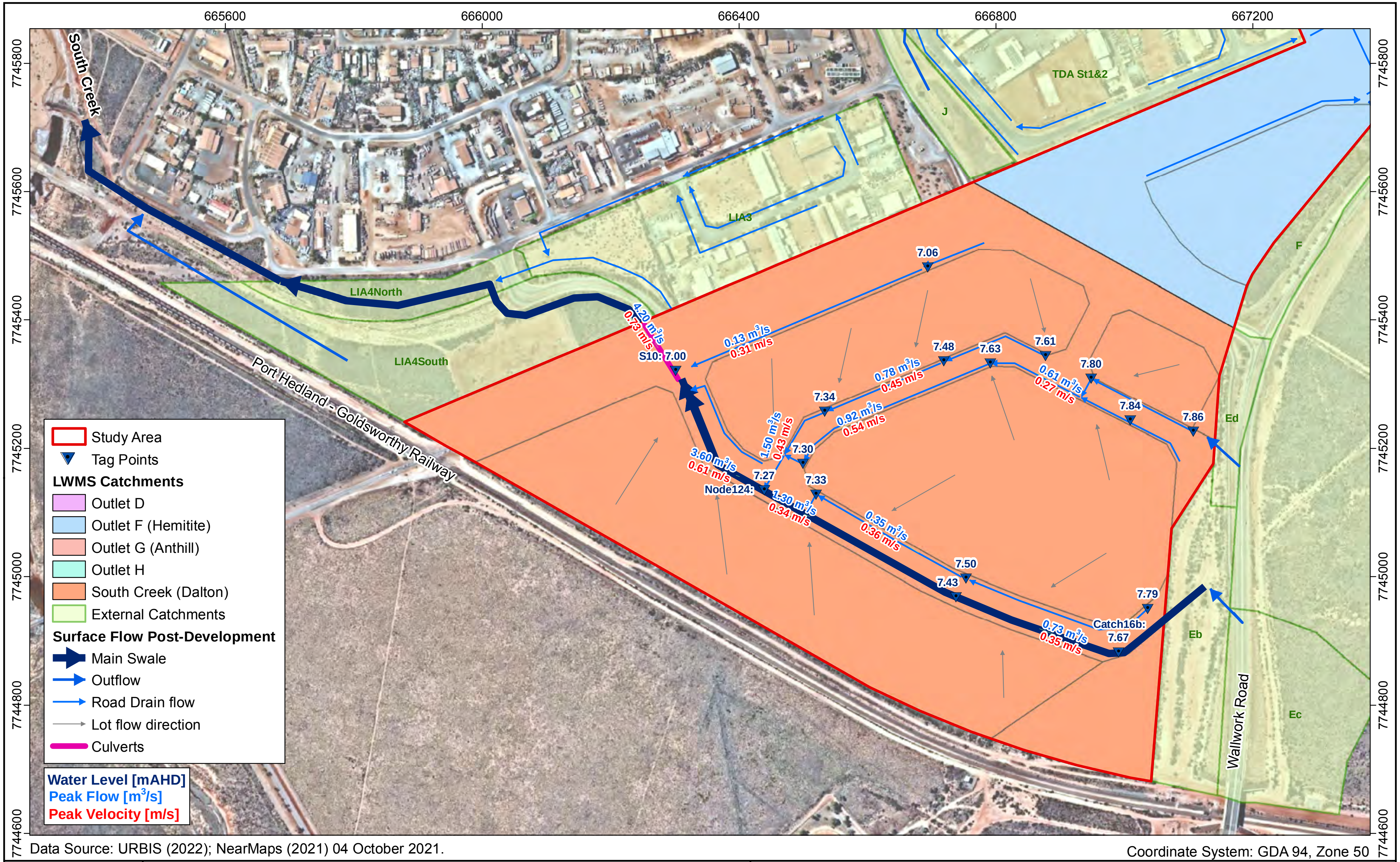

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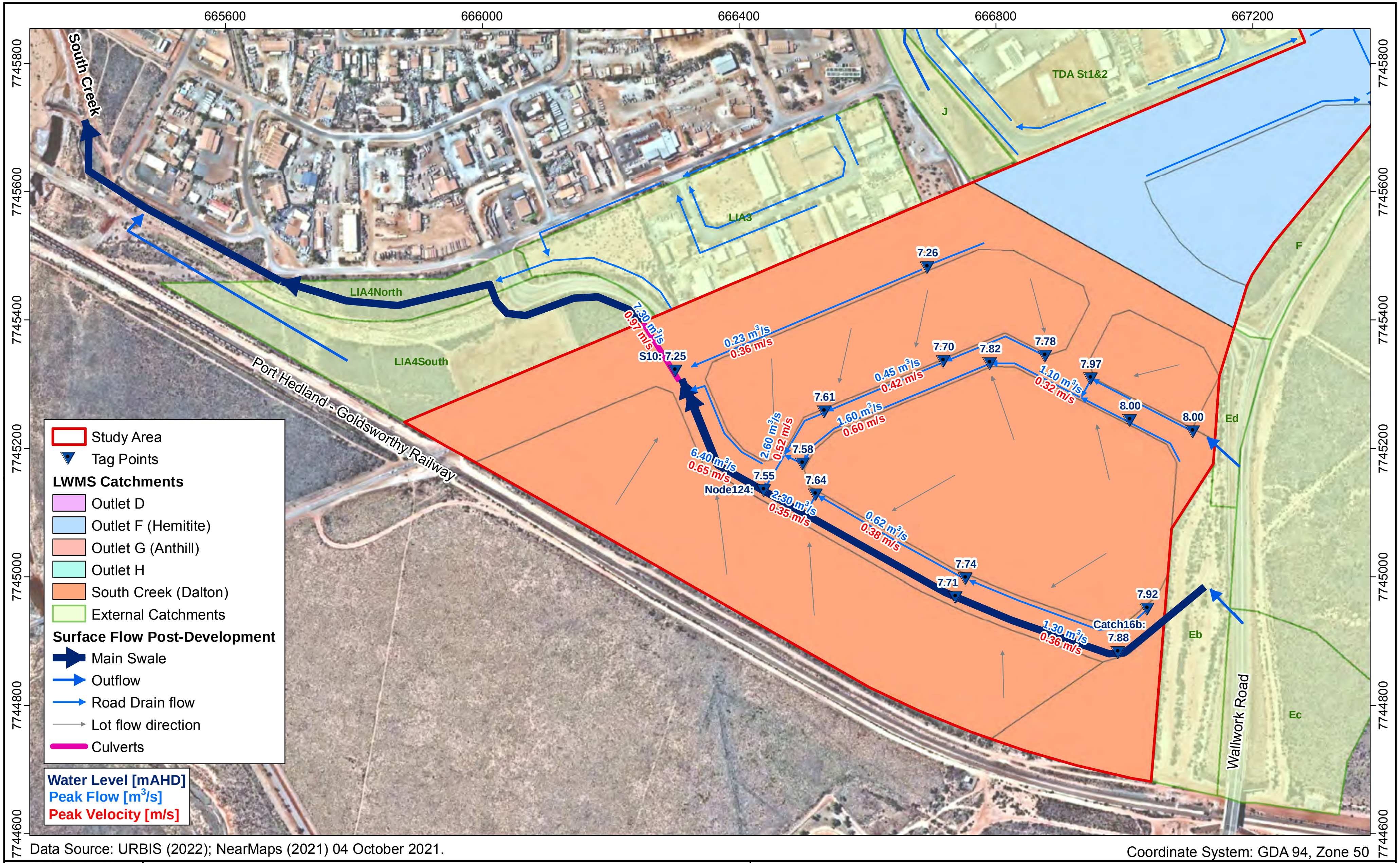
Figure 9: South Area (Dalton) 10% AEP Event Plan



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Coordinate System: GDA 94, Zone 50

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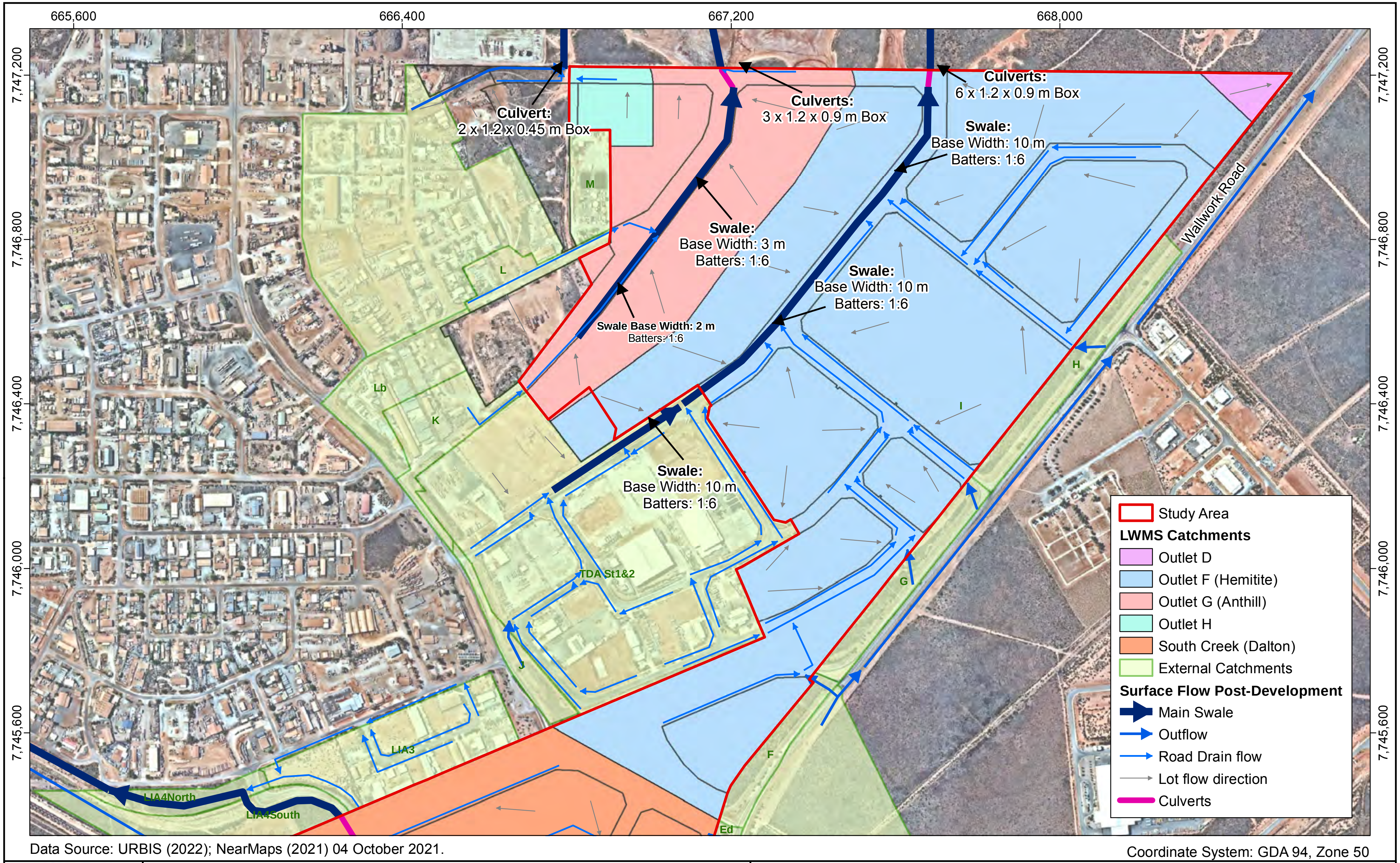
Figure 10: South Area (Dalton) 1% AEP Event Plan



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Coordinate System: GDA 94, Zone 50

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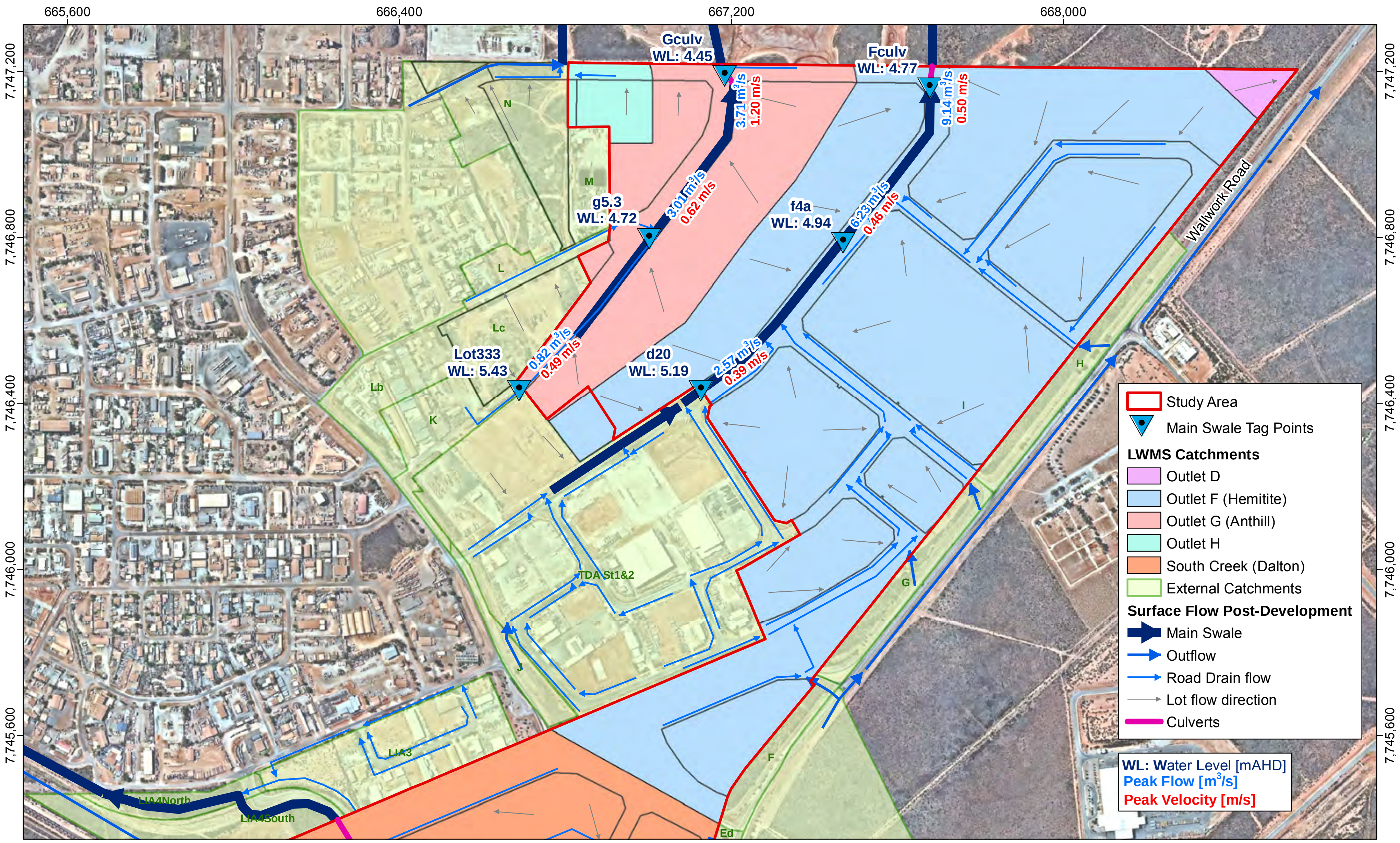
Figure 11: North Area (Hematite & Anthill) Stormwater Management System



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Coordinate System: GDA 94, Zone 50

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Job No. J7157

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Figure 12: North Area (Hematite & Anthill) 10% AEP Event Plan

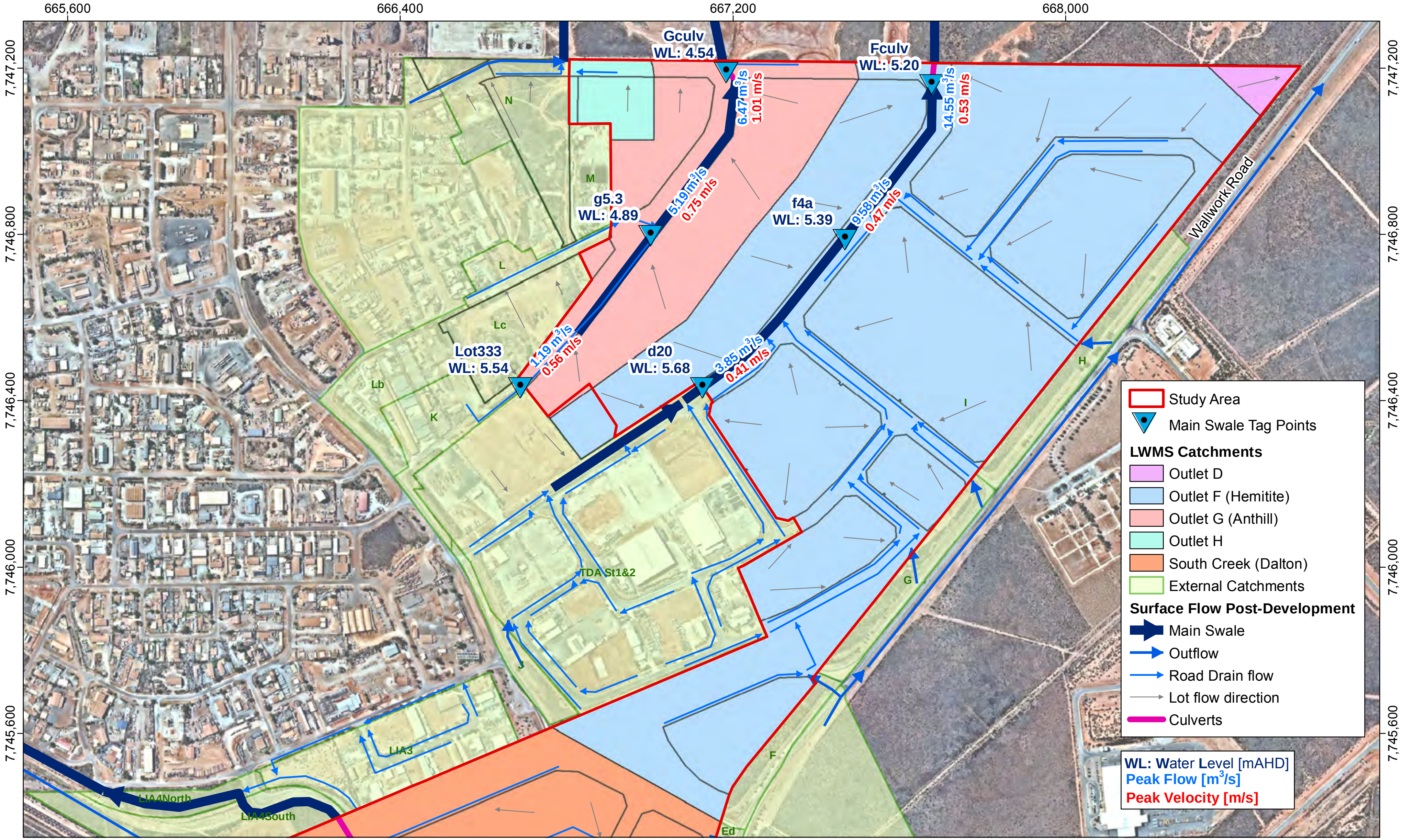

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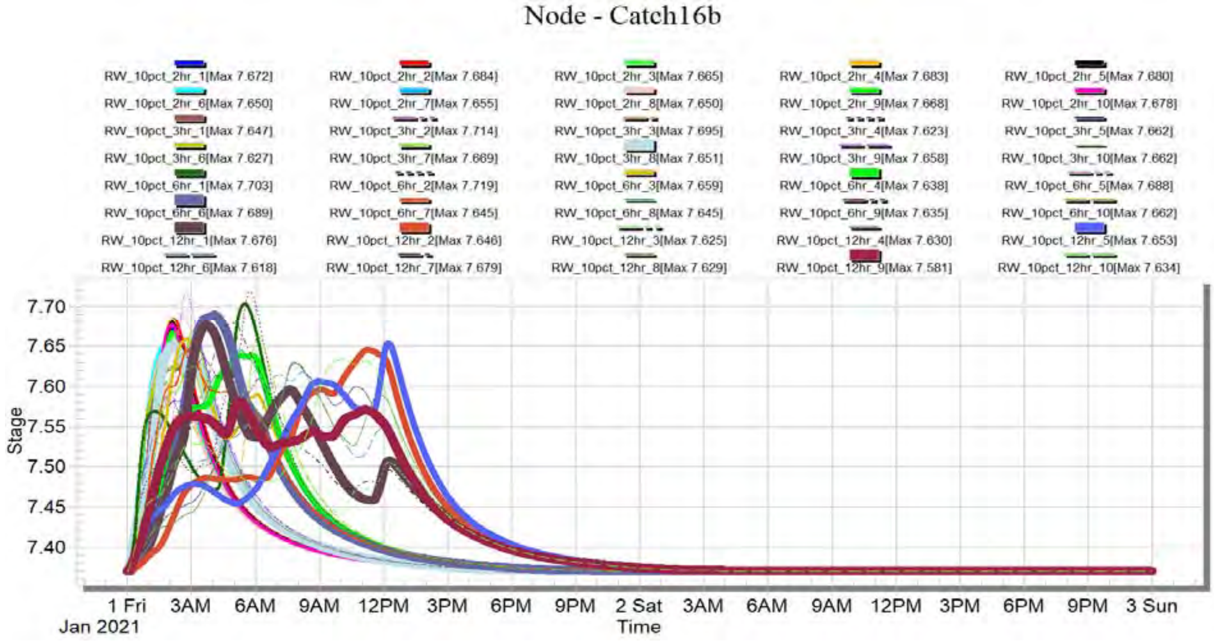
Figure 13: North Area (Hematite & Anthill) 1% AEP Event Plan

10% AEP Hydrographs



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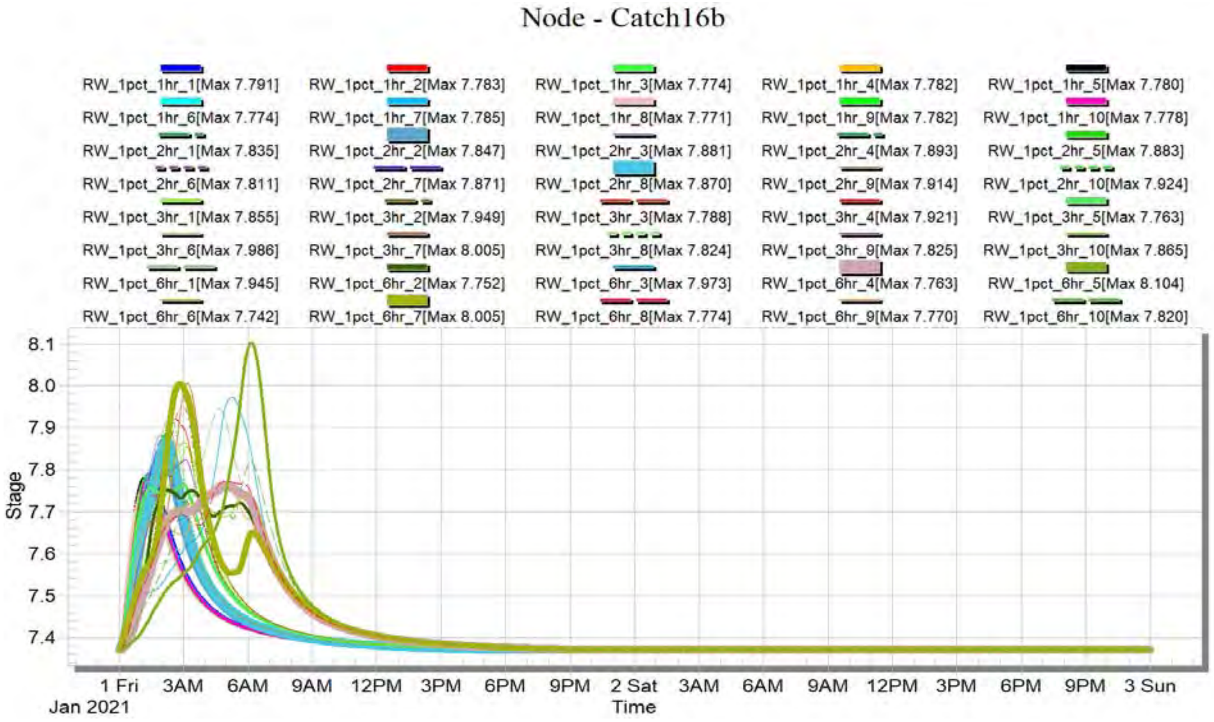

Data Source: JDA XP-Storm Model

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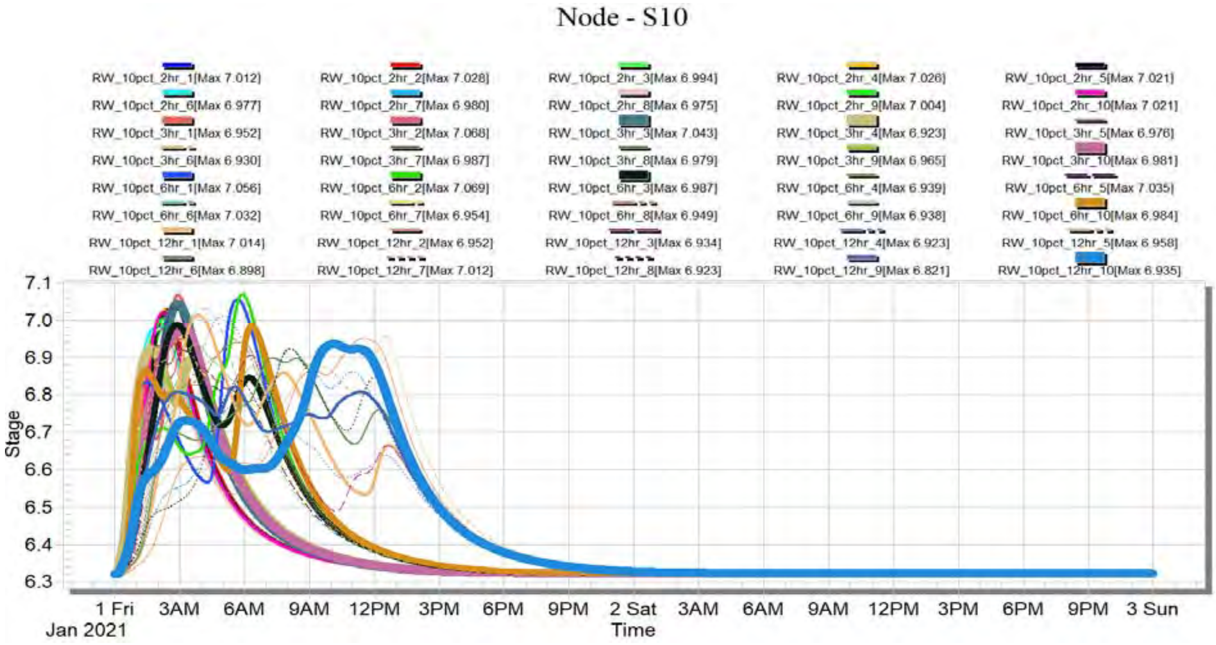
Figure 14: Dalton Main Swale Upstream Flood Hydrographs

10% AEP Hydrographs



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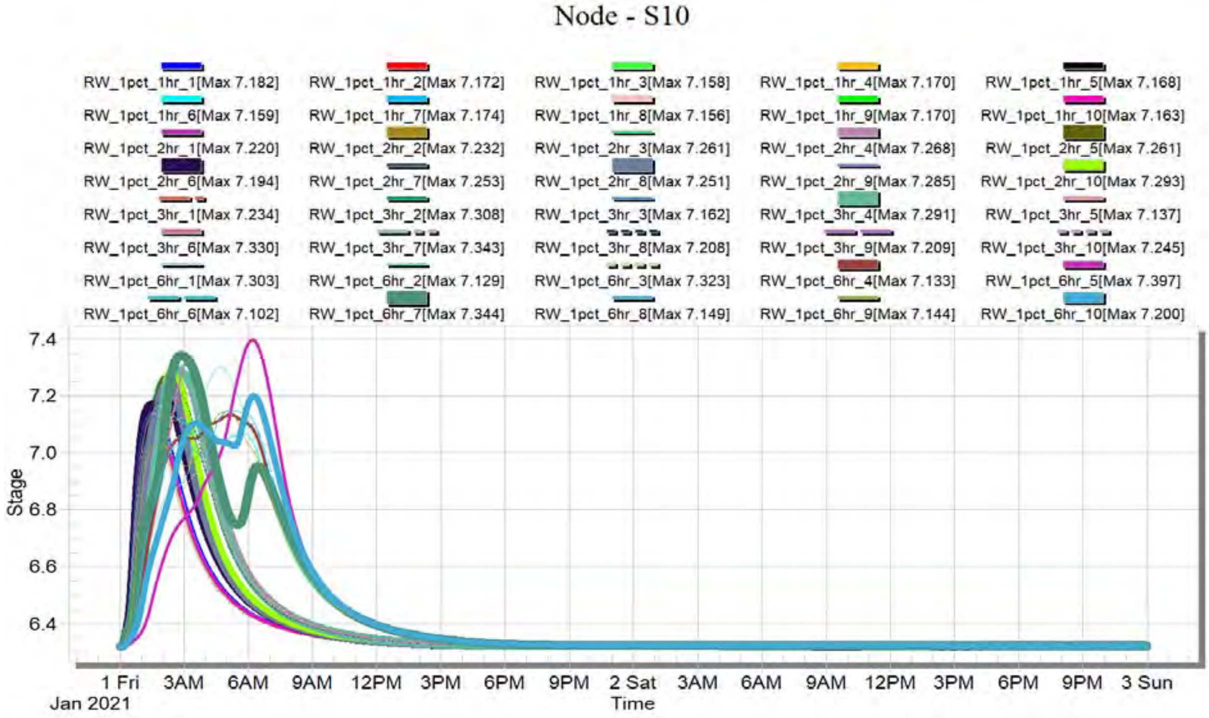

Data Source: JDA XP-Storm Model

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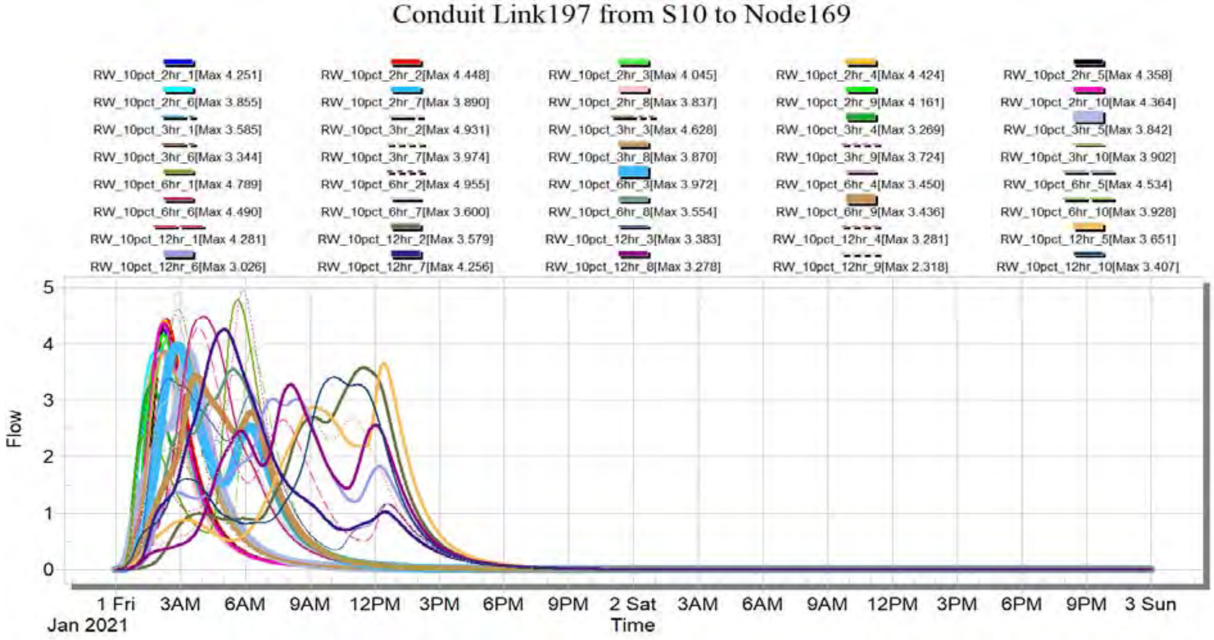
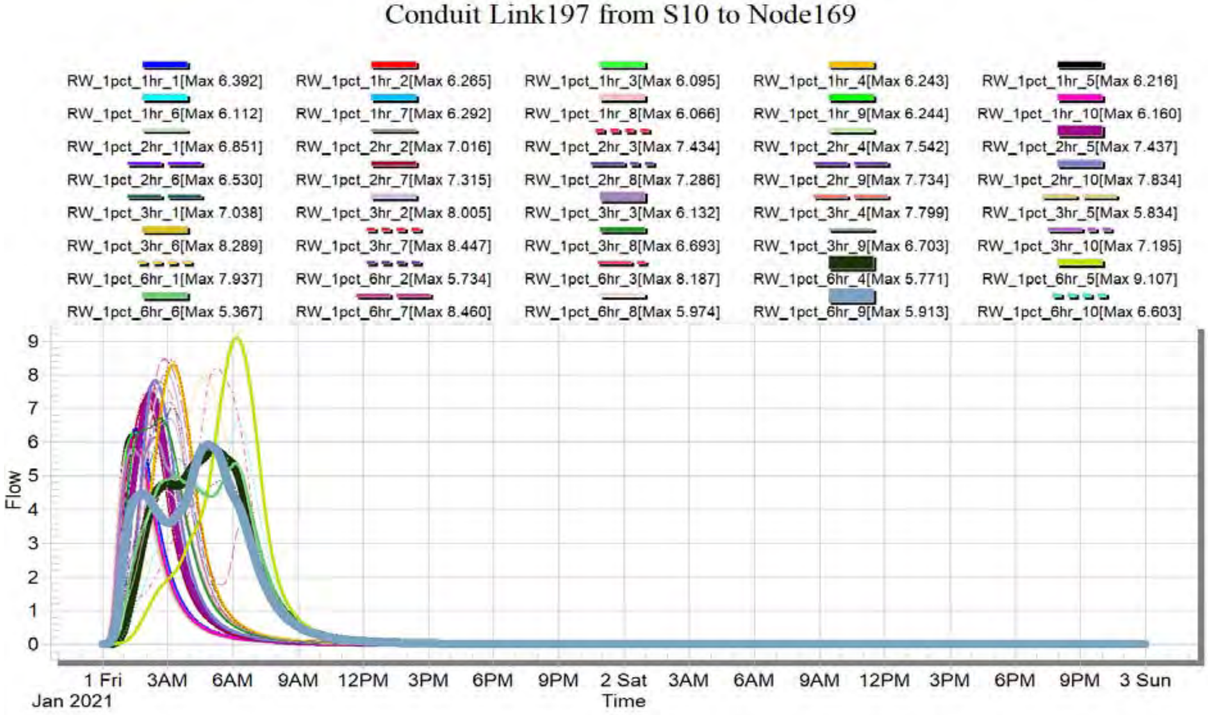
Figure 15: Dalton Main Swale Downstream Flood Hydrographs

10% AEP Hydrographs



1% AEP Hydrographs



Data Source: JDA XP-Storm Model

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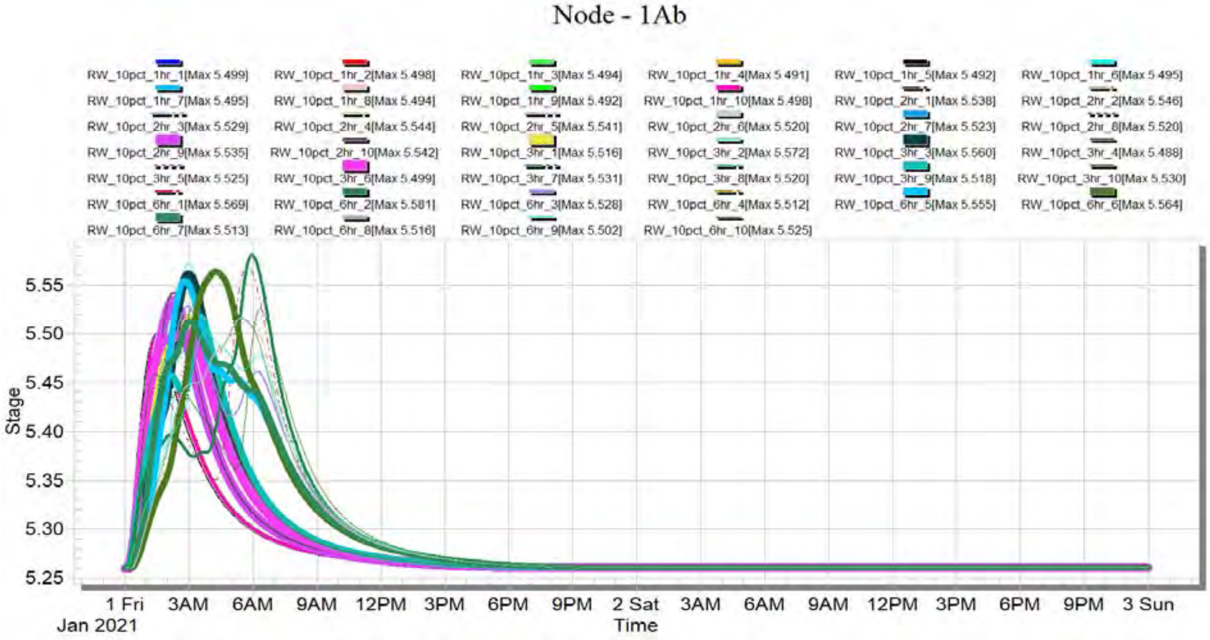
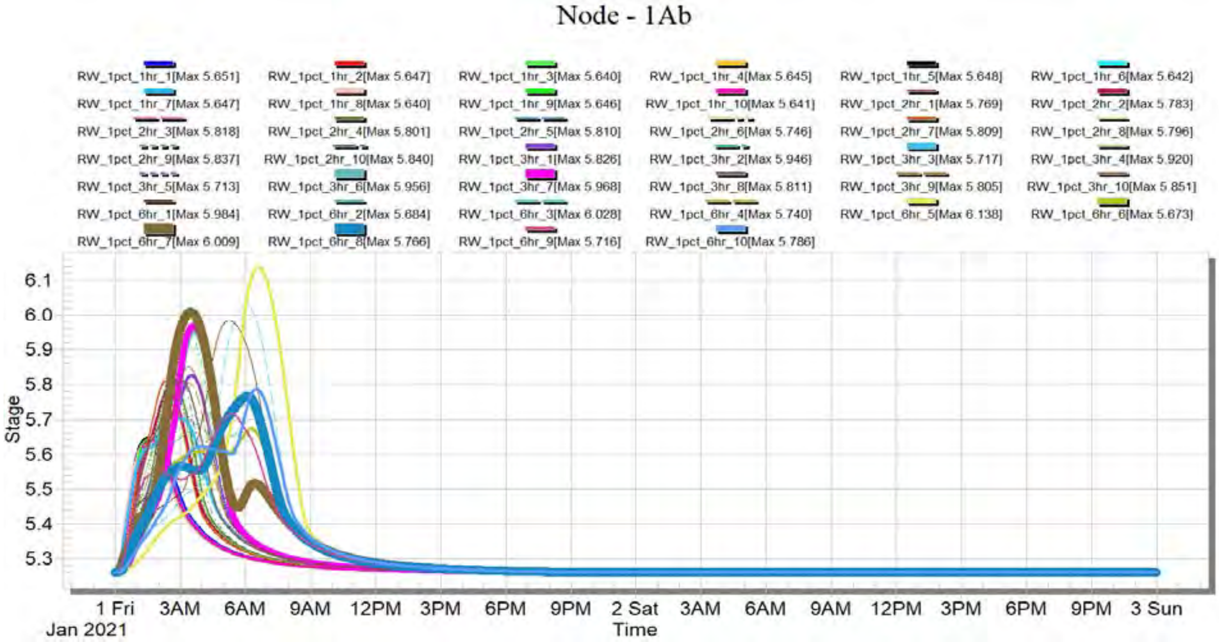
Figure 16: Dalton Main Swale Discharge Flood Hydrographs

10% AEP Hydrographs



1% AEP Hydrographs



Data Source: JDA XP-Storm Model

Job No. J7157

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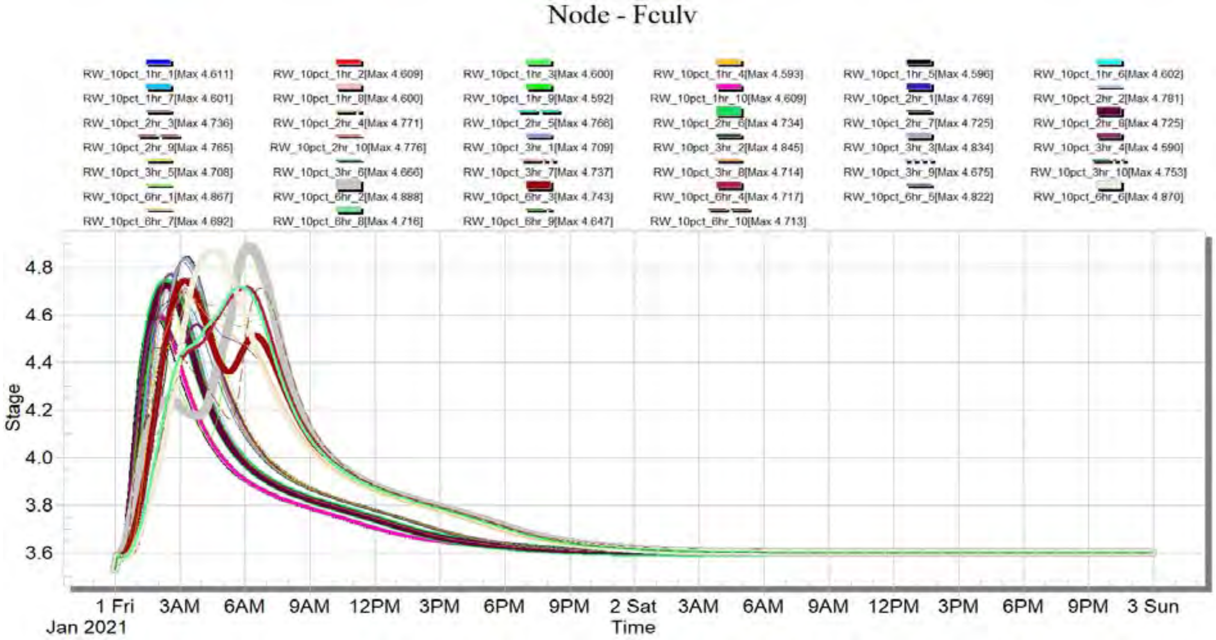
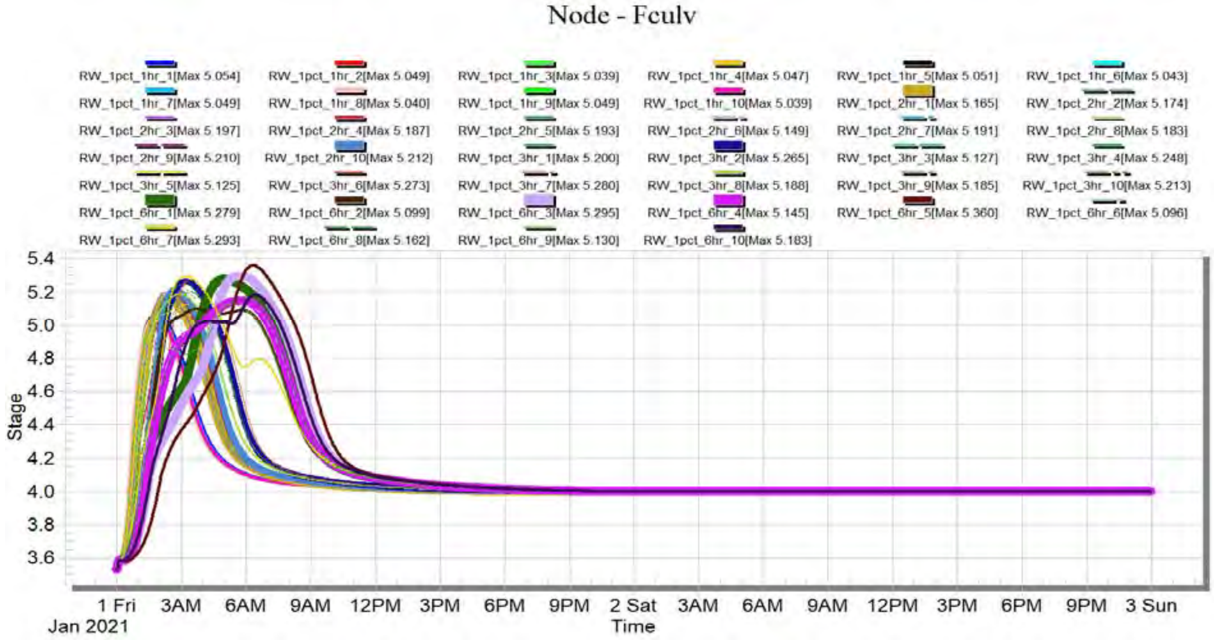
Figure 17: Hematite Main Swale Upstream Flood Hydrographs

10% AEP Hydrographs



1% AEP Hydrographs



Data Source: JDA XP-Storm Model

Job No. J7157

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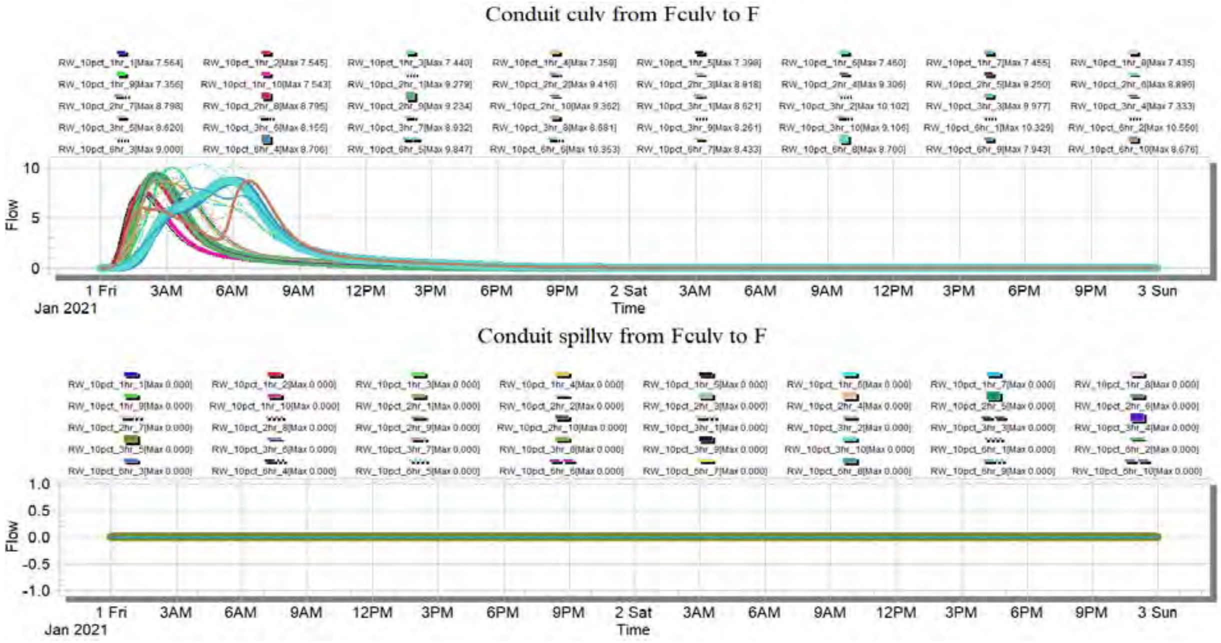
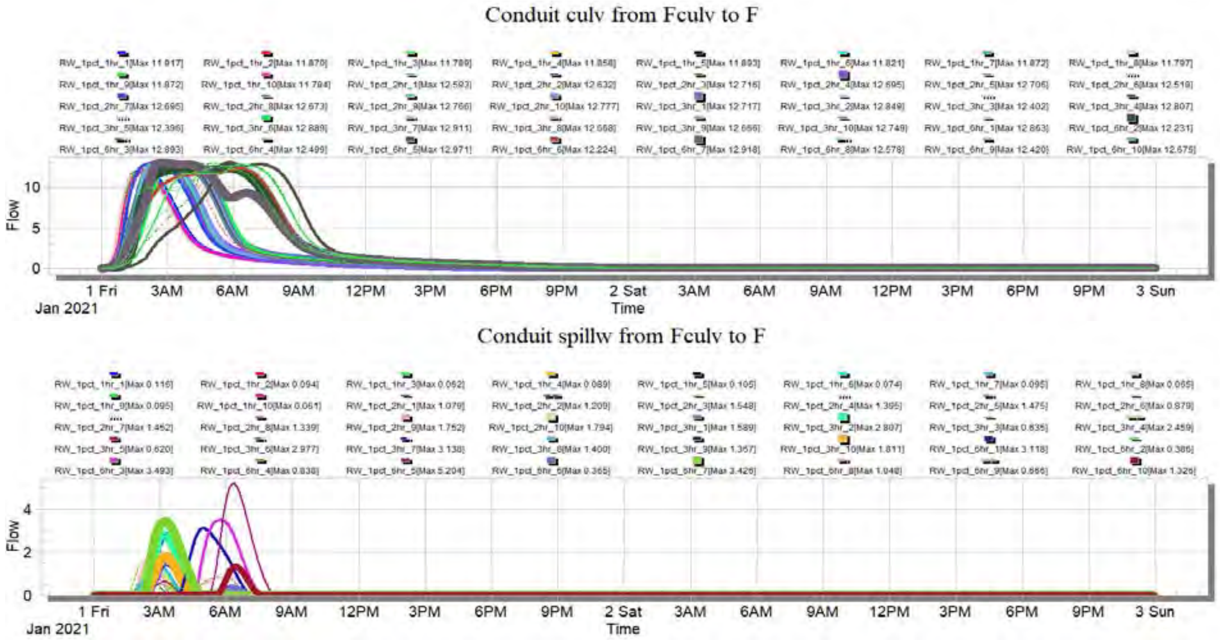
Figure 18: Hematite Main Swale Downstream Flood Hydrographs

10% AEP Hydrographs



1% AEP Hydrographs



Data Source: JDA XP-Storm Model

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Job No. J7157

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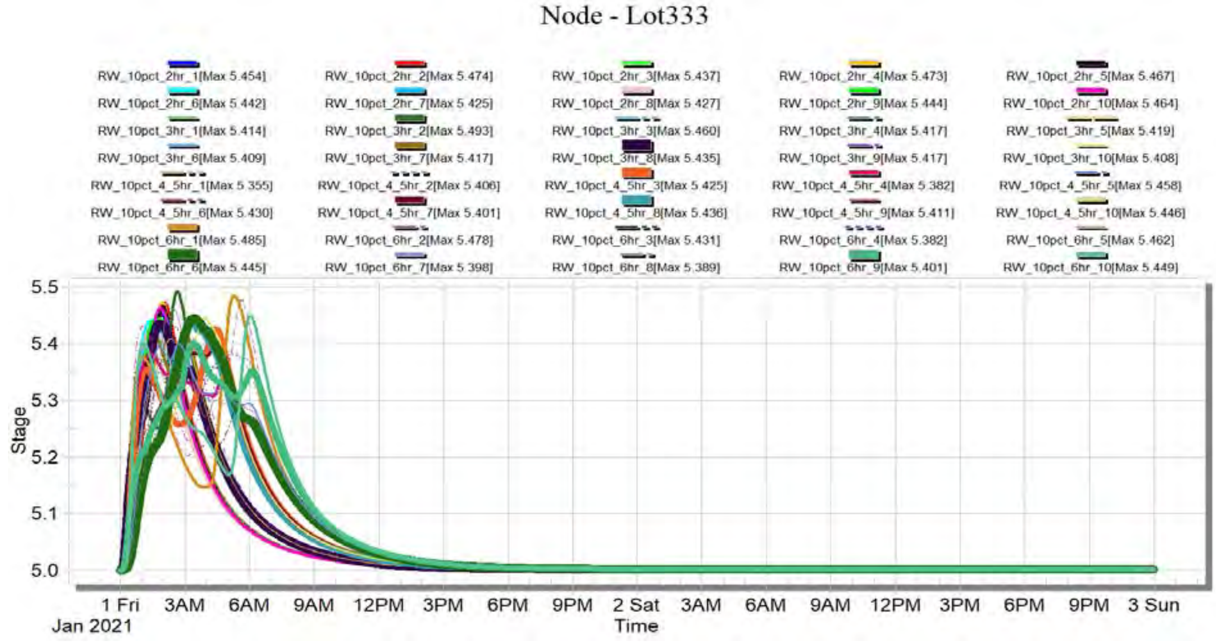
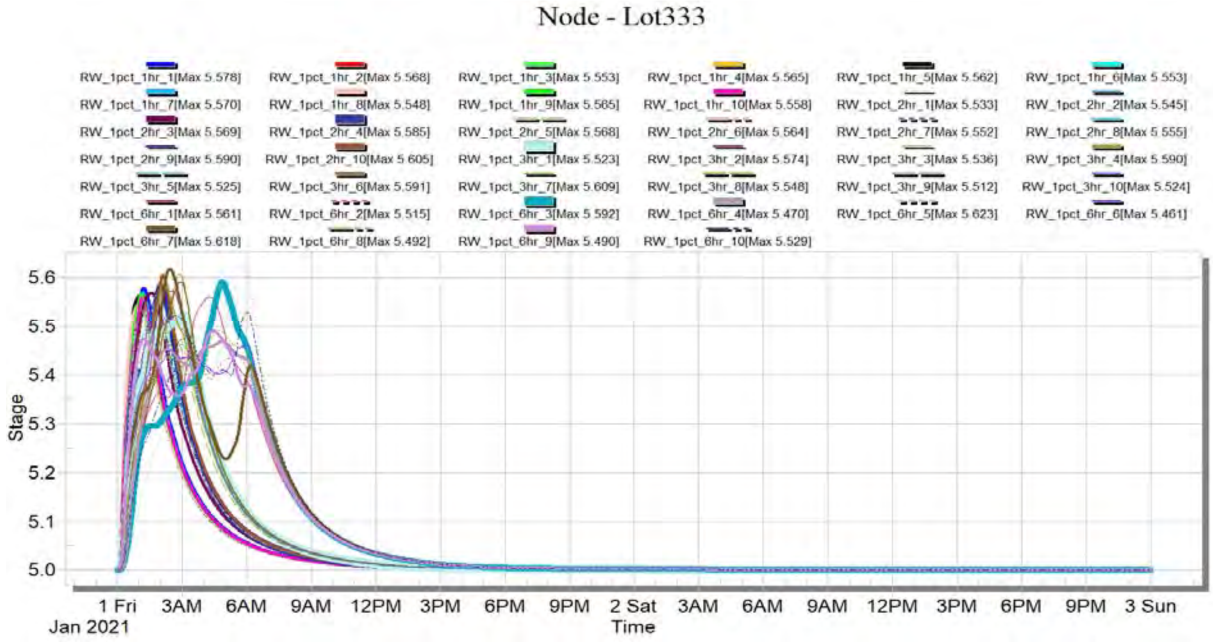
Figure 19: Hematite Main Swale Discharge Flood Hydrographs

10% AEP Hydrographs



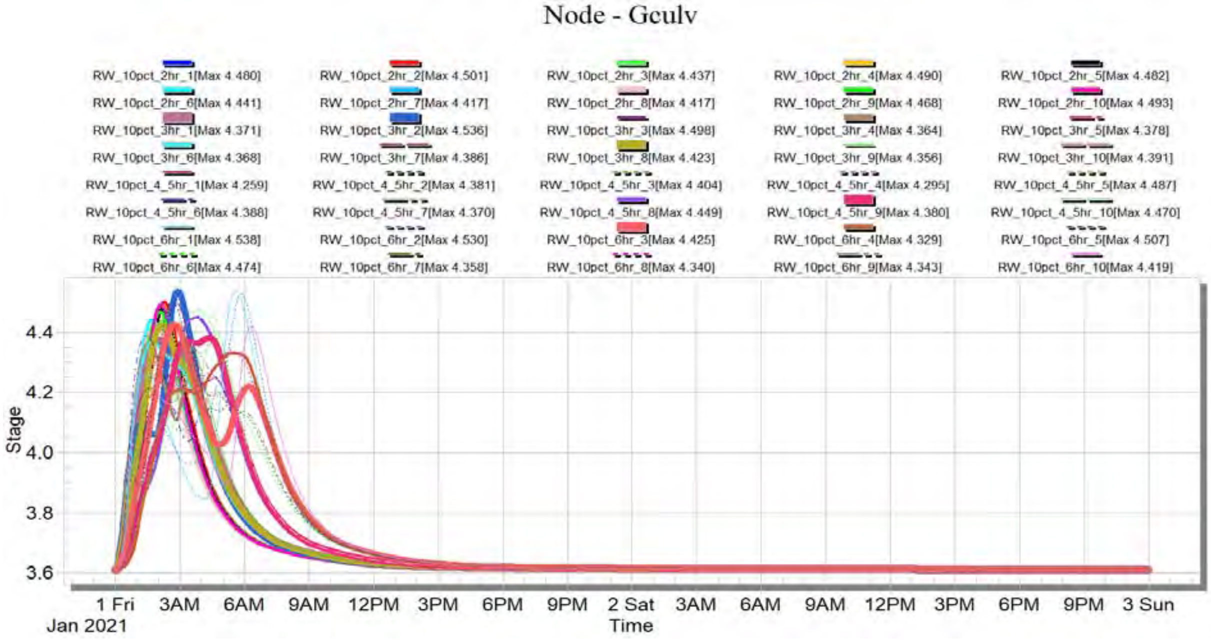
1% AEP Hydrographs



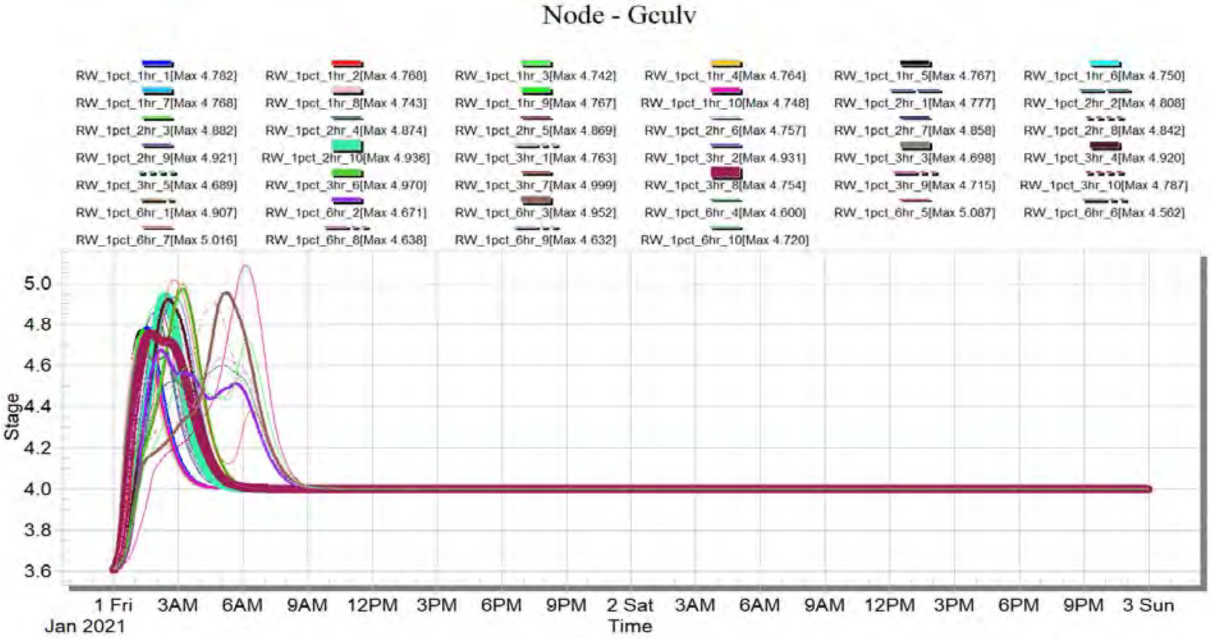
Data Source: JDA XP-Storm Model

JDA Consultant Hydrologists	Job No. J7157 	Development WA Hedland Junction, Wedgefield LWMS: Technical Note **Figure 20: Anthill Main Swale Upstream Flood Hydrographs**

10% AEP Hydrographs



1% AEP Hydrographs



Data Source: JDA XP-Storm Model

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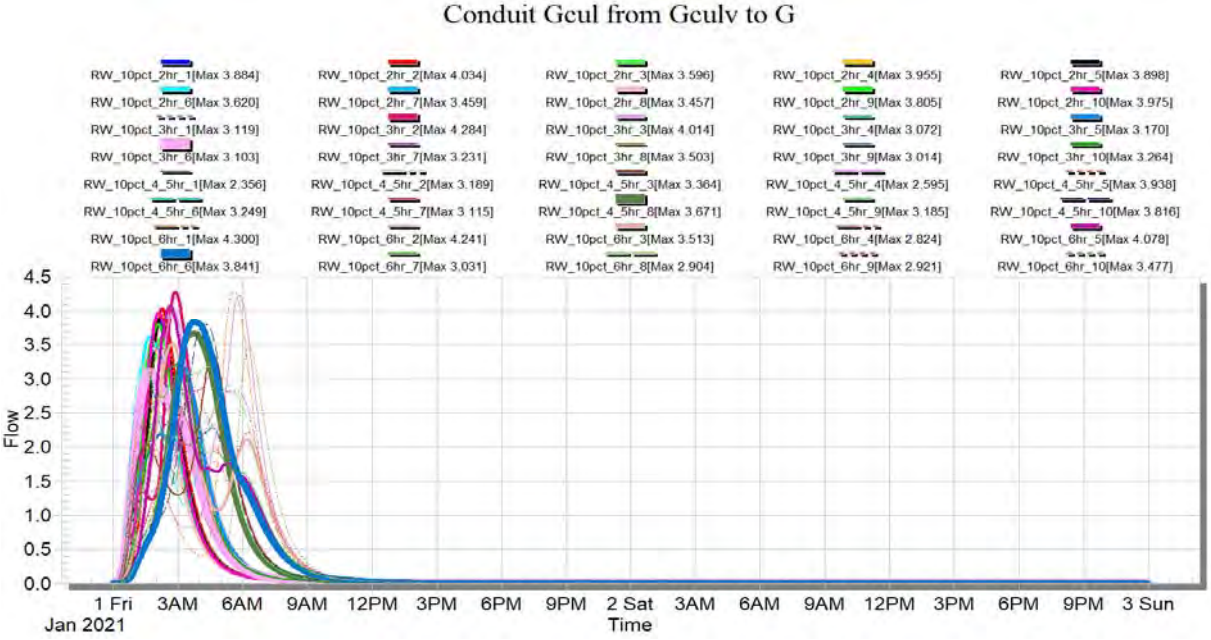
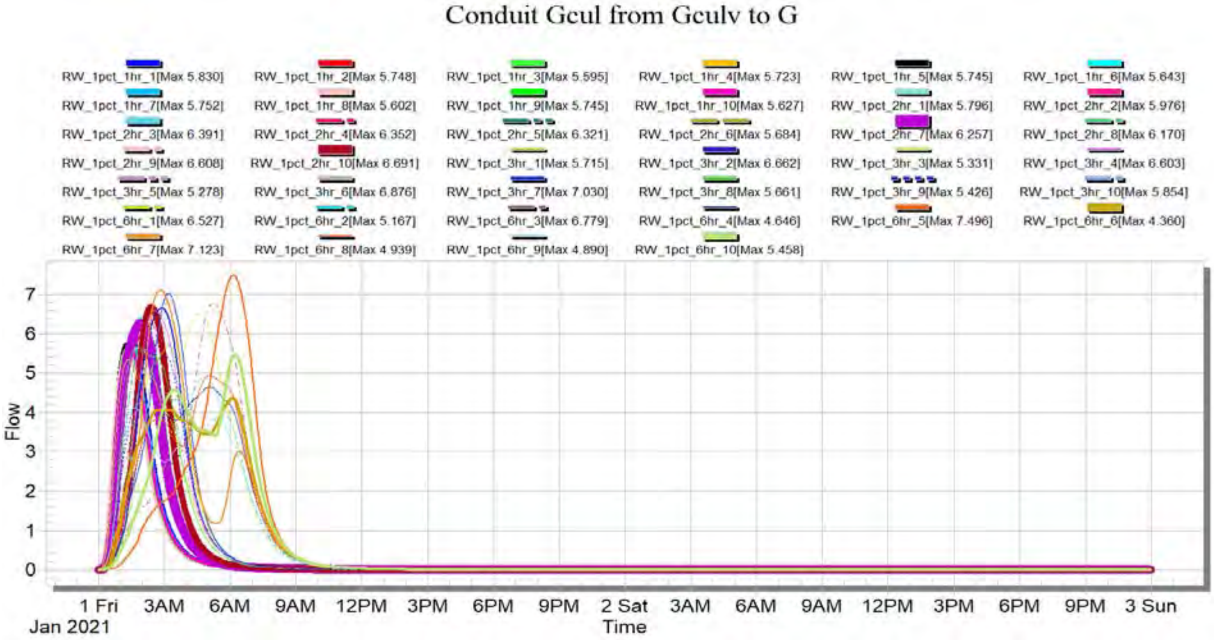
Figure 21: Anthill Main Swale Downstream Flood Hydrographs

10% AEP Hydrographs



1% AEP Hydrographs



Data Source: JDA XP-Storm Model

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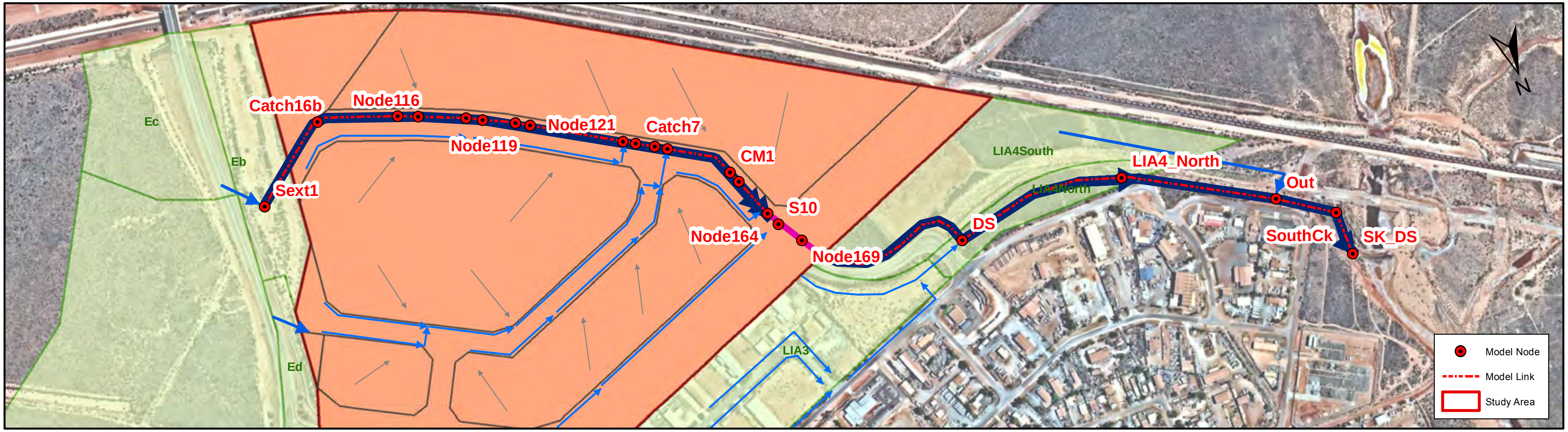
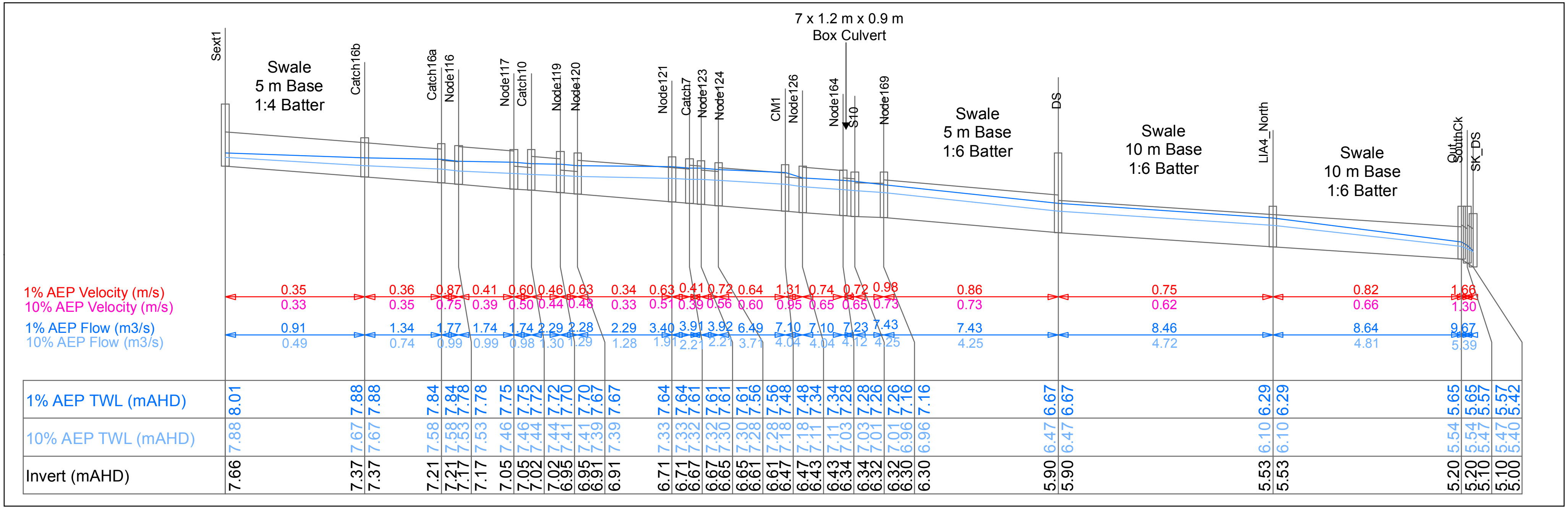
Figure 22: Anthill Main Swale Discharge Flood Hydrographs





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 1 for 10% AEP 2 hour critical duration and Temporal Pattern 3 for 1% AEP 2 hour critical duration; Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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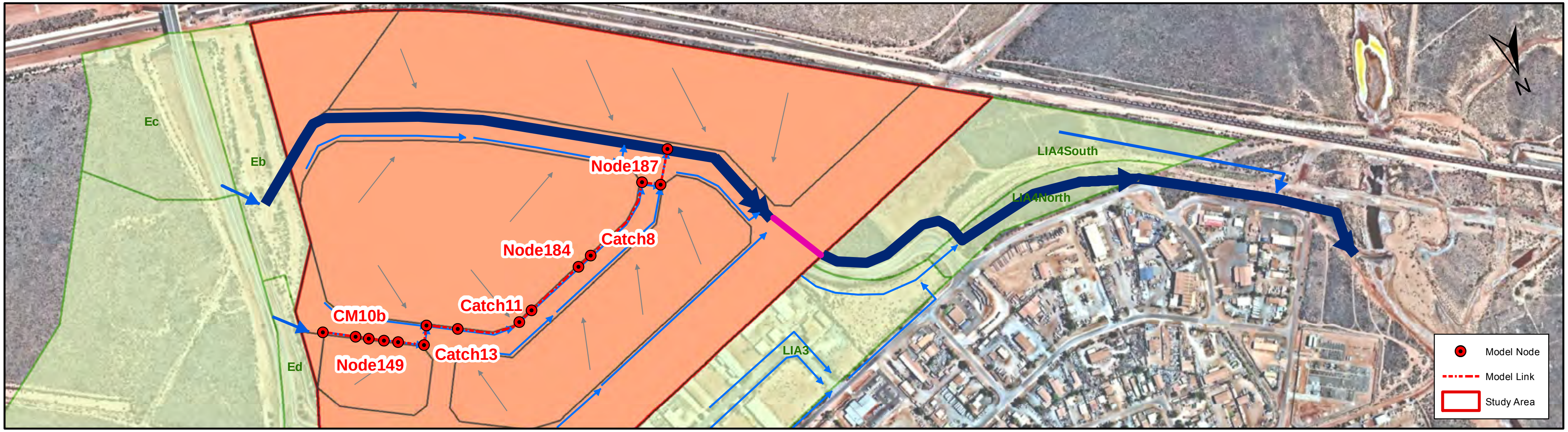
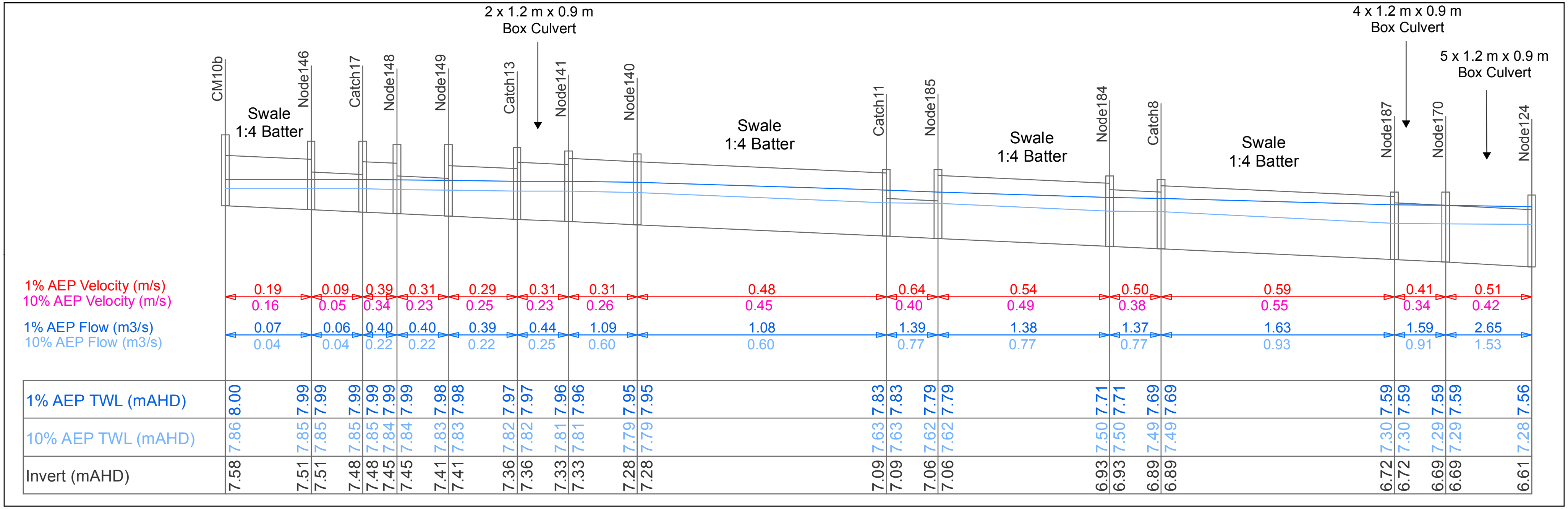
Figure 23: Dalton Longsection 1: Dalton Main Swale





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 9 for 10% AEP 2 hour critical duration and Temporal Pattern 5 for 1% AEP 2 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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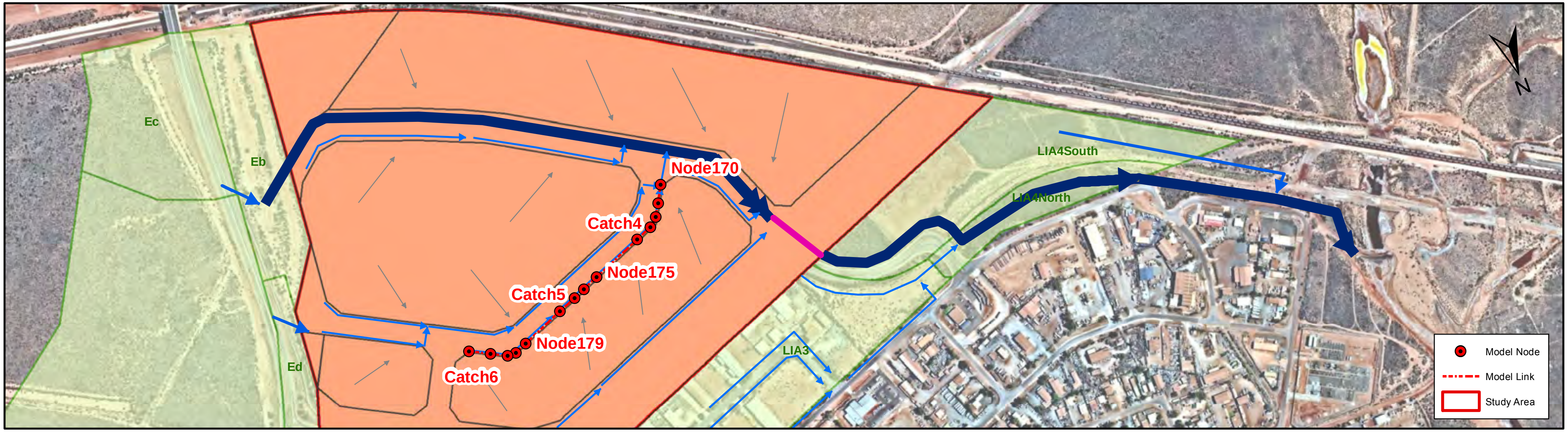
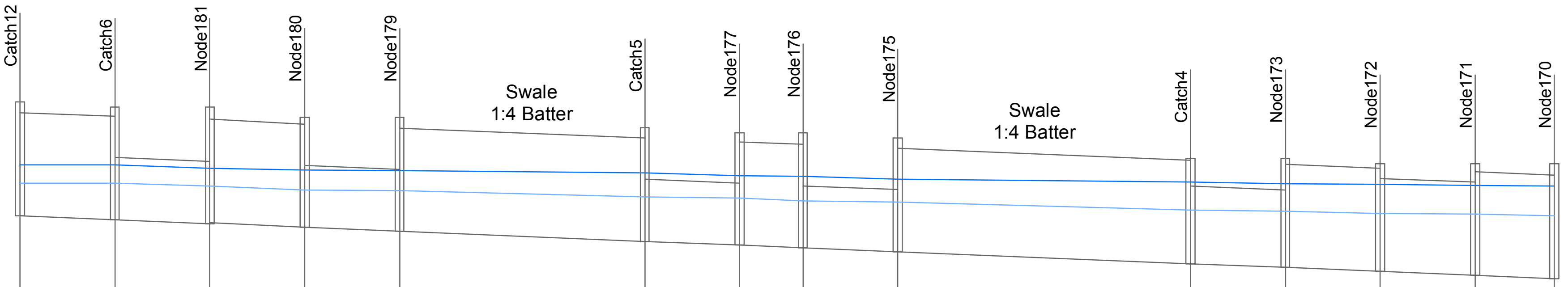
Figure 24: Dalton Longsection 2: Minor Swale #1





1% AEP Velocity (m/s)	0.15	0.75	0.43	0.36	0.33	0.56	0.49	0.56	0.44	0.43	0.55	0.38	0.56
10% AEP Velocity (m/s)	0.13	0.58	1.85	0.28	0.32	0.44	0.47	0.42	0.42	0.35	0.52	0.32	0.52
1% AEP Flow (m3/s)	0.06	0.46	0.45	0.45	0.43	0.81	0.81	0.80	0.79	1.11	1.10	1.09	1.08
10% AEP Flow (m3/s)	0.04	0.25	0.25	0.25	0.24	0.45	0.45	0.45	0.45	0.63	0.63	0.62	0.62

	Catch12	Catch6	Node181	Node180	Node179	Catch5	Node177	Node176	Node175	Catch4	Node173	Node172	Node171	Node170
1% AEP TWL (mAHD)	7.79	7.79 7.79	7.75 7.75	7.74 7.74	7.73 7.73	7.71 7.71	7.68 7.68	7.67 7.67	7.65 7.65	7.62 7.62	7.61 7.61	7.60 7.60	7.59 7.59	7.59
10% AEP TWL (mAHD)	7.61	7.61 7.61	7.59 7.59	7.54 7.54	7.54 7.54	7.48 7.48	7.46 7.46	7.44 7.44	7.43 7.43	7.35 7.35	7.34 7.34	7.32 7.32	7.31 7.31	7.29
Invert (mAHD)	7.29	7.26 7.26	7.22 7.23	7.18 7.18	7.14 7.14	7.05 7.05	7.01 7.01	6.98 6.98	6.95 6.95	6.84 6.84	6.80 6.80	6.76 6.76	6.72 6.72	6.69

Data Source: XP-Storm Model (Modelling results for Temporal Pattern 9 for 10% AEP 2 hour critical duration and Temporal Pattern 5 for 1% AEP 2 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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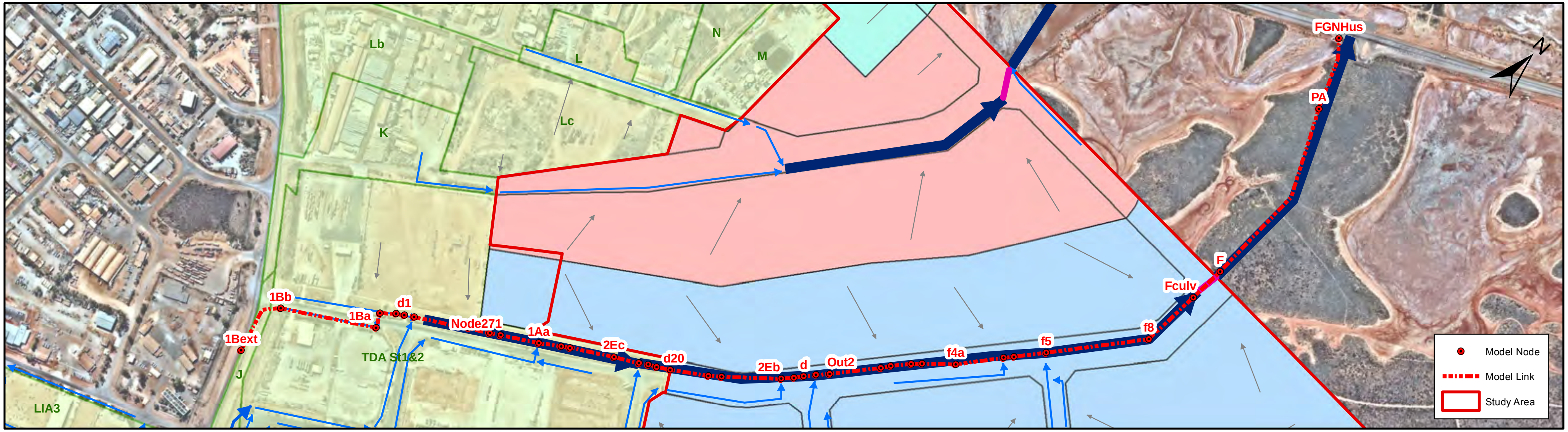
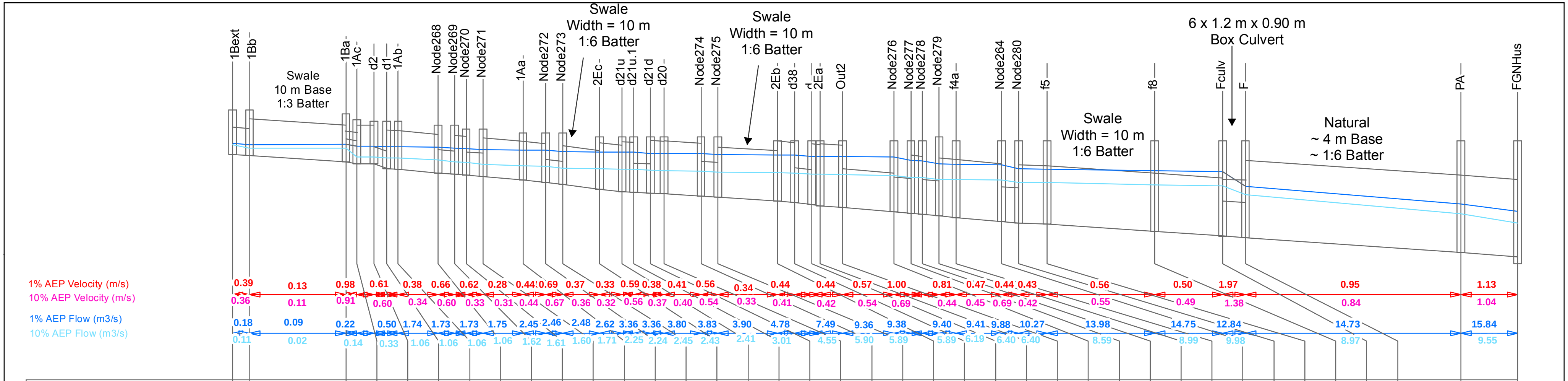
Figure 25: Dalton Longsection 3: Minor Swale #2





1% AEP TWL (mAHD)	5.90	5.90 5.91	5.91 5.86	5.86 5.86	5.86 5.85	5.85 5.85	5.85 5.84	5.84 5.80	5.80 5.80	5.80 5.76	5.76 5.76	5.76 5.76	5.76 5.71	5.71 5.71	5.71 5.70	5.70 5.70	5.70 5.67	5.67 5.67	5.67 5.67	5.67 5.63	5.63 5.63	5.63 5.63	5.63 5.57	5.57 5.57	5.57 5.57	5.57 5.56	5.56 5.48	5.48 5.48	5.48 5.39	5.39 5.39	5.39 5.38	5.38 5.28	5.28 5.28	5.28 5.24	5.24 5.22	5.22 4.84	4.84 4.38	4.38 4.19
10% AEP TWL (mAHD)	5.79	5.79 5.79	5.79 5.57	5.57 5.55	5.55 5.53	5.53 5.53	5.53 5.48	5.48 5.41	5.41 5.40	5.40 5.34	5.34 5.32	5.32 5.30	5.30 5.24	5.24 5.22	5.22 5.21	5.21 5.21	5.21 5.19	5.19 5.18	5.18 5.17	5.17 5.14	5.14 5.13	5.13 5.12	5.12 5.09	5.09 5.09	5.09 5.08	5.08 5.05	5.05 4.99	4.99 4.99	4.99 4.93	4.93 4.93	4.93 4.91	4.91 4.86	4.86 4.85	4.85 4.78	4.78 4.76	4.76 4.57	4.57 4.09	4.09 3.84
Invert (mAHD)	5.62	5.62 5.45	5.45 5.40	5.40 5.40	5.40 5.29	5.28 5.26	5.26 5.20	5.20 5.14	5.14 5.11	5.11 5.05	5.05 4.99	4.99 4.94	4.94 4.85	4.85 4.75	4.75 4.69	4.69 4.68	4.68 4.64	4.65 4.63	4.63 4.58	4.58 4.53	4.53 4.45	4.45 4.43	4.43 4.34	4.34 4.32	4.32 4.28	4.28 4.19	4.19 4.13	4.13 4.10	4.10 4.03	4.03 4.02	4.02 3.94	3.94 3.89	3.89 3.85	3.85 3.66	3.66 3.54	3.54 3.50	3.50 3.11	3.11 3.00

Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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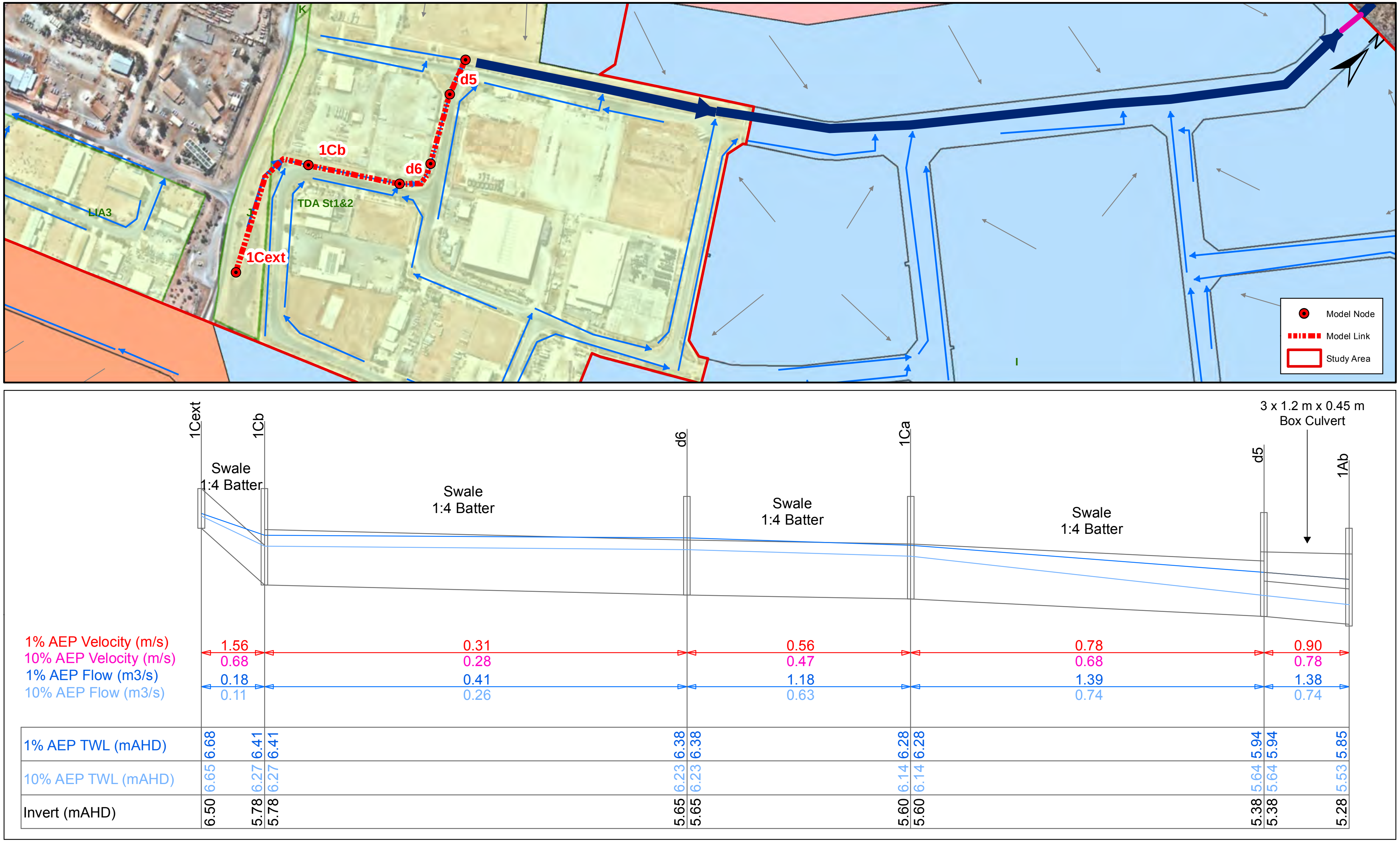
Figure 26: Hematite Longsection 1: Hematite Main Swale



Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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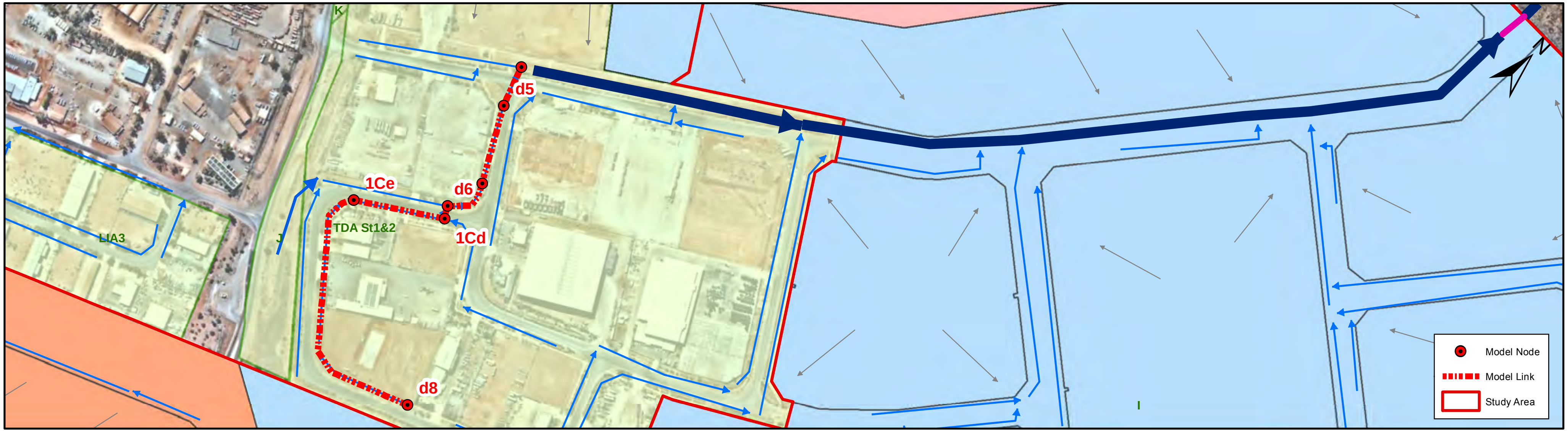
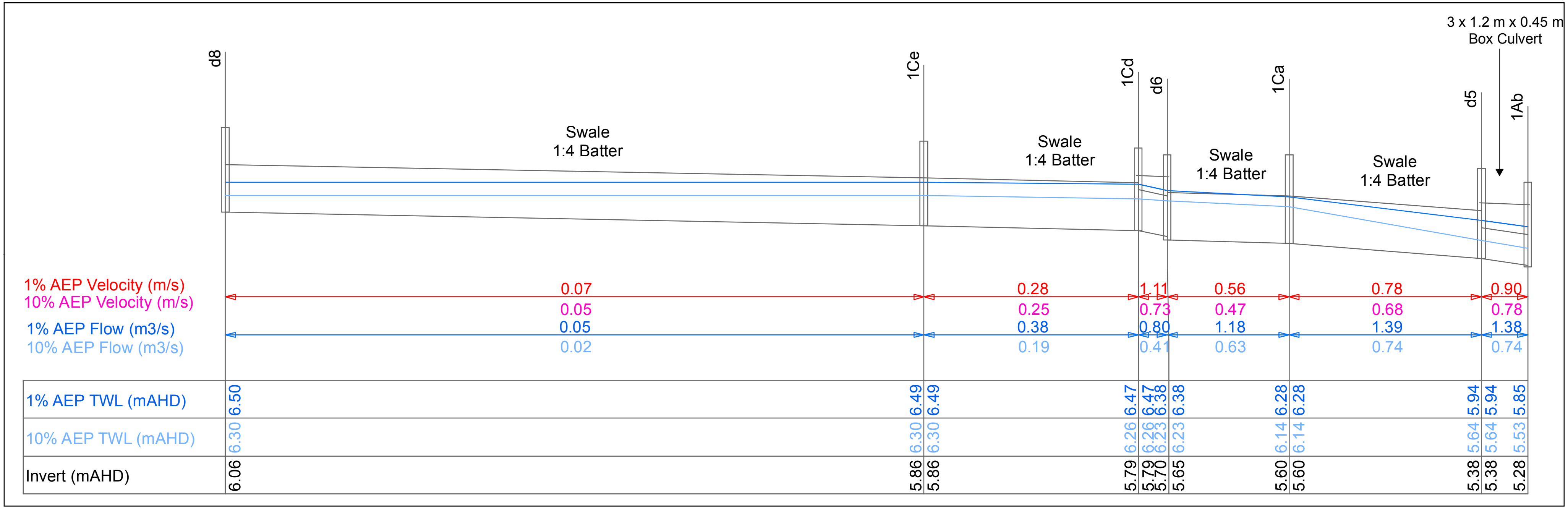
Figure 27: Hematite Longsection 2: Minor Swale #1 (Tailings Elbow & Phosphorus St)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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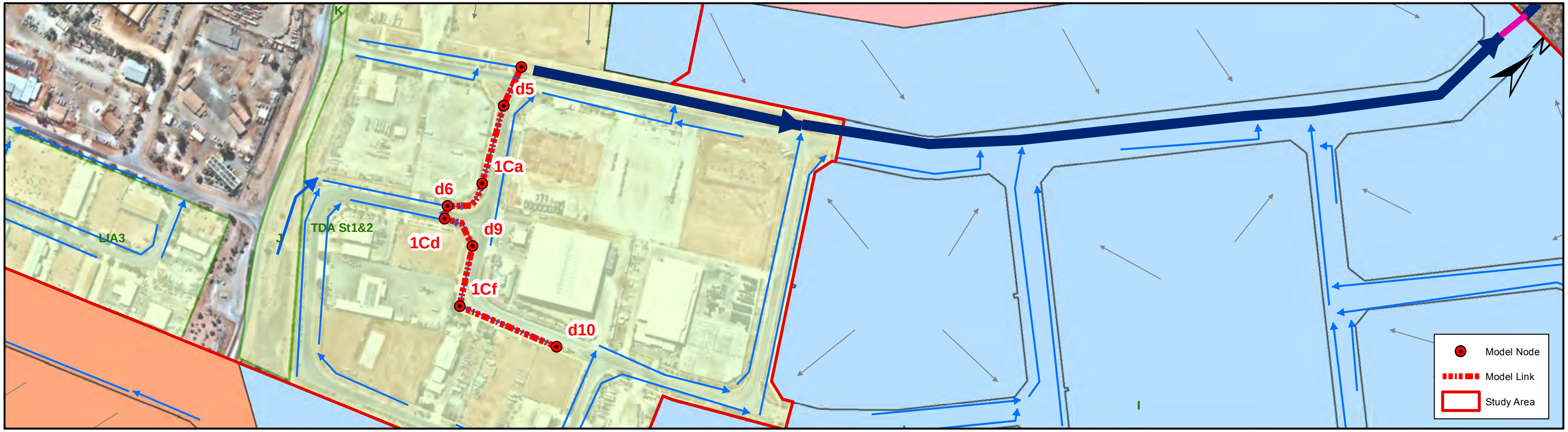
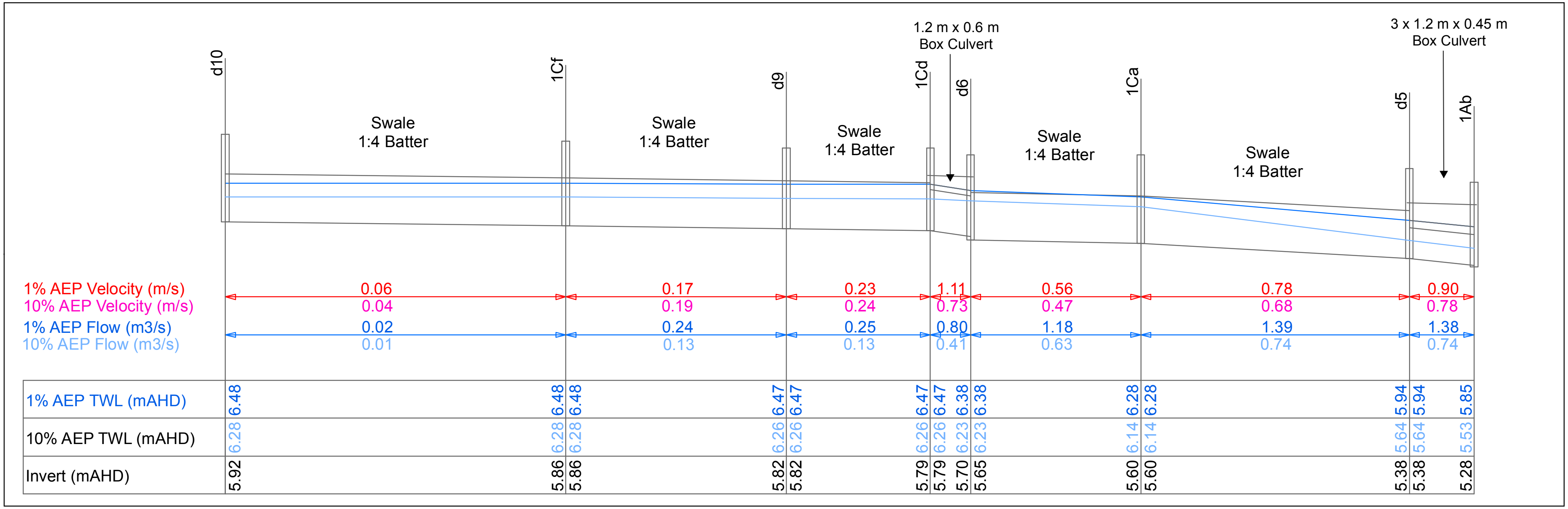
Figure 28: Hematite Longsection 3: Minor Swale #2
(Tailings Elbow & Phosphorus St)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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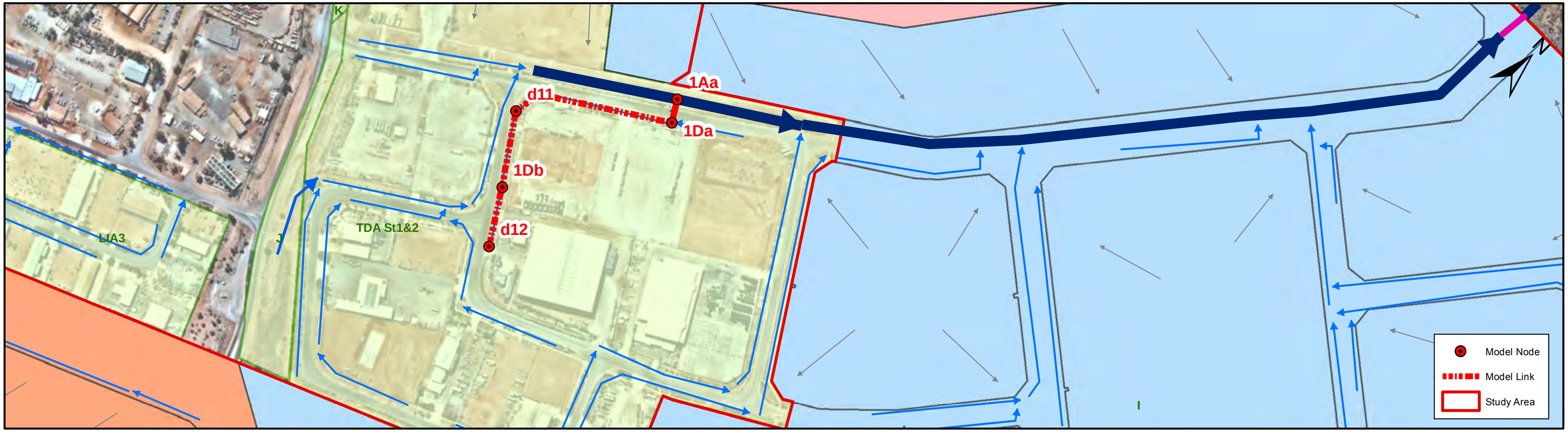
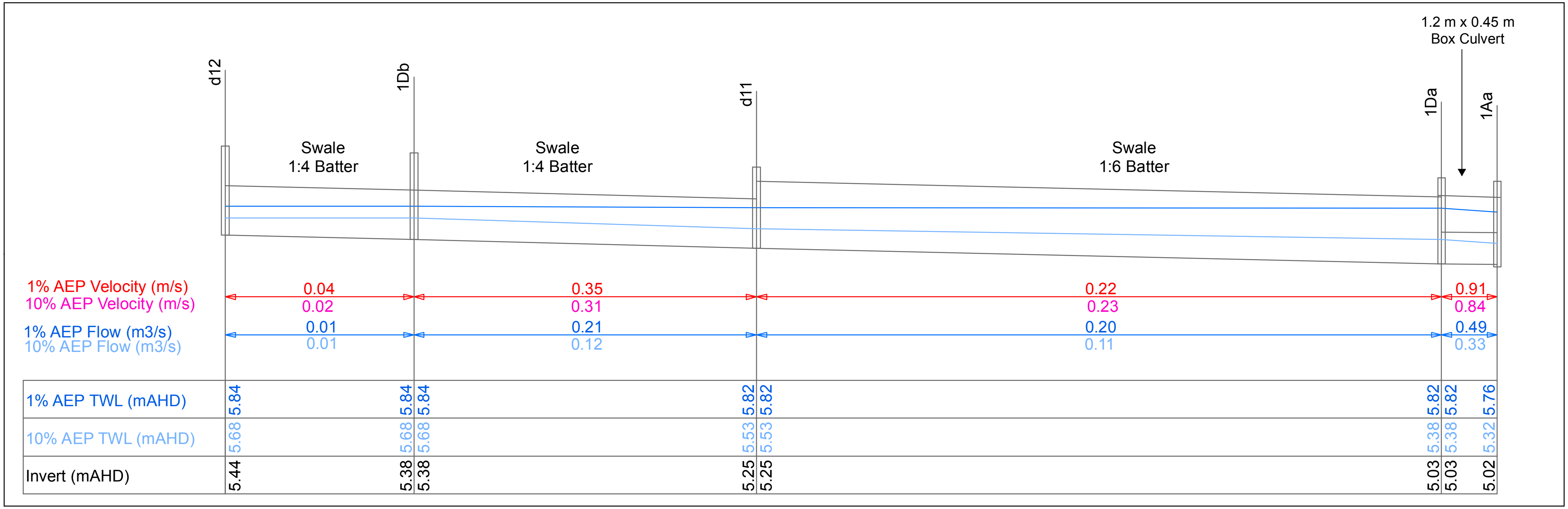
Figure 29: Hematite Longsection 4: Minor Swale #3 (Tailings Elbow)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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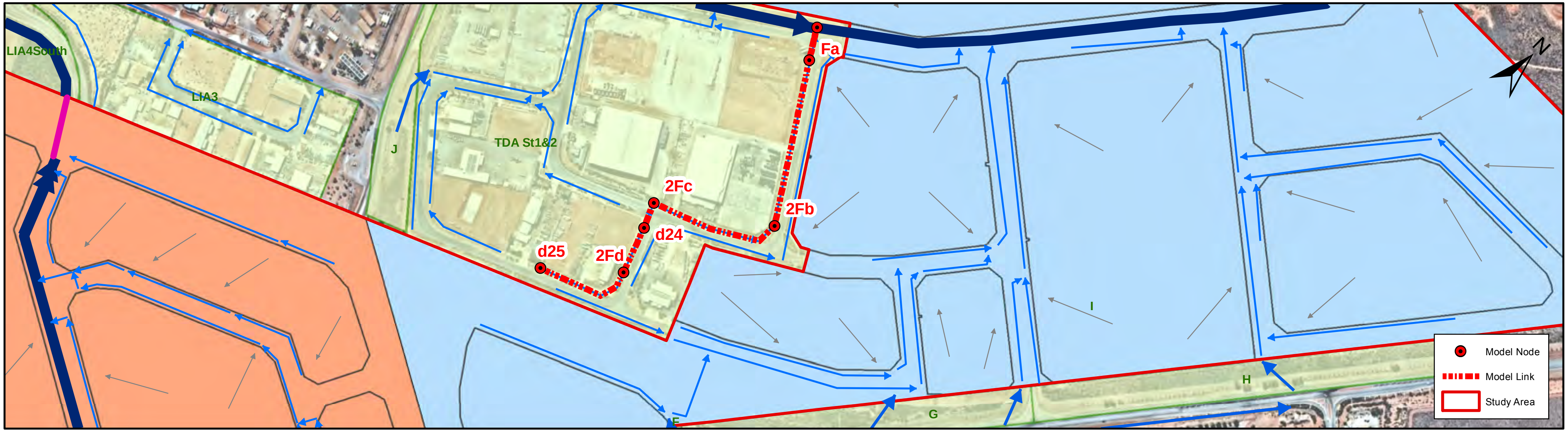
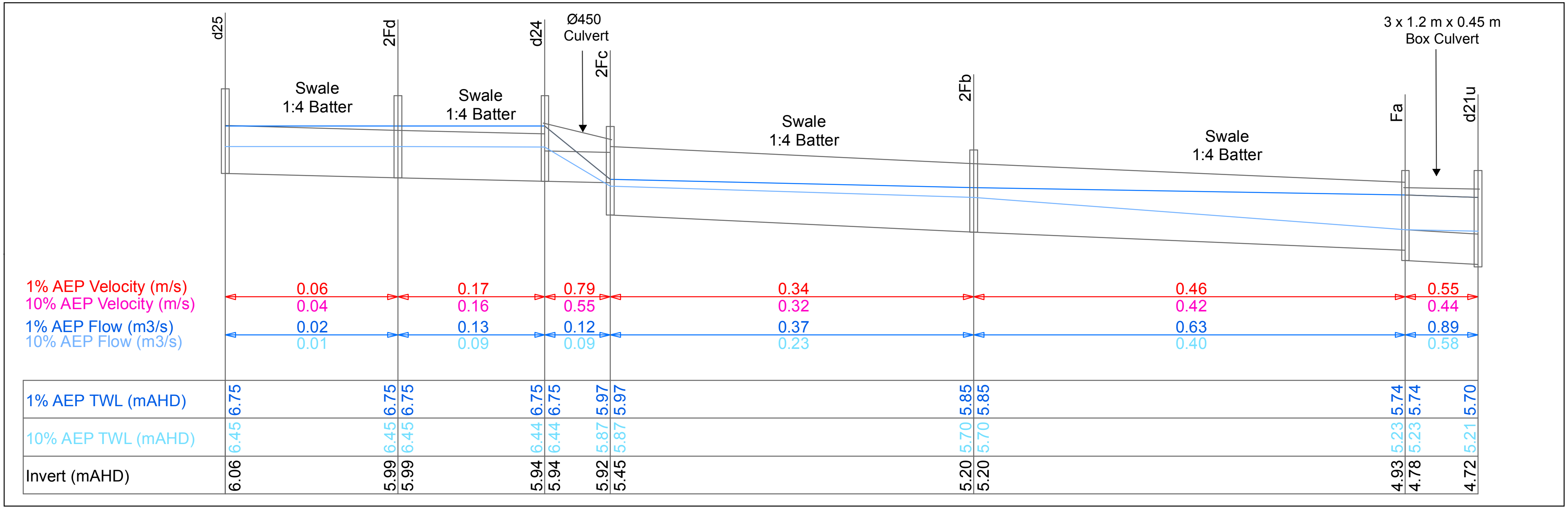
Figure 30: Hematite Longsection 5: Minor Swale #4 (Hematite Dr & Tailings Elbow)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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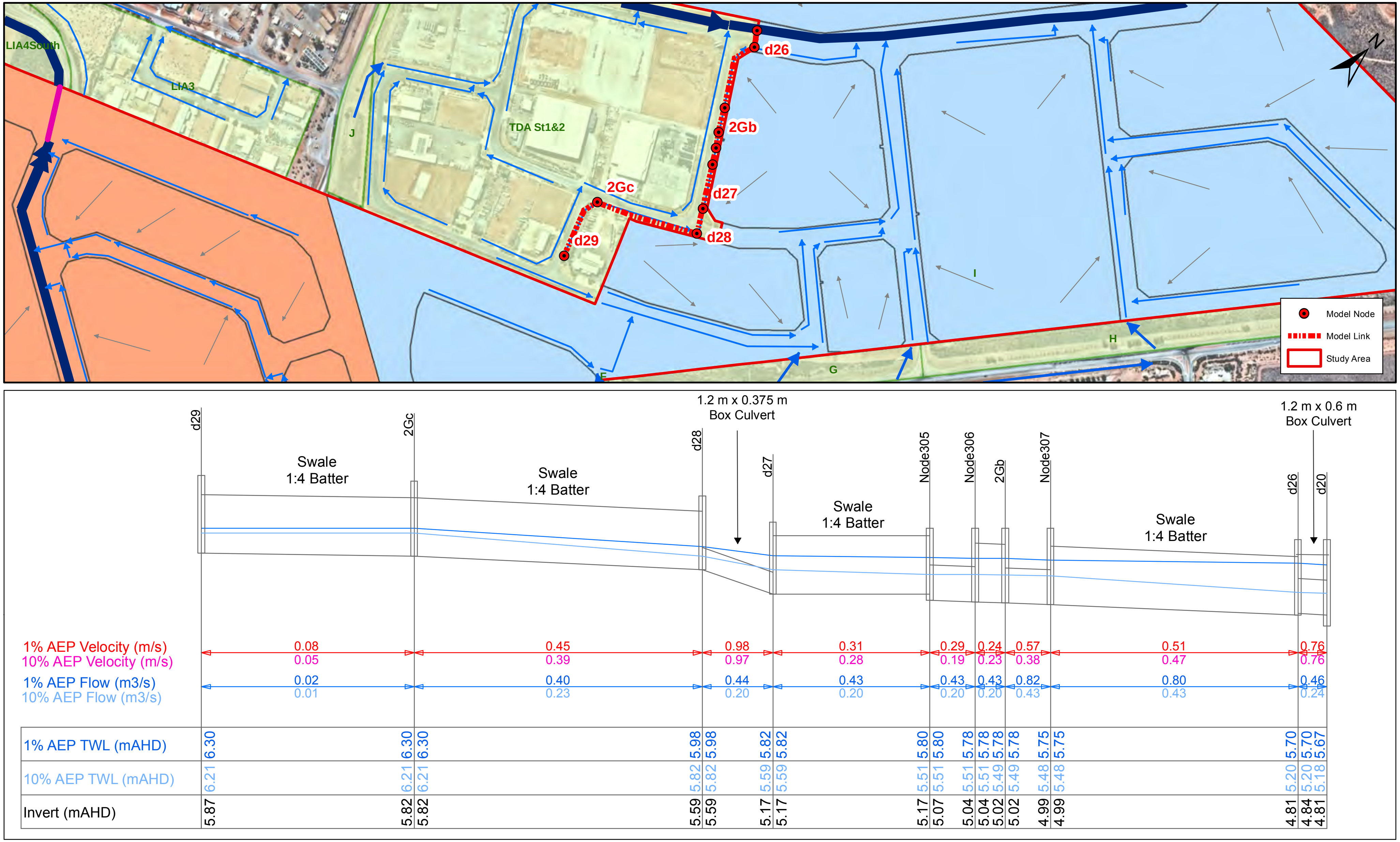
Figure 31: Hematite Longsection 6: Minor Swale #5
(Furnace Rd, Tailings Elbow, Alloy Way, Phosphorus St)



Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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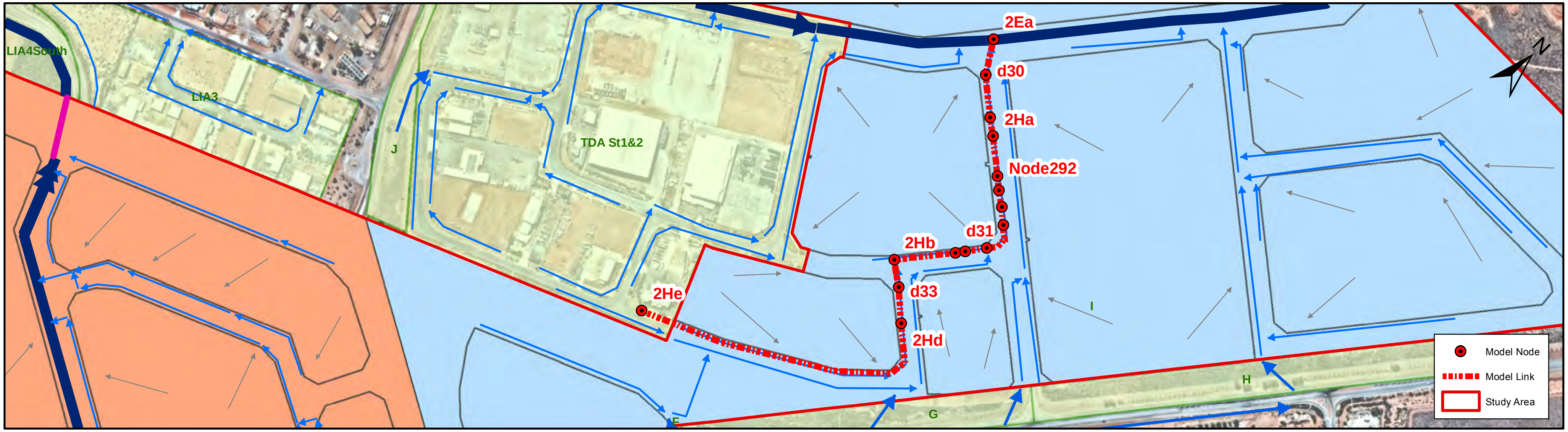
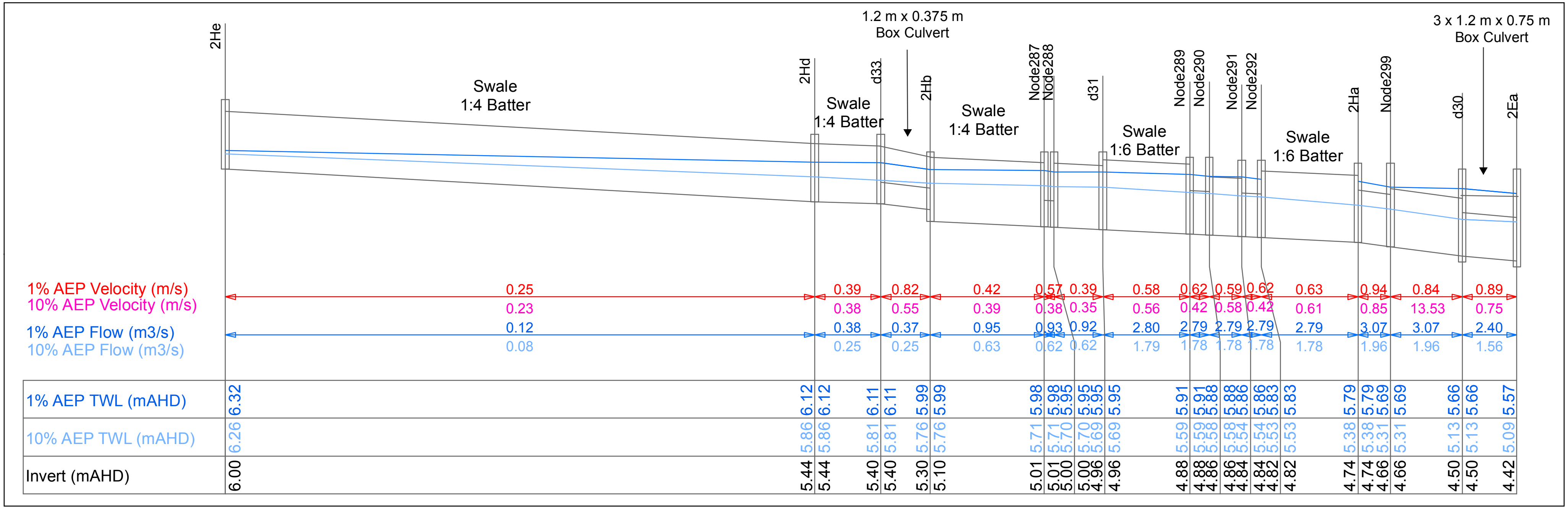
Figure 32: Hematite Longsection 7: Minor Swale #6 (Furnace Rd, Tailing Elbow, Alloy Way)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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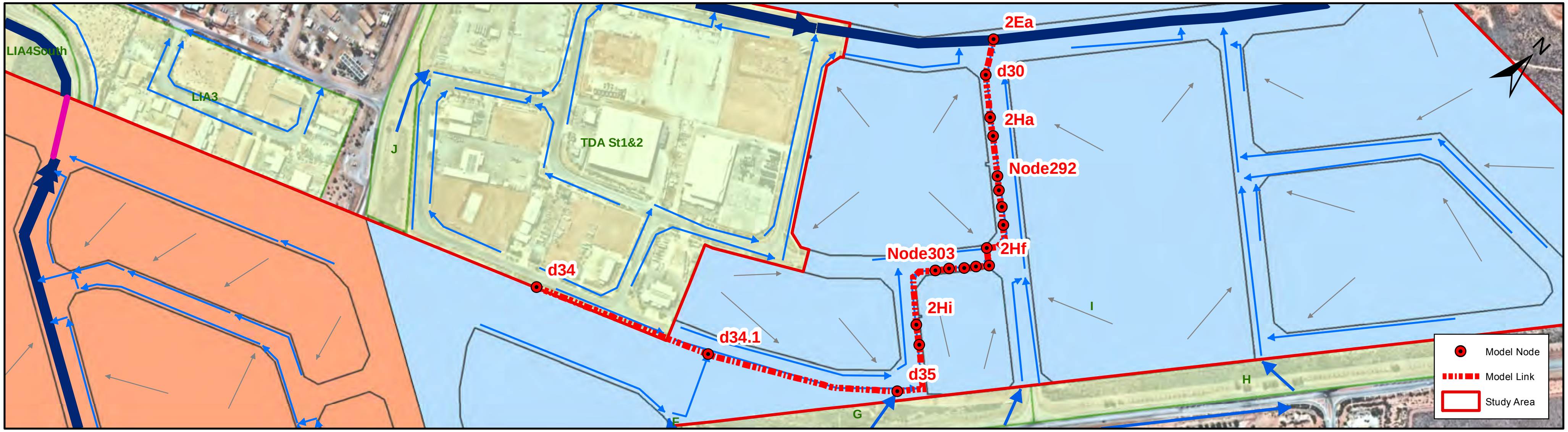
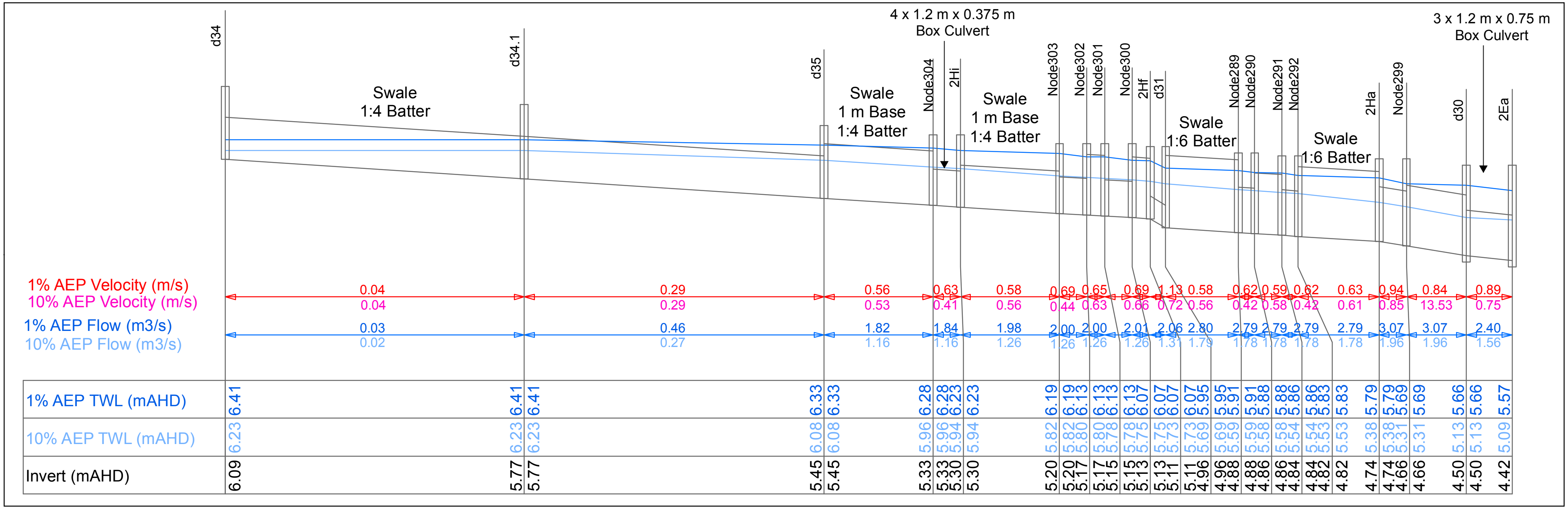
Figure 33: Hematite Longsection 8: Minor Swale #7
(Quarry Rd, Tailings Elbow, Phosphorus St)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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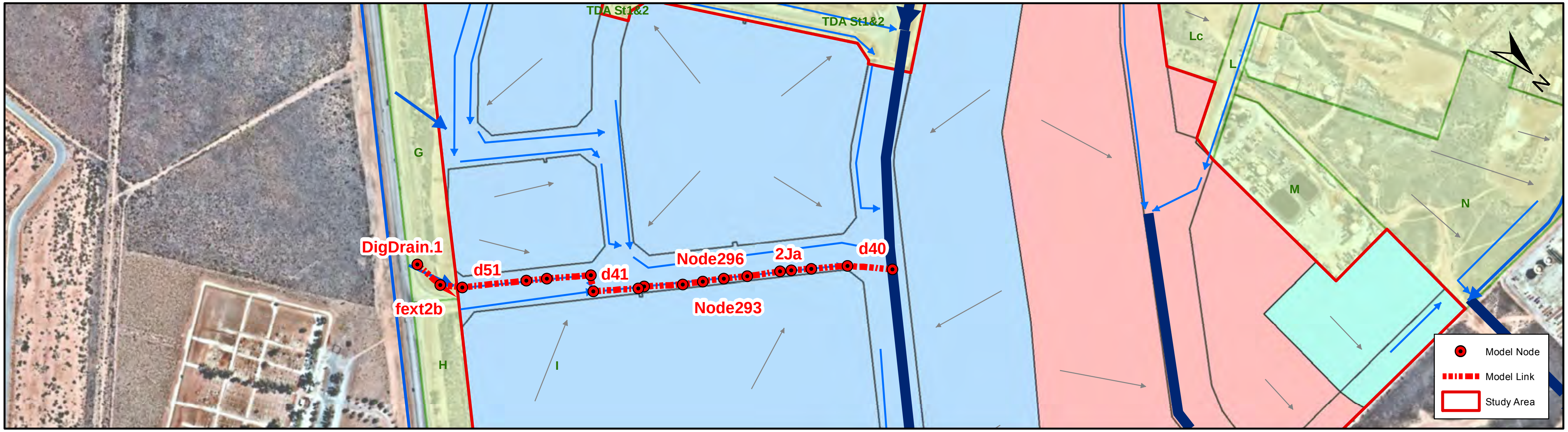
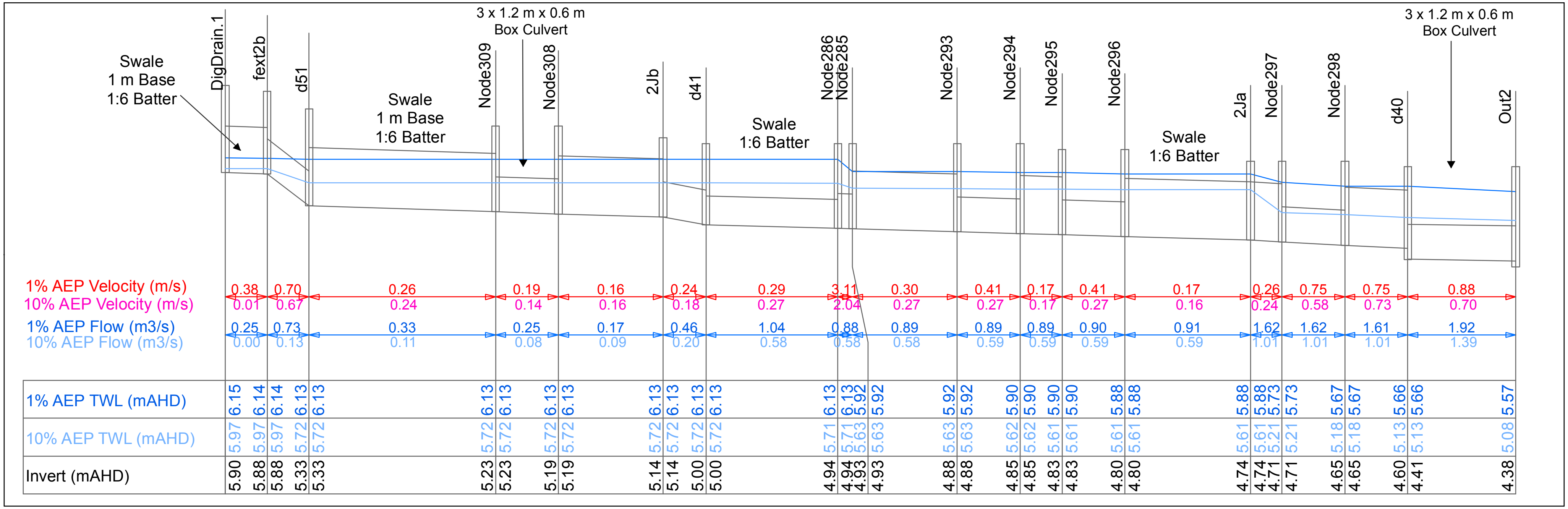
Figure 34: Hematite Longsection 9: Minor Swale #8 (Quarry Rd, Tailings Elbow, Phosphorus St)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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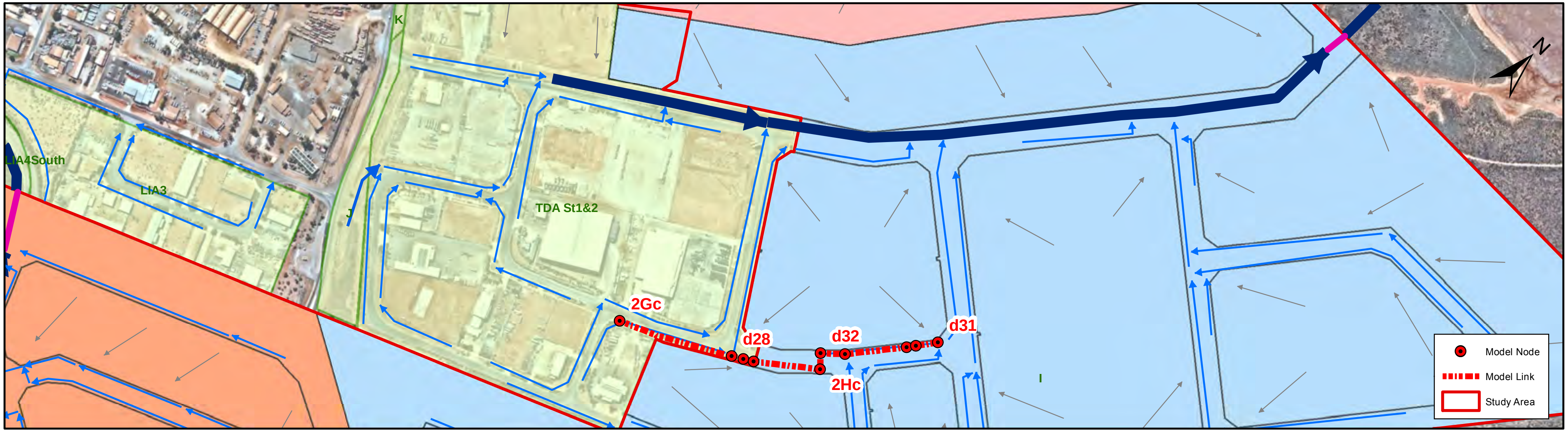
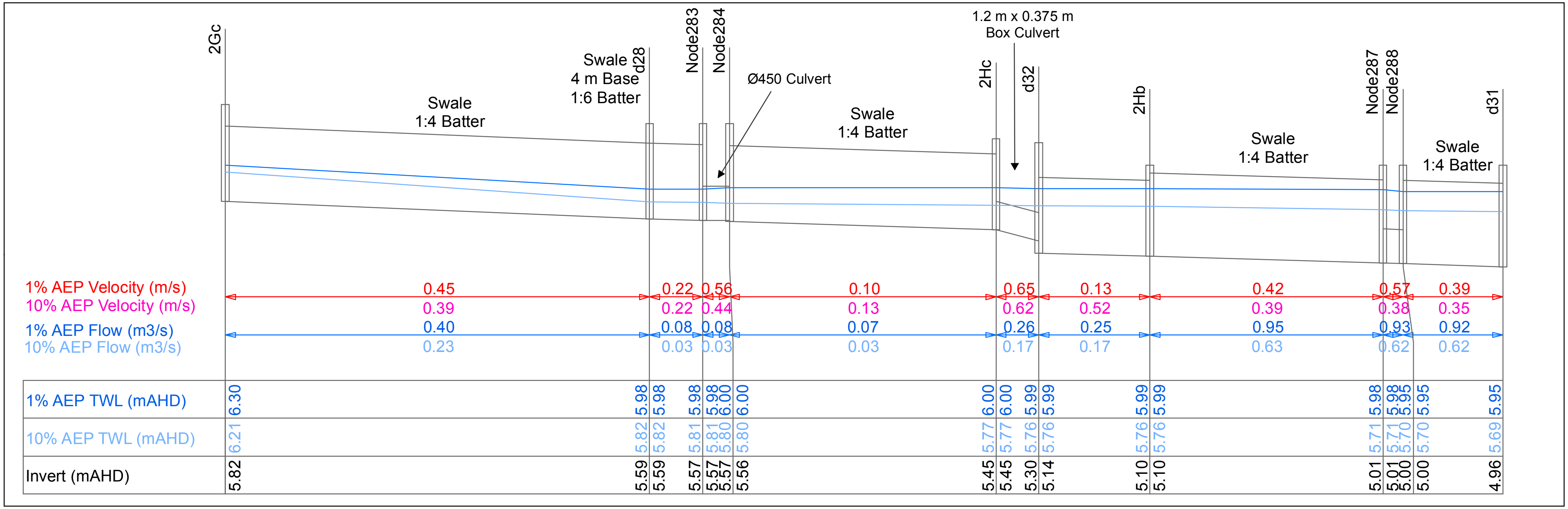
Figure 35: Hematite Longsection 10: Minor Swale #9 (Quarry Rd)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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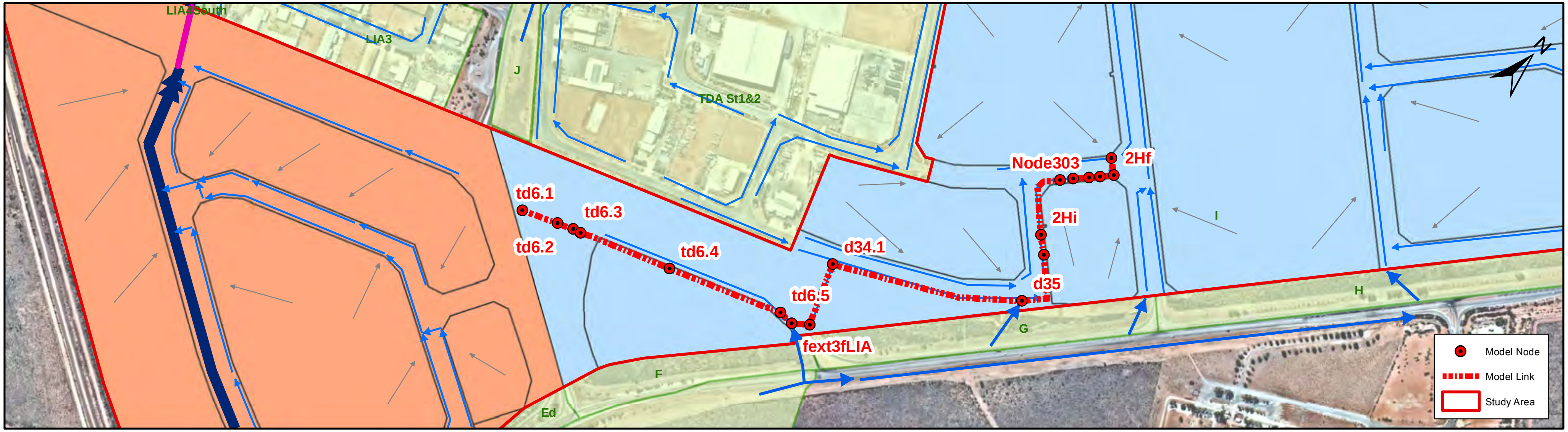
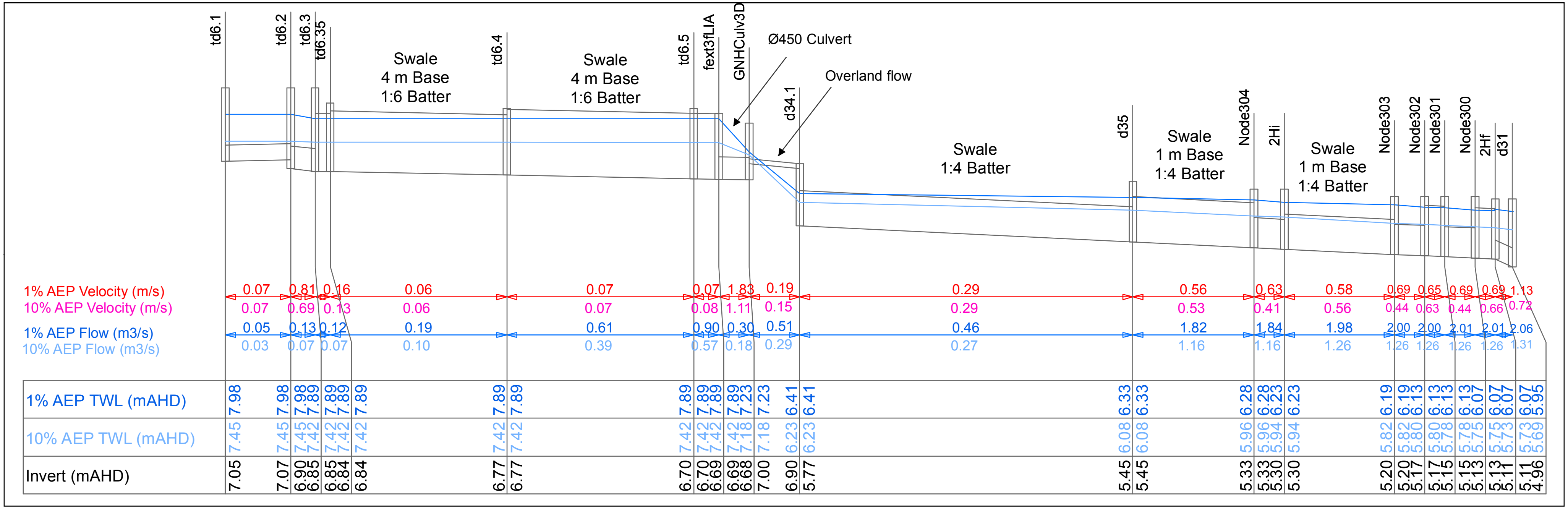
Figure 36: Hematite Longsection 11: Minor Swale #10 (Tailings Elbow)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 3 for 10% AEP 6 hour critical duration and Temporal Pattern 10 for 1% AEP 3 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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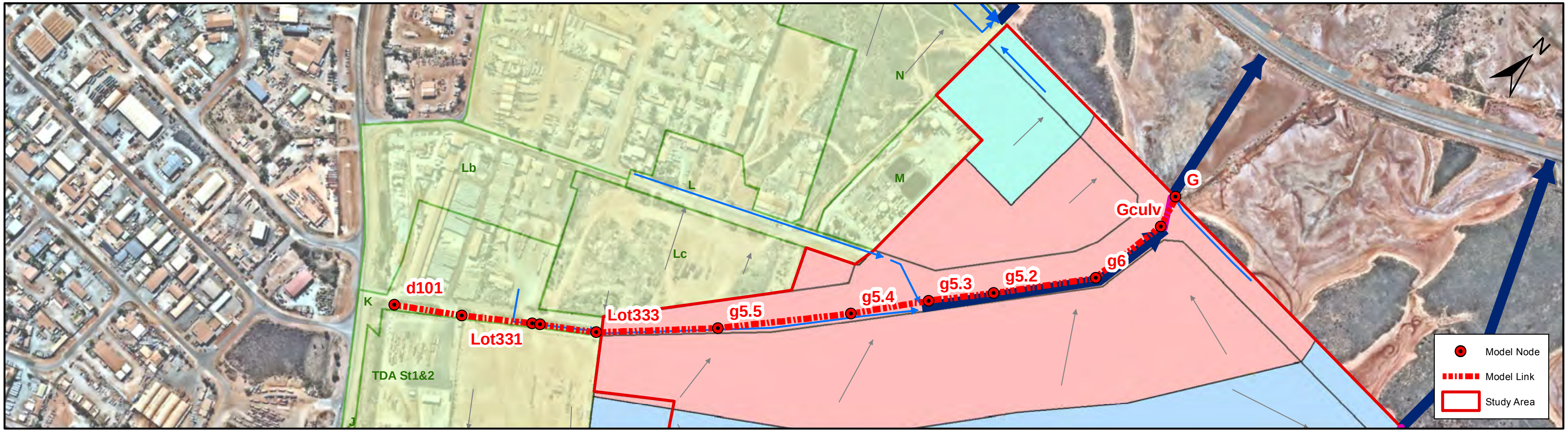
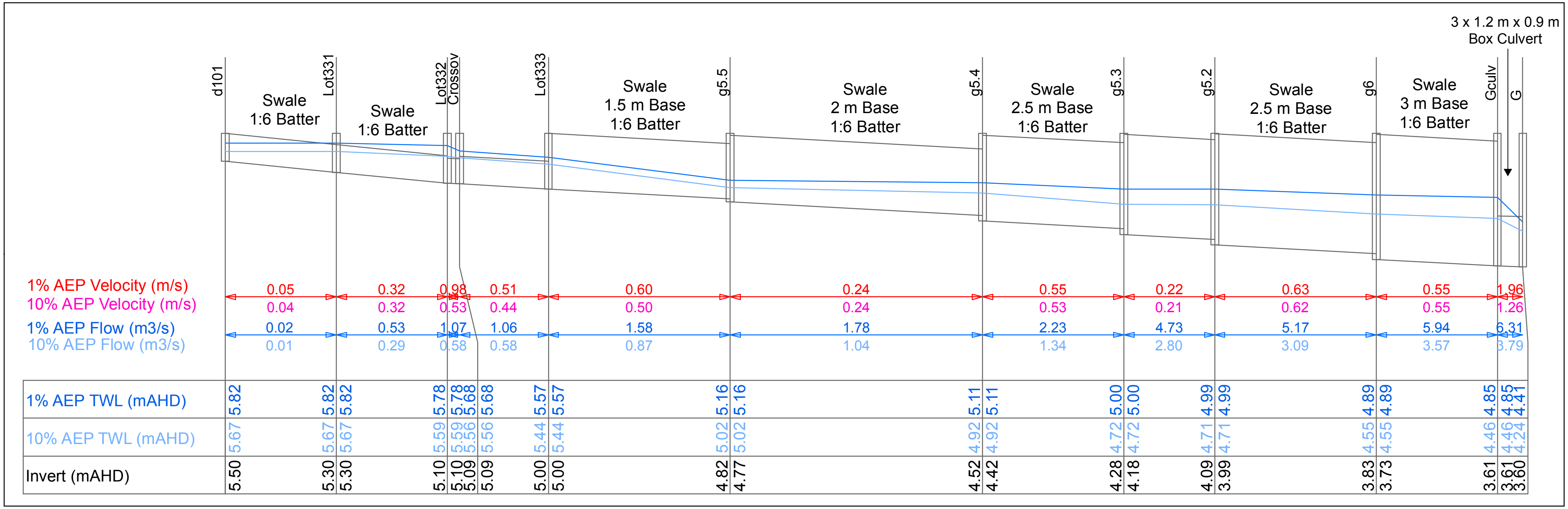
Figure 37: Hematite Longsection 12: Minor Swale #11 (Tailings Elbow, Phosphorus St, Powell Rd)





Data Source: XP-Storm Model (Modelling results for Temporal Pattern 9 for 10% AEP 2 hour critical duration and Temporal Pattern 5 for 1% AEP 2 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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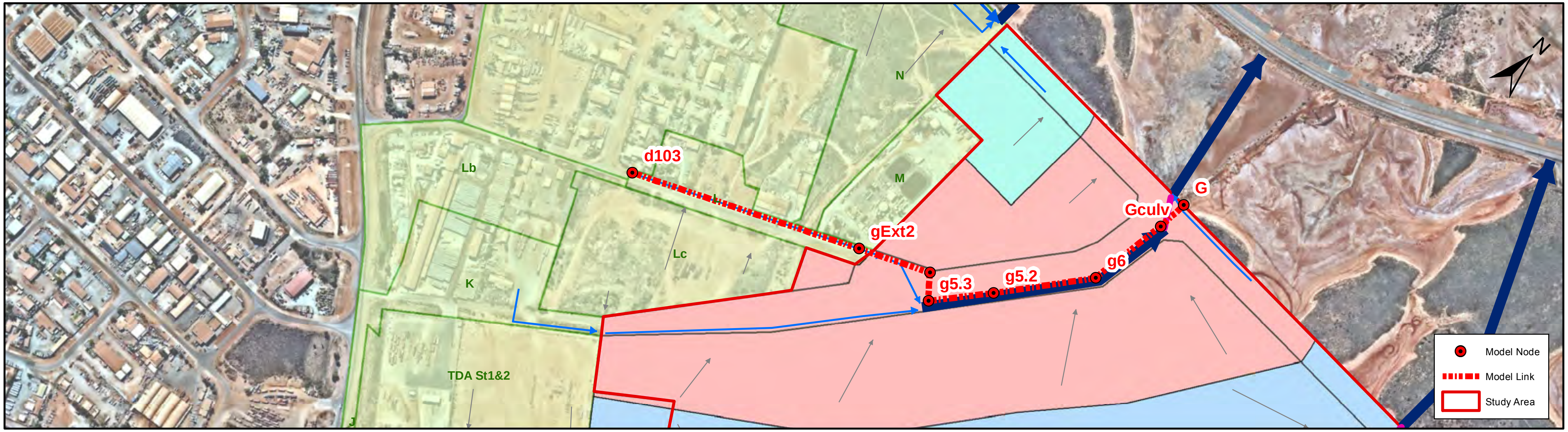
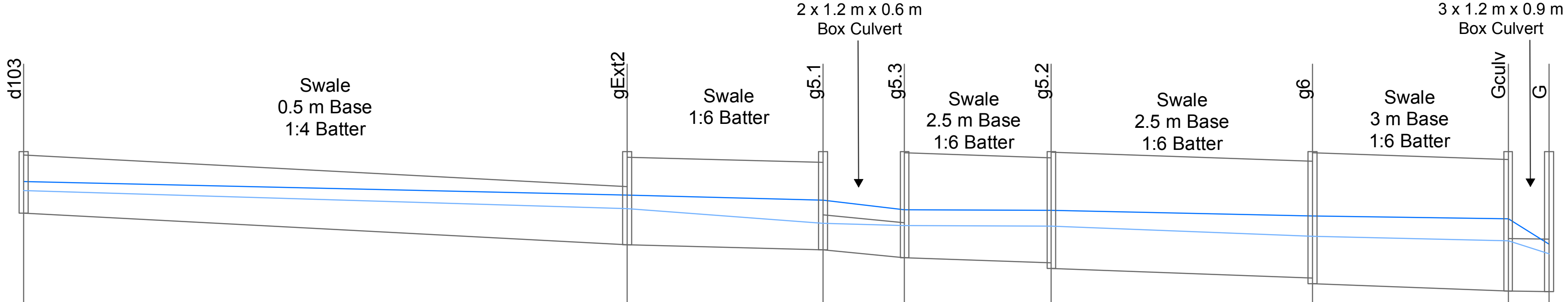
Figure 38: Anthill Longsection 1: Anthill Main Swale





1% AEP Velocity (m/s)	0.40	0.65	1.60	0.22	0.63	0.55	1.96
10% AEP Velocity (m/s)	0.38	0.60	1.39	0.21	0.62	0.55	1.26
1% AEP Flow (m3/s)	0.64	2.33	2.31	4.73	5.17	5.94	6.31
10% AEP Flow (m3/s)	0.34	1.30	1.31	2.80	3.09	3.57	3.79

1% AEP TWL (mAHD)	5.48	5.25	5.25	5.16	5.16	5.00	5.00	4.99	4.99	4.89	4.89	4.85	4.85	4.41
10% AEP TWL (mAHD)	5.34	5.03	5.03	4.77	4.77	4.72	4.72	4.71	4.71	4.55	4.55	4.46	4.46	4.24
Invert (mAHD)	4.94	4.40	4.40	4.31	4.31	4.18	4.18	4.09	3.99	3.83	3.73	3.61	3.61	3.60

Data Source: XP-Storm Model (Modelling results for Temporal Pattern 9 for 10% AEP 2 hour critical duration and Temporal Pattern 5 for 1% AEP 2 hour crtical duration); Crossover culvert details summarised in Section 4.2.6 of Technical Note.

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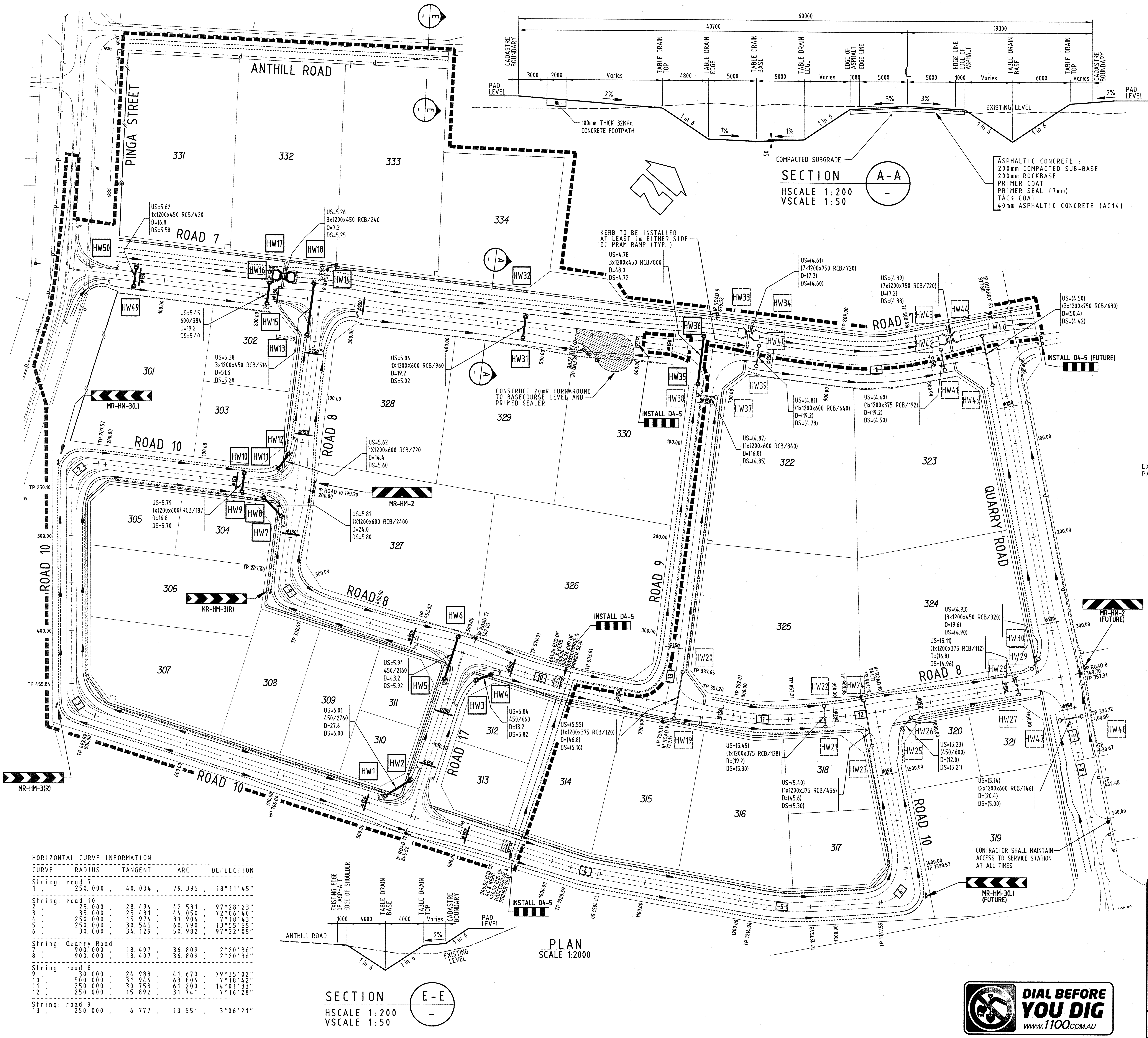
Figure 39: Anthill Longsection 2: Main Swale + Minor Swale (Schillaman St)

APPENDIX A

Available Survey and Engineering Drawings



HORIZONTAL CURVE INFORMATION

CURVE	RADIUS	TANGENT	ARC	DEFLECTION
String: road 7				
1 ,	250. 000 ,	40. 034 ,	79. 395 ,	18°11'45"
String: road 10				
2 ,	25. 000 ,	28. 494 ,	42. 531 ,	97°28'23"
3 ,	35. 000 ,	25. 481 ,	44. 050 ,	72°06'40"
4 ,	250. 000 ,	15. 974 ,	31. 904 ,	7°18'43"
5 ,	250. 000 ,	30. 545 ,	60. 790 ,	13°55'55"
6 ,	30. 000 ,	34. 129 ,	50. 982 ,	97°22'05"
String: Quarry Road				
7 ,	900. 000 ,	18. 407 ,	36. 809 ,	2°20'36"
8 ,	900. 000 ,	18. 407 ,	36. 809 ,	2°20'36"
String: road 8				
9 ,	30. 000 ,	24. 988 ,	41. 670 ,	79°35'02"
10 ,	500. 000 ,	31. 946 ,	63. 806 ,	7°18'42"
11 ,	250. 000 ,	30. 753 ,	61. 200 ,	14°01'33"
12 ,	250. 000 ,	15. 892 ,	31. 741 ,	7°16'28"
String: road 9				
13 ,	250. 000 ,	6. 777 ,	13. 551 ,	3°06'21"

REV.	DESCRIPTION	DRN	VER'D	APPROVED
A	INITIAL ISSUE	SEA	JCZ	JCZ 15/04/11
B	PIPEWORK & ROAD 7 DRAIN REVISED	SEA	JCZ	JCZ 15/04/11
C	REVISED PER TOWN OF PORT HEDLAND COMMENTS	SEA	JCZ	JCZ 20/06/11
D	STAGING AMENDED, REVISED PER MAIN ROADS COMMENTS, ISLAND DETAIL ADDED	SEA	JCZ	JCZ 26/10/11

NOTES

1. GENERAL
1. 1. LEVELS ARE REDUCED FROM A. H. D.
1. 2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL 20423-PER-C-LIA3 DRAWINGS AND THE SPECIFICATION.
1. 3. THE CONTRACTOR SHALL LIMIT THE MOVEMENT OF EQUIPMENT AND MANPOWER TO THE MINIMUM AREA NECESSARY.

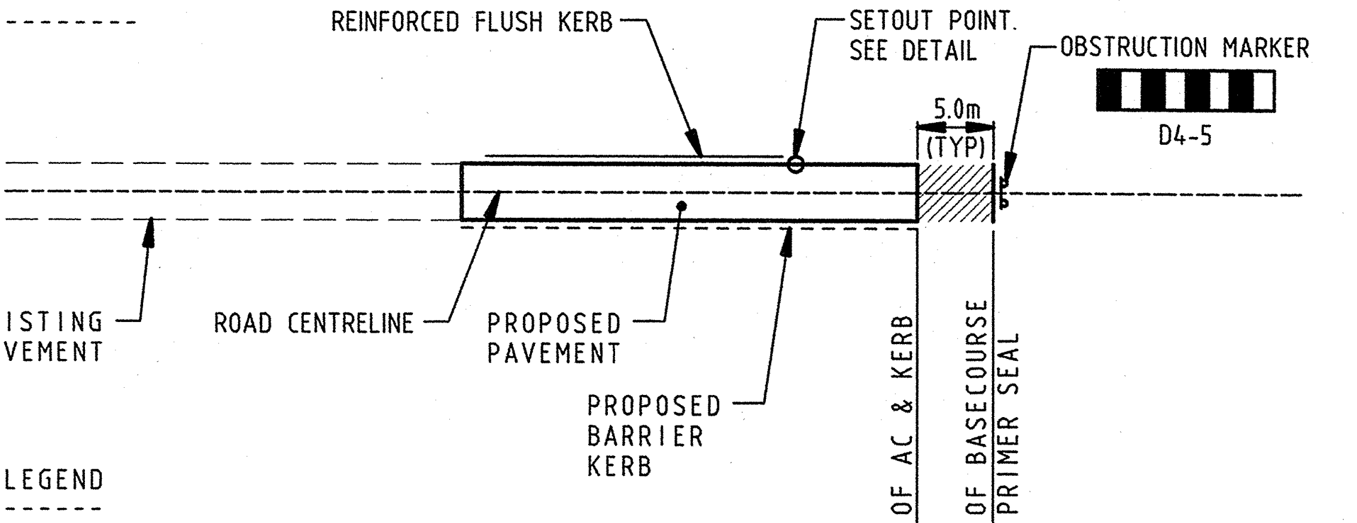
2. ROADWORKS
2. 1. ALL CORNER SWEEPS SHALL BE 30m RADIUS UNLESS OTHERWISE SHOWN ON INTERSECTION DRAWINGS
2. 2. ALL KERBS SHALL BE SEMI-MOUNTABLE UNLESS OTHERWISE SHOWN.
2. 3. PAVEMENT WIDTH SHALL BE AS SHOWN ON THE DRAWING AND SHALL BE MEASURED BETWEEN KERBS.
2. 4. ALL ROAD VERGES AREAS SHALL BE STABILISED WITH UNSEEDED HYDROMULCH

3. SERVICE INSTALLATION
3. 1. THE CONTRACTOR SHALL SUPPLY AND INSTALL UNDERGROUND POWER DUCTS IN THE LOCATIONS SHOWN ON THE POWER DRAWING
3. 2. THE CONTRACTOR SHALL SUPPLY AND INSTALL WATER CROSSINGS IN THE LOCATIONS SHOWN ON WATER RETICULATION DRAWING.

4. TRAFFIC CONTROL
4. 1. THE CONTRACTOR SHALL COMPLY WITH MAIN ROADS WA "GENERAL FIELD GUIDE-TRAFFIC MANAGEMENT FOR ROAD WORKS" AND THE SPECIFICATION.
4. 2. THE CONTRACTOR SHALL SUBMIT A TRAFFIC MANAGEMENT PLAN FOR APPROVAL BY THE SUPERINTENDENT AND THE TOWN OF PORT HEDLAND PRIOR TO MOBILISATION TO SITE, IN ACCORDANCE WITH THE SPECIFICATION.
4. 3. TRAFFIC FLOW SHALL BE MAINTAINED TO ALL EXISTING ROADS DURING THE WORKS. ROAD CLOSURES SHALL NOT OCCUR WITHOUT THE PRIOR APPROVAL OF THE SUPERINTENDENT AND THE TOWN OF PORT HEDLAND, AND DUE NOTIFICATION TO ALL RELEVANT AUTHORITIES AND EMERGENCY SERVICES.

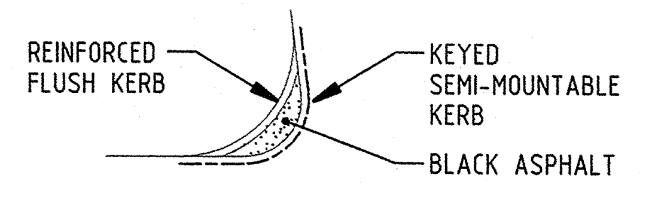
5 FENCING
5. 1 FENCING TO BE INSTALLED WHERE NOTED ON THE DRAWING IN ACCORDANCE WITH MANUFACTURERS SPECIFICATION.
5. 2 FENCE PANELS SHALL BE 1. 8m HIGH BY 2. 0m WIDE. PICKETS SHALL BE 25mm x 25mm x 1. 6mm. POSTS SHALL BE 65mm x 65mm x 2. 5mm, RAILS SHALL BE 40mmx40mmx1. 6mm.
5. 3 FENCE MATERIALS SHALL BE POWDER COATED IN DULUX BLACK.

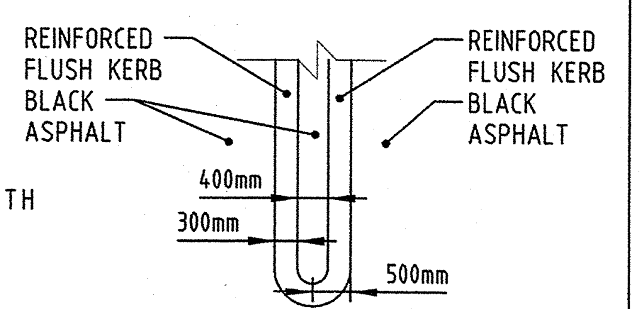
NOTATION



LEGEND

1	HORIZONTAL CURVE NUMBER
┴	STREET SIGNS TO BE SUPPLIED AND INSTALLED BY CONTRACTOR. (TO BE INSTALLED ON STREETLIGHT POLES WHERE POSSIBLE)
═	NO KERB
═	KEYED SEMI-MOUNTABLE KERB REFER TO DRAWING 20423-PER-C-LIA3/R1 FOR CONSTRUCTION DETAILS
═	REINFORCED FLUSH KERB
■ ■ ■	STAGE BOUNDARY
⬡═⬡	PROPOSED REINFORCED CONCRETE BOX CULVERT REFER TO DRAWING 20423-PER-C-LIA3/R14 FOR CONSTRUCTION DETAILS.
⬡—⬡	PROPOSED CULVERT & HEADWALL
⬡- - -⬡	FUTURE CULVERT & HEADWALL
◀	DIRECTION OF FLOW
▨	ROCK PITCHING (REFER KERB TERMINATION DETAIL ON 20423-PER-C-LIA3/R15 FOR ACTUAL EXTENT)
ɸ150	NUMBER & DIAMETER OF DUCT REQUIRED PVC CLASS 9 LANDSCAPING DUCT. MARK ENDS WITH TAPE TO THE SURFACE AND PROVIDE DIMENSIONS ON AN AS CONSTRUCTED PLAN TO THE SUPERINTENDENT. ENDS OF DUCT TO BE 700mm PAST BACK OF PATH OR FACE OF KERB. DUCT TO HAVE 700mm COVER.
ɸ150 - - -	FUTURE DUCT
- - - -	TABLE DRAIN BASE
········	TABLE DRAIN TOP
—P— - -	EXISTING OVERHEAD POWER
▤	2. 0m WIDE CONCRETE FOOTPATH
—//—	1. 8m HIGH, BLACK POWDER COATED GUARDIAN FENCING





WOOD & GRIEVE ENGINEERS

Wood & Grieve Pty Ltd
A.B.N. 75 900 165 652
Level 3, Hyatt Centre
3 Plain Street East Perth
Western Australia 6004
Phone 08 6222 7000
Fax 08 6222 7100
Email wge@wge.com.au
Web www.wge.com.au

PERTH
MELBOURNE
SYDNEY
BRISBANE
ALBANY
BUSSELTON

CLIENT: LANDCORP

PROJECT: PORT HEDLAND-LIA3, TD1 & TD2

TITLE: ROADS & DRAINAGE PLAN - SHEET 2

DESIGNED: S.ATTARD	VERIFIED: J.ZELONES	15 /04 / 11	WAPC No.: 143413	DATUM: A. H. D.	
DRAWN: S.ATTARD	APPROVED FOR TENDER: J.ZELONES	15 /04 / 11	DRAWING No. 20423-PER-C-LIA3/R2		REV. D
APPROVED FOR CONSTRUCTION:		26 /10 /11			

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NOTES:

1. GENERAL
1.1. LEVELS ARE REDUCED FROM A.H.D.
1.2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL 301248402 DRAWINGS AND THE SPECIFICATION.
1.3. THE CONTRACTOR SHALL LIMIT THE MOVEMENT OF EQUIPMENT AND MANPOWER TO THE MINIMUM AREA NECESSARY.

2. ROADWORKS
2.1. ALL CORNER SWEEPS SHALL BE 30m RADIUS UNLESS OTHERWISE SHOWN ON INTERSECTION DRAWINGS
2.2. ALL KERBS SHALL BE SEMI-MOUNTABLE UNLESS OTHERWISE SHOWN.
2.3. PAVEMENT WIDTH SHALL BE AS SHOWN ON THE DRAWING AND SHALL BE MEASURED BETWEEN KERBS.
2.4. ALL ROAD VERGES AREAS SHALL BE STABILISED WITH SEEDED HYDROMULCH UNLESS SPECIFIED OTHERWISE. REFER TO EARTHWORKS, ROADS DETAILS AND LANDSCAPE DRAWINGS.

3. SERVICE INSTALLATION
3.1. THE CONTRACTOR SHALL SUPPLY AND INSTALL UNDERGROUND POWER DUCTS IN THE LOCATIONS SHOWN ON THE POWER DRAWING
3.2. THE CONTRACTOR SHALL SUPPLY AND INSTALL WATER CROSSINGS IN THE LOCATIONS SHOWN ON WATER RETICULATION DRAWING.

4. TRAFFIC CONTROL
4.1. THE CONTRACTOR SHALL COMPLY WITH MAIN ROADS WA "GENERAL FIELD GUIDE-TRAFFIC MANAGEMENT FOR ROAD WORKS" AND THE SPECIFICATION.
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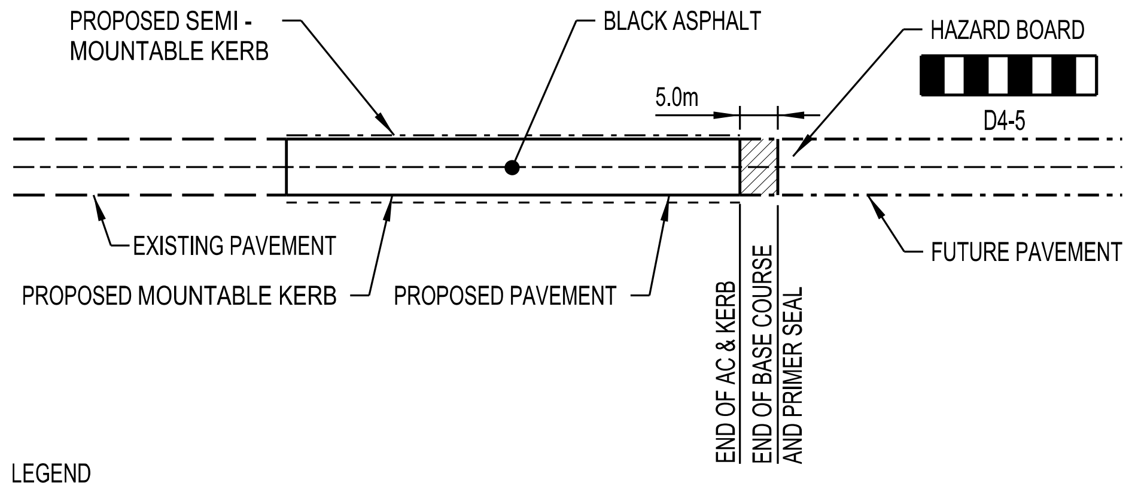
4.3. TRAFFIC FLOW SHALL BE MAINTAINED TO ALL EXISTING ROADS DURING THE WORKS. ROAD CLOSURES SHALL NOT OCCUR WITHOUT THE PRIOR APPROVAL OF THE SUPERINTENDENT AND THE TOWN OF PORT HEDLAND, AND DUE NOTIFICATION TO ALL RELEVANT AUTHORITIES AND EMERGENCY SERVICES.

5. CULVERTS
5.1 REINFORCED BOX CULVERTS AND ASSOCIATED ITEMS TO BE CONSTRUCTED IN ACCORDANCE WITH MAIN ROADS WA DRAWINGS 201131-0084, 201131-0085 AND 201131-0086

NOTATION



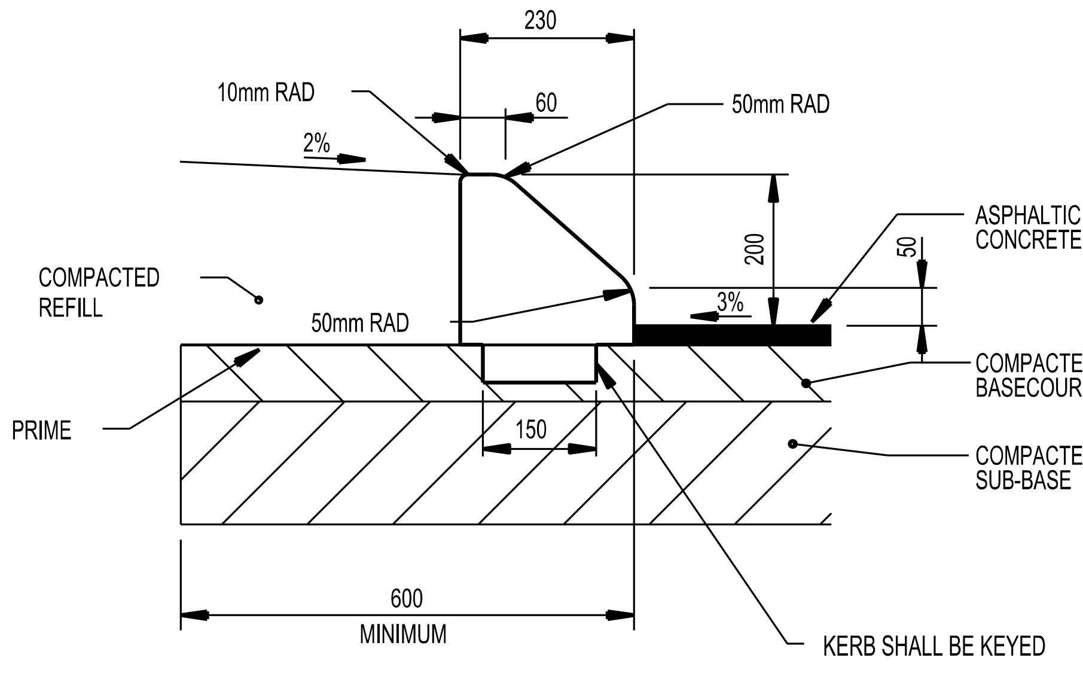
LEGEND

---①---	HORIZONTAL CURVE NUMBER
	STREET SIGNS TO BE SUPPLIED AND INSTALLED BY CONTRACTOR. (TO BE INSTALLED ON STREETLIGHT POLES WHERE POSSIBLE)
	NO PARKING SIGN REFER TO SIGNAGE AND LINEMARKING PLAN
═══	REINFORCED FLUSH KERB
■ ■ ■ ■	STAGE BOUNDARY
	PROPOSED REINFORCED CONCRETE BOX CULVERT
	PROPOSED CULVERT & HEADWALL
	EXISTING CULVERT & HEADWALL
	FUTURE CULVERT & HEADWALL
	DIRECTION OF FLOW
ø150	EXISTING DUCT
	TABLE DRAIN BASE
···········	TABLE DRAIN TOP
	EXISTING TABLE DRAIN BASE
	EXISTING TABLE DRAIN TOP
	FUTURE TABLE DRAIN BASE
- - - - - -	FUTURE TABLE DRAIN TOP
▨	MORTARED ROCK PITCHING (REFER TO ROADS AND DRAINAGE PLAN - SHEET 3 & 4 AND INTERSECTION PLANS FOR EXTENTS. REFER TO ROADWORKS DETAILS AND DRAINAGE DETAILS PLANS FOR DETAILS)
▨	2.0m WIDE RED ASPHALT FOOTPATH
= = = = =	EXISTING CONCRETE FOOTPATH

Table 1

CURVE	RADIUS	TANGENT	ARC	DEFLECTION
1	250.000	40.035	79.395	18^11'46"
2	250.000	15.974	31.904	7^18'43"
3	250.000	30.545	60.790	13^55'55"
4	30.000	34.129	50.982	97^22'5"
5	900.000	18.407	36.809	2^20'36"
6	900.000	18.407	36.809	2^20'36"
7	500.000	31.946	63.806	7^18'42"
8	250.000	30.753	61.200	14^1'33"
9	250.000	15.892	31.741	7^16'28"
10	250.000	6.777	13.551	3^6'21"

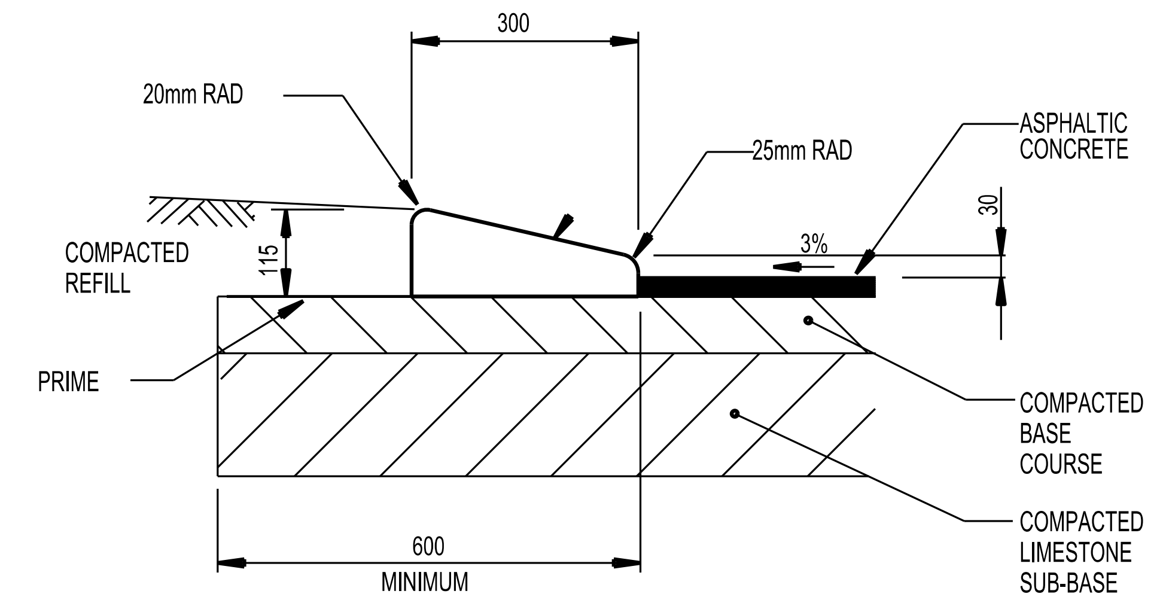
0 10 20 40 100
1: 2000 @A1
1: 4000 @A3



SEMI-MOUNTABLE KERB DETAIL

SCALE 1:10

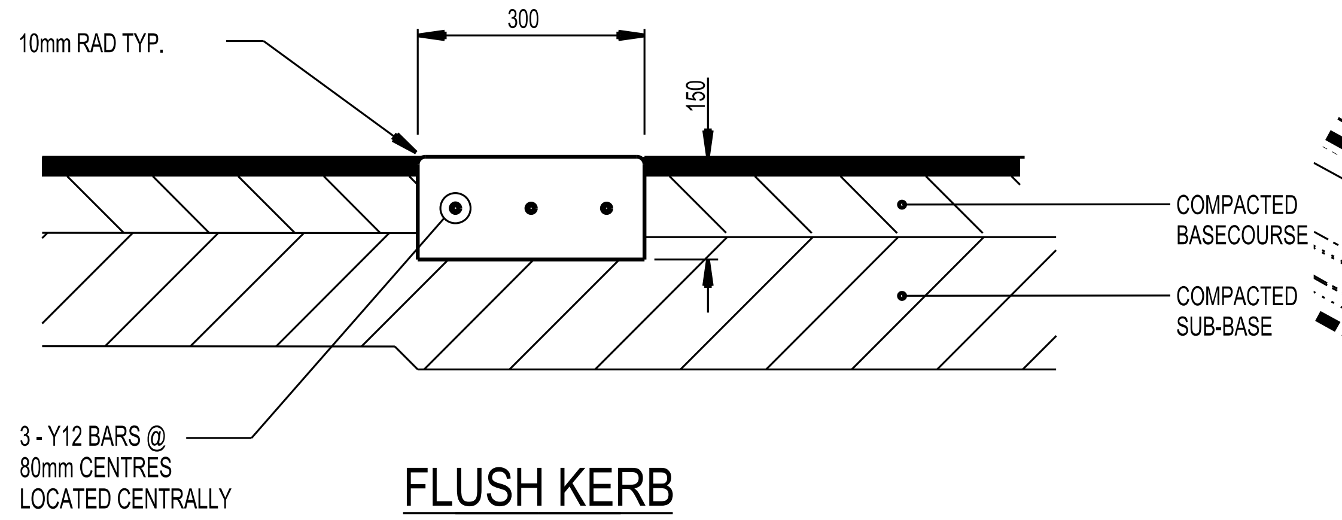
NOTE: ALL KERBS TO BE INSITU CONCRETE
F'c 20 MPa AT 28 DAYS.



MOUNTABLE KERB DETAIL

SCALE 1:10

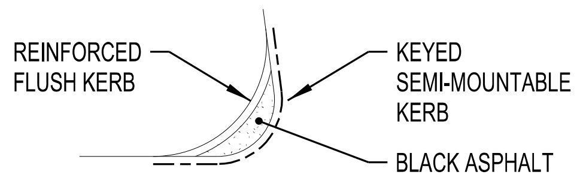
NOTE: ALL KERBS TO BE INSITU CONCRETE
F'c 20 MPa AT 28 DAYS.



FLUSH KERB

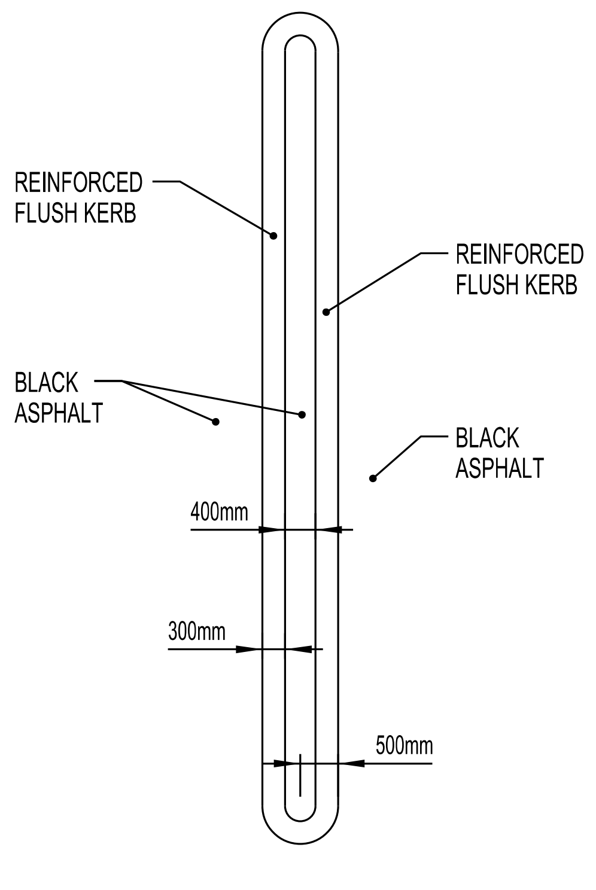
SCALE 1:10

NOTE: ALL KERBS TO BE INSITU CONCRETE
F'c 20 MPa AT 28 DAYS.



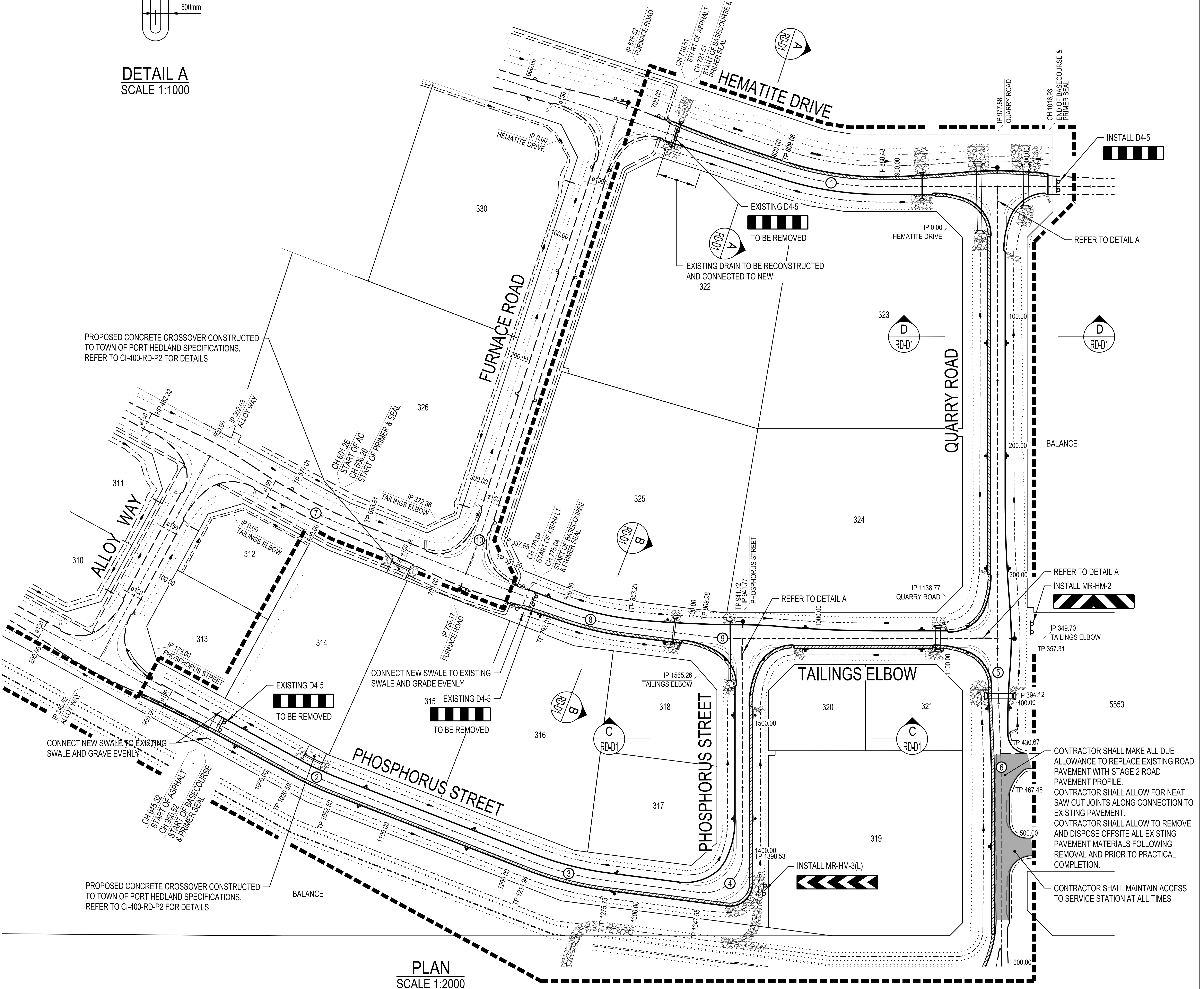
DETAIL B

SCALE 1:1000



DETAIL A

SCALE 1:1000



PLAN

SCALE 1:2000

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REV	DESCRIPTION	DRAWN	APP'D	DATE
C	TENDER AMENDMENTS	LUL		30/03/2021
B	LOT 314 CROSSOVER ADDED	SEA		16/02/2021
A	PRELIMINARY ISSUE	LUL		05/02/2021

DEVELOPMENT WA
DevelopmentWA
ARCHITECT/CLIENT

WEDGEFIELD INDUSTRIAL ESTATE - STAGE 2
ROADS AND DRAINAGE PLAN - SHEET 1
PROJECT/TITLE

Stantec

PRELIMINARY
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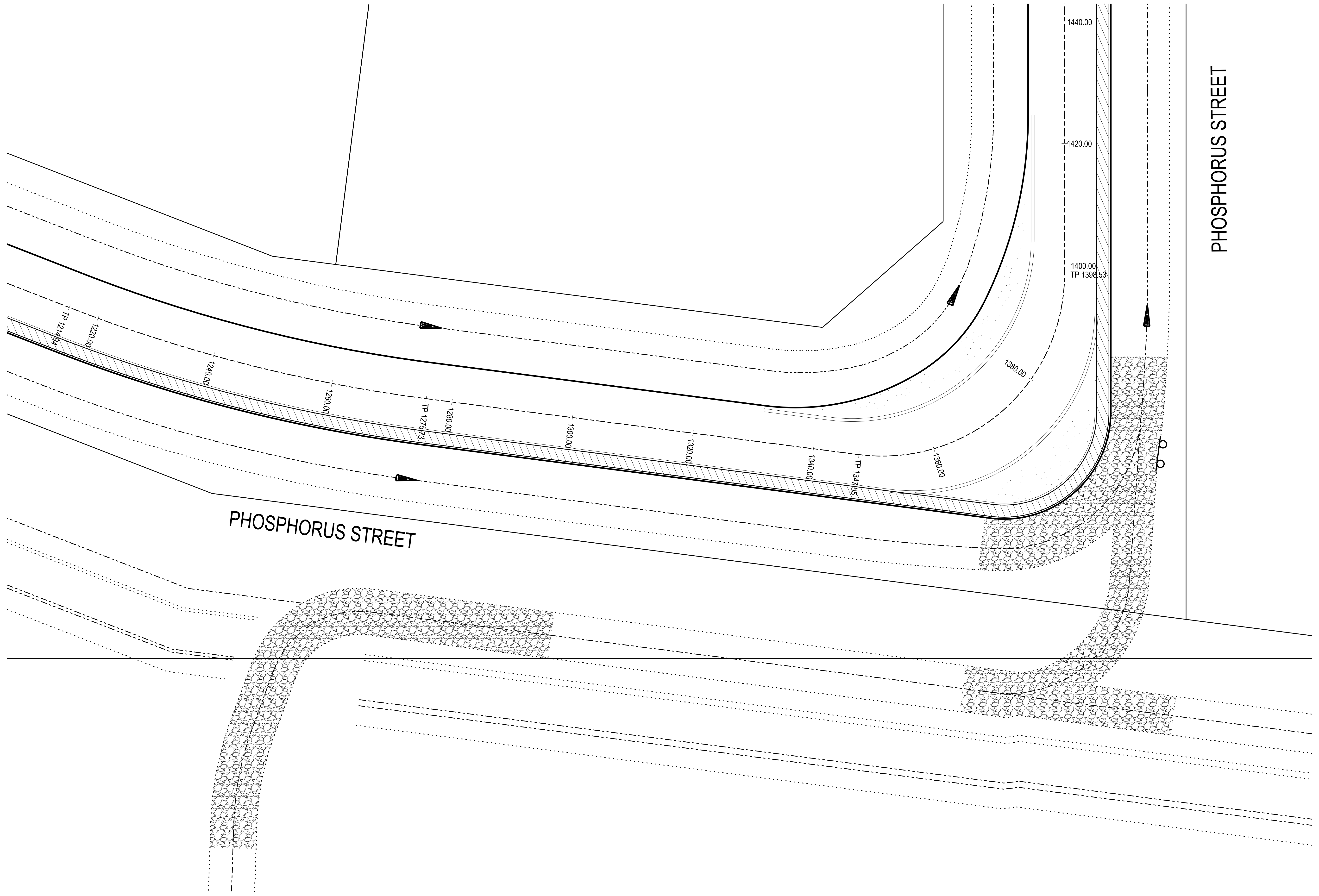
CIVIL

WAPC	COORDS	DATUM	SCALE @ A1	PROJECT No	DRAWING No	REV
157742	PHG94	mAHD	1:2000	301248402	CI-400-RD-P1	C

DATE PLOTTED:

REFER TO DRAWING CI-400-RD-P1 FOR NOTES AND LEGEND



PLAN
SCALE 1:500

0 5 10 25 1: 500 @A1
1: 1000 @A3

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REV	DESCRIPTION	DRAWN	APP'D	DATE
A	PRELIMINARY ISSUE	LUL		30/03/2021

DEVELOPMENT WA
ARCHITECT/CLIENT

WEDGEFIELD INDUSTRIAL ESTATE - STAGE 2
ROADS AND DRAINAGE PLAN - SHEET 4
PROJECT/TITLE

Stantec

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WAPC	COORDS	DATUM	SCALE @ A1	PROJECT No	DRAWING No	REV
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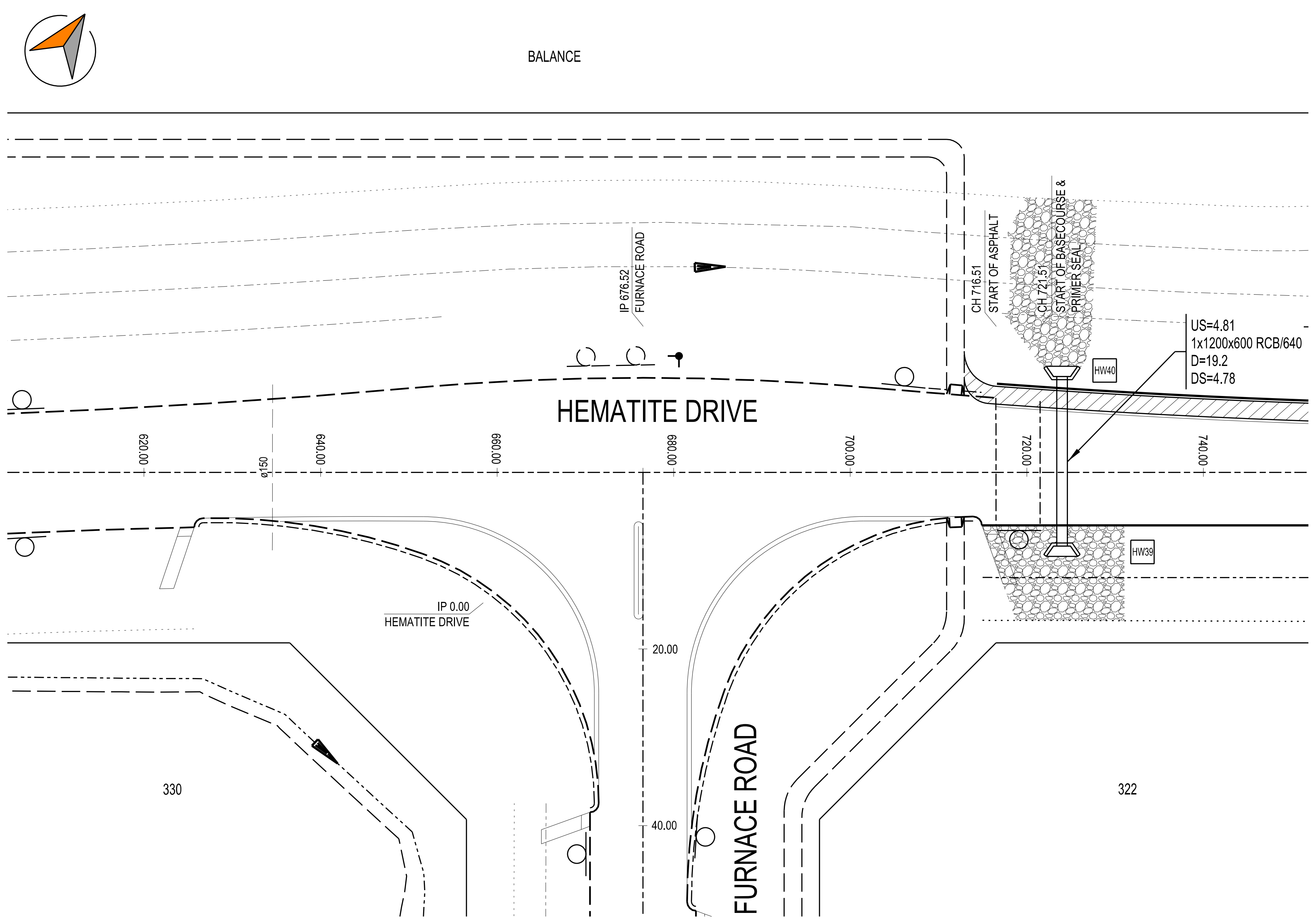
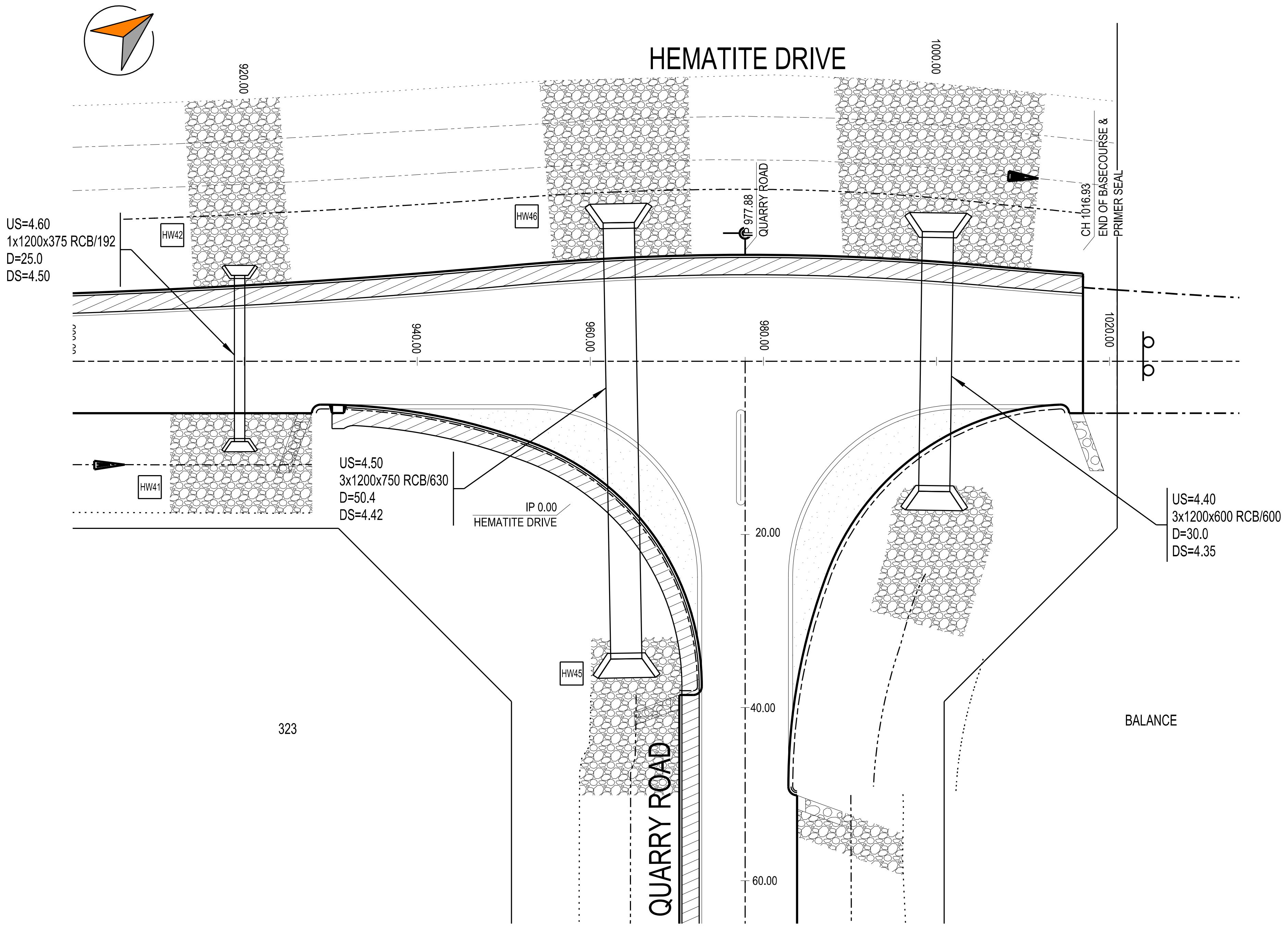
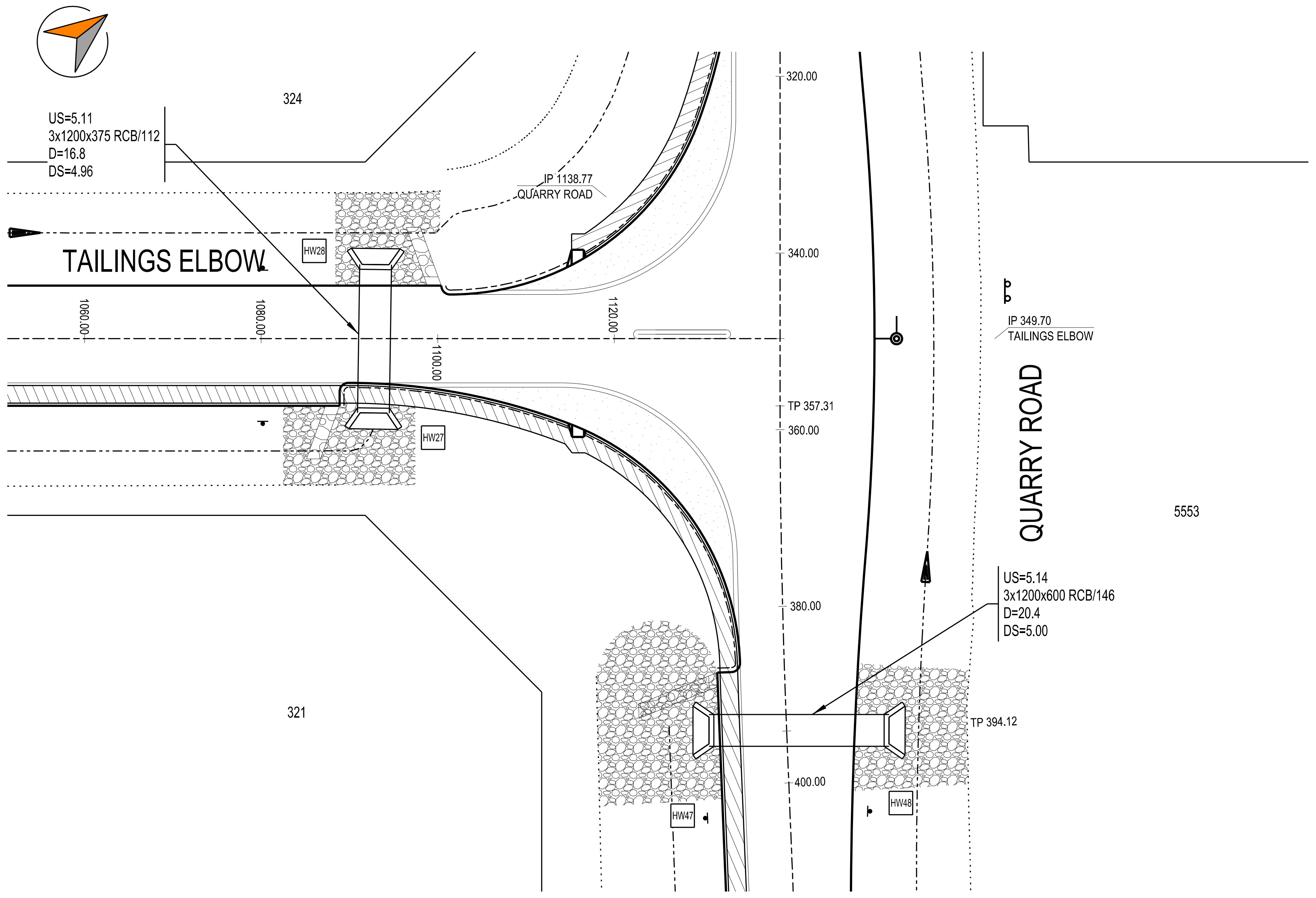
CAD FILE: P:\301248402\Project Documentation\Civil\Drawings & Design\c Plan Roads and Drainage.dgn

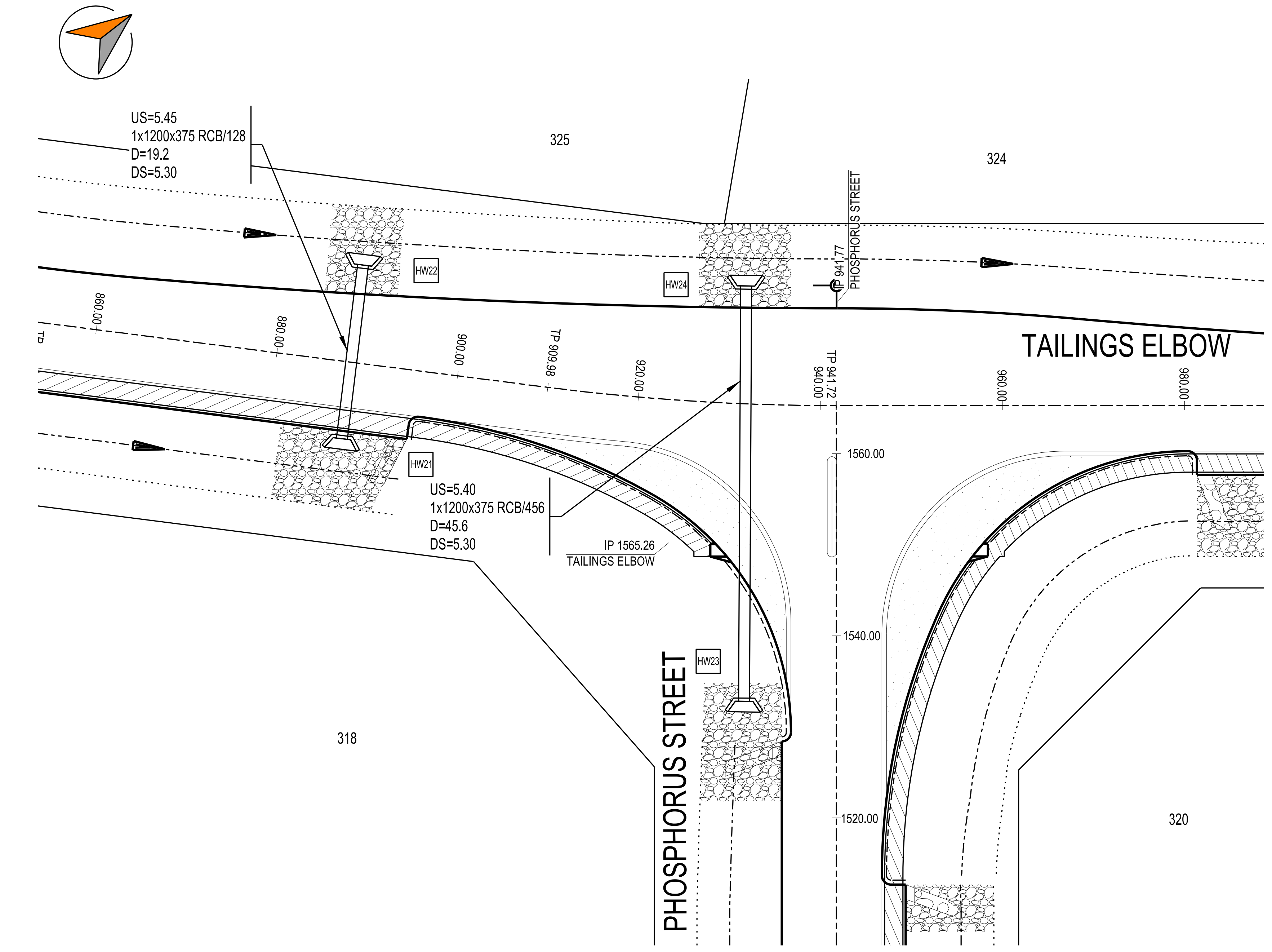
DATE PLOTTED:

REFER TO DRAWING CI-400-RD-P1 FOR NOTES AND LEGEND









0 5 10 25 1: 500 @A1
1: 1000 @A3

PLAN
SCALE 1:500

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REV	DESCRIPTION	DRAWN	APP'D	DATE
A	PRELIMINARY ISSUE	LUL		30/03/2021

DEVELOPMENT WA
ARCHITECT/CLIENT

WEDGEFIELD INDUSTRIAL ESTATE - STAGE 2
ROADS AND DRAINAGE PLAN - SHEET 3
PROJECT/TITLE

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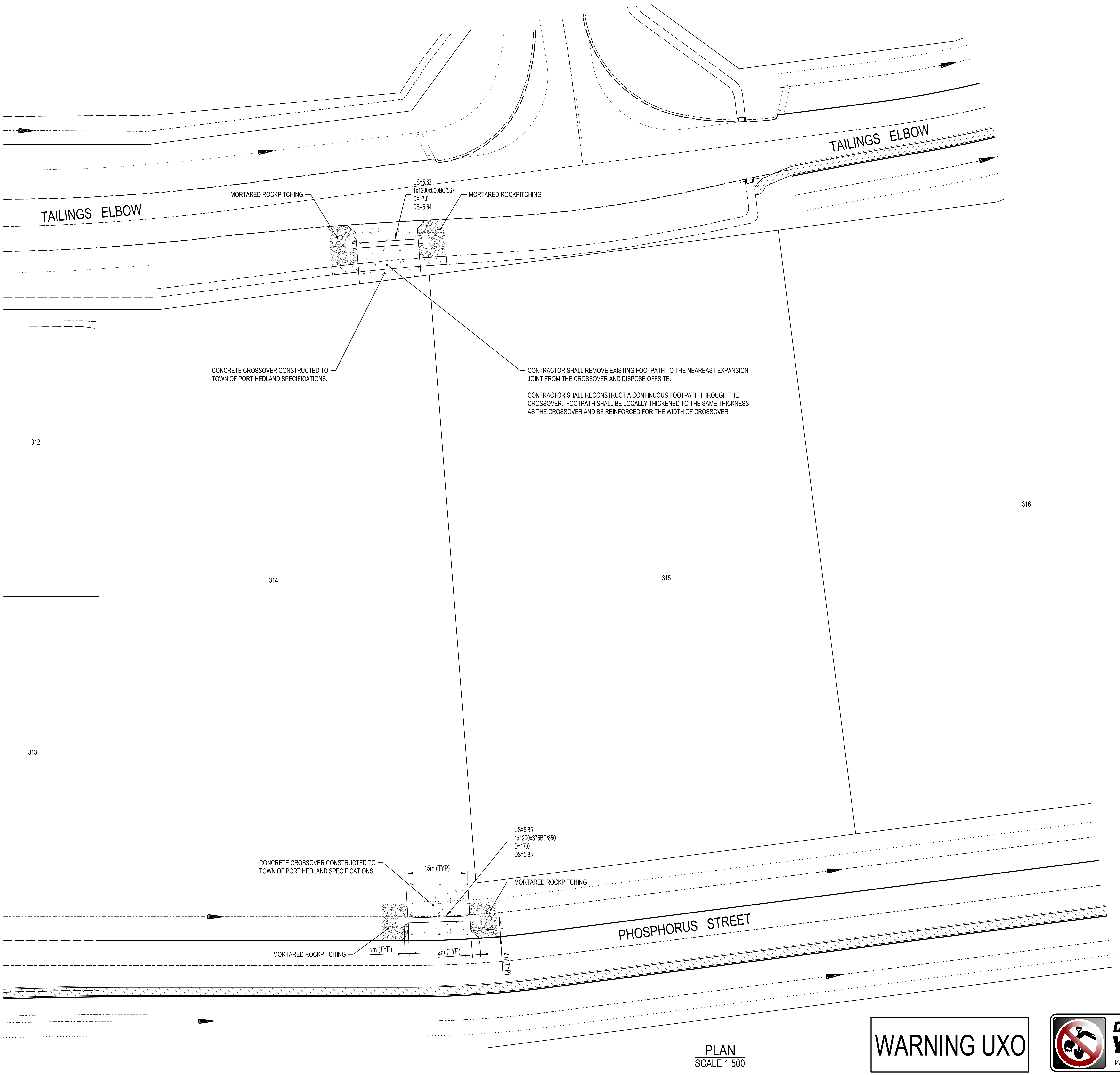
WAPC	COORDS	DATUM	SCALE @ A1	PROJECT No	DRAWING No	REV
157742	PHG94	mAHD	1:500	301248402	CI-400-RD-P3	A

CAD FILE: P:\301248402\Project Documentation\Civil\Drawings & Design\c Plan Roads and Drainage.dgn

DATE PLOTTED:

REFER TO DRAWING CI-400-RD-P1 FOR NOTES AND LEGEND



CONCRETE CROSSOVER CONSTRUCTED TO TOWN OF PORT HEDLAND SPECIFICATIONS.

CONTRACTOR SHALL REMOVE EXISTING FOOTPATH TO THE NEAREAST EXPANSION JOINT FROM THE CROSSOVER AND DISPOSE OFFSITE.

CONTRACTOR SHALL RECONSTRUCT A CONTINUOUS FOOTPATH THROUGH THE CROSSOVER. FOOTPATH SHALL BE LOCALLY THICKENED TO THE SAME THICKNESS AS THE CROSSOVER AND BE REINFORCED FOR THE WIDTH OF CROSSOVER.

CONCRETE CROSSOVER CONSTRUCTED TO TOWN OF PORT HEDLAND SPECIFICATIONS.

PLAN
SCALE 1:500

0 5 10 25 1: 500 @A1
1: 1000 @A3

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REV	DESCRIPTION	DRAWN	APP'D	DATE
B	TENDER AMENDMENTS	LUL		30/03/2021
A	PRELIMINARY ISSUE	SEA		16/02/2021

ARCHITECT/CLIENT
DEVELOPMENT WA

PROJECT/TITLE
WEDGEFIELD INDUSTRIAL ESTATE - STAGE 2
ROADS AND DRAINAGE PLAN - SHEET 2

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
CIVIL

WAPC	COORDS	DATUM	SCALE @ A1	PROJECT No	DRAWING No	REV
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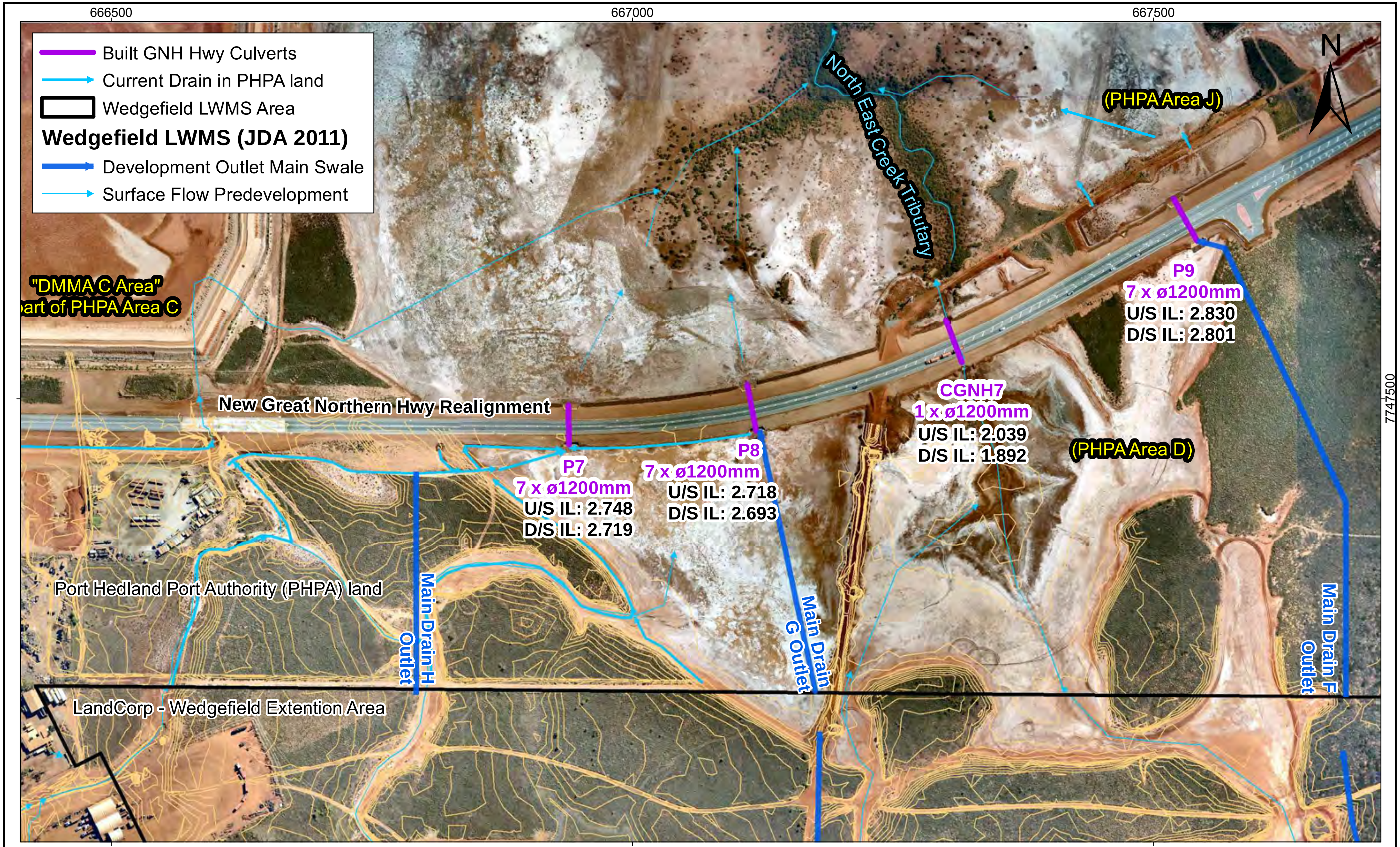


Data Source: Nearmap (2014) Aerial 11 July 2014; BGE (2013) GNH Drainage Plans & Culvert Schedule (RD15); JDA (2011) Wedgefield IE Expansion LWMS; JDA (2011) Advice Letter to Main Roads and PHPA

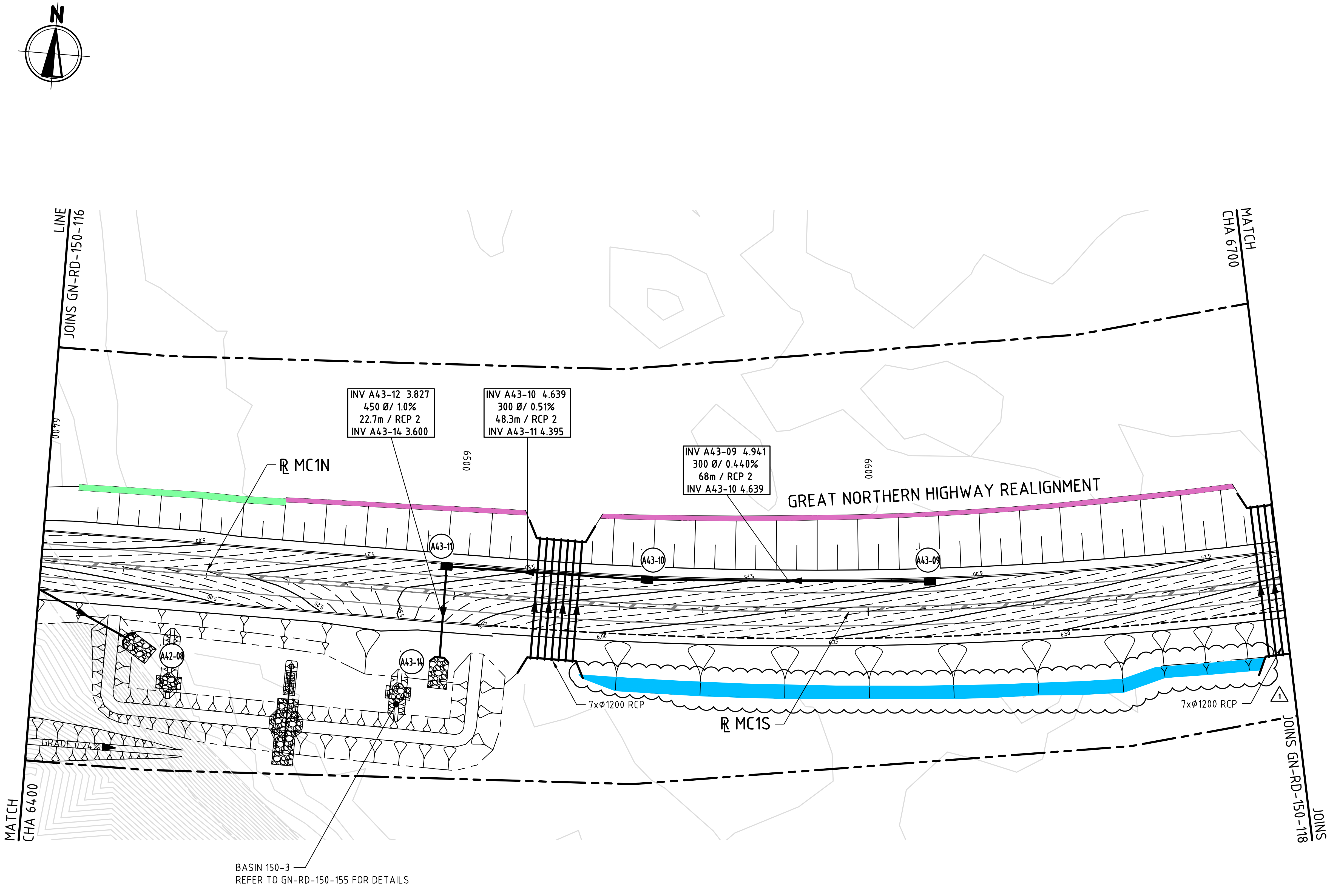
JDA Consultant Hydrologists

Job No. J5837
Scale: 1:5,000

0 100 200 300 400 Meters

Landcorp
Wedgefield Industrial Area Expansion TDA1&2: UWMP

Figure F1: MRWA New Great Northern Hwy Realignment Culverts (Constructed)



LEGEND:

— — —	SITE BOUNDARY
——▶——	PROPOSED STORMWATER DRAINAGE PIPE
)——▶——(	PROPOSED CULVERT
●	PROPOSED MANHOLE
▬	PROPOSED SIDE ENTRY GULLY OR GRATED GULLY
⌋⌊	PROPOSED KERB OPENING
▨	PROPOSED CATCHPIT (WITH ROCK PITCHING)
(	PROPOSED HEADWALL (H/W)
╕	PROPOSED DRAINAGE CAP
▨	ROCK PROTECTION (THICKNESS VARIES)
C1-01	STRUCTURE NUMBER
- - ->- -	EXISTING OPEN DRAIN
🟩	ROCK PROTECTION TYPE 1
🟪	ROCK PROTECTION TYPE 2
🟦	RIPRAP BALLAST ARMOURING

INV A-3-2 15.03 300 Ø / 9.45% 8.55m / RCP 2 INV A-3-1 14.22	UPSTREAM INVERT DIAMETER (mm)/SLOPE LENGTH/CLASS DOWNSTREAM INVERT

1

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY. BOUNDARIES TO BE VERIFIED BY SURVEY.
3. EXTENT AND TYPE OF ROCK PROTECTION AT HEADWALL OUTLETS SHALL BE AS DETAILED ON DRAWINGS GN-RD-150-135 AND GN-RD-150-151.
4. DRAINAGE INLETS, PITS AND PIPE SHALL BE INSTALLED IN ACCORDANCE WITH MAIN ROADS SPECIFICATIONS 404, 405 AND STANDARD DRAWINGS
5. FOR CULVERT DETAILS REFER TO DRAWING GN-RD-150-135.
6. REDUNDANT PAVEMENTS SHALL BE REMOVED AND REHABILITATED IN ACCORDANCE WITH SPECIFICATIONS.
7. FOR DETAILS ON ULTIMATE STAGE DRAINAGE WORKS REFER TO REPORT RD-150-REP-001.
8. AREAS BOUNDED BY ROADS AND RAMPS SHALL BE REGRADED TOWARDS CULVERTS OR PROPOSED OPEN DRAINS TO ENSURE NO STANDING WATER.
9. EXISTING DRAINAGE SHALL BE REMOVED UNLESS NOTED OTHERWISE.
10. EXISTING DRAINS HIGHLIGHTED ON THE DRAWINGS SHALL BE RECONDITIONED UNLESS NOTED OTHERWISE.
11. EXISTING SERVICES SHOWN ARE INDICATIVE AND SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
12. DEPTH TO SERVICES AT ALL CROSSING POINTS SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
13. FOR SETOUT DETAILS OF MODELLED OPEN DRAINS REFER TO DESIGN MODEL.
14. MODELLED OPEN DRAINS SHALL BE TYPE 'F' DRAINS IN ACCORDANCE WITH MAIN ROADS DRAWING 9831-5498 UNLESS NOTED OTHERWISE.

1:1000 0 5m 10 15 20 25 30 35 40 45 50 55 60 65 70 75

LOCAL AUTHORITY: TOWN OF PORT HEDLAND (813)
MRWA RESPONSIBILITY AREA: PILBARA
MRWA DRAWING No.: -
MRWA CONTRACT No.: 183/10
MRWA SLK: GREAT NORTHERN HWY (H006) - 1602.58 SLK TO 1612.53 SLK

No.	DATE	DESCRIPTION	APPROVED
1	30.08.13	RE-ISSUED FOR CONSTRUCTION	C.S
0	24.05.13	ISSUED FOR CONSTRUCTION	C.S

VERIFIER:
Kellogg Brown & Root Pty Ltd
KBR
ABN 91 007 660 317
256 St George's Terrace
Perth, Western Australia 6000
VERIFIED DATE

CO-ORDINATOR & DESIGNER:
Perth Office—
484 Murray St Perth WA 6000
P/ +61 8 6364 3300
E/ info@bgeeng.com
bgeeng.com—
BG&E
APPROVED DATE

DRAWN: DM
DESIGNED: TM/TT
CHECKED: SM
DESIGNER PROJECT No: P11120
GRID: PHG94
DATUM: AHD
SCALE: 1:1000
SCALE 1:1000 0 10m 20 30

CONTRACTOR:
John Holland
PROJECT MANAGER DATE

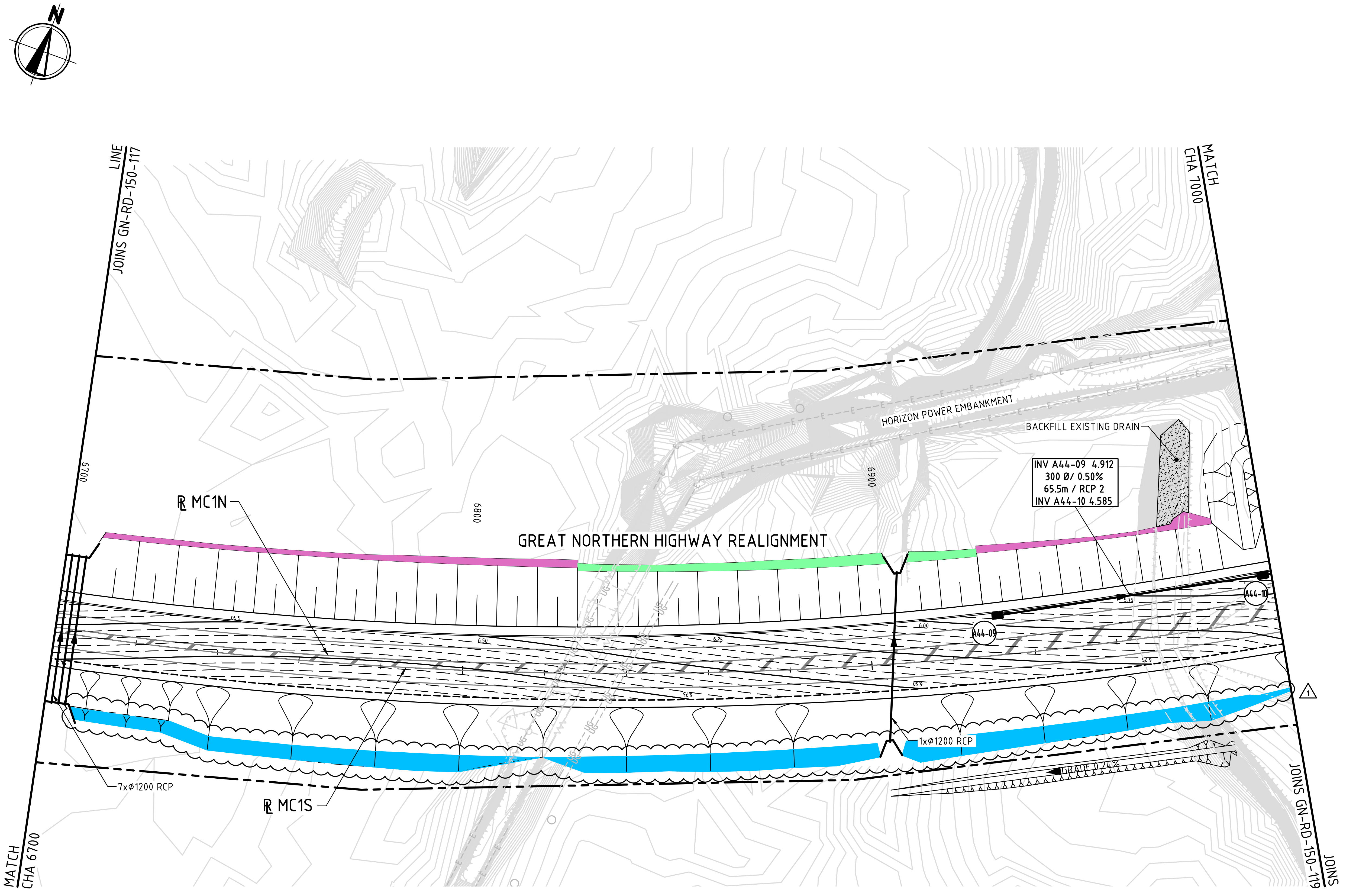
CLIENT:
Government of Western Australia
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
PROJECT DIRECTOR DATE 2013-11-08

PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
DRAINAGE PLAN (RD150)
SHEET 18

SHEET SIZE: A3
PROJECT: GN
DESIGN LOT: RD150
DRAWING No.: 117
REV: 1

P:\P11120 GREAT NORTHERN HWAY - MACMAHON\100 DRAWINGS\RD150\AutoCad\GN-RD-150-100 to 126.dwg, 30/08/2013 1:55:20 PM



LEGEND:

— — —	SITE BOUNDARY
——▶——	PROPOSED STORMWATER DRAINAGE PIPE
)——▶——(	PROPOSED CULVERT
●	PROPOSED MANHOLE
▬	PROPOSED SIDE ENTRY GULLY OR GRATED GULLY
⌋ ⌊	PROPOSED KERB OPENING
▨	PROPOSED CATCHPIT (WITH ROCK PITCHING)
(	PROPOSED HEADWALL (H/W)
⌐	PROPOSED DRAINAGE CAP
▨	ROCK PROTECTION (THICKNESS VARIES)
(C1-01)	STRUCTURE NUMBER
- - -> - -	EXISTING OPEN DRAIN
🟩	ROCK PROTECTION TYPE 1
🟪	ROCK PROTECTION TYPE 2
🟦	RIPRAP BALLAST ARMOURING

INV A-3-2 15.03 300 Ø / 9.45% 8.55m / RCP 2 INV A-3-1 14.22	UPSTREAM INVERT DIAMETER (mm)/SLOPE LENGTH/CLASS DOWNSTREAM INVERT

1

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY. BOUNDARIES TO BE VERIFIED BY SURVEY.
3. EXTENT AND TYPE OF ROCK PROTECTION AT HEADWALL OUTLETS SHALL BE AS DETAILED ON DRAWINGS GN-RD-150-135 AND GN-RD-150-151.
4. DRAINAGE INLETS, PITS AND PIPE SHALL BE INSTALLED IN ACCORDANCE WITH MAIN ROADS SPECIFICATIONS 404, 405 AND STANDARD DRAWINGS
5. FOR CULVERT DETAILS REFER TO DRAWING GN-RD-150-135.
6. REDUNDANT PAVEMENTS SHALL BE REMOVED AND REHABILITATED IN ACCORDANCE WITH SPECIFICATIONS.
7. FOR DETAILS ON ULTIMATE STAGE DRAINAGE WORKS REFER TO REPORT RD-150-REP-001.
8. AREAS BOUNDED BY ROADS AND RAMPS SHALL BE REGRADED TOWARDS CULVERTS OR PROPOSED OPEN DRAINS TO ENSURE NO STANDING WATER.
9. EXISTING DRAINAGE SHALL BE REMOVED UNLESS NOTED OTHERWISE.
10. EXISTING DRAINS HIGHLIGHTED ON THE DRAWINGS SHALL BE RECONDITIONED UNLESS NOTED OTHERWISE.
11. EXISTING SERVICES SHOWN ARE INDICATIVE AND SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
12. DEPTH TO SERVICES AT ALL CROSSING POINTS SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
13. FOR SETOUT DETAILS OF MODELLED OPEN DRAINS REFER TO DESIGN MODEL.
14. MODELLED OPEN DRAINS SHALL BE TYPE 'F' DRAINS IN ACCORDANCE WITH MAIN ROADS DRAWING 9831-5498 UNLESS NOTED OTHERWISE.

1:1000 0 5m 10 15 20 25 30 35 40 45 50 55 60 65 70 75

LOCAL AUTHORITY	MRWA RESPONSIBILITY AREA
TOWN OF PORT HEDLAND (813)	PILBARA
MRWA DRAWING No. -	MRWA CONTRACT No. 183/10

MRWA SLK
GREAT NORTHERN HWY (H006) - 1602.58 SLK TO 1612.53 SLK

No.	DATE	DESCRIPTION	APPROVED
1	30.08.13	RE-ISSUED FOR CONSTRUCTION	C.S
0	24.05.13	ISSUED FOR CONSTRUCTION	C.S

VERIFIER:
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KBR
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256 St George's Terrace
Perth, Western Australia 6000
VERIFIED DATE

CO-ORDINATOR & DESIGNER:
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E/ info@bgeeng.com
bgeeng.com
BG&E
APPROVED DATE

DRAWN	DM	DESIGNED	TM/TT
CHECKED	SM		
DESIGNER PROJECT No	P11120		
GRID	PHG94	DATUM	AHD
SCALE	1:1000		

SCALE 1:1000 0 10m 20 30

CONTRACTOR:
John Holland
PROJECT MANAGER DATE

CLIENT:
Government of Western Australia
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
PROJECT DIRECTOR CK. DATE 2013-11-08

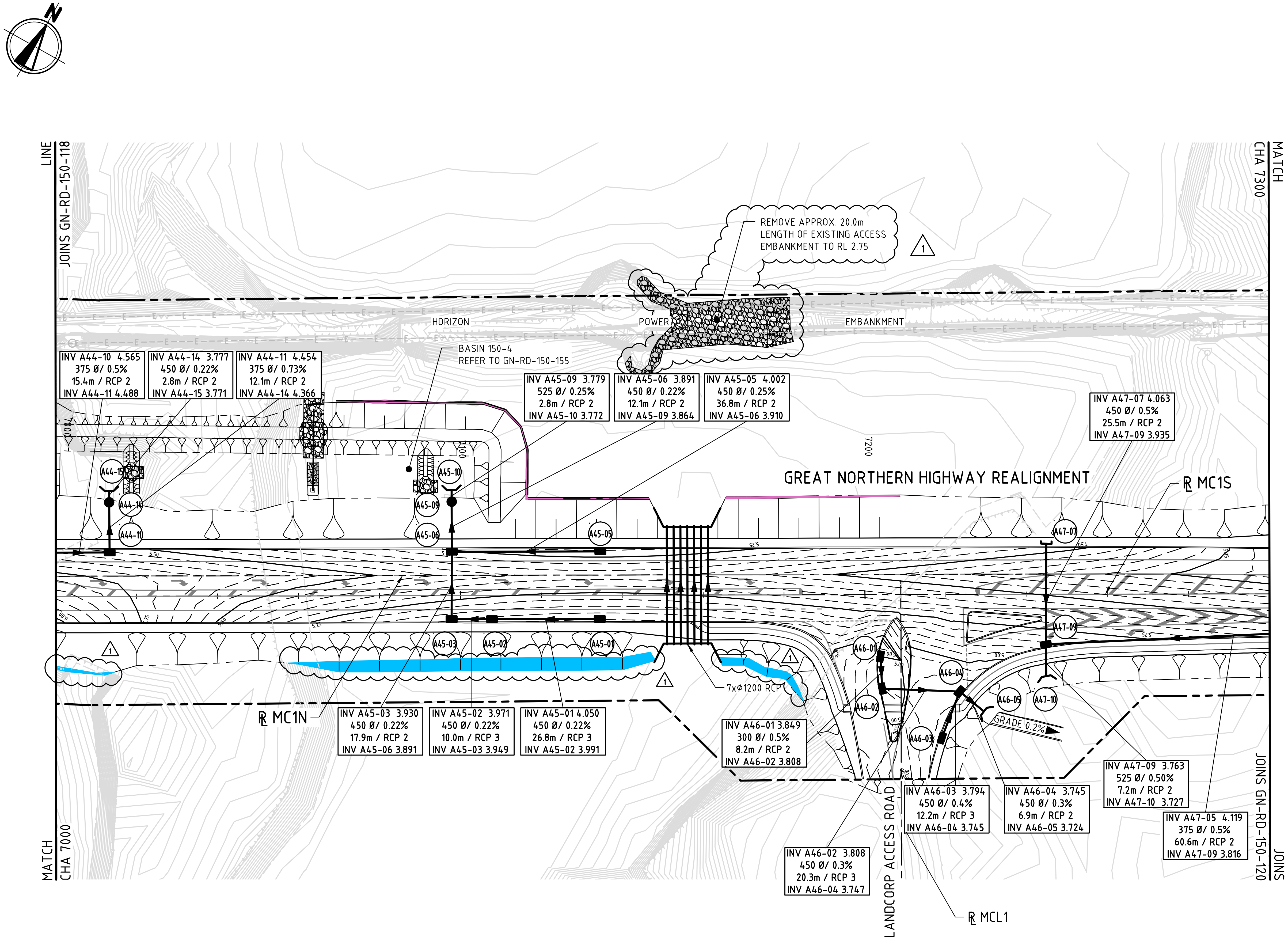
PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
DRAINAGE PLAN (RD150)
SHEET 19

SHEET SIZE A3

PROJECT GN DESIGN LOT RD150 DRAWING No. 118 REV 1

P:\P11120 GREAT NORTHERN HWAY - MACMAHON\100 DRAWINGS\RD150\AutoCad\GN-RD-150-100 to 126.dwg. 30/08/2013 1:55:31 PM



LEGEND:

— — —	SITE BOUNDARY
——▶——	PROPOSED STORMWATER DRAINAGE PIPE
)——▶——(	PROPOSED CULVERT
●	PROPOSED MANHOLE
▬	PROPOSED SIDE ENTRY GULLY OR GRATED GULLY
⌋ ⌊	PROPOSED KERB OPENING
▨	PROPOSED CATCHPIT (WITH ROCK PITCHING)
(	PROPOSED HEADWALL (H/W)
╕	PROPOSED DRAINAGE CAP
▨	ROCK PROTECTION (THICKNESS VARIES)
E1-01	STRUCTURE NUMBER
- - > - -	EXISTING OPEN DRAIN
🟩	ROCK PROTECTION TYPE 1
🟪	ROCK PROTECTION TYPE 2
🟦	RIPRAP BALLAST ARMOURING
INV A-3-2 15.03 300 Ø / 9.45% 8.55m / RCP 2 INV A-3-1 14.22	UPSTREAM INVERT DIAMETER (mm)/SLOPE LENGTH/CLASS DOWNSTREAM INVERT

1

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. CADASTRAL BOUNDARIES ARE INDICATIVE ONLY. BOUNDARIES TO BE VERIFIED BY SURVEY.
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5. FOR CULVERT DETAILS REFER TO DRAWING GN-RD-150-135.
6. REDUNDANT PAVEMENTS SHALL BE REMOVED AND REHABILITATED IN ACCORDANCE WITH SPECIFICATIONS.
7. FOR DETAILS ON ULTIMATE STAGE DRAINAGE WORKS REFER TO REPORT RD-150-REP-001.
8. AREAS BOUNDED BY ROADS AND RAMPS SHALL BE REGRADED TOWARDS CULVERTS OR PROPOSED OPEN DRAINS TO ENSURE NO STANDING WATER.
9. EXISTING DRAINAGE SHALL BE REMOVED UNLESS NOTED OTHERWISE.
10. EXISTING DRAINS HIGHLIGHTED ON THE DRAWINGS SHALL BE RECONDITIONED UNLESS NOTED OTHERWISE.
11. EXISTING SERVICES SHOWN ARE INDICATIVE AND SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
12. DEPTH TO SERVICES AT ALL CROSSING POINTS SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.
13. FOR SETOUT DETAILS OF MODELLED OPEN DRAINS REFER TO DESIGN MODEL.
14. MODELLED OPEN DRAINS SHALL BE TYPE 'F' DRAINS IN ACCORDANCE WITH MAIN ROADS DRAWING 9831-5498 UNLESS NOTED OTHERWISE.

1:1000

No.	DATE	DESCRIPTION	APPROVED
1	30.08.13	RE-ISSUED FOR CONSTRUCTION	C.S
0	24.05.13	ISSUED FOR CONSTRUCTION	C.S

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E/ info@bgeeng.com
bgeeng.com
BG&E
APPROVED DATE

DRAWN	DM	DESIGNED	TM/TT
CHECKED	SM		
DESIGNER PROJECT No	P11120		
GRID	PHG94	DATUM	AHD
SCALE	1:1000		
SCALE 1:1000	0 10m 20 30		

CONTRACTOR:
John Holland
PROJECT MANAGER DATE

CLIENT:
Government of Western Australia
mainroads WESTERN AUSTRALIA
INFRASTRUCTURE DELIVERY DIRECTORATE
PROJECT MANAGER DATE 2013-11-08
PROJECT DIRECTOR CK. DATE 2013-11-08

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)	MRWA RESPONSIBILITY AREA PILBARA
MRWA DRAWING No. -	MRWA CONTRACT No. 183/10

MRWA SLK
GREAT NORTHERN HWY (H006) - 1602.58 SLK TO 1612.53 SLK

PROJECT
GREAT NORTHERN HIGHWAY REALIGNMENT
PORT HEDLAND

TITLE
GREAT NORTHERN HIGHWAY
DRAINAGE PLAN (RD150)
SHEET 20

SHEET SIZE A3

PROJECT GN | DESIGN LOT RD150 | DRAWING No. 119 | REV 1

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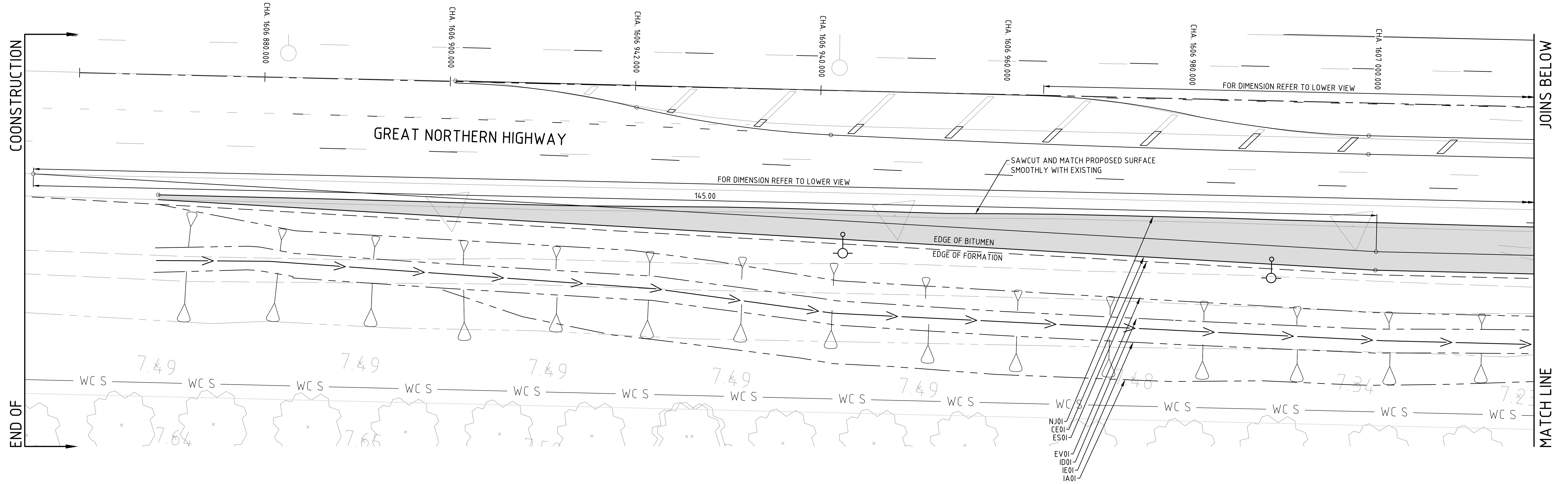
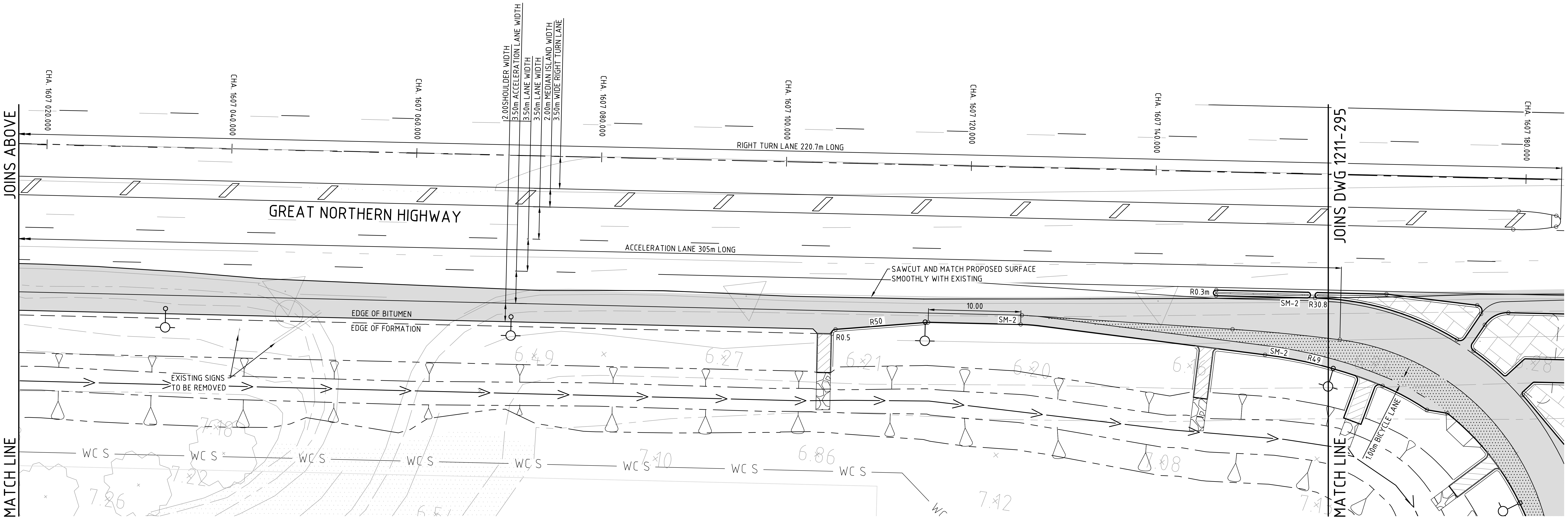
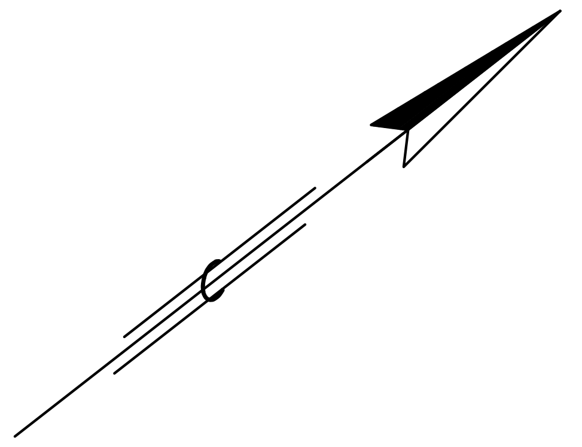






LEGEND

— · —	EXISTING CENTRELINE OF GREAT NORTHERN HWY
——	SEALED ROAD EDGE
SM-2	SEMI-MOUNTABLE KERB SM-2(40) AND TANGENT POINT
▥	NEW CULVERT
⇠	OPEN DRAIN
	PEDESTRIAN RAMP TYPE 'A'
— WC S —	PROPOSED SEWER PRESSURE MAIN
	KERB BREAK
	ROCK PROTECTION
▨	BRICK PAVING
▒	40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX
░	40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX WITH 2% RED OXIDE
☐	EXISTING ROAD TO BE REHABILITATED

PERTH ONE CALL SYSTEM
DIAL 1100
DIAL BEFORE YOU DIG

E:\WORKING\2011\11-125\CIVIL

AMENDMENTS

No.	DESCRIPTION	APPROVED & DATE
B	ISSUED FOR FINAL REVIEW	31/07/12
C	REVISED TO INCLUDE ACCELERATION LANE AND TRAFFIC ISLANDS	11/02/13
D	MODIFIED GNH RAISED MEDIAN, ADDED STREET LIGHTING & DIMENSIONS; MODIFIED OPEN DRAIN	4/07/13
E	ISSUED FOR FINAL REVIEW	19/08/13
F	REVISED ACCELERATION LANE	13/09/13
0	ISSUED FOR CONSTRUCTION	16/10/13
1	REVISED OPEN DRAIN	16/04/14
2	REVISED LIGHTING AND OPEN DRAIN	13/05/14

NOTES

1. REFER TO 3D MODEL OUTPUT AND REPORTS FOR SETOUT DETAILS
2. DESIGN BASED UPON :
   REFERENCE: "96976T - 96976de-010H"
   BY "McMULLEN NOLAN"
3. HORIZONTAL DATUM: PHG94
   MAP PROJECTION ZONE 50
   VERTICAL DATUM AHDM
4. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE NOTED
5. ALL LEVELS ARE DESIGNED TO THE TOP OF PAVEMENT
6. ALL BATTERS ARE TO BE 1 IN 4 UNLESS NOTED OTHERWISE
7. ANY GUIDEPOSTS AFFECTED BY WORKS TO BE RELOCATED TO EDGE OF NEW SHOULDER.
8. ALL SERVICES TO BE VERIFIED USING 'POT HOLING' AND RELEVANT SERVICE PROVIDERS NOTIFIED PRIOR TO CONSTRUCTION.
9. DESIGN VEHICLE IS A 27.5m B-DOUBLE TRUCK WITH A 20m TURNING TEMPLATE RADII
10. FOR TYPICAL CROSS SECTIONS AND DETAILS REFER TO DRG No 1211-0302
11. FOR CULVERT AND DRAINAGE INFORMATION REFER TO DRG No's 1211-301 AND 1211-303
12. FOR HIGHWAY INFORMATION REFER TO DRG No 1211-293
13. FOR CROSS SECTIONS REFER TO DRG No's 1211-297 AND 1211-298
14. FOR SIDE ROAD INFORMATION REFER TO DRG No's 1211-294 AND 1211-299
15. FOR SIGNS AND PAVEMENT MARKING INFORMATION REFER TO DRG No 1211-300
16. FOR STREET LIGHT INFORMATION REFER TO DRG No's 1311-1406 TO 1311-1409

METADATA

GROUND SURVEY STANDARD: PHG94
DATE OF CAPTURE:
MAPPING SURVEY STANDARD:
DATE OF CAPTURE:
MAIN ROADS PROJECT ZONE: Z50
HEIGHT DATUM: AHD

pritchard francis
civil and structural engineering consultants

Level 1, 430 Roberts Road
PO Box 2150
Subiaco WA 6904
Telephone: (08) 9382 5111
Facsimile: (08) 9382 5199
admin@pfeng.com.au
ACN: 008 891 094

DRAWING NUMBER/DOCUMENT ID
DESIGNED / DRAWN MJC
VERIFIED RF
DIRECTOR CJ

Government of Western Australia
mainroads WESTERN AUSTRALIA
PLANNINREGIONATECHNICALSERVICES DIRECTORATE
ROAD AND TRAFFIC ENGINEERING BRANCH
WAXEELMOCIRESKENT CENTRE BRAND ST, SOUTH HEDLAND
Telephone (08) 9323 4111 Fax (08) 9323 4730

SCALES 1:250
0 2.5m 5 7.5 10 12.5 15 17.5 20 22.5 25 27.5 30 32.5 35 37.5
A1

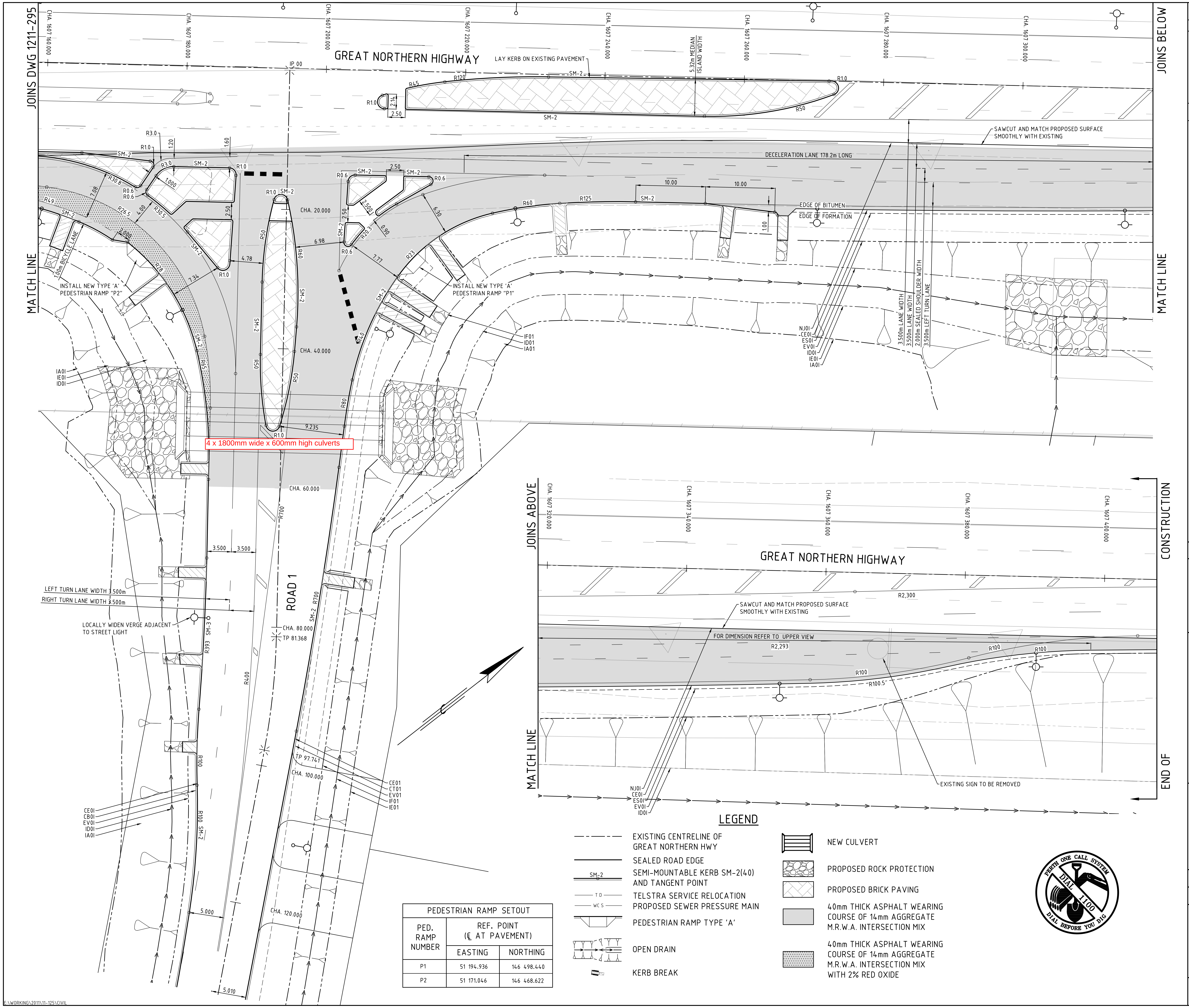
MRWA FILE NUMBER

APPROVED (MRWA)

GREAT NORTHERN HIGHWAY (H006)
PRECINCT 3 - ROAD 1 INTERSECTION
SLK 1607.2
INTERSECTION PLAN - GNH
SHEET 1 OF 2

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)

MRWA DRAWING NUMBER
1211-295 2



LEGEND

- EXISTING CENTRELINE OF GREAT NORTHERN HWY
- SEALED ROAD EDGE
- SM-2 SEMI-MOUNTABLE KERB SM-2(40) AND TANGENT POINT
- TD TELSTRA SERVICE RELOCATION
- WCS PROPOSED SEWER PRESSURE MAIN
- PEDESTRIAN RAMP TYPE 'A'
- OPEN DRAIN
- KERB BREAK
- NEW CULVERT
- PROPOSED ROCK PROTECTION
- PROPOSED BRICK PAVING
- 40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX
- 40mm THICK ASPHALT WEARING COURSE OF 14mm AGGREGATE M.R.W.A. INTERSECTION MIX WITH 2% RED OXIDE

PEDESTRIAN RAMP SETOUT

PED. RAMP NUMBER	REF. POINT (℄ AT PAVEMENT)	
	EASTING	NORTHING
P1	51 194.936	146 498.440
P2	51 171.046	146 468.622

PERTH ONE CALL SYSTEM DIAL 1100 DIAL BEFORE YOU DIG

AMENDMENTS

No.	DESCRIPTION	APPROVED & DATE
C	REVISED TO INCLUDE ACCELERATION LANE AND TRAFFIC ISLANDS	11/02/13
D	MODIFIED GNH RAISED MEDIAN, ADDED STREET LIGHTING & DIMENSIONS; MODIFIED OPEN DRAIN	04/07/13
E	ISSUED FOR FINAL REVIEW	19/08/13
F	REVISED ACCELERATION LANE	13/09/13
G	ADDED KERB OPENINGS	24/09/13
0	ISSUED FOR CONSTRUCTION	16/10/13
1	REVISED OPEN DRAIN	16/04/14
2	REVISED LIGHTING AND OPEN DRAIN	13/05/14

NOTES

1. REFER TO 3D MODEL OUTPUT AND REPORTS FOR SETOUT DETAILS
2. DESIGN BASED UPON :
   REFERENCE: "96976T - 96976de-010H"
   BY "McMULLEN NOLAN"
3. HORIZONTAL DATUM: PHG94
   MAP PROJECTION ZONE 50
   VERTICAL DATUM AHDM
4. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE NOTED
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11. FOR CULVERT AND DRAINAGE INFORMATION REFER TO DRG No's 1211-301 AND 1211-303
12. FOR HIGHWAY INFORMATION REFER TO DRG No 1211-293
13. FOR CROSS SECTIONS REFER TO DRG No's 1211-297 AND 1211-298
14. FOR SIDE ROAD INFORMATION REFER TO DRG No's 1211-294 AND 1211-299
15. FOR SIGNS AND PAVEMENT MARKING INFORMATION REFER TO DRG No 1211-300
16. FOR STREET LIGHT INFORMATION REFER TO DRG No's 1311-1406 TO 1311-1409

METADATA

GROUND SURVEY STANDARD: PHG94
DATE OF CAPTURE:
MAPPING SURVEY STANDARD:
DATE OF CAPTURE:
MAIN ROADS PROJECT ZONE: Z50
HEIGHT DATUM: AHD

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civil and structural engineering consultants

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REGIONAL SERVICES DIRECTORATE
PILBARA REGION
MAXINE MCGILLVRAY CENTRE
Telephone (08) 9172 8877
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Fax (08) 9140 1076

SCALES 1:250
0 2.5m 5 7.5 10 12.5 15 17.5 20 22.5 25 27.5 30 32.5 35 37.5
A1

MRWA FILE NUMBER

APPROVED (MRWA)

GREAT NORTHERN HIGHWAY (H006)
PRECINCT 3 - ROAD 1 INTERSECTION
SLK 1607.2
INTERSECTION PLAN - GNH
SHEET 2 OF 2

LOCAL AUTHORITY TOWN OF PORT HEDLAND (813)

MRWA DRAWING NUMBER
1211-296 2

APPENDIX B

Catchment Data

Hematite Swale Catchment

Catchment ID	Industrial Lots	Road Reserves	Drainage	Total
h1	7.27	2.08	0.8	10.15
h2	3.80	0.30	0.14	4.23
h3	3.76	0.35	0.1	4.21
h4	2.98	0.33	0.08	3.39
h5	1.06	0.36	0.08	1.50
h6	1.29	0.78	0.07	2.14
h7	3.04	0.38	0.21	3.62
h8	3.21	0.50	0.45	4.16
h9	2.17	0.49	0.21	2.87
h10	3.55	0.13	0.28	3.96
h11	1.12	0.28	0.18	1.58
h12	2.50	0.62	0.1	3.21
h13	2.14	0.35	0.04	2.53
h14		0.42	0.06	0.48
h15	0.00	4.73	0	4.73
h16	4.25	0.25	0.32	4.82
h17	8.45	6.93	0.8	16.18
h18	5.90	0.19	0.05	6.14
h19	5.20	0.39	0.6	6.19
h20		0.11	0.12	0.23
h21		0.34	0.17	0.51
h22	6.18	0.30	0.38	6.86
h23	1.70	0.10	0.13	1.93
h24	4.97	0.31	0.33	5.61
h25	0.39	1.08	0.29	1.77
h26	23.22	0.53	0.75	24.50
h27	4.80	0.33	0.73	5.86
h28	2.24	0.22	0.31	2.77
h29	2.41	0.48	0.4	3.29
h30	2.59	0.51	0.22	3.32
h31	0.73	0.37	0.17	1.26
h32	1.40	0.31	0.25	1.97
h33	0.95	1.28	0.55	2.78
h34	0.01	1.59	0	1.60
h35	16.89	0.70	0.37	17.95
h36		1.50	0.8	2.30
h37		1.69	3	4.69
h38	1.75	0.69	0.23	2.67
h39	1.69	0.35	0.06	2.10
h40	2.73	0.65	0.21	3.60
h41	1.60	0.19	0.34	2.13
h42	0.90	0.16	0.06	1.12
h43	2.09	0.48	0.26	2.84
h44	2.08	0.30	0.11	2.49
h45	3.81	1.82	0.26	5.89
h46	0.86	1.15	0.24	2.25

Hematite Swale Catchment (continued)

Catchment ID	Industrial Lots	Road Reserves	Drainage	Total
h47	3.23	0.35	0.61	4.18
h48		0.20	0.35	0.55
h49		0.66	0.38	1.04
h50		3.44	0.34	3.78
h51	2.20	0.28	0.09	2.57
h52	1.04	0.74	0.18	1.95
h53	2.95	0.26	0.23	3.44
h54	1.64	0.24	0.1	1.98
h55	1.79	0.36	0.05	2.20
h56	1.14	0.49	0.13	1.76
h57	2.81	0.73	0.16	3.69
h58	1.95	0.32	0.05	2.31
h59		0.34	0.95	1.29
h60		3.44	0.15	3.59
h61	3.96	2.04	0.42	6.41
h62	8.40	0.62	0.44	9.46
h63		1.74	0.4	2.14
h64		0.65	0.33	0.98
h65	9.26	0.79	0.38	10.43
Grand Total	188.03	55.06	21.05	264.14

Anthill Swale Catchment

Catchment ID	Industrial Lots	Road Reserves	Drainage	Total
a1		1.76	0.1	1.86
a2	2.07	0.00	0	2.07
a3	2.73	0.00	0	2.73
a4	3.08	0.79	0.31	4.18
a5	3.25	0.79	0.26	4.29
a6	2.51	0.76	0.16	3.43
a7		0.19	0.09	0.28
a8	2.62	0.20	0.06	2.88
a9	3.42	1.01	0.17	4.60
a10	1.71	0.29	0.06	2.06
a11	1.93	0.56	0.15	2.64
a12	5.62	0.76	0.08	6.45
a13	2.27	0.24	0.07	2.58
a14	2.27	0.27	0.07	2.61
a15	2.26	1.73	0.06	4.05
a16	6.62	1.21	0.2	8.03
Grand Total	42.34	10.55	1.84	54.73

Dalton Swale Catchment

Catchment ID	Industrial Lots	Road Reserves	Drainage	Total
d1		0.37	1.8	2.17
d2		2.46	5.5	7.96
d3	5.78	2.73	0.98	9.49
d4		10.26		10.26
d5		1.26	0.38	1.64
d6	5.06	1.14	0.3	6.50
d7	1.01	0.30	0.14	1.46
d8	2.00	0.38	0.06	2.44
d9	4.22	0.44	0.38	5.04
d10	4.08	0.49	0.35	4.92
d11	3.59	0.37	0.22	4.18
d12	5.85	0.65	0.39	6.89
d13	4.11	0.45	0.21	4.77
d14	0.00	1.24	0.5	1.74
d15	4.64	3.06	0.27	7.97
d16		0.37	0.12	0.49
d17		0.66	0.15	0.81
d18	3.76	0.32	0.19	4.28
d19	2.20	0.59	0.13	2.92
d20		0.37		0.37
d21		0.34		0.34
d22	1.90	0.24	0.16	2.30
d23	2.78	0.19	0.11	3.09
d24	2.46	0.27	0.14	2.87
d25	1.49	0.39	0.19	2.07
Grand Total	54.93	29.37	12.67	96.96


a1
a2
a3
h1
h3
Outlet D
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h2
Outlet H
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Hematite
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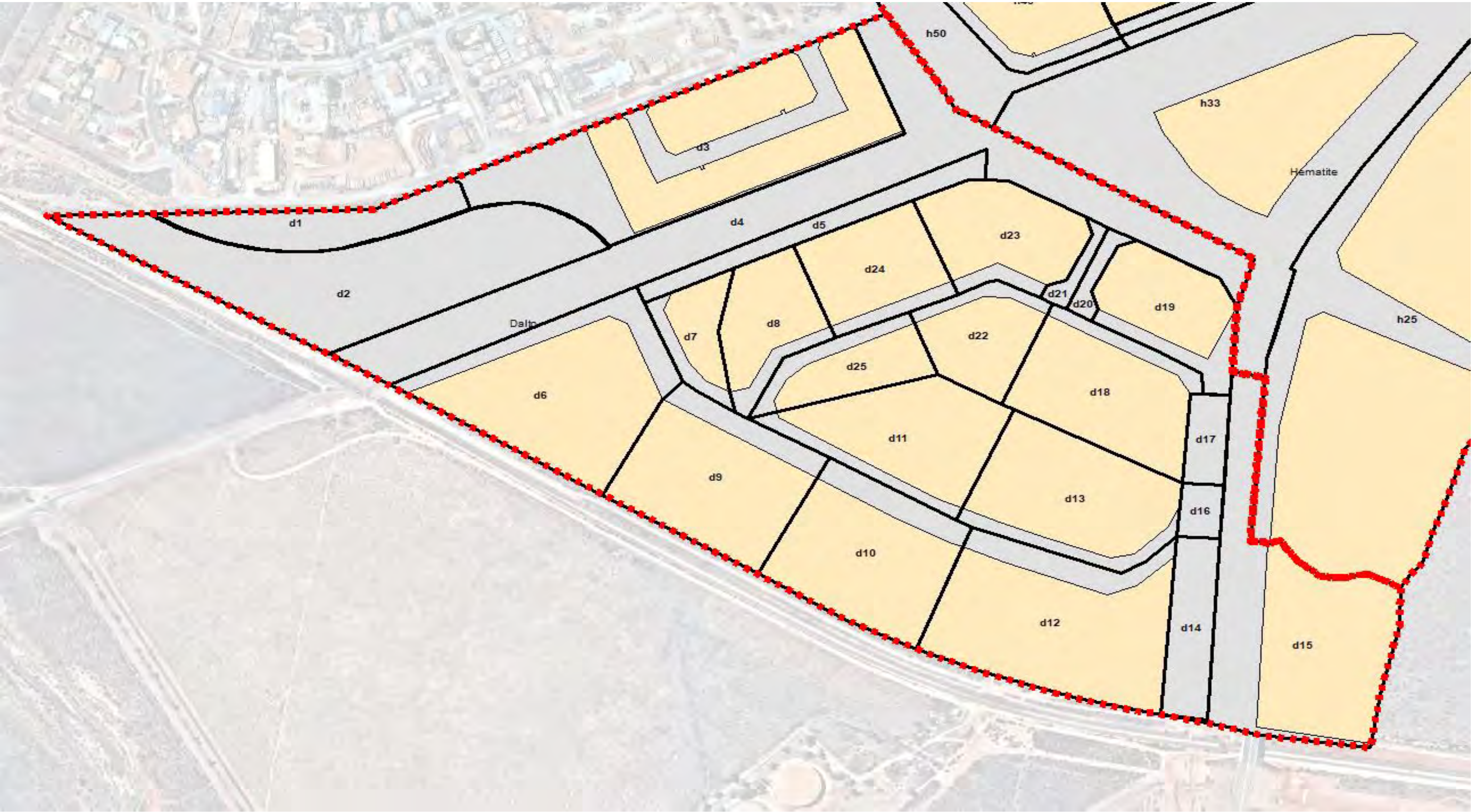
h50
h33
Hematite
h25
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d3
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Dalto
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Suite 1, 27 York St, Subiaco WA 6008
PO Box 117, Subiaco WA 6904
Ph: +61 8 9388 2436

www.jdahydro.com.au

info@jdahydro.com.au

JDA Consultant Hydrologists

APPENDIX D – TRANSPORT IMPACT ASSESSMENT

TRAFFIC IMPACT ASSESSMENT

HEDLAND JUNCTION STRUCTURE PLAN

REPORT PREPARED FOR

Development WA

Prepared by	**Porter Consulting Engineers**
Postal address	PO Box 1036 Canning Bridge WA 6153
Phone	(08) 9315 9955
Email	office@portereng.com.au

Job number	21-11-159
Date	13 July 2023
Our reference	R01.22C
Checked	EW

HISTORY AND STATUS OF THE DOCUMENT

Revision	Date issued	Author	Issued to	Revision type
Rev A	21/02/2022	JH	Development WA	First Issue
Rev B	13/04/2022	JH	Development WA	Second Issue
Rev B	13/07/2023	JH	Development WA	Updated to address WAPC requirements

CONTENTS

Appendix A – Structure Plan Layout
Appendix B – Intersection Turn Counts
Appendix C – SIDRA Detailed Results

1.0 INTRODUCTION

1.1 Background

Porter Consulting Engineers has been engaged to prepare a Transport Impact Assessment (TIA) for the Hedland Junction Structure Plan (HJSP) located to the east and south of the existing Wedgefield industrial area, within the Town of Port Hedland. Wedgefield is situation between Port Hedland (to the north) and South Hedland (to the south). The HJSP area is approximately 155 hectares of land which would comprise the creation of some 90 industrial lots.

Figure 1.1 shows an aerial view of the site and its immediate surrounds.

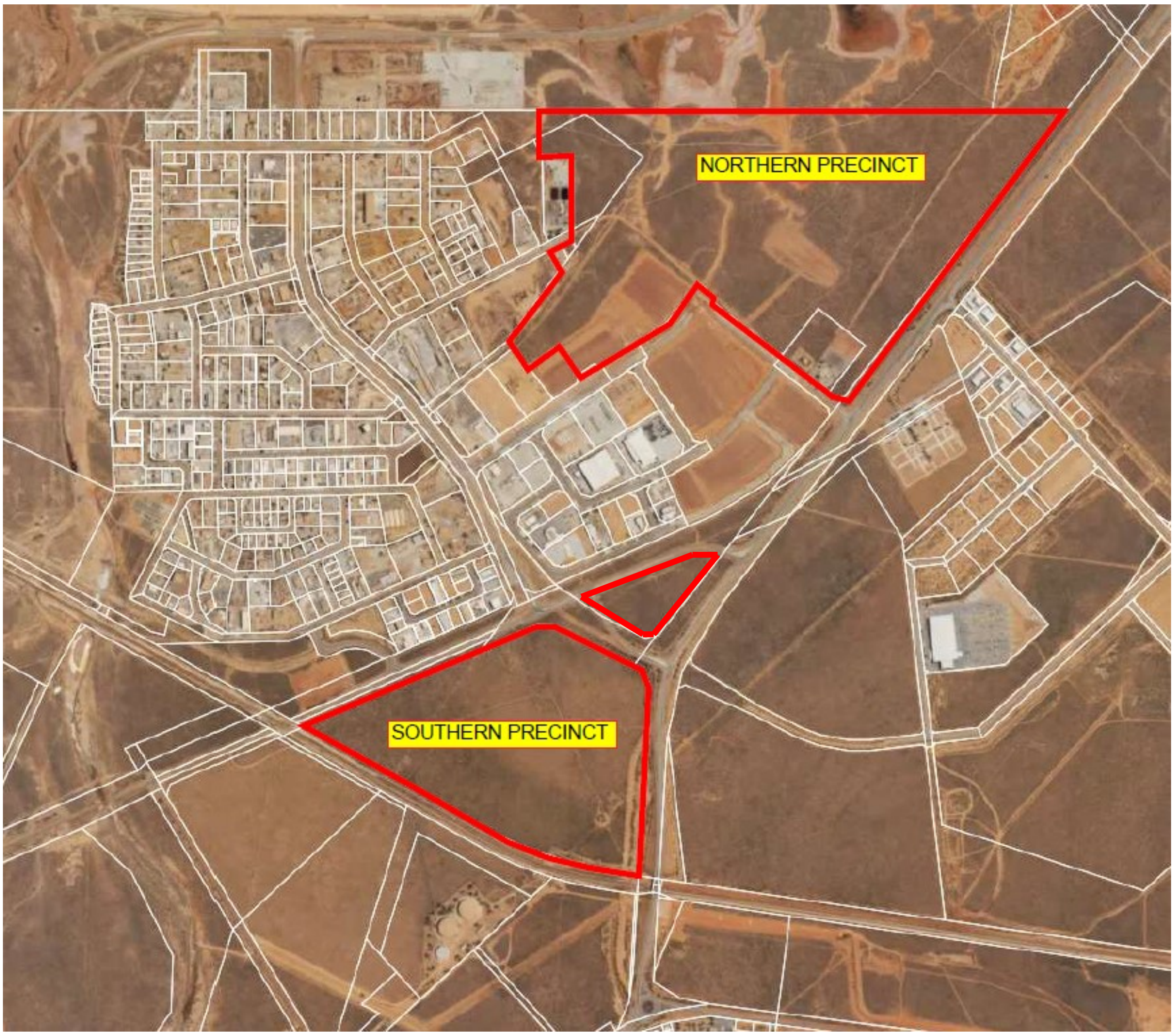


Figure 1.1: Aerial View of Site

1.2 Scope of Assessment

The intent of this assessment is to provide the approving authority with sufficient traffic information to confirm that the proponent has adequately considered the traffic aspects of the development. The key objective has been to access the proposed internal and external transport networks with respect to accessibility, permeability, road hierarchy classification and intersection capacity requirements.

The HJSP is anticipated to be implemented over a number of stages driven by the land use market demand. In this regard the external intersection connections were reviewed with respect to the staged release of lots within the HJSP in particular the need and timing for the connection of Hematite Drive to Great Northern Highway. A new connection to Great Northern Highway is considered to provide improved accessibility and permeability of the HJSP as two connections to the Primary Distributor road network (Great Northern Highway) is provided i.e. via the existing Pinga Street intersection and the new Hematite Drive intersection.

2.0 STRUCTURE PLAN PROPOSAL

2.1 Structure Plan Context

The subject Site is currently zoned for “industrial development” under the Town of Port Hedland Planning Scheme as shown in **Figure 2.1**

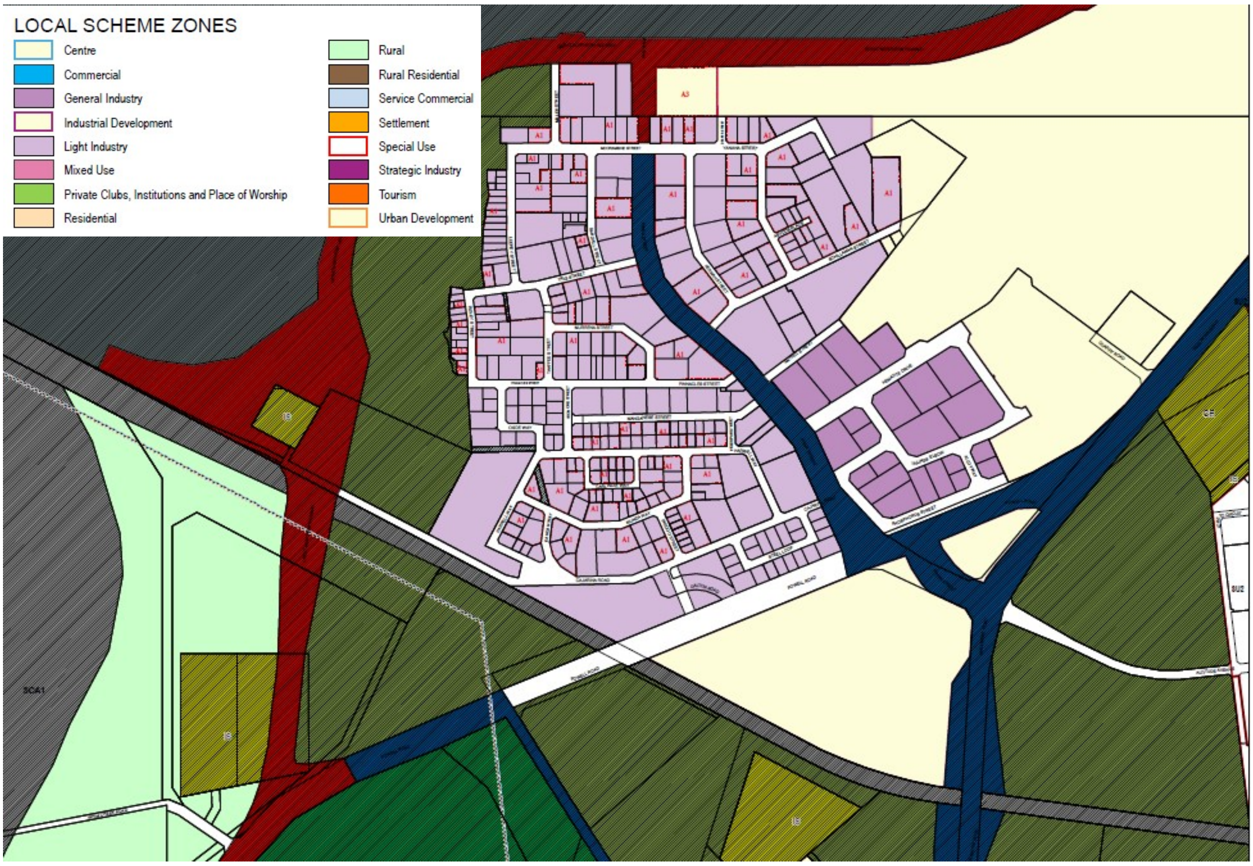


Figure 2.1: Structure Plan Lots (*Town of Port Hedland Scheme*)

Wedgefield is situated approximately 20 km to the south of the original Port Hedland townsite and approximately 7 km north of South Hedland residential locality. The major roads linking Wedgefield to these local areas and other regions include Great Northern Highway, Wallwork Road, Wilson Street and Powell Road. **Figure 2.2** shows the Site in a local context.

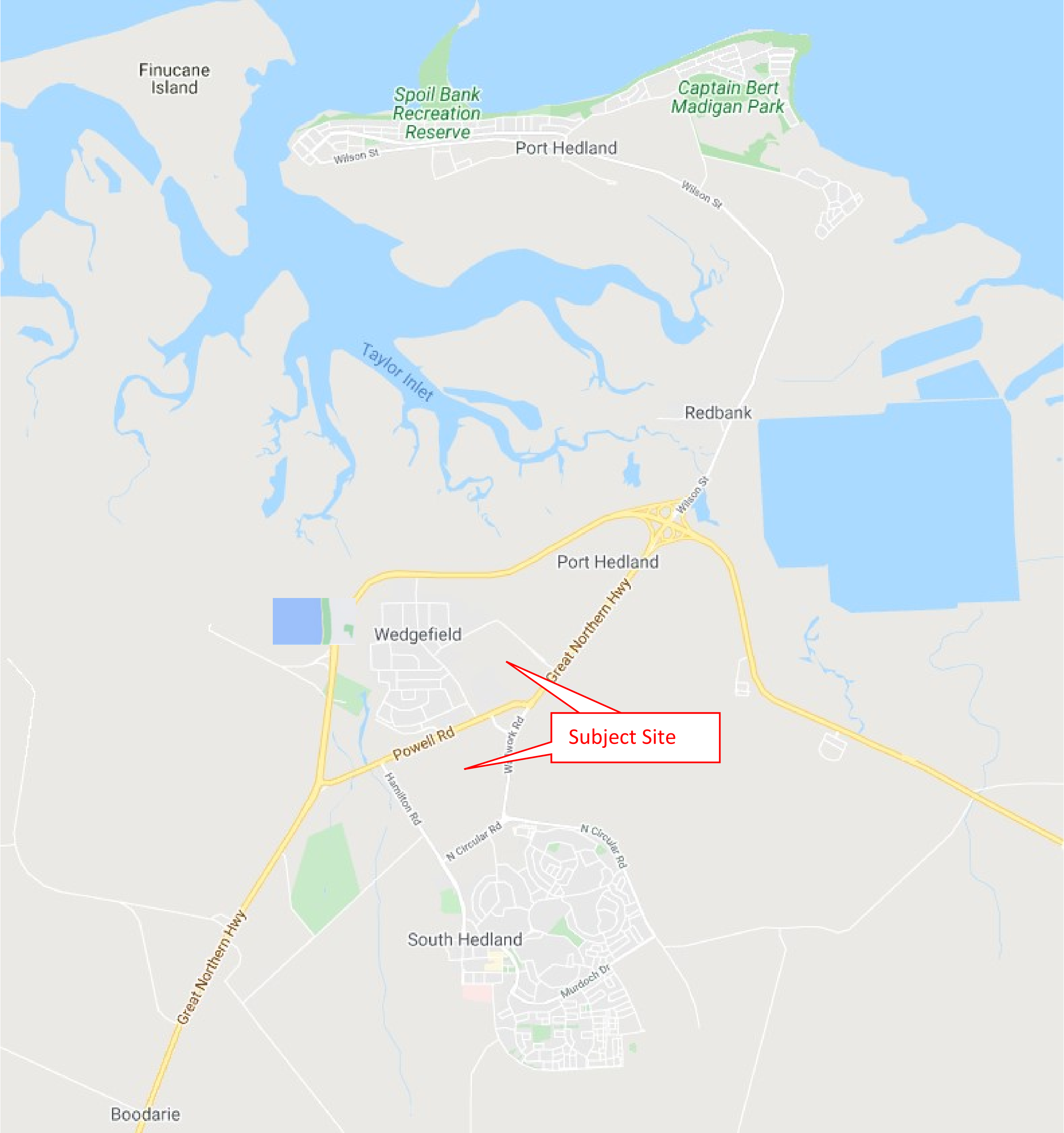


Figure 2.2: Location in a Local Context

2.2 Proposed Land Uses

Based on the indicative lots layout the structure plan will incorporate approximately 90 industrial lots subject to detailed design. The total developable area is approximately 155 hectares. Based on the indicative lot layout the lot sizes vary from 4800m^2 to a maximum of 4.8 hectares.

For the purpose of the traffic assessment the Hedland Junction Structure Plan was divided into a number of areas based on an indicative timing for development. These stages and lots are indicative only to provide a framework for the traffic assessment. The actual lots developed may vary. Since trip generation is based on developable area, lots within close proximity using the same road network are interchangeable with the traffic assessment remaining valid. The indicative stages adopted for the traffic assessment are as follows and shown in **Figure 2.3**.

- Stage 2 – road network recently completed
- Stage 3
- Stage 4
- Stage 5 – remaining lots north of Powell Street
- Lots south of Powell Street.

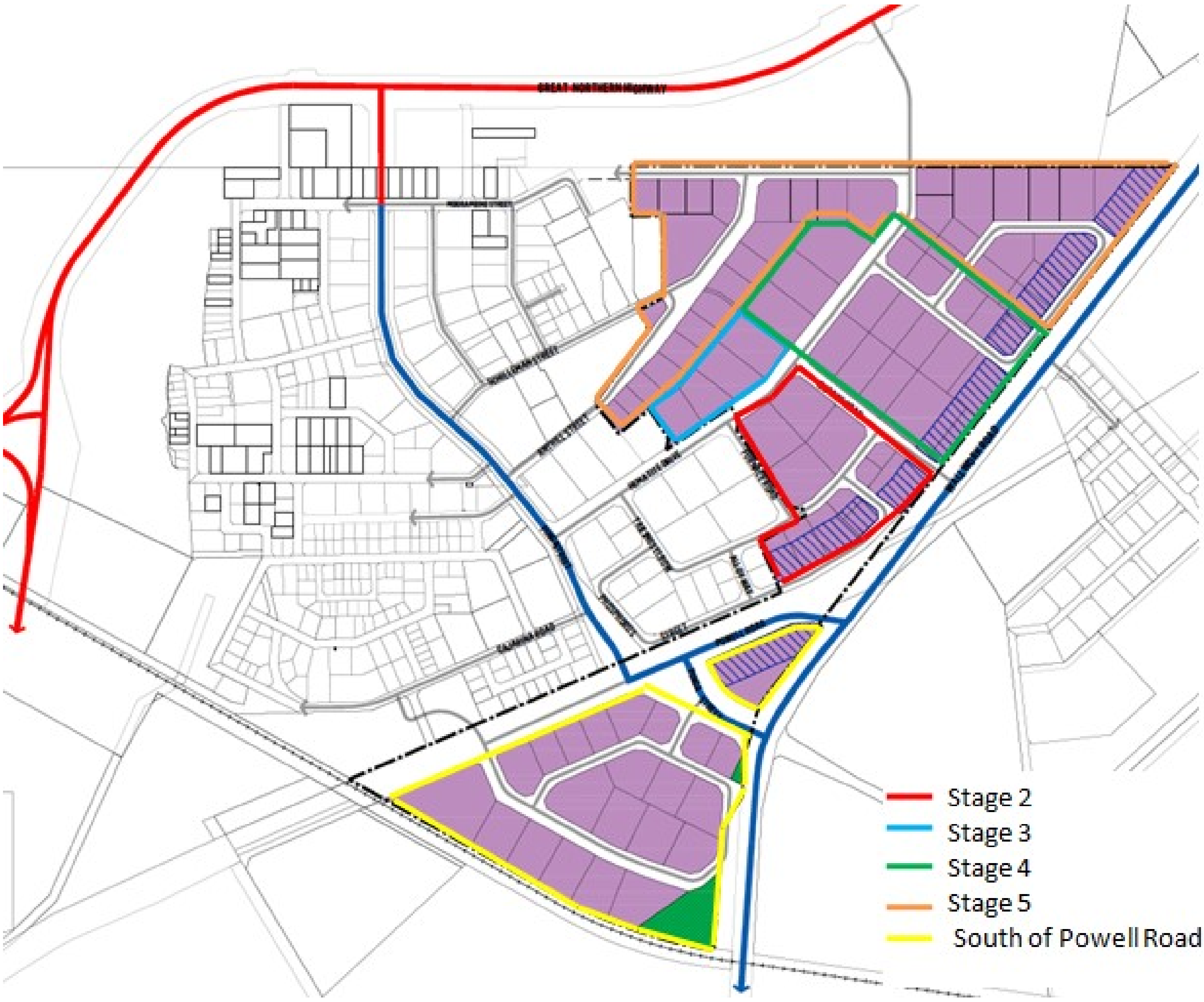


Figure 2.3: Indicative Lot Layout including the various Stages

2.3 Major Attractors and Generators of Traffic

Due to the nature of the proposed industrial structure plan it is likely to become a major employment attractor from surrounding areas. The key residential areas within the Town of Port Hedland include Port Hedland located to the north of Wedgefield and South Hedland located to the south.

Forecast population data for the Town of Port Hedland suggest the following projections:

Port Hedland – 3,736 (2022) increasing to 6,903 (2041)
South Hedland - 9,804 (2022) increasing to 18,574 (2041)

On this basis it is likely that the commuter traffic distribution patterns to/from work during the peak periods is likely to be similar to the existing patterns given both residential areas are anticipated to expand by a similar percentage.

3.0 ROAD NETWORK SITUATION

3.1 Existing Road Network

Figure 3.1 illustrates the road network within approximately 2 kilometres surrounding the area to the north of Powell Road and the Site area to the south of Powel Road. Key distributor roads surrounding the Site include: Great Northern Highway, Powell Road, Wallwork Road and Pinga Street.

2 km radius to area north of Powell Rd

2 km radius to area south of Powell Rd

Figure 3.1: Existing Surrounding Road Network

3.2 Road Infrastructure and Road Hierarchy Classification

The road hierarchy classification of the surrounding road network as defined by Main Roads WA functional road hierarchy is shown in **Figure 3.2**. Posted speed limits assigned by Main Roads are shown in **Figure 3.3.**

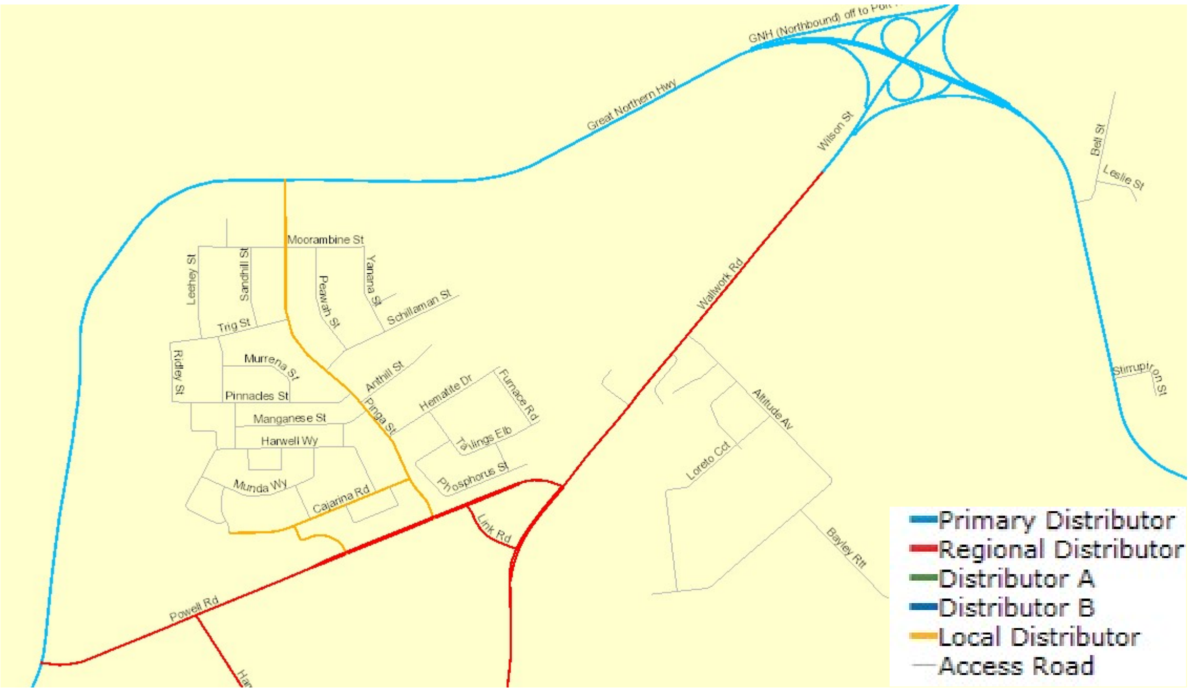


Figure 3.2 Functional Road Hierarchy (MRWA)

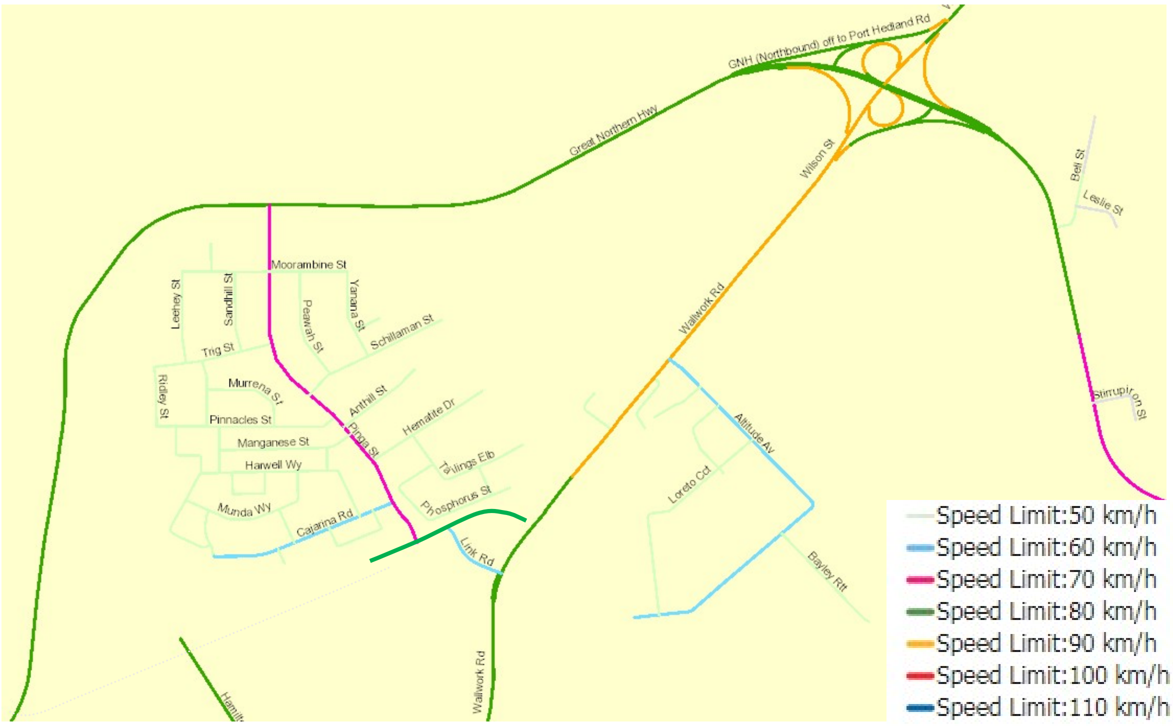


Figure 3.3 Speed Limits (MRWA)

Great Northern Highway

Great Northern Highway forms part of the Primary Distributor Road network and as such is controlled by Main Roads WA. By definition its function is to "*provide for major regional and inter-regional traffic movement and carry large volumes of generally fast moving traffic.*" This road runs in a generally east-west direction and forms the northern boundary of the Site. Great Northern Highway has a posted speed limit of 80km/h in the vicinity of Wedgefield.

Great Northern Highway is typically constructed to a two lane single carriageway standard. However, at its intersection with Pinga Street and a future connection into the Hedland Junction Structure Plan channelised treatments are provided as shown in **Figures 3.4 and 3.5.** Great Northern Highway approaches to Pinga Street provide 300m and 180m left and right turn deceleration lanes. Advanced flashing lights to "watch for entering traffic" are installed along the Great Northern Highway approaches to Pinga Street. Similarly, left and right turning lanes have been provided along Great Northern Highway for the future intersection to Wedgefield. At these intersections the westbound on-road cycle lane in the form of a sealed shoulder along Great Northern Highway transitions to a protected off road cycle path.

Figure 3.4a Great Northern Highway and Pinga Street – Aerial View

Figure 3.4b Great Northern Highway and Pinga Street – looking west along GNH

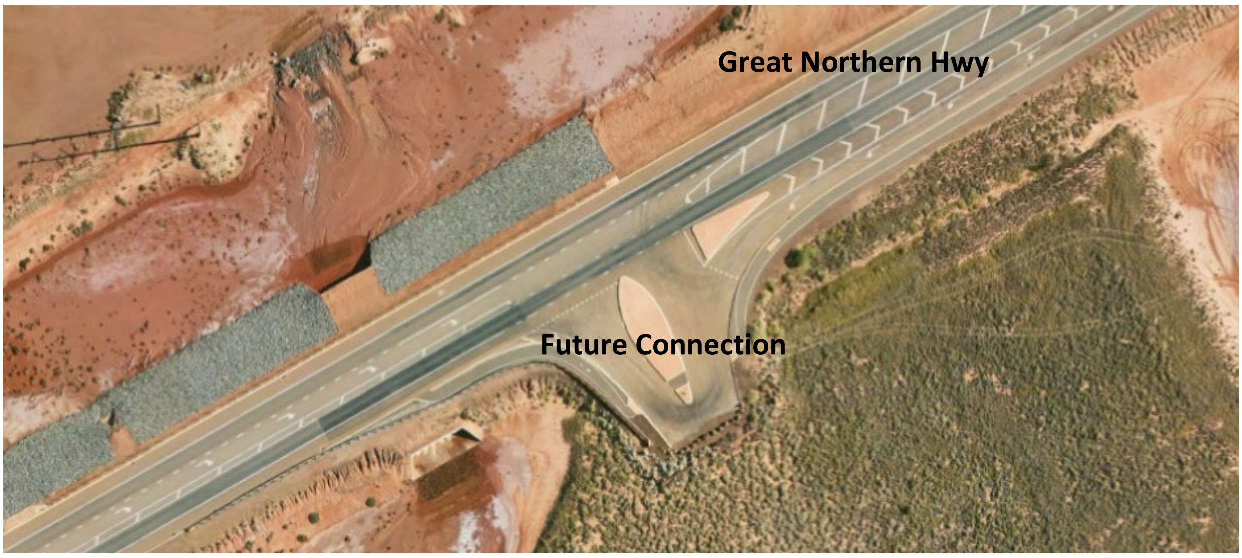


Figure 3.5 Great Northern Highway and Future Wedgefield Intersection – Aerial View

Pinga Street

Pinga Street is classified as a Local Distributor road between Great Northern Highway and Powell Street. A Local Distributor Road role is to "*carry traffic within a cell and link District Distributors/Primary Distributors to local access roads.*" Based on the road hierarchy this category of road typically carries 3,000 to 7,000 vehicles per day. The latest available traffic count held by the Town indicates that traffic volumes near Powell Street were in the order of 6,600 vehicles per day (March 2015). The recent peak hour counts suggest that traffic volumes along Pinga Street may range from 4,500 vehicles per day near Great Northern Highway to 10,200 vehicles per day near Powell Street (Nov 2021). This is based on the peak hour representing 8% of the daily traffic. This road is controlled by the Town of Port Hedland.

Pinga Street runs in a north-south direction and forms the minor intersection leg at Great Northern Highway at its northern end and Powell Road at its southern end. The road has a posted speed of 70km/h along its length.

Pinga Street is a two lane road typically with a painted median to separate opposing traffic and to provide right turn lanes to various side road intersections along its length. An indicative cross section comprises of 2 x 1.5m sealed shoulders, 2 x 3.5m traffic lanes and a 4m painted median or right turn lane creating a total sealed pavement width of approximately 14m (based on aerial imagery only). Localised widening on Pinga Street at intersections typically occurs to allow for the swept path of larger vehicles from side roads.

There are eight minor side road connections along its 2.2km length. All minor roads with Pinga Street operate under Give Way control. A 4-way intersection is created with Moorambine Street with the remaining seven being T-junctions. **Figures 3.6a to 3.6h** show the geometric layout of these various side roads. Each intersection has localised kerbing.

Cajarina Road/Dalton Road

Cajarina Road and Dalton Road are also classified as Local Distributor roads hence should "*carry traffic within a cell and link District Distributors/Primary Distributors to local access roads.*" Based on the road hierarchy this category of road typically carries 3,000 to 7,000 vehicles per day. This road is controlled by the Town of Port Hedland.

Hematite Drive, Anthill Street, Schillaman Street and Moorambine Street

Hematite Drive, Anthill Street, Schillaman Street and Moorambine Street are classified as local access roads whose role is defined as "*to provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function.*" Based on the road hierarchy this category of road typically carries 1,000 to 3,000 vehicles per day. These roads are subject to the built up area default speed limit of 50km/h.

These access roads and others within the original Wedgefield Industrial Estate are all two lane undivided roads with varying pavement widths ranging from 6m to 10m (based on aerial imagery only). Hematite Drive is constructed to the typical industrial roads standard recommended within Policy DC 4.1 Industrial Subdivision i.e. 10m pavement width. Road pavement widths of the original subdivision are typically less than the current recommended standard.

Figure 3.6a Pinga Street and Moorambine Street– Aerial View

Figure 3.6b Pinga Street and Trig Street– Aerial View

Figure 3.6c Pinga Street and Schillaman Street– Aerial View

Figure 3.6d Pinga Street/Pinnacles Street and Pinga Street/Anthill Street– Aerial View

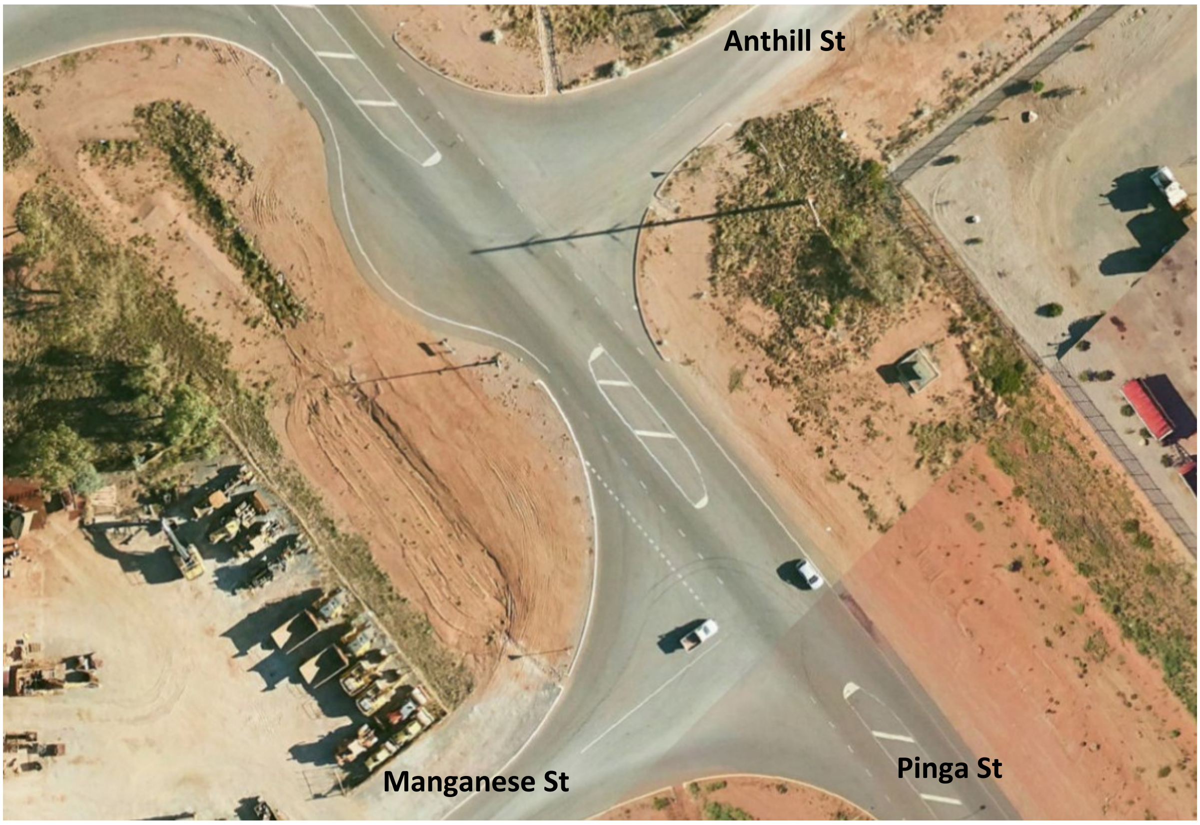


Figure 3.6e Pinga Street/Anthill Street and Pinga Street/Manganese Street– Aerial View

Figure 3.6f Pinga Street and Hematite Drive– Aerial View

Figure 3.6g Pinga Street and Cajarina Road– Aerial View

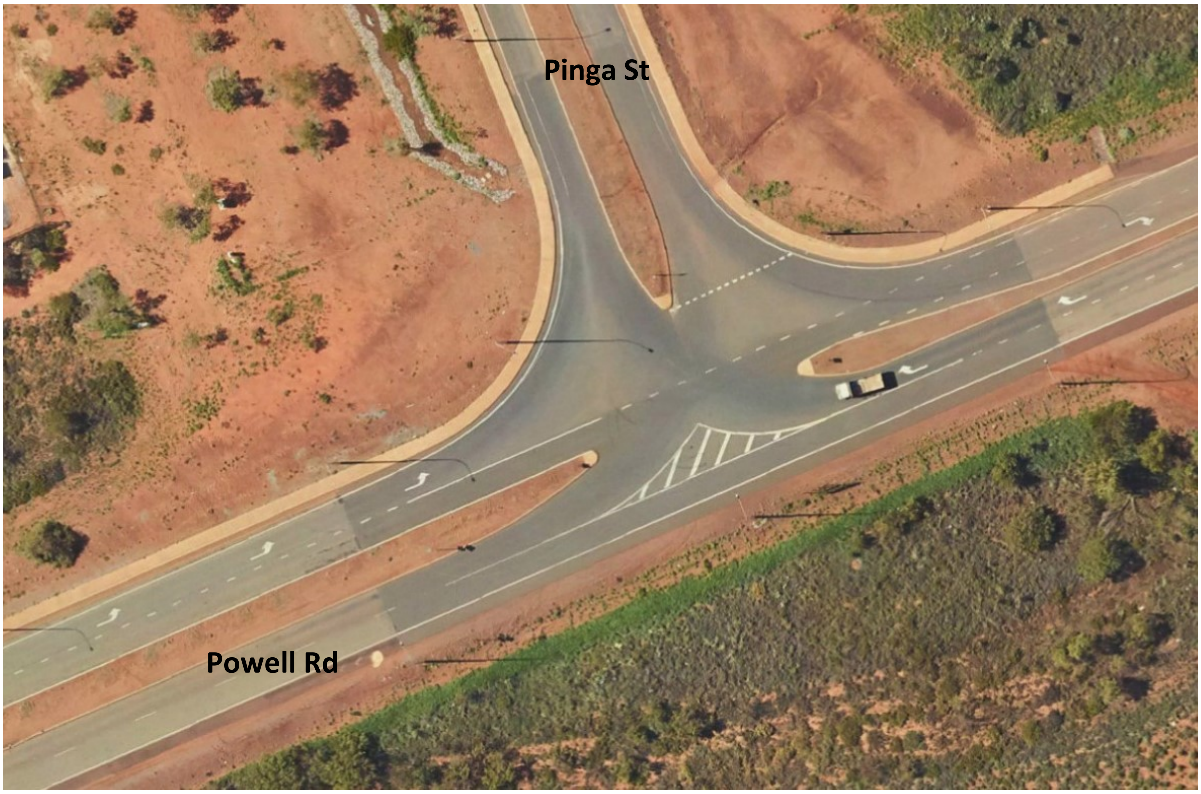


Figure 3.6h Pinga Street and Powell Road– Aerial View

Powell Road and Wallwork Road

Powell Road and Wallwork Road are classified as regional distributor roads. These roads whilst not Primary Distributor roads that still link significant destinations and are designed for efficient movement of people and goods within and beyond regional areas. Historically, these roads formed the original route of Great Northern Highway prior to its current alignment to the north of the Wedgefield Industrial Estate. Powell Road and Wallwork Road is the main route between South Hedland and Port Hedland. The posted speed limit ranges from 80 to 90km/h.

Powell Road in the vicinity of the Structure Plan is constructed to a two lane divided carriageway standard.

Both Powell Road and Wallwork Road are controlled and managed by the Town of Port Hedland.

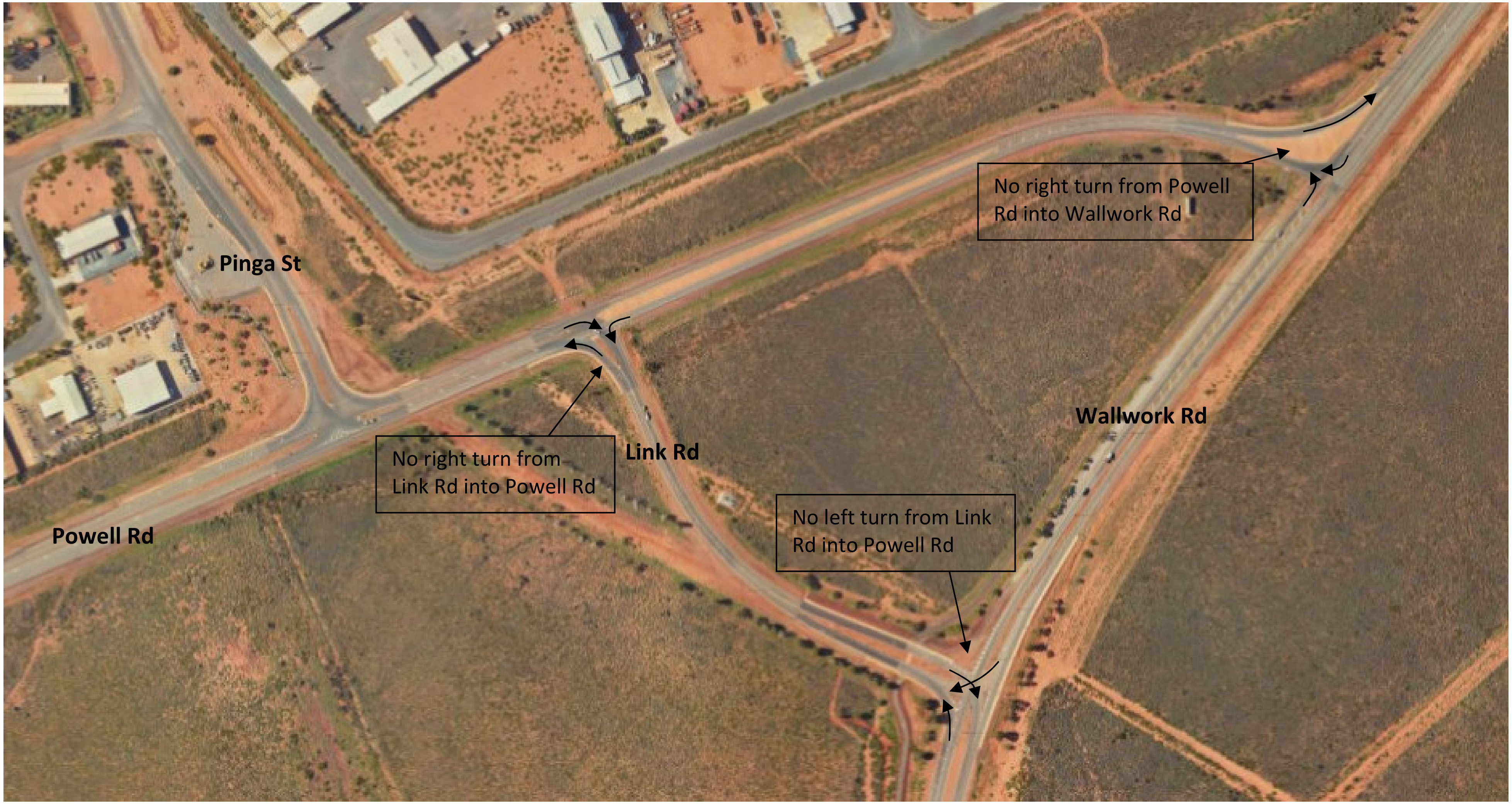


Figure 3.7. Powell Road, Link Rd and Wallwork Rd

3.3 Existing Traffic Volumes

Traffic count data was obtained for the study area from a number of sources: Main Roads WA traffic map website, the Town of Port Hedland and specific intersection turn counts. **Figure 3.8** and **Table 3.1** summarise the traffic flows recorded on the road network surrounding the development Site. **Figures 3.8 to 3.10** show graphically the hourly traffic flows, daily traffic flows and vehicle classification on the surrounding road network.

Intersection turn counts were also undertaken on Tuesday 30th November 2021 to facilitate SIDRA analysis of various intersections on the surrounding road network and included:

- Pinga St/ Great Northern Highway
- Pinga St / Hematite Drive
- Pinga St / Powell Road and
- Powell St / Link Road (also referred to as Pinga St –south)

These detailed results are contained within **Appendix B.**

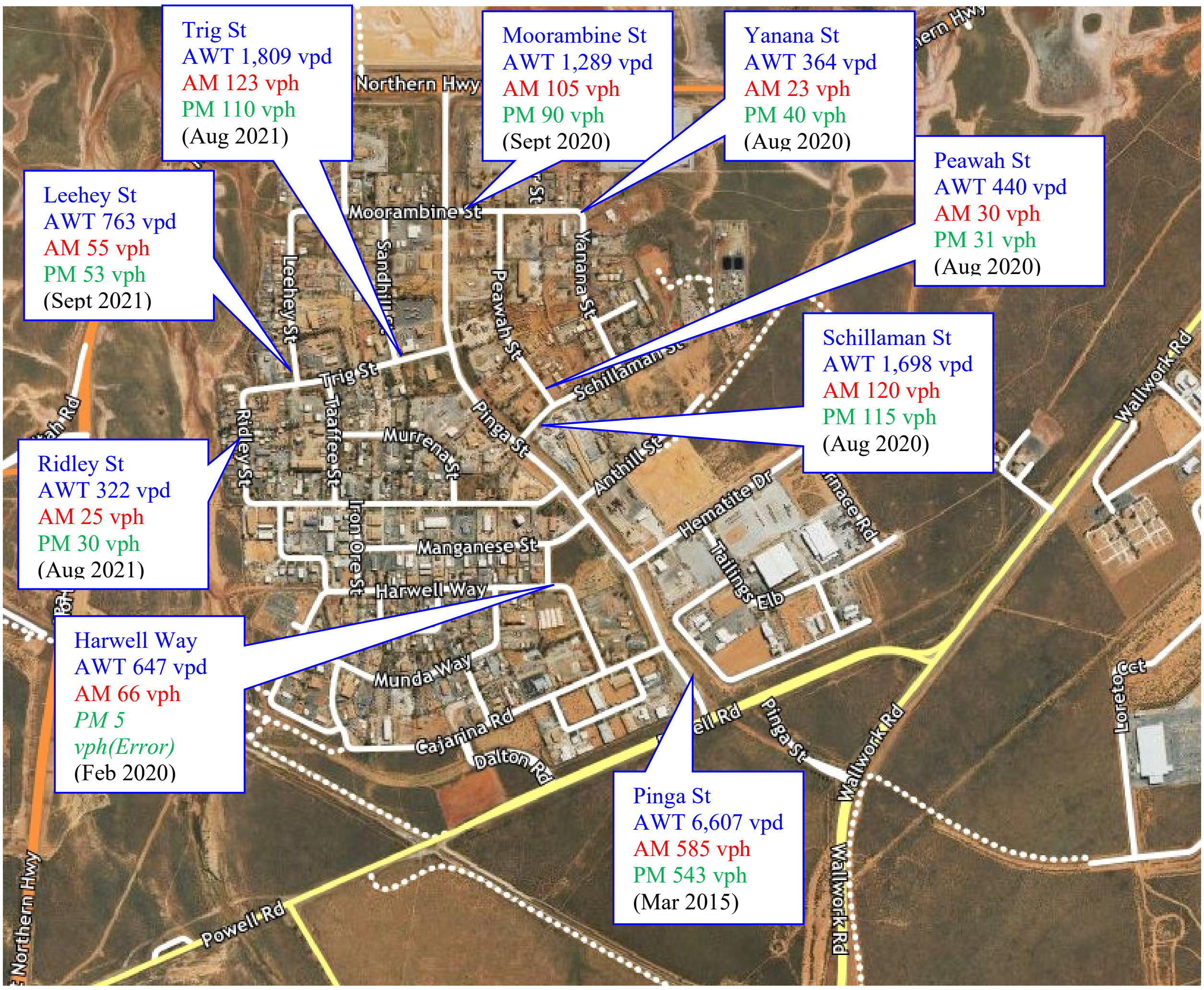


Figure 3.8. Existing Traffic Volumes on the Surrounding Road Network

Table 3.1: Recorded Traffic Volumes on the Surrounding Road Network

Location	**Date**	**AWT (veh/day)**	**Am Peak Hour**	**Pm Peak Hour**	**Heavy Vehicles(%)**		
					Truck (3-5)	**Semis (6-9)**	**Road Trains (10-12)**
Town of Port Hedland Counts							
Harwell St	Feb 2020	647	7-8am 66vph	11pm-12 40vph	26.6	1.4	0.1
Leehey St	Aug 2021	763	6-7am 55vph	4-5pm 53vph	20.6	3.1	4.5
Moorambine St	Aug 2020	1,288	7-8am 104vph	4-5pm 90vph	33.4	6	4.2
Peawah St	Aug 2020	440	6-7am 30vph	4-5pm 31vph	27.6	6	19.9
Pinga St	Mar 2015	6,606	6-7am 585vph	5-6pm 543vph	26.4	1.7	0.2
Ridley St	Aug 2021	322	10-11am 29vph	2-3pm 30vph	35.5	2.5	0.6
Schillaman St	Sept 2020	1,699	6-7am 120vph	1-2pm 142vph	40.7	0.6	2.7
Trig St	Aug 2021	1,031	6-7am 67vph	4-5pm 74vph	10.7	1.8	2.4
Yanana St	Aug 2020	364	9-10am 24vph	3-5pm 40vph	32.8	3.5	10
Survey Tech Peak Hour Counts							
Hematite Dr	Nov 2021	-	6.15-7.15am 142vph	4.15-5.15pm 105vph	8.2	0.9	11.9
Pinga St, south of Great Northern Hwy	Nov 2021	-	7-8am 348vph	4.30-5.30pm 371vph	8.3	2.2	16.3
Pinga St, South of Hematite Dr	Nov 2021		6.15-7.15am 689vph	4.15-5.15pm 668vph	8.0	1.7	1.1
Pinga St, north of Powell Rd	Nov 2021	-	6.30-7.30am 811vph	4.30-5.30pm 818vph	7.2	1.4	0
Powell Rd, east of Pinga St	Nov 2021	-	6.30-7.30am 811vph	4.30-5.30pm 818vph	7.2	1.4	0
Powell Rd, east of Link Rd	Nov 2021	-	6.15-7.15am 253vph	4.30-5.30pm 201vph	9.4	1.8	0
Link Rd	Nov 2021	-	6.15-7.15am 556vph	4.30-5.30pm 612vph	6.3	1.3	0
Great Northern Hwy, west of Pinga St	Nov 2021	-	7-8am 318vph	4.30-5.30pm 393vph	6.5	1.3	19.9
Great Northern Hwy, east of Pinga St	Nov 2021	-	7-8am 296vph	4.30-5.30pm 334vph	7.9	2.4	11.6
Main Roads Traffic Map							
Great Northern Hwy, East of Utah Point Road	2017/18	3,082	5.15-6.15am 230vph	4.45-5.45pm 215vph	8.0	2.2	23.4
Powell Rd, west of Pinga St	2019/20	2,075	11.30-12.30am 154vph	4.15-5.15pm 177vph	10.7	1.7	0.1
Link Rd, south of Powell Rd	2019/20	3,283	6.15-7.15am 313vph	4.30-5.30pm 307vph	17.6	1.0	0
Wallwork Road, south of Pinga St	2019/20	11,472	7.30-8.30am 973vph	4.30-5.30pm 1,093vph	3.7	0.8	0

The existing traffic counts on the surrounding road network held by the Town of Port Hedland indicated that the peak hour traffic volumes are approximately 8% of the daily traffic flows. Additionally, Austroad classes 3-5 typically represent 10-40% of traffic flows, with classes 6-9 representing up to 6% of traffic flows with classes 10-12, RAV vehicles being up to 20% of daily traffic volumes.

The local road network typically only carries less than 1,700 vehicles per day which is within the anticipated range of up to 3,000 vehicles per day for this category of road.

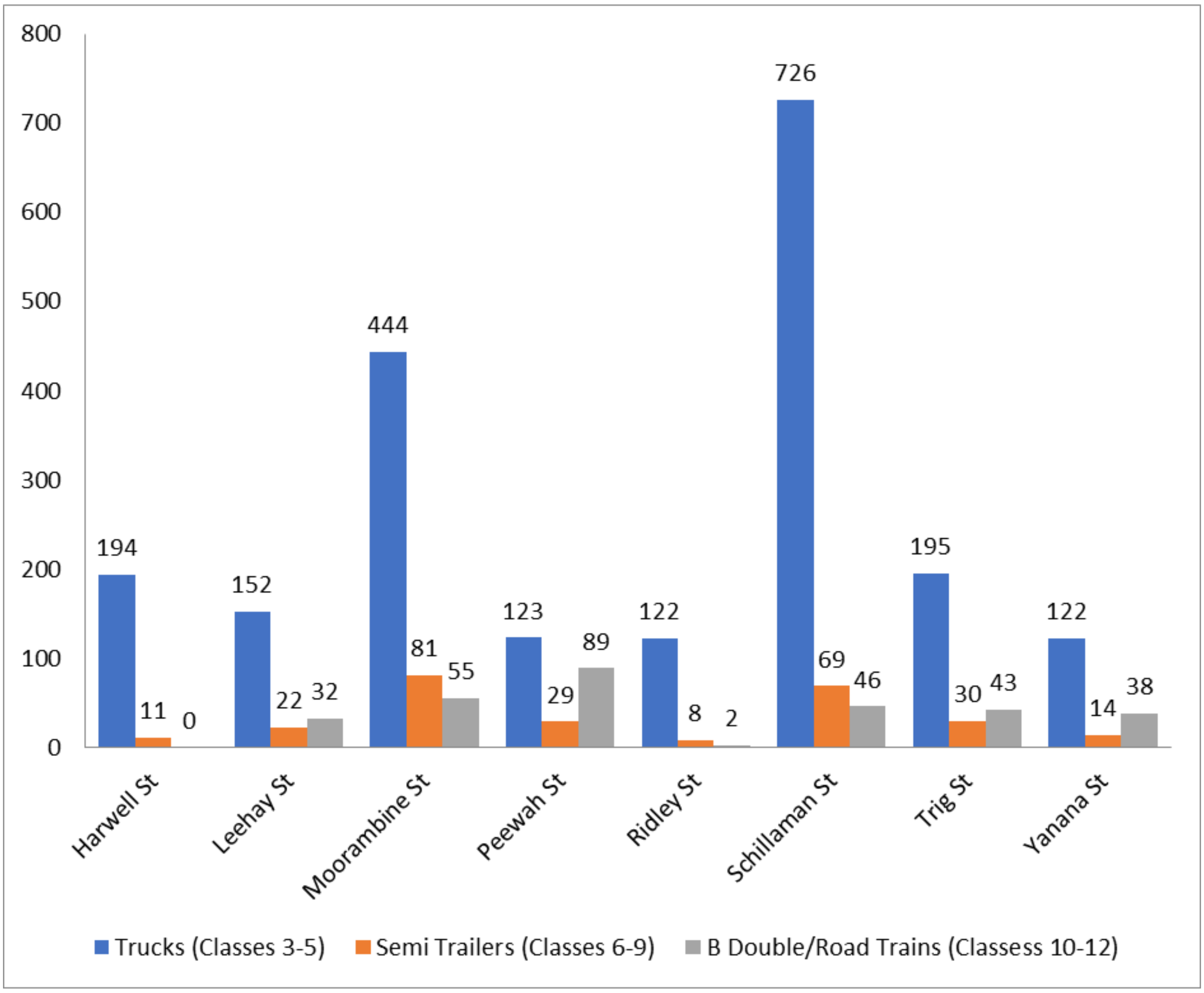


Figure 3.9. Existing Daily Heavy Vehicles on the Surrounding Road Network
(source Town of Port Hedland Counts)

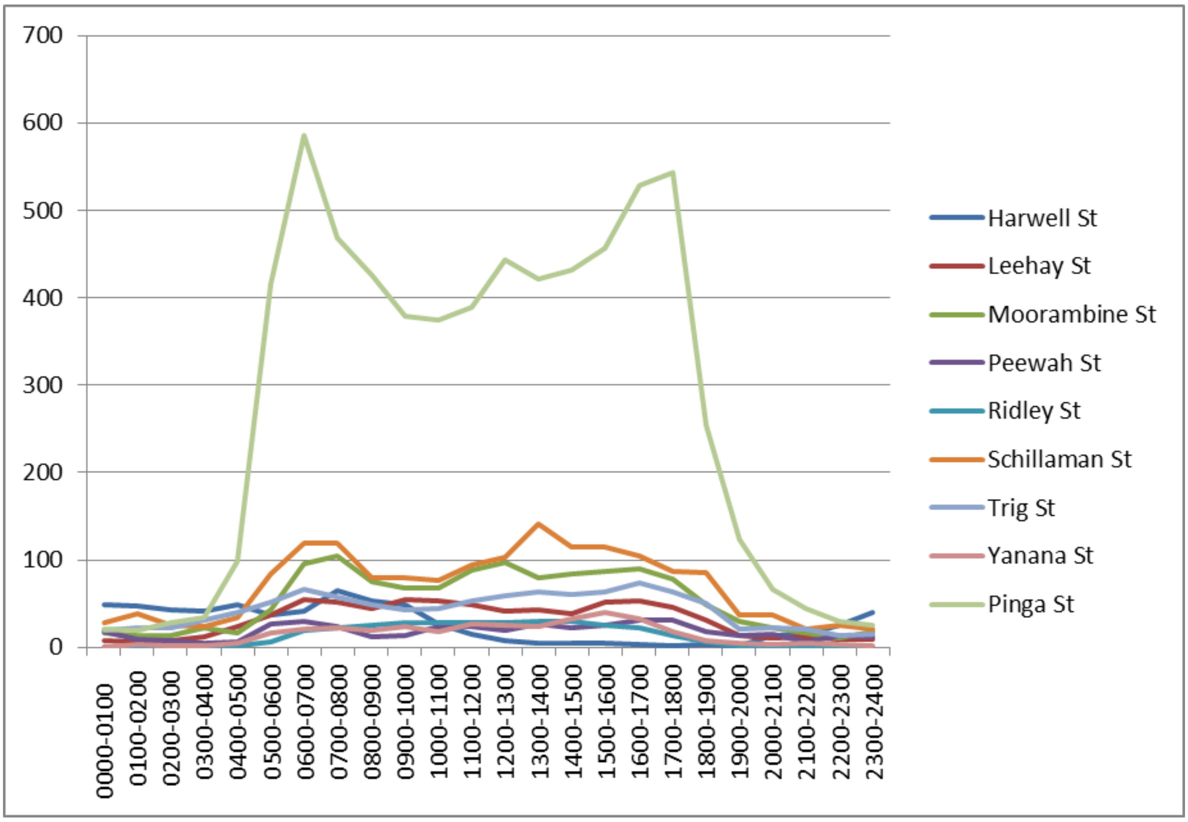


Figure 3.10. Existing Hourly Traffic Flow on the Surrounding Road Network
(source Town of Port Hedland Counts)

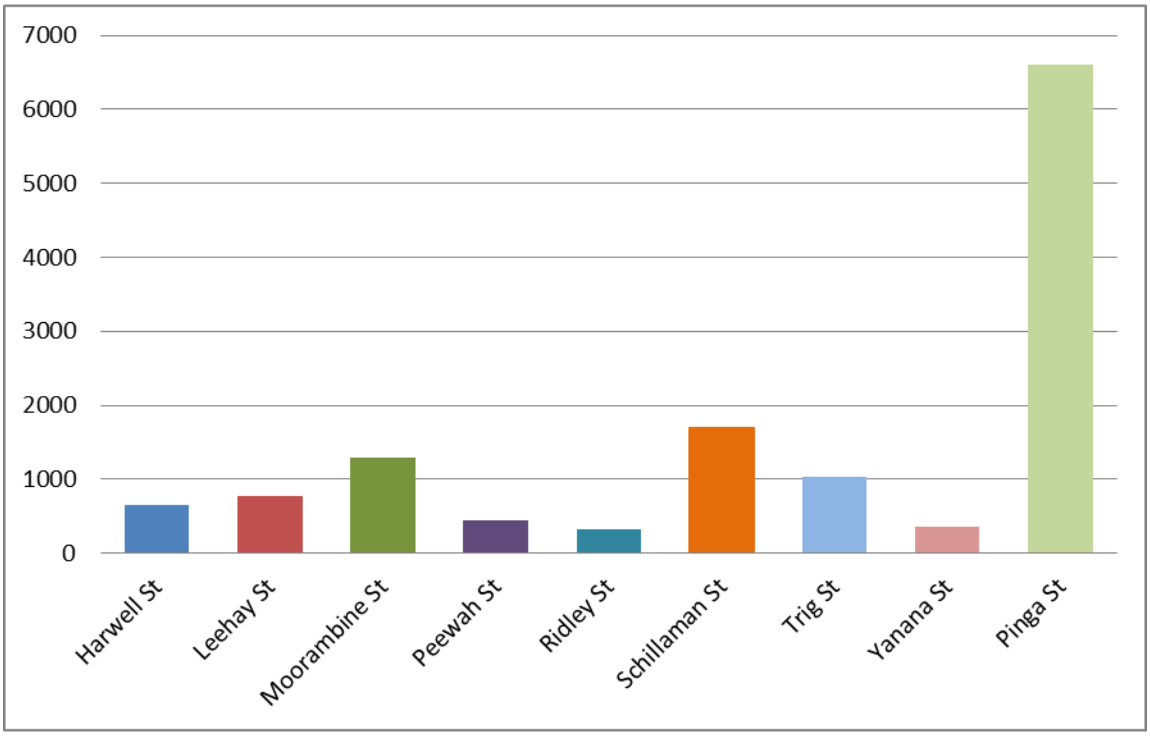


Figure 3.11. Existing Daily Traffic Flow on the Surrounding Road Network
(source Town of Port Hedland Counts)

3.4 Crash History

A study of the recent crash history for Wedgefield Industrial Estate and its immediate surrounds has been conducted for the five year period to the end of December 2020 from the Main Roads Western Australia Integrated Road Information System (IRIS) crash database. A total of 26 crashes have occurred as shown in **Figure 3.12** and summarised in **Table 3.2**. The database records the following crashes:

Table 3.2: Recorded Crashes within Wedgefield Industrial Estate

		Crash Severity			
Crash Nature	**Total**	**Hospital**	**Medical**	**PDO Major**	**PDO Minor**
Right Angle	16	1	1	13	1
Right Turn Thru	1	1	-	-	-
Rear End	3		1	2	-
Hit Object	5	2	-	1	2
Non Collision	1	-	-	1	-
Total	**26**	**4**	**2**	**3**	**19**
Road User Type					
Car	11	3	1	6	1
Station Wagon	3	-	-	2	1
Truck + 1 Trailer	1	-	-	1	-
Prime Mover + 1 Trailer	2	-	-	2	-
Road Train	6	-	1	4	1
4WD	2	-	1	1	-
Utility	11	1	-	10	-
Truck	5	-	1	4	-
Bus	1	-	-	1	-
Motorcycle	2	2	-	-	-
Total	**44**	**6**	**4**	**31**	**3**

Eight of these crashes have occurred at the existing 4 way intersection of Moorabine Street and Pinga Street with one of these crashes resulting in medical attention. The majority of these crashes were designated as thru-thru intersection crashes suggesting that vehicles were travelling along Moorambine Street through Pinga Street and are not necessarily turning onto Pinga Street. Four of these crashes did involve road trains or a prime mover with a trailer.

Four intersection crashes occurred at Pinga Street and Powell Road. The closure of Powell Road at the railway line will decrease of the volume of through traffic along Powell Road at this location. Less through traffic at this location will also reduce the potential for conflict.

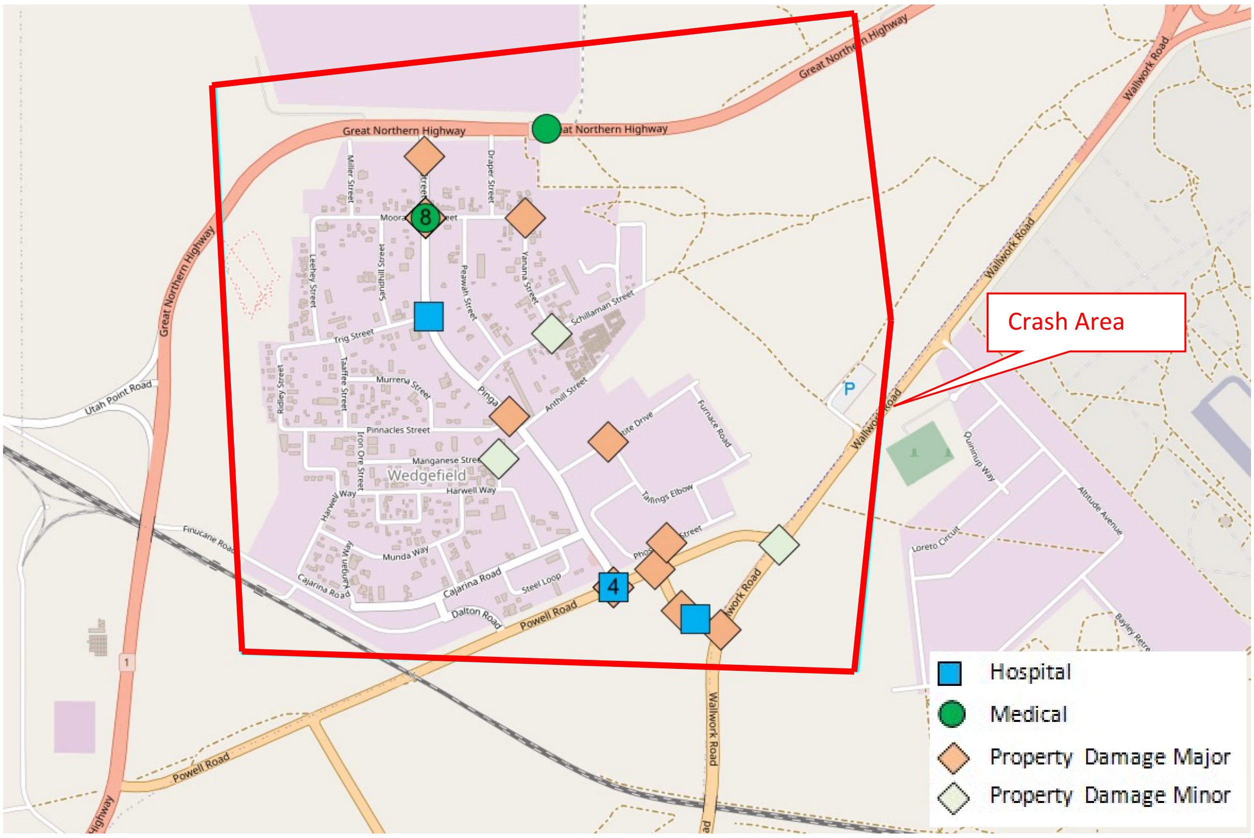


Figure 3.12. Location of Crashes in the vicinity of the Site

3.5 RAV Network

The Wedgefield Industrial Estate is generally designated for Restricted Access Vehicles (RAV) for standard RAV 10 and some roads more specifically for PBS Tri Drive Quad Axle Level 4B.3 as shown in **Figure 3.13a and 13.13b** respectively**.** Historically, the older sections of Wedgefield i.e. west of Pinga Street and north of Anthill Street were not designed specifically for RAV 10 vehicles meaning that numerous intersections and bends do not allow for RAV 10 vehicles to turn lane correct. The typical pavement widths are less than the industrial roads standard of 10m which is current practice. Regardless, the roads have generally been classified as RAV 10 which does create some safety issues.

The newer area of Wedgefield south of Anthill Street and east of Pinga Street has been designed to current industrial roads standards.

The Port Hedland "Heavy Vehicle Access Strategy" acknowledges the historic development of the Wedgefield Estate with respect to RAV 10 access. Over time within the older area of Wedgefield residential uses –such as caretaker units - were developed which has resulted in conflict between incompatible uses. In order to minimise the existing land use conflict further it has been recommended that the old part of Wedgefield be restored to a light industry zone with more intense industrial and transport activities be encouraged to settle in new purpose built expansion of Wedgefield. The following has been recommended within this report:

- Routes within the area west of Pinga Street should not be upgraded any further as the Town of Port Hedland will seek to remove roads in Wedgefield from the RAV 10 network as Transport Depot businesses relocate.
- The following roads east of Pinga Street should be considered for RAV 10 connections:
  - Moorambine Street – pending kerb amendment to allow lane correct left turn movements from Pinga Street
  - Schillaman Street – pending upgrade of the carriageway to a sealed width of 7.2m
  - Hematite Drive

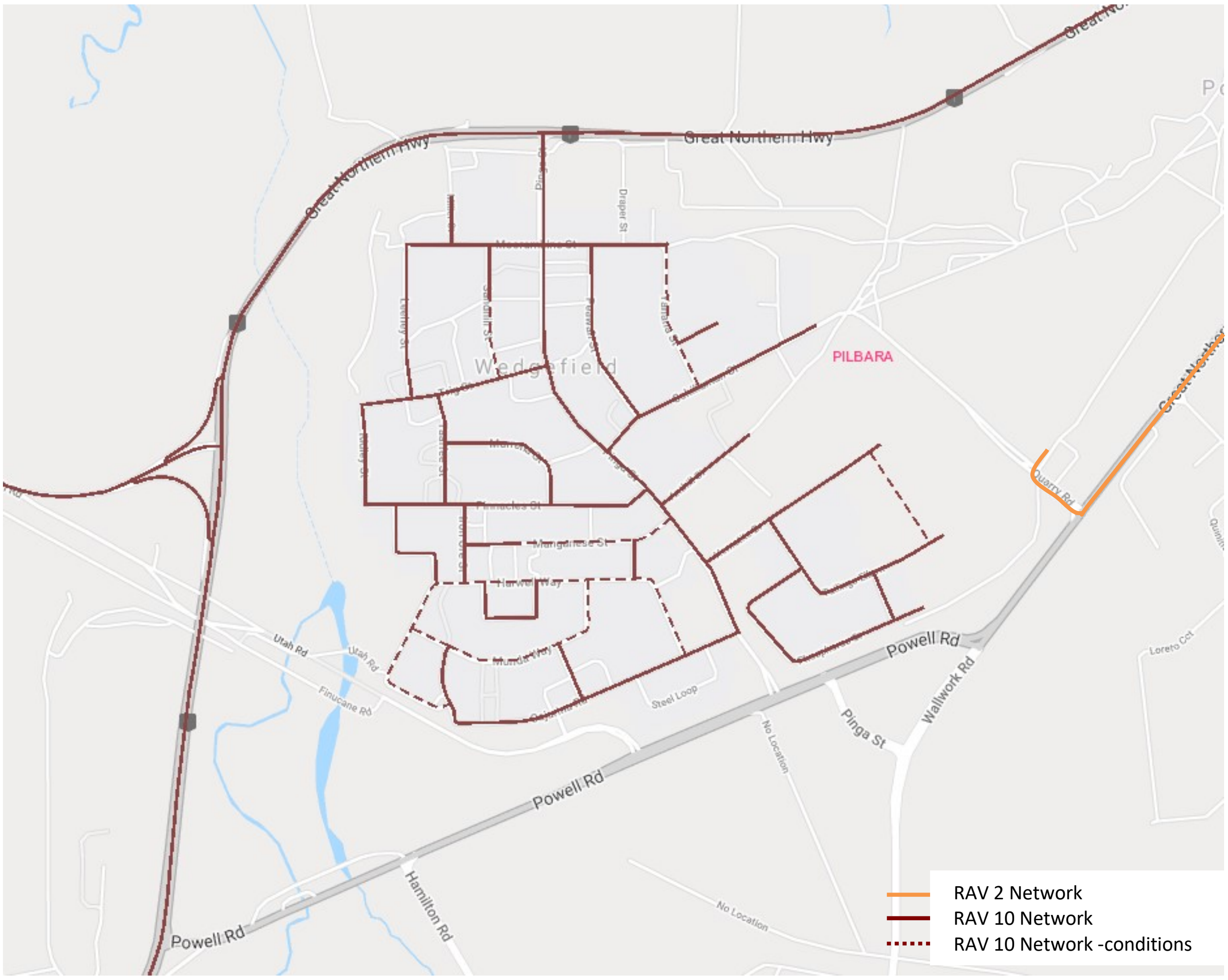


Figure 3.13a. RAV Network (MRWA)

Figure 3.13b. PBS Tri Drive Quad Axle 4B.3 Network (MRWA)

The proposed HJSP also proposes RAV design standards suitable for PBS Tri Drive Quad Axle 4B.3 Network.

Liaison with the Town of Port Hedland has indicated that their preference is for RAV access to the proposed industry land to the south of Powell Road to be via Cajarina Street and Dalton Street as shown in **Figure 3.14**. RAV (PBS Tri Drive Quad Axle) access to the triangular parcel of land bounded by Link Road, Powell Road and Wallwork Road is unlikely under the current road network layout.

Figure 3.14: Proposed RAV Access within Structure Plan

3.6 Public Transport

There are existing bus routes through the existing Wedgefield Estate as shown in **Figure 3.15.** Route 870 travels between South Hedland and Port Hedland via Wedgefield. There is an existing bus stop located on Pinga Street, near Schillaman Street. This bus stop is typically more than 800 metres or 10 minutes walking distance from the HJSP.

A special school service also travels through the old Wedgefield Industrial Estate with a number of bus stops along the route. (The creation of a bus route through the industrial estate is evident of the residential type uses within this industrial estate)

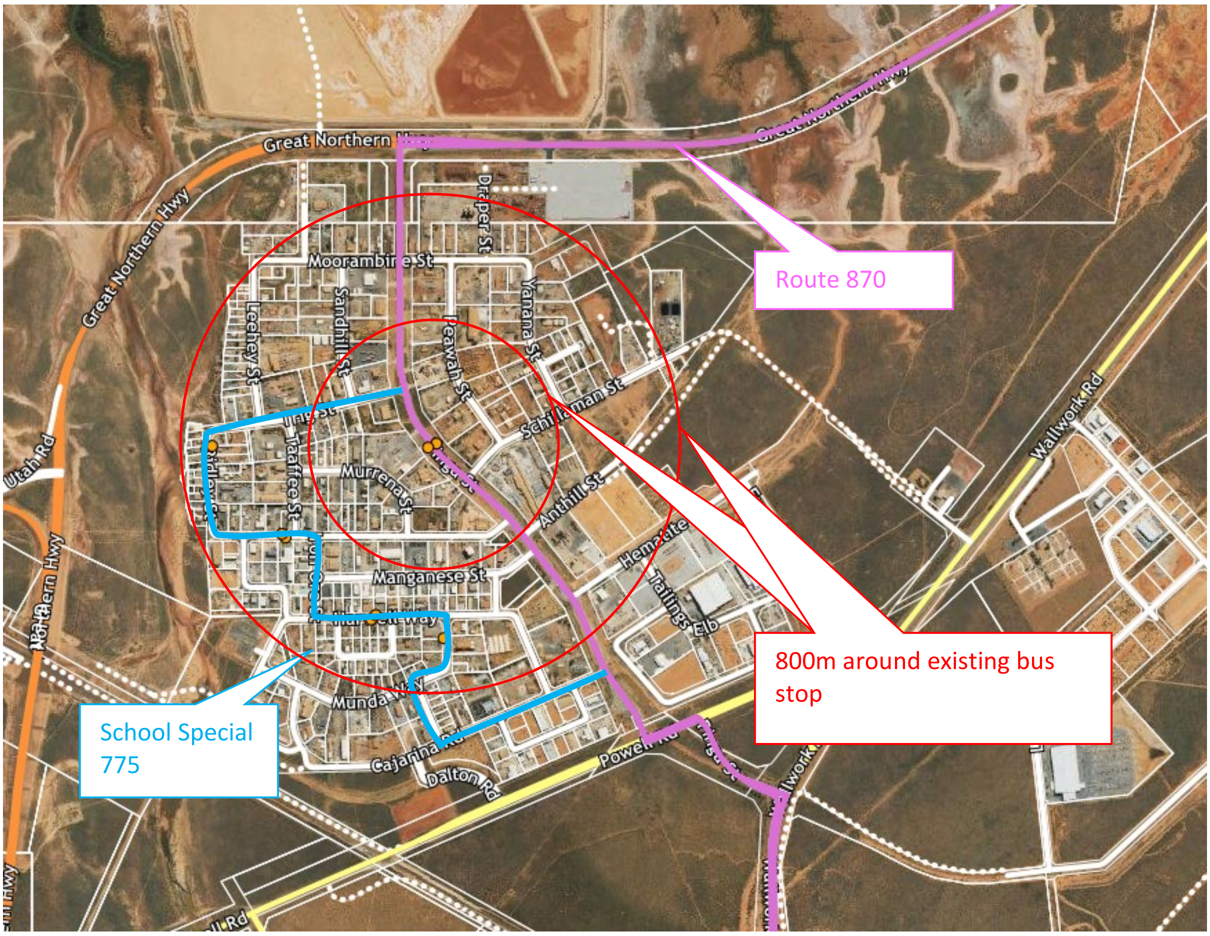


Figure 3.15: Existing Public Transport Routes Surrounding the Site (*PTA Network Maps)*

3.7 Pedestrian and Cyclist Network

At this stage there are no clear pedestrian desire lines within the Structure Plan. Historically, industrial estates do not always include footpaths as evident by the established areas of Wedgefield immediately to the west of Pinga Street and north of Hematite Drive. It is noted that Hematite Drive provides a path along its northern side. Similarly, the newer areas of Furnace Road, Tailings Elb, Alloy Way, Phosphorous St typically have a path on one side. The road reserve widths proposed are sufficient to accommodate a path network should the proposed land uses create a demand for pedestrian and cyclist facilities. A potential demand for footpaths may result should public transport be sufficiently available and used by staff into the HJSP.

The Pilbara 2050 Cycling Strategy (June 2021) outlines the proposed routes for the Town of Port Hedland. A key element of the Strategy is connecting Port Hedland and South Hedland with a primary high quality shared path. There is an existing path link between Redbank Bridge to South Hedland along Wallwork Road that passes the HJSP. This would also allow access to the HJSP. The Strategy proposes the upgrading the substandard section of Wallwork Road shared path between Pinga Street and Wedgefield Interchange to match the standard of the adjacent path sections.

The Strategy mentions the provision of local connections to employment generators including the Wedgefield. For this purpose the provision of a path network on at least one side of the road within the HJSP will provide opportunities for pedestrians and cyclists to use travel to/from this employment area in the future.

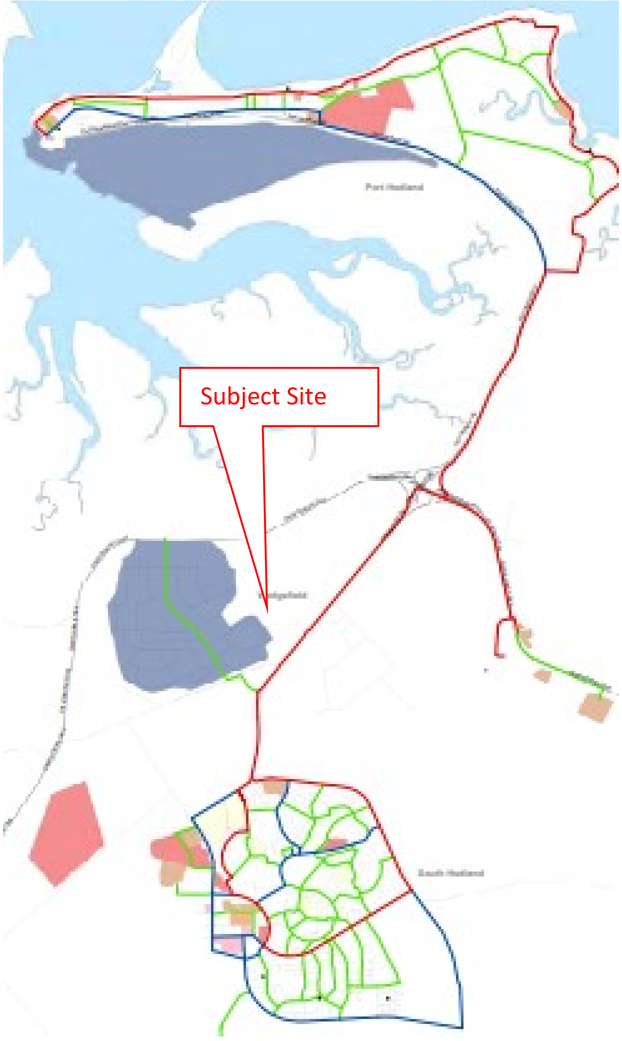
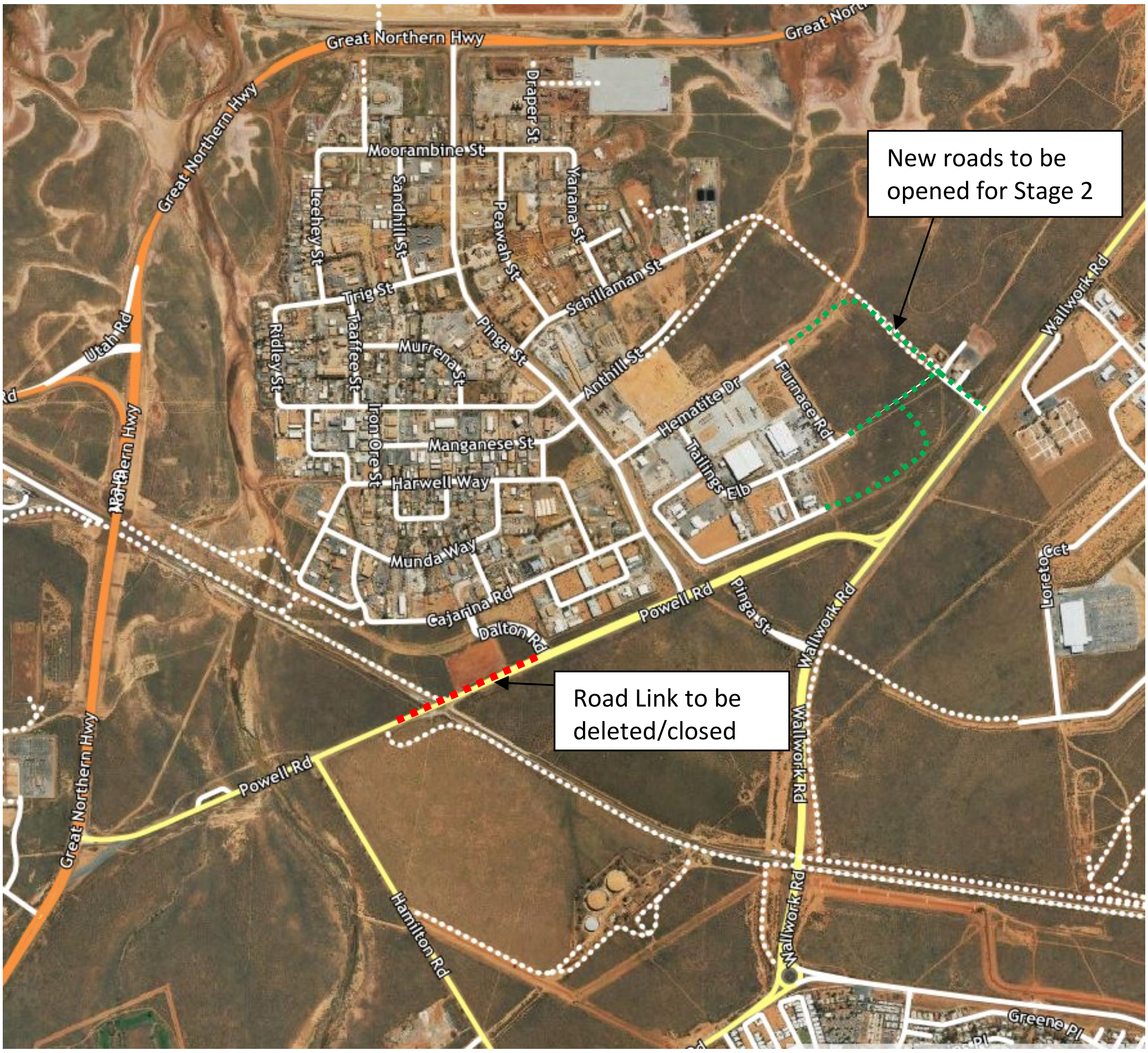


Figure 3.16: Cycling Network
(*Pilbara 2050 Cycling Strategy*

4.0 PROPOSED CHANGES TO THE EXTERNAL ROAD NETWORK

The Town of Port Hedland has recently closed Powell Road each side of the Rail Crossing. Powel Road (east) will end at a new roundabout to be constructed at Dalton Road and Powell Road.

Quarry Road extension into the Hedland Junction Estate from its intersection with Wallwork Road was recently completed allowing light vehicle traffic to access the Estate via this intersection.



New roads to be opened for Stage 2

Road Link to be deleted/closed

Figure 4.1: Current Road Network Modifications (Dec 2021)

5.0 ANALYSIS OF THE TRANSPORT NETWORK

5.1 Assessment Year

The various stages of the Hedland Junction Structure Plan are likely to be developed over various timeframes between 2026 and 2029. The opening scenarios are assumed to occur in 2026 with 2039 considered to represent the 10 year post development timeframe should development commence later (i.e. 2029).

5.2 Traffic Generation

The trip generation of land uses within Industrial Estates can vary depending on the industry type (low to high traffic generators) and the subsequent number of employees. Typically trip rates are based on Gross Floor Area (GFA) of buildings. The use of GFA to estimate trip generation for Hedland Junction may not be accurate as the plot ratio to estimate GFA for general industry land use can vary significantly as evident from aerial imagery where some existing sites have no GFA and some have a large GFA. On this basis site area is anticipated to more accurately reflect trip generation for HJSP due to be nature of these industrial sites.

The existing trip generation for the existing properties that use Hematite Drive was estimated from traffic surveys as this area forms a distinct cell with all traffic entering and exiting Hematite Drive (refer **Figure 5.1**). The exception to this is the existing lot on the corner of Hematite Drive/Anthill Street/Pinga St where vehicles can exit from Anthill Street. Ignoring this lot results in a robust trip generation rate. During the am peak hour a total of 153 trips were recorded using Hematite Drive with 113 using it during the pm peak hour. This Hematite Drive cell currently comprises of a total developable area of 23 hectares with approximately 18 hectares currently developed. This equates to a trip rate of 7.65 and 5.65 trips per hectare in the am and pm peak hours respectively.

Pinga Street at Great Northern Highway and Pinga Street at Powell Road together accommodate approximately 1,152 and 1,189 vehicles entering and exiting Pinga Street during the am and pm peak hours respectively. This translates to an approximate trip generation rate of 6.6 to 6.8 trips per hectare based on existing development over approximately 175 hectares.

To ensure a robust assessment the highest observed peak hour trip rate from the Hematite Drive precinct of 7.65 trips per hectare for both the am and pm peak hours has been adopted for the subsequent analysis.

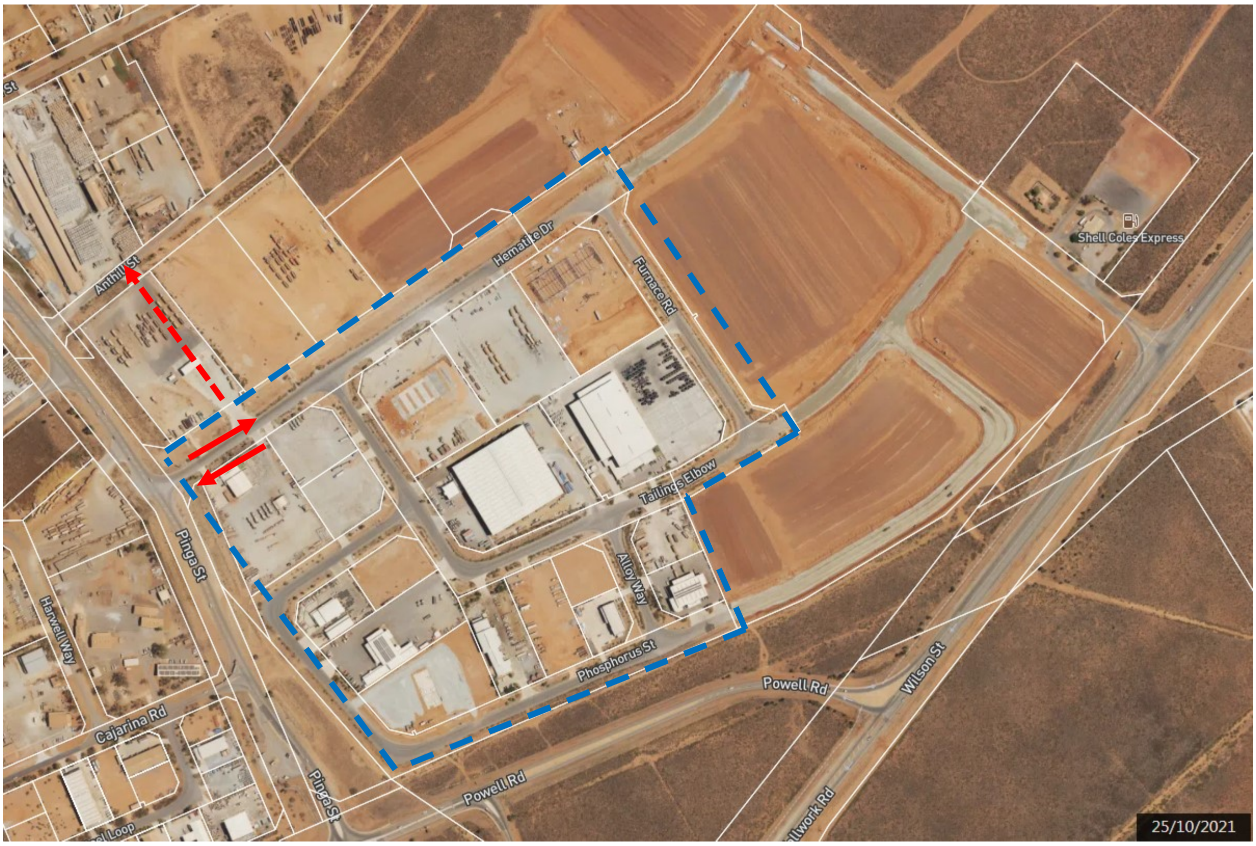


Figure 5.1: Hematite Drive Precinct

Based on existing traffic counts the am and pm peak hours on average equate to approximately 8% of the daily traffic on the local road network. On this basis the daily trip generation can be estimated by 96 trips/hectare.

Table 5.1 summarises the trip generation of the various lot stages. In total the HJSP as shown is estimated to generate in the order of 14,834 daily trips and that corresponds to approximately 1,182 peak hour trips.

Table 5.1 - Estimated Trip Generation

Stage	**Site Area (hectares)**	**Trip Generation**		
		Daily	**Am Peak**	**Pm Peak**
		veh/day	veh/hr	veh/hr
Stage 2 – Roads built but lots not subdivided	*18.5287*	*1,779*	*142*	*142*
Stage 3	9.4352	906	72	72
Stage 4	29.5303	2,835	226	226
Stage 5 - Balance of lots north of Powell Rd	48.9501	3,741	374	374
South of Powell Rd	48.0832	4,699	368	368
Total	***154.5275***	***14,834***	***1,182***	***1,182***

As previously outlined the stages and lots adopted are indicative only to provide a framework for the traffic assessment. The actual lots developed may vary. Since trip generation is based on developable area, lots within close proximity using the same road network are interchangeable with the key outcomes of the traffic assessment remaining valid.

5.3 Traffic Distribution

The proposed HJSP will become a major employment attractor for the two main residential suburbs of Port Hedland and South Hedland. The traffic distribution patterns take into account the likely workforce catchment area, the surrounding residential areas including the potential areas for growth as well as the road network, existing trip distribution patterns and existing inbound/outbound patterns of Wedgefield as currently developed. The resulting trip distribution patterns have subsequently been estimated as shown in **Table 5.2.**

Table 5.2- Estimated Trip Distribution Patterns

Approach/Departure Routes	Approach Patterns (Inbound)			Departure Patterns (Outbound)		
	Am	Pm	Daily	Am	Pm	Daily
Great Northern Highway - west	12%	11%	12%	9%	8%	8%
Great Northern Highway - east	12%	6%	9%	6%	12%	9%
Wallwork Road - west	30%	11%	21%	11%	35%	23%
Wallwork Road - east	13%	5%	8%	7%	12%	10%
	67%	33%	50%	33%	67%	50%

The indicative daily and peak hour traffic flows and the anticipated approach and departure routes are shown in **Table 5.3.**

Table 5.3 - Estimated Trip Generation with inbound and outbound splits

Approach /Departure Route	Daily	Am Peak			Pm Peak		
		Total	In	Out	Total	In	Out
Stage 2							
Great Northern Highway - west	356	30	17	13	27	16	11
Great Northern Highway - east	320	26	17	9	26	9	17
Wallwork Road - west	783	58	43	16	65	16	50
Wallwork Road - east	320	28	18	10	24	7	17
Sub-total	1,779	142	95	47	142	47	95
Stage 3							
Great Northern Highway - west	181	15	9	6	14	8	6
Great Northern Highway - east	163	13	9	4	13	4	9
Wallwork Road - west	399	30	22	8	33	8	25
Wallwork Road - east	163	14	9	5	12	4	9
Sub-total	906	72	48	24	72	24	48
Stage 4							
Great Northern Highway - west	569	47	27	20	43	25	18
Great Northern Highway - east	510	41	27	14	41	14	27
Wallwork Road - west	1,247	93	68	25	104	25	79
Wallwork Road - east	510	45	29	16	38	11	27
Sub-total	2,835	226	151	75	226	75	151
Stage 5							
Great Northern Highway - west	940	79	45	34	71	41	30
Great Northern Highway - east	846	67	45	22	67	22	45
Wallwork Road - west	2,068	154	112	41	172	41	131
Wallwork Road - east	846	75	49	26	64	19	45
Sub-total	4,699	374	251	124	374	124	251
South of Powell Rd							
Great Northern Highway - west	923	77	44	33	70	40	29
Great Northern Highway - east	831	66	44	22	66	22	44
Wallwork Road - west	2,031	151	110	40	169	40	129
Wallwork Road - east	831	74	48	26	63	18	44
Sub-total	4,616	368	246	121	368	121	246
Ultimate – Full Development							
Great Northern Highway - west	1,780	248	142	106	225	130	95
Great Northern Highway - east	1,335	213	142	71	213	71	142
Wallwork Road - west	3,115	485	355	130	544	130	414
Wallwork Road - east	1,187	236	154	83	201	59	142
Total	**14,835**	**1,182**	**792**	**390**	**1,182**	**390**	**792**

5.4 Design Traffic Flows

Design traffic flows for the ultimate development traffic of the HJSP based on the ultimate road network are shown in **Figure 5.2** (excludes existing traffic).

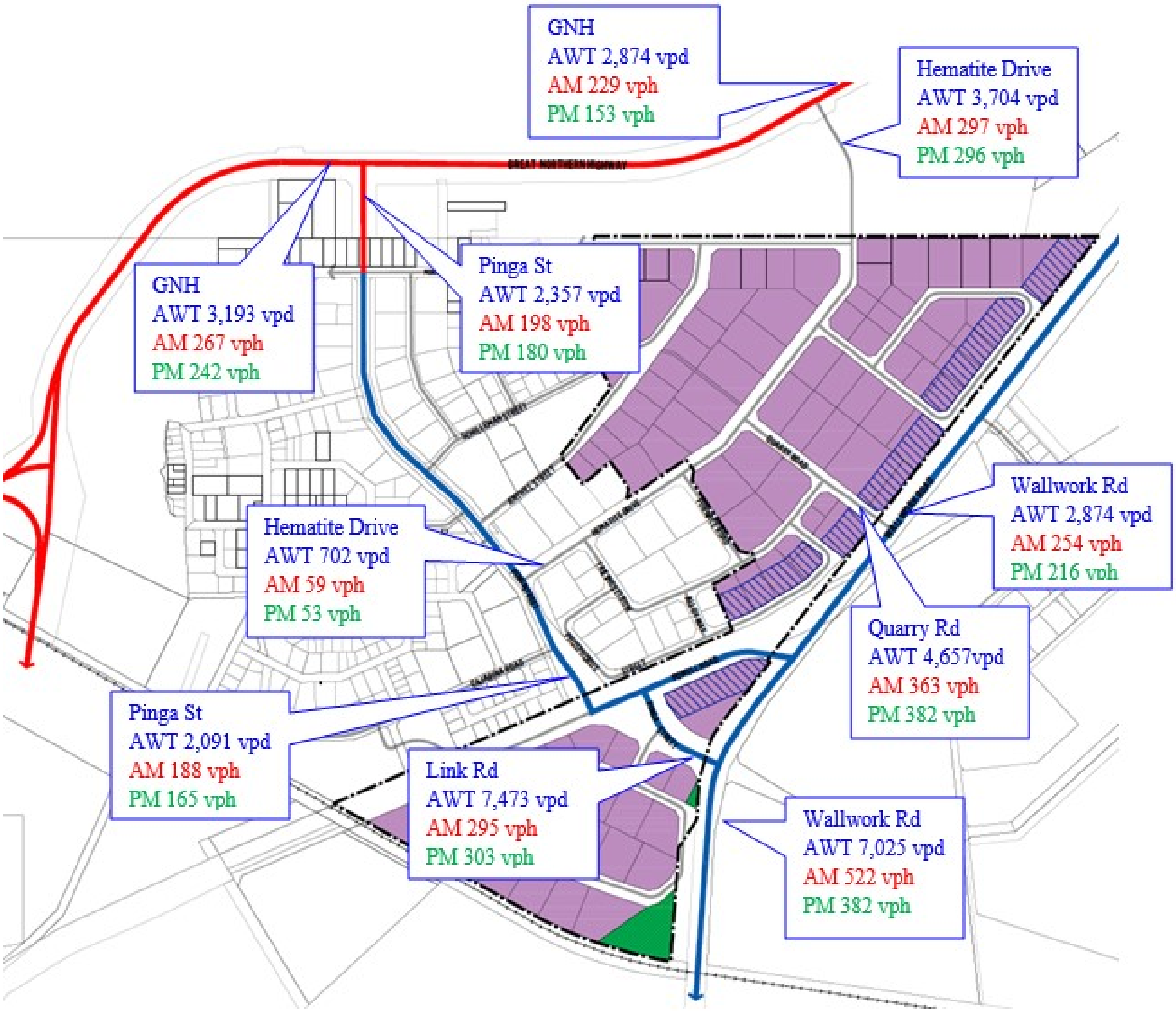


Figure 5.2: Design Traffic Flows – Ultimate Development Traffic Only
(*excludes existing traffic)*

The HJSP is likely to be constructed in a number of stages. For this reason a number of scenarios have been modelled to reflect the corresponding trip generation and distribution based on an assumed road network layout. These scenarios are as follows:

- Scenario 1
  - Existing December 2021 traffic volumes
  - no Quarry Road connection between Hematite Drive and Wallwork Road
  - Powell Road temporarily closed at Pinga Street

- Scenario 2
  – Existing 2022
  – existing traffic redistributed with Quarry Road connection and Powell Road connection to Dalton Road reinstated

- Scenario 3
  – 2026 without new Great Northern Highway connection
  - Stages 2, 3, 4 (includes other light industry near Moorambine Rd)

- Scenario 4
  – 2026 with new Great Northern Highway connection
  - Stages 2, 3, 4 (includes other light industry near Moorambine Rd)

- Scenario 5
  – 2026 Opening for Stages 2,3,4, area south of Powell Road with new Great Northern Highway connection

- Scenario 6
  – 2039 Ultimate Development – Stages 2,3,4,5 and south of Powell Road

Historic traffic count data indicates that Great Northern Highway, west of Port Hedland Road has experienced an annual average growth rate of 5% per annum between 2016 and 2019. Similarly, Wilson Street, south of Cook Point Road has experienced a 2.5% per annum growth over the same 3 year period.

A review of the ABS population projections for the Town of Port Hedland predicts growth is in the order of 3.71%, 3.60% and 3.35% per annum over the 5 year periods to 2031, 2036 and 2041. This data suggests that the above annual growth factors for traffic are appropriate to apply into the future.

The subsequent peak hour traffic flows for the various scenarios including the aforementioned traffic growth along Great Northern Highway and Wallwork Road are as shown in **Figures 5.3 to 5.9.**

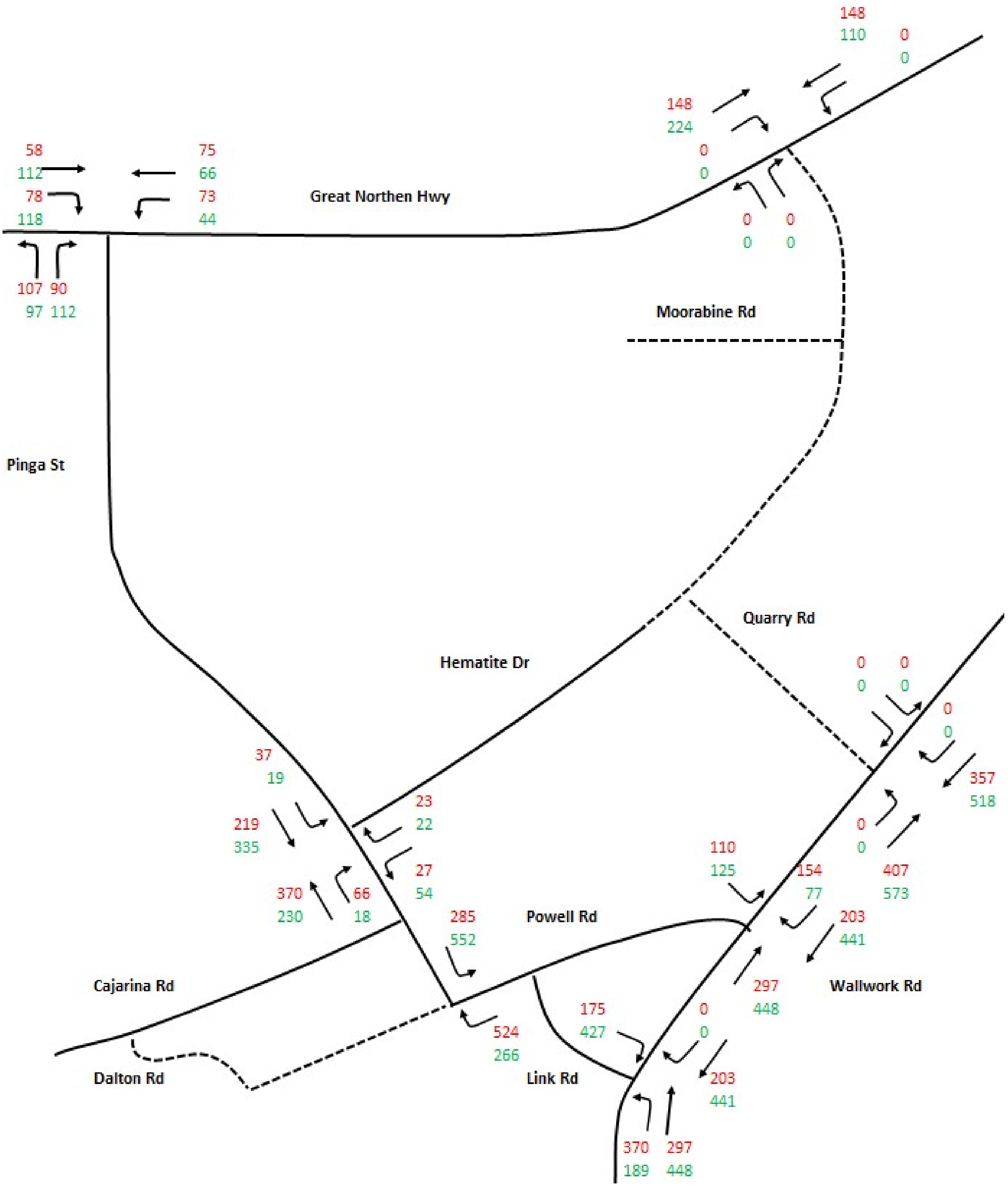


Figure 5.3: Scenario 1 - Existing Peak Hour Traffic Flows (2021)

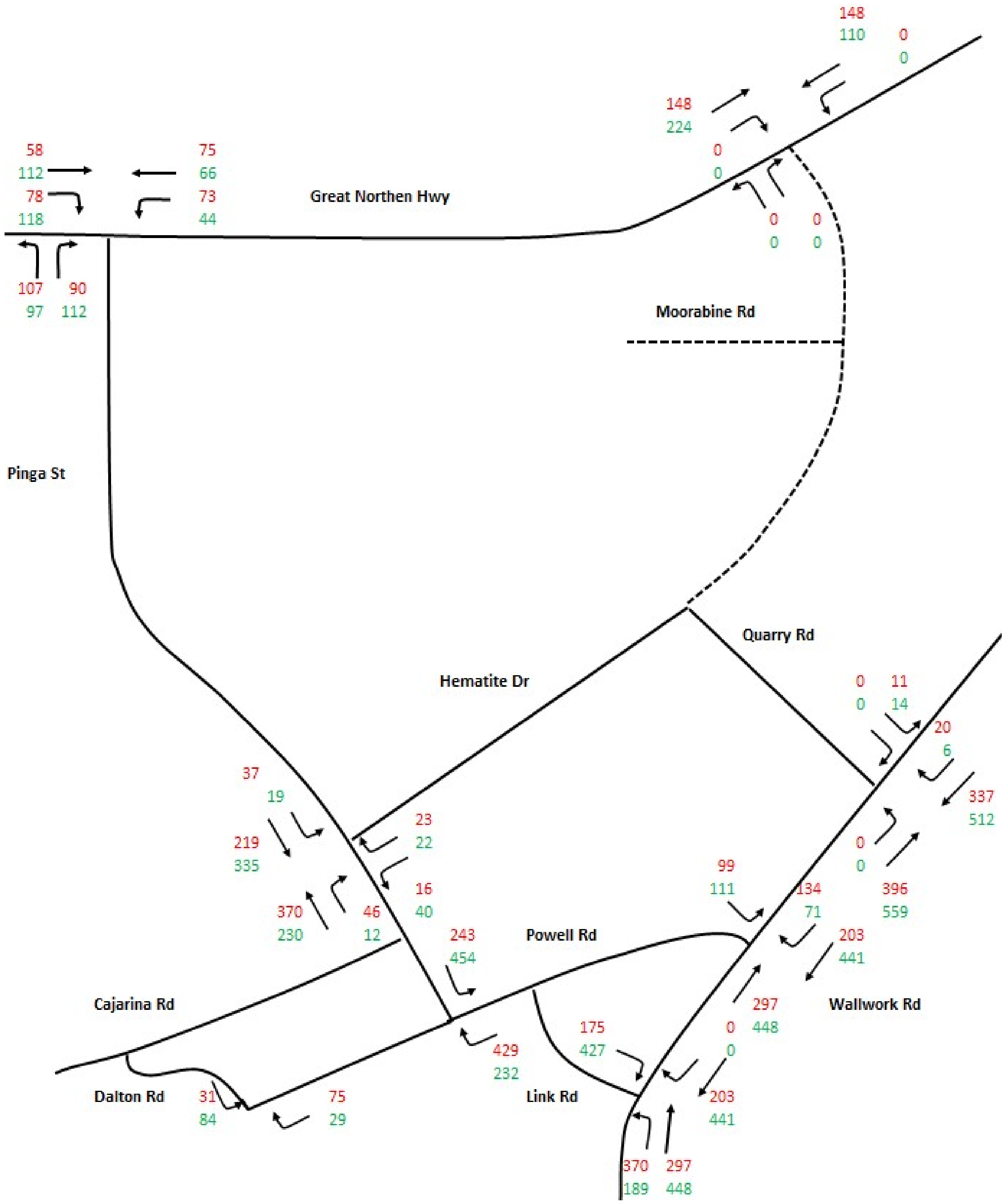


Figure 5.4: Scenario 2 - 2022 Peak Hour Traffic Flows with Quarry Rd and Powell Rd connected

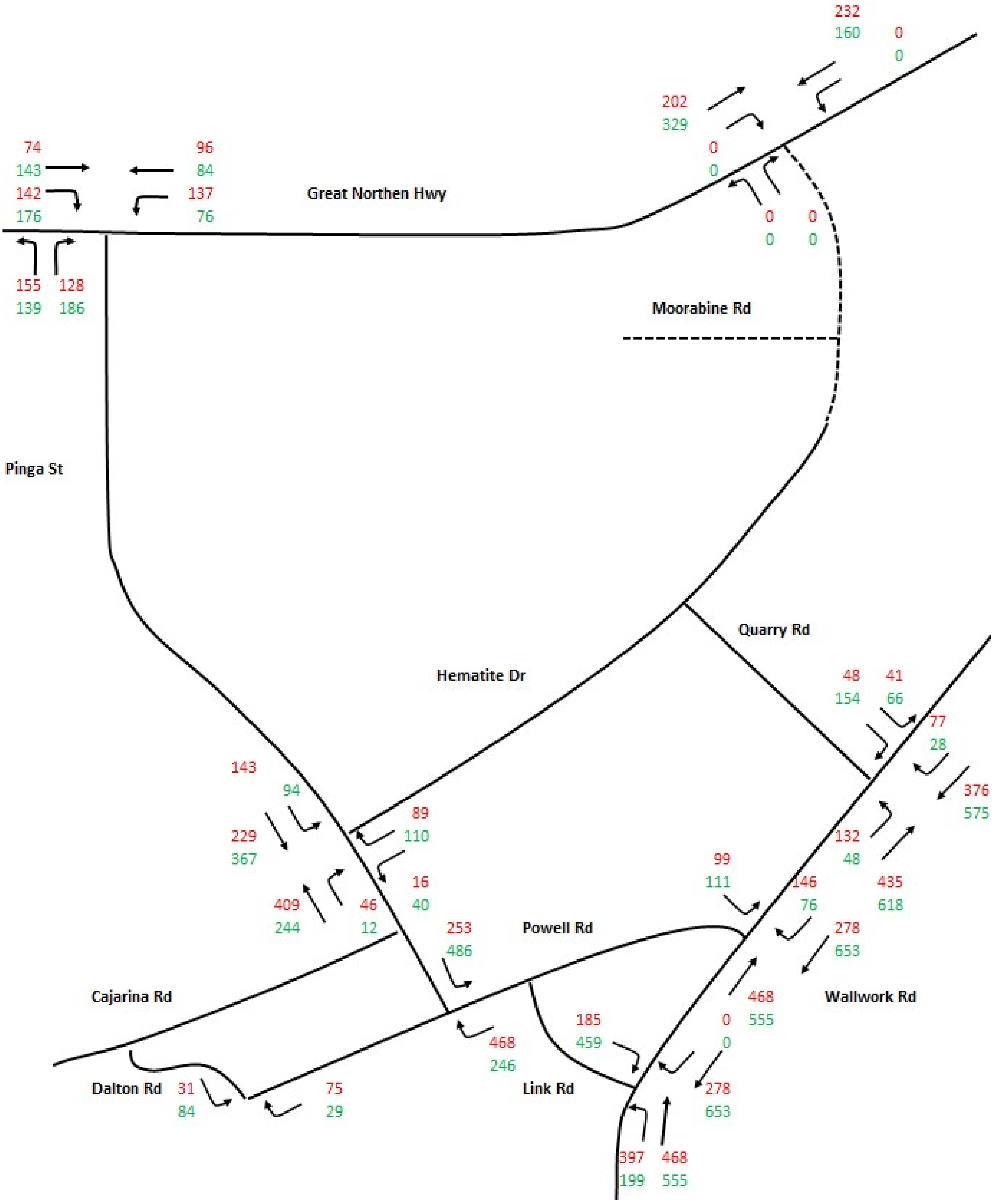


Figure 5.5: Scenario 3 – 2026, Stages 2,3,4 without GNH Connection

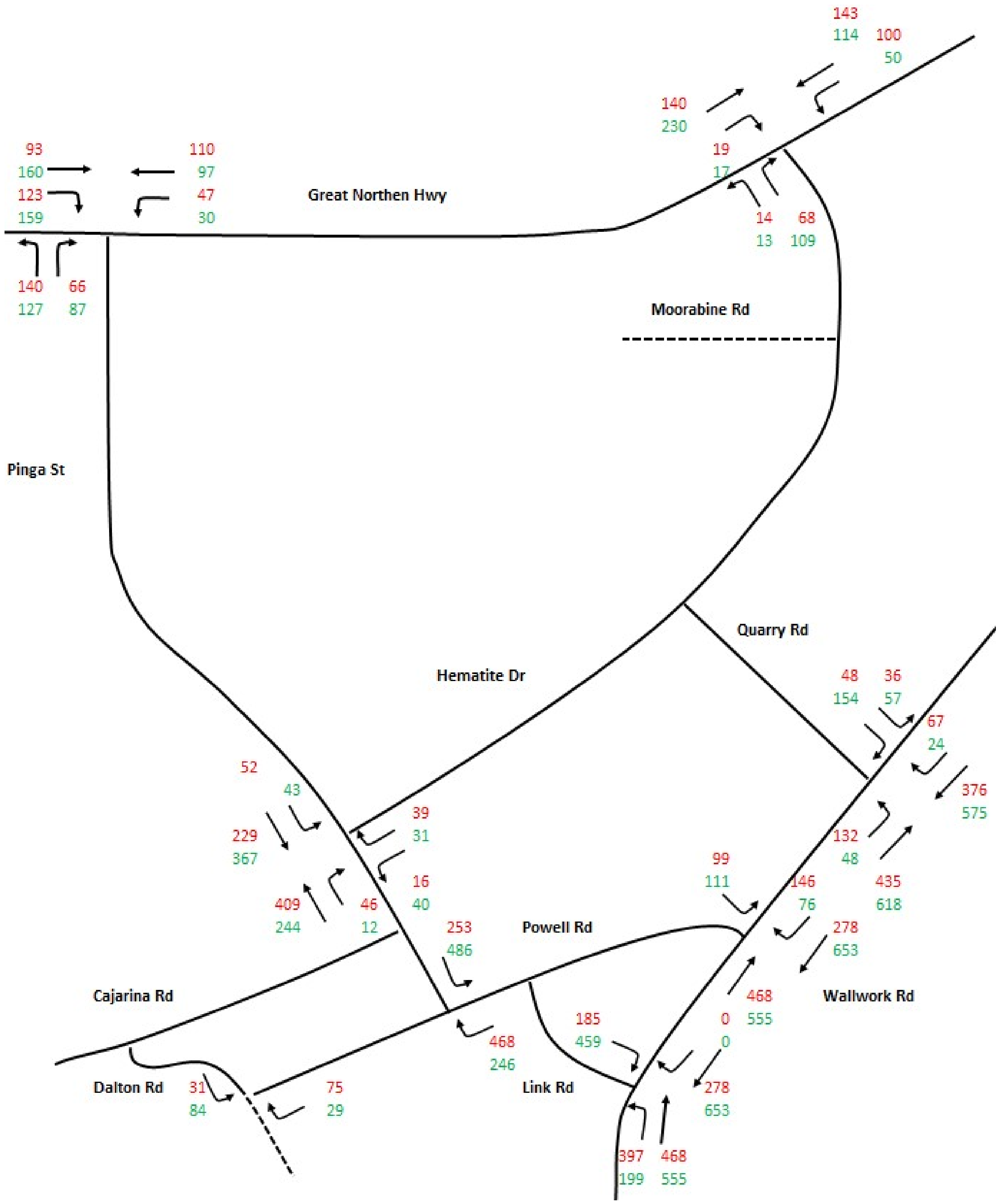


Figure 5.6: Scenario 4 – 2026, Stages 2,3,4 with GNH Connection

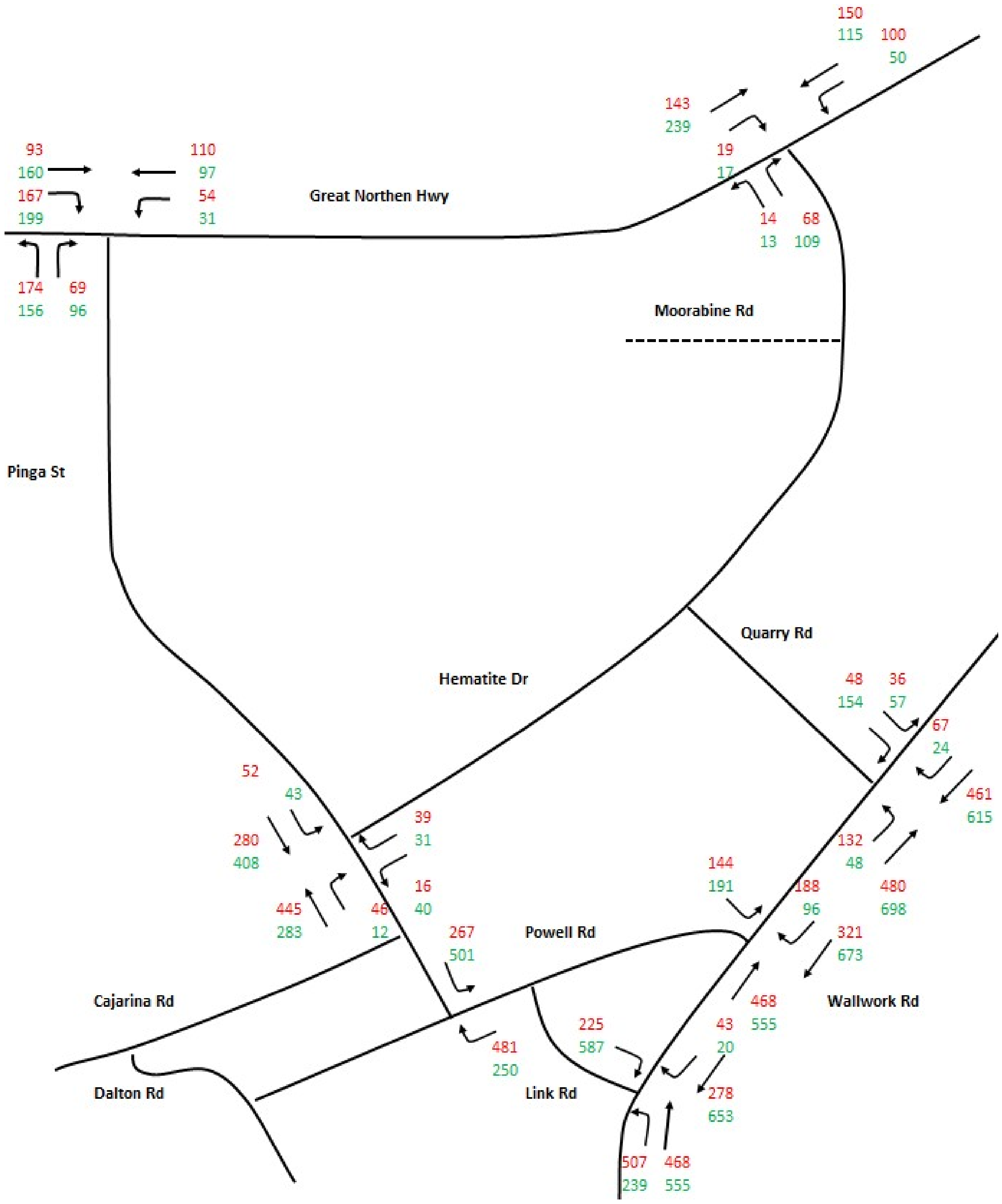


Figure 5.7: Scenario 5 – 2026, Stages 2,3,4 and south of Powell Rd with GNH Connection

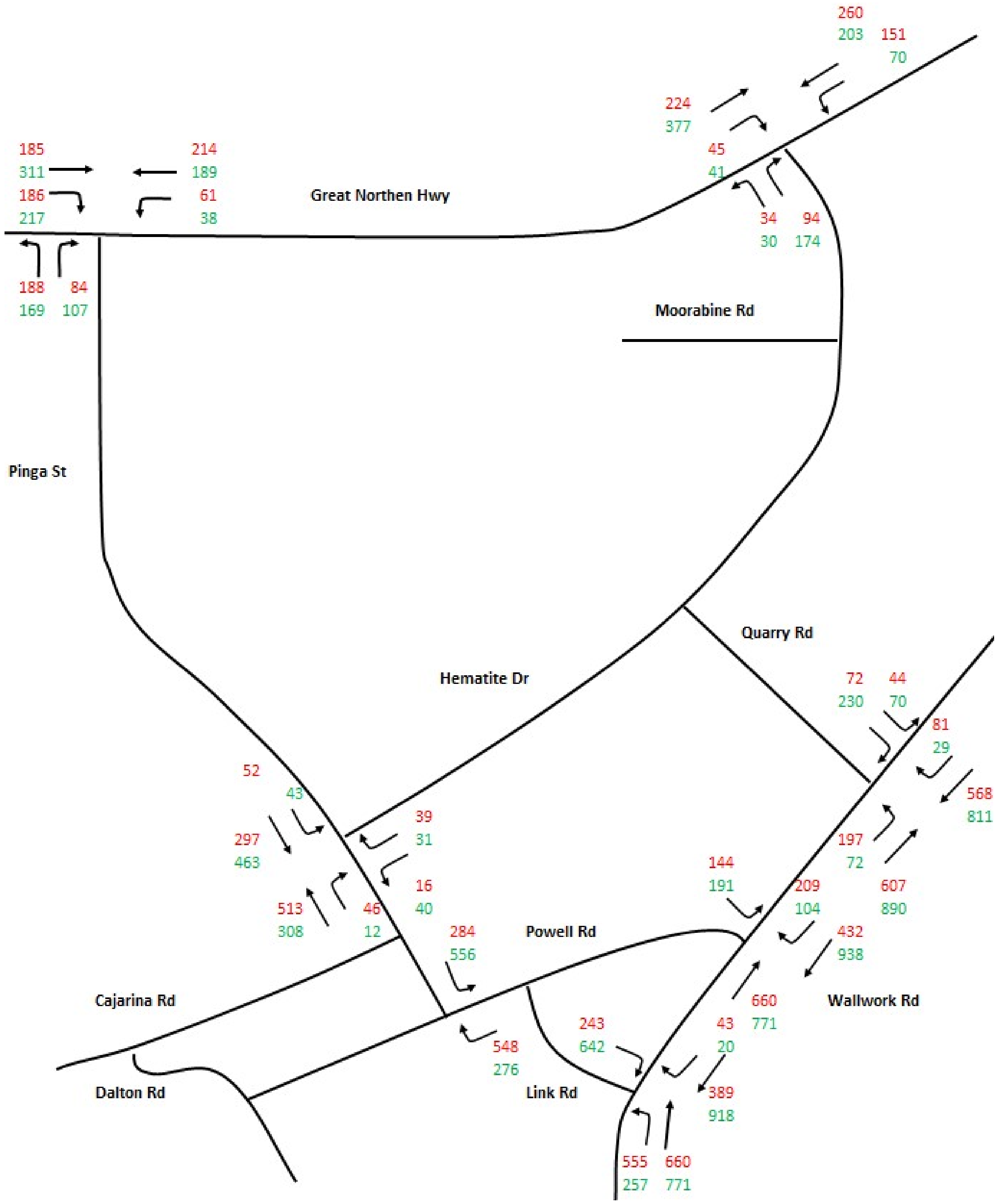


Figure 5.8: Scenario 6 – 2039, Ultimate Development and Road Network

5.5 Intersection Analysis

Key intersections were analysed using the SIDRA Intersections traffic modelling computer package (*version 9*). These included:

- Great Northern Highway and Pinga Street;
- Great Northern Highway and Hematite Road extension (new connection);
- Pinga Street and Schillaman Street;
- Pinga Street and Hematite Drive;
- Pinga Street and Cajarina Road;
- Pinga Street and Powell Road;
- Hematite Drive and Quarry Road and
- Wallwork Road and Quarry Road.

SIDRA is an intersection modelling tool used by traffic engineers for analysing all types of intersections. The key SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. Those characteristics are defined as follows:

Degree of Saturation (DOS): is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for extremely low traffic flow up to one for saturated flow or at capacity. For unsignalised intersection a degree of saturation of 0.8 or less is acceptable.

Level of Service (LOS): is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of services, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst . In this instance it is important to note that the average delays are typically higher due to the percentage of heavy vehicles using the intersections and the greater gaps and times these vehicles require to clear an intersection.

Average Delay: is the average of all travel time delays for vehicles through the intersection.

95% Queue: is the queue length below which 95% of all observed queue lengths fall.

SIDRA results are summarised in **Table 5.5** with detailed output provided in **Appendix C.**

The SIDRA model makes allowance for heavy vehicles with the gap acceptance factor and opposing vehicle factor for various classes in accordance with MRWA operational modelling guidelines. A robust approach has been used for the SIDRA analysis with a factor of 4.5 adopted for Class 12 vehicles (i.e. triple and quad vehicles) where the guidelines indicate a potential range of 2.5-.4.5 can be used.

Scenario 1 – Existing 2021

All the existing intersections have been modelled based on their current geometric layout. The analysis indicates that all intersections operate satisfactorily as summarised in **Table 5.4a**. The intersection of Hematite Drive currently is designed without a designated right turn pocket on Pinga Street. There is a painted median approximately 4.0m wide. Observations of the video survey indicates that some vehicles do use the painted median as a pocket which allows traffic to pass a stopped vehicle however not all vehicles. Vehicles are also able to pass a stopped right turning vehicle due to the heavy vehicle apron supplied for turning movements of heavy vehicles. (Refer **Figure 5.9)**. For this reason the intersection was modelled both with and without a right turn pocket to reflect the existing conditions. It was noted that the intersection operates at a lower LOS with the right turn pocket for example having the worst LOS of F (i.e 51 second average delay for the right turn from Hematite Drive). With no right turn pocket the worst LOS is D (i.e. an average delay of 29 seconds). This is likely attributed to the fact that right turning traffic from Pinga Street within the through lane in the SIDRA model would slow through traffic hence creating an opportunity for vehicles to turn right from Hematite Drive into Pinga Street. In both scenarios the DOS indicates there is additional capacity for increased traffic at present.

Figure 5.9: Pinga St and Hematite Dr - allows right turning movement to store clear of through traffic

Table 5.5a –SIDRA analysis for Scenario 1 – Existing 2021

	Am Peak				Pm Peak			
	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)
Pinga St and GNH - Staged	0.201	B	14	12	0.196	B	12	12
Pinga St and Hematite Dr	0.268	C	17	6	0.206	D	29	11
- with right turn pocket	0.213	D	26	7	0.264	F	52	20
Pinga St and Cajarina Rd	0.227	C	17	6	0.448	C	18	17
Pinga St and Powell St	0.397	B	12	19	0.448	A	9	20
Powell Rd and Link Rd	0.285	A	8	11	0.275	A	7	12

Scenario 2 – Existing 2022 with Quarry Road and Powell Road

At the time of this analysis the Quarry Road connection to Wallwork Road was closed however its opening was imminent whilst Powell Road was temporarily closed west of Pinga Street due to proposed construction works at Powell Road and Dalton Road. Existing traffic as surveyed was redistributed based on the opening of these two road connections in the short term which is considered to reflect the current 2022 scenario.

All the existing intersections were modelled based on their current geometric layout and primarily the key operating performance indicators are the same as those assessed under Scenario 1. Once again the intersection of Hematite Drive and Pinga Street was modelled both with and without a right turn lane with lower performance indicators with the right turn pocket.

The intersection of Wallwork Road and Quarry Road was modelled as a standard T-junction. Staged right turn movements were not modelled as the existing median width on Wallwork Road is only approximately 4m and therefore does not meet minimum width requirements to store a right turning vehicle from Quarry Road onto Wallwork Road. (Refer **Figure 5.10**.) On this basis the intersection is predicted to operate with a DOS of 0.152 with the highest average delay of 29 seconds corresponding to a LOS D.

Figure 5.10: Quarry Rd and Wallwork Rd – 4m wide median gap non-compliant for staged crossing

Table 5.5b –SIDRA analysis for Scenario 2 – Existing 2022 with Quarry Road and Powell Rd Connections

	Am Peak				Pm Peak			
	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)
Pinga St and GNH - Staged	0.201	B	14	12	0.196	B	12	9
Pinga St and Hematite Dr	0.251	C	17	4	0.206	D	28	11
- with right turn pocket	0.212	C	25	7	0.259	F	51	20
Pinga St and Cajarina Rd	0.216	B	14	5	0.219	C	17	9
Pinga St and Powell Rd	0.336	B	13	14	0.401	A	10	16
Pinga St and Link Rd	0.279	A	7	11	0.274	A	7	12
Wallwork Rd and Quarry Rd	0.108	C	20	1	0.152	D	29	1

<u>Scenario 3 – 2026, Stages 2,3,4 with no New Great Northern Highway Connection</u>

Scenario 3 tested the existing external road network connections with the development of Stages 2, 3 and 4 i.e. no extension of Hematite Drive north to connect to Great Northern Highway.

Once again the intersection of Hematite Drive and Pinga Street was modelled both with and without a right turn lane with lower performance indicators with the right turn pocket which is likely to more accurately reflect the way the intersection is used based on current observations. This analysis suggests that the intersection of Hematite Drive and Pinga Street is at capacity (i.e. DOS is 0.852) with the assumption of a right turn pocket based on the observed operation where light vehicles overtake light vehicles stopped to turn right into Hematite Drive. The worst LOS is F associated with a delay of 92 seconds for the right turn movement from Hematite Drive into Pinga Street.

Sensitivity testing has indicated that the operation of the intersection of Hematite Drive and Pinga Street is influenced by the percentage of heavy vehicles, in particular Classes 10, 11 and 12. Review of the current vehicle classes on Moorambine Street, Schillaman Street and others suggests that up to 43% are heavy vehicles (Classes 3 to 12) on these local access roads. Within the peak hours up to 13% of Classes 10, 11, 12 has been allowed for. Based on these percentages under scenario 3, the am peak allows for up to 19 inbound vehicles and 12 outbound vehicles of classes 10, 11, 12 at Hematite Drive, whilst the pm peak allows for up to 12 inbound vehicles and 14 outbound vehicles of classes 10, 11, 12 at Hematite Drive. By comparison from the existing surveys approximately 10 inbound vehicles and 5 outbound vehicles (classes 10, 11, 12) were counted in the am peak hour and 10 inbound vehicles and 8 outbound vehicles (classes 10, 11,12) were counted in the pm peak hour. It is suggested that the percentage of classes 10, 11, 12 is likely influenced by the type of development within the existing Hematite Drive precinct which may not necessarily occur in the same proportions with the development of Stages 2, 3, and 4. Therefore sensitivity testing with respect to heavy vehicle percentage was undertaken as the exact percentage of heavy vehicles to be generated by the expansion of Stages 2, 3 and 4 is variable. Increasing the percentage of classes 10, 11, 12 only 5% (i.e. from 13% to 18%) would result in the intersection reaching capacity with a DOS of 1.079 and excessive delays (>180 minutes). For this reason it is suggested that the traffic movements at the intersection of Hematite Drive and Pinga Street be monitored as development within stage 2 occurs as well as stage 3. This will determine if the new connection to Great Northern Highway will be required before or after Stage 4. A robust approach would see the construction of the new connection to Great Northern Highway with the development of Stages 3 and 4.

The intersection of Wallwork Road and Quarry Road is the most direct route to/from Wallwork Road for Stage 2, 3 and 4 and subsequently the intersection becomes oversaturated (DOS 1.135) when modelled as a standard T-junction – with no staged right turn movements due to the limited storage width on Wallwork Road. Widening along Wallwork Road to allow for a staged right turn from Quarry Road to Wallwork Road yields satisfactory performance with the highest DOS being 0.489 and an average delay of 23 seconds or LOS C.

Table 5.5c –SIDRA analysis - Scenario 3 - 2026 (at Opening) Stage 2,3,4 – No New GNH Connection

	Am Peak				Pm Peak			
	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)
Pinga St and GNH- Staged	0.434	C	24	33	0.425	C	17	26
Pinga St and Hematite Dr	0.553	D	34	35	0.461	C	22	29
- with right turn pocket	0.852	F	92	80	0.640	E	40	51
Sensitivity Testing – for heavy vehicles – i.e. 18% class 10,11 and 12.								
Pinga St and Hematite Dr	*0.814*	*F*	*68*	*90*	*0.572*	*D*	*30*	*44*
- with right turn pocket	*1.162*	*F*	*269*	*258*	*0.824*	*F*	*68*	*90*
Pinga St and Powell Rd	0.366	B	15	16	0.429	B	10	18
Pinga St and Link Rd	0.303	A	7	12	0.296	A	7	13
Wallwork Rd and Quarry Rd	0.339	D	35	11	1.135	F	201	167
Wallwork Rd and Quarry Rd - Staged	0.131	C	17	4	0.514	C	25	24

Scenario 4 – 2026 Stages 2, 3 and 4 with New Great Northern Highway Connection

Scenario 4 evaluated the intersections with the additional connection to Great Northern Highway with the extension of Hematite Drive with the development of Stages 2, 3 and 4. Subsequently, there is a reduced traffic load on the intersection of Hematite Drive and Pinga Street resulting in improved LOS D compared to the existing LOS F at this intersection during the pm peak under scenario 2. This analysis also confirms that the opening of the new connection in conjunction with Stages 3 and 4 would alleviate potential traffic congestion at the intersection of Hematite Drive and Pinga Street should the percentage of heavy vehicles adopted in the assessment vary due to the types of development that may result within these stages.

Widening along Wallwork Road to allow for a staged right turn from Quarry Road to Wallwork Road yields satisfactory performance with the highest DOS being 0.488 and an average delay of 23 seconds or LOS C.

The new connection to Great Northern Highway operates at a DOS 0.164 with a LOS B or average delay of 15 seconds. The additional connection to Great Northern Highway also reduces the traffic load at the intersection of Great Northern Highway and Pinga Street resulting in slight operational improvements. It is however the intersection of Hematite Drive and Pinga Street that benefits the most from the new connection to Great Northern Highway as previously outlined.

Table 5.5d –SIDRA analysis for Scenario 4 - 2026 (at Opening) Stage 2,3,4 – With New GNH Connection

	Am Peak				Pm Peak			
	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)
New GNH Connection	0.164	B	15	10	0.161	B	11	8
Pinga St and GNH - Staged	0.221	C	17	17	0.242	B	14	8
Pinga St and Hematite Dr	0.275	C	22	10	0.243	C	19	7
- with right turn pocket	0.312	E	38	18	0.243	D	30	11
Pinga St and Powell Rd	0.366	B	15	16	0.429	B	10	18
Pinga St and Link Rd	0.303	A	7	12	0.296	A	7	13
Wallwork Rd and Quarry Rd	0.371	D	35	13	1.195	F	244	271
Wallwork Rd and Quarry Rd - Staged	0.128	C	16	4	0.510	C	25	24

Scenario 5 – 2026, Stages 2, 3, 4 and south of Powell Street with New Great Northern Highway Connection

Scenario 5 allows for the development of the land to the south of Powell Street. The Town of Port Hedland's preference is for heavy vehicle access to this area to be via Cajarina Road as shown in **Figure 3.14**. For this reason the intersection of Cajarina Road and Pinga Street was analysed with the anticipated increased heavy vehicle movements. The intersection operates with a DOS of 0.396 with a LOS E or an average delay of 49 seconds during the am peak.

Due to the increased volumes along Pinga Street due to the additional traffic anticipated to be generated by development of the area to the south of Powell Street, the operating conditions of the intersection of Pinga Street and Schillaman Street was also assessed. Schillaman Street was selected as this side road off Pinga Street currently experiences the highest volume of traffic of the various side roads based on the existing traffic counts (i.e. Aug 2020 1,698 vpd, 120 vph –am peak, 115vph – pm peak). Similar to Pinga Street and Hematite Drive the 4m median and localised widening for heavy vehicle turning movements allows through movements to typically pass light vehicles stopped to turn right. (Refer **Figure 5.11**). Once again SIDRA modelling was undertaken with and without a right turn lane. Under both models the key performance indicators were satisfactory. The intersection operating at a DOS of 0.322 with an average delay of 19 seconds or LOS C.

Figure 5.11: Pinga St and Schillaman St - allows right turning movement to store clear of through traffic

Traffic volumes at the intersection of Link Road and Wallwork Road will occur with the development of the area to the south of Powell Road. Preliminary review of traffic volumes indicate that this intersection may have increased significantly with the closure of Powell Road at the railway line. SIDRA analysis suggests that this intersection may already be exceeding its practical capacity (i.e. 0.923> 0.8). General increase in traffic flows of 2.5% per annum along Wallwork Road (in line with growth of the Town) up to 2026 is likely to result in this intersection becoming over saturated triggering the need for this intersection to be upgraded regardless of increased traffic volumes associated with development of the land south of Powell Road. The installation of a roundabout or traffic signals would both likely provide increased capacity to accommodate local traffic volumes with improved operating conditions. Preliminary SIDRA analysis for this intersection under a roundabout scenario plus future traffic from indicate that satisfactory operating conditions can be achieved under roundabout control.

Table 5.5e –SIDRA analysis for Scenario 5- 2026 (at Opening) Stage 2,3,4 and Powell – With New GNH Connection

	Am Peak				Pm Peak			
	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)
New GNH Connection	0.169	B	15	10	0.161	B	10	8
Pinga St and GNH - Staged	0.300	C	21	25	0.303	C	16	25
Pinga St and Schillaman	0.322	C	19	11	0.215	B	14	7
- with right turn pocket	0.237	D	29	10	0.239	C	22	11
Pinga St and Hematite Dr	0.298	D	28	12	0.266	C	23	8
- with right turn pocket	0.395	E	50	22	0.270	E	39	15
Pinga St and Cajarina Rd	0.396	E	49	49	0.305	D	29	52
Pinga St and Powell Rd	0.400	C	18	18	0.510	B	13	29
Pinga St and Link Rd	0.328	A	8	13	0.312	A	7	14
Wallwork Rd and Quarry Rd	0.442	E	48	13	1.364	F	390	289
Wallwork Rd and Quarry Rd - Staged	0.140	C	17	5	0.612	D	31	30
Wallwork Rd and Link Rd								
Existing	0.445	C	18	20	0.923	E	40	115
2026 – with 2.5% growth – existing layout	0.478	C	21	23	1.033	F	86	211
2026 – with 2.5% growth – roundabout	0.232	A	12	12	0.471	B	14	26
2026 – with 2.5% growth plus scenario 5 – roundabout	0.304	B	12	16	0.673	B	19	60

Scenario 6 – Ultimate Development 2039

All intersections will operate with additional spare capacity. The highest average delays do typically increase which does result in the intersection of Hematite Drive and Pinga Street experiencing a LOS F. This is simply an attribute of the average delay. The highest average delay at this intersection is in the order of 78 seconds. This is due to the volume of heavy vehicles and the additional time these vehicles take to clear an intersection – this is similar to the existing conditions currently experienced at the intersection. There is still spare capacity as indicated by the DOS 0.546.

Under the ultimate scenario with the projected increase in traffic along Wallwork Road it is anticipated that the channelised intersection treatment with staged right turns will become over saturated in the future (2039) due to the through traffic volumes. It has been assumed that through traffic will continue to grow at 2.5% per annum. Traffic volumes along this regional distributor should be monitored into the future by the Town to confirm the likely per annum growth and therefore the timing of any future upgrade in the future if required. The construction of a roundabout at this location in the future should provide the additional traffic capacity required.

Table 5.5f – SIDRA analysis – Scenario 6 -2039 Ultimate (10+ years after opening)

	Am Peak				Pm Peak			
	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)	Highest DoS	Worst LoS	Highest Average Delay (sec)	Longest 95% Queue (m)
New GNH Connection	0.447	D	32	32	0.353	B	15	20
Pinga St and GNH - Staged	0.519	E	41	37	0.418	C	22	37
Pinga St and Hematite Dr	0.338	E	38	17	0.298	D	28	10
- with right turn pocket	0.546	F	78	31	0.352	F	53	19
Pinga St and Cajarina Rd Increase right turn lane 100m	0.533	F	73	69	0.342	D	34	60
Pinga St and Powell Rd	0.456	C	22	22	0.564	C	15	38
Pinga St and Link Rd	0.411	A	8	18	0.377	A	7	18
Wallwork Rd and Quarry Rd - Staged	0.298	C	25	11	1.201	F	234	293
Wallwork Rd and Quarry Rd - Roundabout	0.288	B	13	17	0.348	B	14	21
Hematite Rd/Quarry Rd	0.396	B	11	22	0.201	B	11	8
Hematite Rd/southeast road, north of Quarry Rd	0.245	C	18	16	0.358	C	16	19

The busiest intersection along Hematite Dr is Quarry Road, as Quarry Road will ultimately carry in the order of 5,000vpd due to its connection to Wallwork Road. Right turning traffic at this location is likely to be primarily light vehicles accessing Wallwork Road. (There are only 6 lots with the potential to have RAV access) along Quarry Road. The next busiest intersection is to the northeast of Hematite Drive/Quarry Road. This link will carry in the order of 3,500vpd. Again it is likely that the majority of right turning traffic would be light vehicles given RAVs would likely approach via the new GNH link therefore turning left from Hematite Drive. Preliminary SIDRA assessment suggests that these two busiest intersections would operate satisfactorily as a standard t-junction without turning lanes with minimal disruption to through traffic. Intersections southwest of Hematite Dr/Quarry Road will carry less traffic and so too will Hematite Drive i.e. decreasing to 1,800 vpd near Pinga St therefore increasing the opportunity for right turns into these intersections.

Typically, a 10m carriageway provides a 5m traffic lane which is adequate to store a right turning light vehicle and still allow a through light vehicle to pass at slow speed if needed. The preliminary design for the intersection of Quarry Road/Hematite Drive indicates localised widening along Hematite Drive to accommodate RAV swept paths hence would readily accommodate light vehicles passing. It is envisaged that the same is likely at each intersection along Hematite Drive.

5.6 Impact on the Local Road Network

The indicative daily traffic volumes on the surrounding road network have been summarised in **Table 5.6** based on the assumption that the peak hour traffic flows remain approximately 8% of the daily flows.

Table 5.6 – Indicative Traffic Volumes on the Adjacent Road Network

Location	Scenarios					
	1	2	3	4	5	6
Hematite Dr, east of Pinga St	1,700	1,400	3,400	1,800	1,800	1,800
Hematite Dr, west of GNH	0	0	0	2,400	2,400	4,000
Quarry Rd, north of Wallwork Rd	0	300	3,700	3,500	3,500	5,000
Pinga St, north of GNH	4,500	4,500	7,100	4,900	5,900	6,600
Pinga St, north of Hematite Dr	7,800	7,800	10,500	8,900	9,900	10,900
Pinga St, north of Powell Rd	10,200	8,500	9,100	9,000	9,700	10,700
Powell St, west of Pinga St	0	1,400	1,400	1,400	2,800	2,800
Powell St, east of Pinga St	10,200	7,300	10,400	10,400	11,900	12,900
Powell St, east of Link Rd	2,900	2,600	2,700	2,700	3,900	4,000
Link Rd, north of Wallwork Rd	7,300	7,300	7,700	7,700	9,100	11,000

Hematite Drive is expected to carry in the order of 1,400 - 4,000 vehicles per day which is considered appropriate for a two lane undivided road standard as it is currently constructed at its western end near Pinga Street. Hematite Drive is defined as a local distributor road and therefore should be designed to discourage through traffic. For this purpose it should be designed as a slower speed road (50km/h). The use of dedicated auxiliary turn lanes to store turning vehicles may encourage through traffic and higher traffic speeds. It is envisaged that localised widening along Hematite Drive to accommodate RAV swept paths will be adequate to allow for light vehicles to pass stopped right turning vehicles as required.

Similarly, Quarry Road is anticipated to carry up to 5,000 vehicles per day with the ultiamte development of the HJSP. This volume of traffic can be accommodated on a two lane undivided road.

Pinga Street is estimated to currently carry between 4,500 – 10,200 vehicles per day at its northern and southern ends respectively based on the peak hour being 8% of daily traffic volumes. Ultimately, traffic volumes are expected to increase to between 6,600 – 10,900 vehicles per day. This volume of traffic can typically be accommodated on a two lane road with a painted median as per the existing standard.

Powell Street, east of Pinga Street at the time of the traffic surveys carried in the order of 10,200 vehicles per day due to its closure to the west to accommodate the construction of Dalton Road and Powell Road roundabout. This section of road is constructed to a two lane divided carriageway standard. Additional development traffic that will increase traffic flows along this road section to 11,900 vehicles per day can be readily accommodated on this standard of road.

Lots fronting Anthill Street, Schillaman Street and Moorambine Street are expected to be part of Stage 5 of the HJSP. The new connection to Great Northern Highway is envisaged to be required prior to the release of Stage 5 therefore minimising any impact to these local access roads. As local access roads, the function of these road is to carry traffic that services the lots with the same street address. Lots fronting these roads total the following areas which would equate to the following additional daily traffic

- Anthill Street – 6.5 hectares or 630 vehicles per day
- Schillaman Street – 10.1hectares or 970 vehicles per day
- Moorambine Street – 7.8 hectares or 750 vehicles per day

Schillman Street and Moorambine Street currently carry in the order of 1,700 and 1,300 vehicles per day. Subsequently, total traffic volumes are anticipate to be less than 3,000 vehicles per day and would therefore be in line with that expected on a local access road. The Port Hedland "Heavy Vehicle Access Strategy" recommends that Schillaman Street and Moorambine should be considered RAV routes with upgrades recommended.

In summary, a two lane two way single carriageway road with 10m wide pavement throughout the HJSP can adequately cater for the indicative design traffic flows on the new internal road network with localised widening along to accommodate RAV swept paths at intersections.

5.7 Subdivisional TIA requirements

WAPC has resolved that a TIA is required to be prepared at each new subdivision application to inform the requirement for intersection upgrades associated with the staged development of the HJSP. An updated TIA at each subdivision stage can evaluate the existing situation based on development within the HJSP at that time including realised trip generation, heavy vehicle types by percentage, most recent trip distribution patterns based on the current road network and traffic growth along the external regional road network. This HJSP data can then be used for further development of the HJSP to better inform the need for intersection upgrades.

6.0 PROPOSED INTERNAL ROAD TRANSPORT NETWORK

6.1 Connections to the Existing Road Network

Ultimately the HJSP will connect to the existing road network at the following location at various staging of development:

- Hematite Drive – east of Furnace Road;
- Tailing Elbow – east of Furnace Road;
- Wallwork Road and Quarry Road intersection;
- Hematite Drive and Great Northern Highway intersection;
- Moorambine Road, east of Yanana Street;
- Schillaman Street, east of Yanana Street;
- Eastern end of Anthill Street;
- Dalton Road and Powell Road roundabout; and
- Link Road, between Powell Road and Wallwork Road.

The proposed Link Road connection is located on the outside of the horizontal bend in Link Road and as such sight distance in both directions is provided with visibility to both Powell Road and Wallwork Road. Safe Intersection Sight Distance (SISD) based on 70km/h is 161m whilst ASD is 103m. Powell Road is potentially located approximately 130-140m away but it is noted that vehicles entering Link Road from Powell Road will be visible at the new connection and therefore will be able to judge an appropriate gap in the traffic stream given that these vehicles will negotiate the intersection at a speed lower than 70km/hr.

Link Road currently has a posted speed limit of 60km/h. Based on a design speed of 70km/h auxiliary turn lane lengths of approximately 75m are recommended for deceleration lanes for deceleration plus storage as required as outlined in *Austroads Guide to Road Design, Part 4A Unsignalised and Signalised Intersection*. It is envisaged that minimal right turn traffic from Link Road into the new road is likely and as such a right turn deceleration is not likely to be required. Potentially, localised widening to ensure through traffic can safely pass a stopped right turning vehicle.

6.2 Road Hierarchy, Road Reserve Widths and Speed Limits

The Structure Plan intends to provide Industrial Development lots. Under Development Control Policy (DCP 4.1) a minimum road reserve of 20m is required to accommodate a two lane single carriageway having a 10m wide road pavement.

HJSP is proposed to primarily comprise of 40m road reserves with the exception of Hematite Drive which will continue the existing 60m road reserve. These road reserve widths accommodate the space required for RAV vehicles to manoeuvre through the industrial estate as well as facilitating access in to and out of individual properties.

There are a number of right angle bends incorporated within the Structure Plan. Bends can assist with reducing the speed limit however they can also result in drivers “cutting the corner” which can increase the crash risk for head-on collision. Based on the low volume of traffic on the internal road network and the subsequent design speed, the bends are likely to be considered “low risk”. Good practice would be to include road widening to separate vehicle movements. To ensure that the road network is RAV compliant these bends will need to be designed accordingly with the RAV vehicle being the checking vehicle. Truncations (larger than typical) on the corner lots are likely to be required to provide adequate sight distance between opposing vehicles approaching the bend as well as for potential driveways located around bends.

The ultimate design will need to demonstrate that the road reserve is adequate to accommodate swept paths of the design vehicle (PSB Tri Drive Quad Axle) at intersections and bends however recent stages along Hematite Drive have demonstrated that the proposed road widths are adequate.

Hematite Drive will form a new east-west route and would operate as a local distributor road with ultimately direct connection to Great Northern Highway (Primary Distributor) at its eastern end and Pinga Street (currently classified as a local distributor) at its western end. Quarry Road will provide a direct connection to Wallwork Road that links to the key residential areas for employees being South Hedland and Port Hedland. For this reason its role is also that of a local distributor within the HJSP connection the regional distributor Wallwork Road. Hematite Drive and Quarry Road are estimated to carry in the order of 4,000 to 5,000 vehicles per day which is in line with this category of road.

Pinga Street is estimated to currently carry in the order of 4,000 vehicles per day at its northern end and 8,500 vehicles per day at its southern end. This is based on the peak hour traffic representing approximately 8% of the daily traffic volume. This volume of traffic is more in line with that of a district distributor i.e. >6 - 7,000 vehicles per day. Ultimately it is anticipated that Pinga Street will carry in the order of 6,500 vehicles per day at its northern end and 10,500 vehicles per day at its southern end at full development of the HJSP.

Powell Road, west of Pinga Road is proposed to be downgraded to a local distributor road to tie into the existing local distributor classification of Dalton Road however traffic volumes are anticipated to be less than 3,000 vehicles per day, That is typically the minimum for a local distributor however based on its function it provides a link to the southwest area of Wedgefield.

The proposed road hierarchy for the Structure Plan is shown in **Figure 6.1**.

Figure 6.1: Proposed Road Hierarchy

6.3 Intersection Control

Intersection spacing has been guided by the indicative lot sizes to be incorporated within the road network grid. Typically T-junctions are proposed throughout the internal road network that will operate under standard give way control.

6.4 Proposed Road Access Strategies

Individual access to lots will need to be considered at the subdivisional stage to ensure all lots can be serviced in accordance with Australian Standards e.g. proximity of driveways to intersections and sight line requirements. There are a number of lots fronting Hematite Drive and Quarry Road that will require direct lot frontage onto these local distributor roads however it is noted that some of these lots will also have the option of access via side roads which would be preferred.

6.5 Pedestrian and Cycle Networks

At this stage there are no clear pedestrian desire lines within the Structure Plan. Historically, industrial estates do not always include footpaths as evident by the established areas of Wedgefield immediately to the west of Pinga Street and north of Hematite Drive. It is noted that Hematite Drive provides a path along its northern side. Similarly, Furnace Road, Tailings Elb, Alloy Way, Phosphorous St typically have a path on one side. The road reserve widths proposed are sufficient to accommodate a path network should the proposed land uses create a demand for pedestrian and cyclist facilities.

The Pilbara 2050 Cycling Strategy mentions the provision of local connections to employment generators including the Wedgefield or Hedland Junction. For this purpose the provision of a path network on at least one side of the road within the HJSP will provide opportunities for pedestrians and cyclists to use this mode of travel to/from this employment area in the future.

6.6 Public Transport Routes

There are some existing bus routes through the existing Wedgefield Estate (Refer **Figure 3.15**. As the road network is designed to cater for trucks it could readily accommodate bus routes if they were to be introduced in the future should the demand warrant services feasible. Hematite Drive would be a suitable road for a route as it is relatively central to the HJSP. It is noted that Hematite Drive also contains a path which would facilitate pedestrian movements from future bus stops along Hematite Drive.

6.7 Restricted Access Vehicle Network

The internal road network shall allow access for Restricted Access Vehicle, typically the RAV10 Tandem Drive Network 10 (53.5m) and more specifically the PBS Tri Drive Quad Axle Level 4B.3. Engineering detailed design will need to consider this design vehicle with respect to road widths, turning radius, clear zones, swept paths and pavement strength.

7.0 SUMMARY AND CONCLUSION

The HJSP comprises of approximately 155 hectares of land zoned for general industry. Based on the indicative lots layout the structure plan will incorporate approximately 90 industrial lots subject to detailed design ranging in size from 4800m2 to 4.8 hectares.

The trip generation of land uses within Industrial Estates can vary depending on the industry type (low to high traffic generators) and the subsequent number of employees with generic rates being based on Gross Floor Area (GFA) of buildings. In this instance site surveys on the existing Hematite Drive precinct was used to confirm appropriate trip generation rates for the typical industrial development in this region. To ensure a robust assessment the highest observed peak hour trip rate from the Hematite Drive precinct of 7.65 trips per hectare for both the am and pm peak hours has been adopted.

The HJSP is therefore estimated to generate in the order of 14,834 vehicle trips per weekday with approximately 1,182 vehicle trips during both the am and pm peak hours respectively.

For the purpose of the traffic assessment the Hedland Junction Structure Plan was divided into a number of areas based on an indicative timing for development. These stages and lots are indicative only to provide a framework for the traffic assessment. The actual lots developed may vary. Since trip generation is based on developable area, lots within close proximity using the same road network are interchangeable with the traffic assessment remaining valid. These scenarios are as follows:

- Scenario 1 - Existing December 2021 traffic volumes
- Scenario 2 - Existing 2022, traffic redistributed with Quarry Road connection
- Scenario 3 – 2026 without new Great Northern Highway connection for Stages 2,3,4
- Scenario 4 – 2026 with new Great Northern Highway connection for Stages 2,3,4
- Scenario 5 – 2026 Opening for Stages 2,3,4, area south of Powell Road with new Great Northern Highway connection
- Scenario 6 – 2039 Ultimate Development – Stages 2,3,4,5 and south of Powell Road

Key intersections were analysed using the SIDRA Intersections traffic modelling computer package (*version 9*). The following recommendations are made based on the SIDRA analysis with respect to the modelling undertaken:

- Intersection of Quarry Road and Wallwork Road to be upgraded to accommodate staged right turn movements from Quarry Road onto Wallwork Road in conjunction with the development of Stage 2, 3, and 4.
- Intersection of Hematite Drive and Pinga Street will reach capacity in 2026 with full development of Stages 2, 3 and 4. The operation of the intersection has proved to be

very sensitive with respect to the percentage of Class 10, 11 and 12 heavy vehicles.). For this reason it is suggested that the traffic movements at the intersection of Hematite Drive and Pinga Street be monitored as development within stage 2 occurs as well as stage 3. This will determine if the new connection to Great Northern Highway will be required before or after Stage 4. A robust approach would see the construction of the new connection to Great Northern Highway with the development of Stages 3 and 4.

- The existing intersection of Wallwork Road and Link Road may already be operating over its practical capacity in peak hours potentially due to the closure of Powell Road at the rail way line. It is recommended that the Town actively investigate geometric improvements to this intersection to accommodate the anticipated per annum traffic growth due to population growth in the Town. Preliminary analysis conducted in this report indicates that under roundabout control this intersection would provide the additional spare capacity not only for traffic resulting from the general population growth of the Town but also future traffic associated with development of the industrial land to the south of Powel Road.
- It is anticipated that the channelised intersection treatment of Quarry Road and Wallwork Road with staged right turns will become over saturated in the future (2039) due to the through traffic volumes should they continue to increase at 2.5% per annum. This will ultimately be dependent on traffic growth. It is recommended that the Town monitor traffic growth along this regional distributor to inform future analysis of this intersection for 2039 and beyond. The construction of a roundabout at this location in the future should provide the additional traffic capacity required.

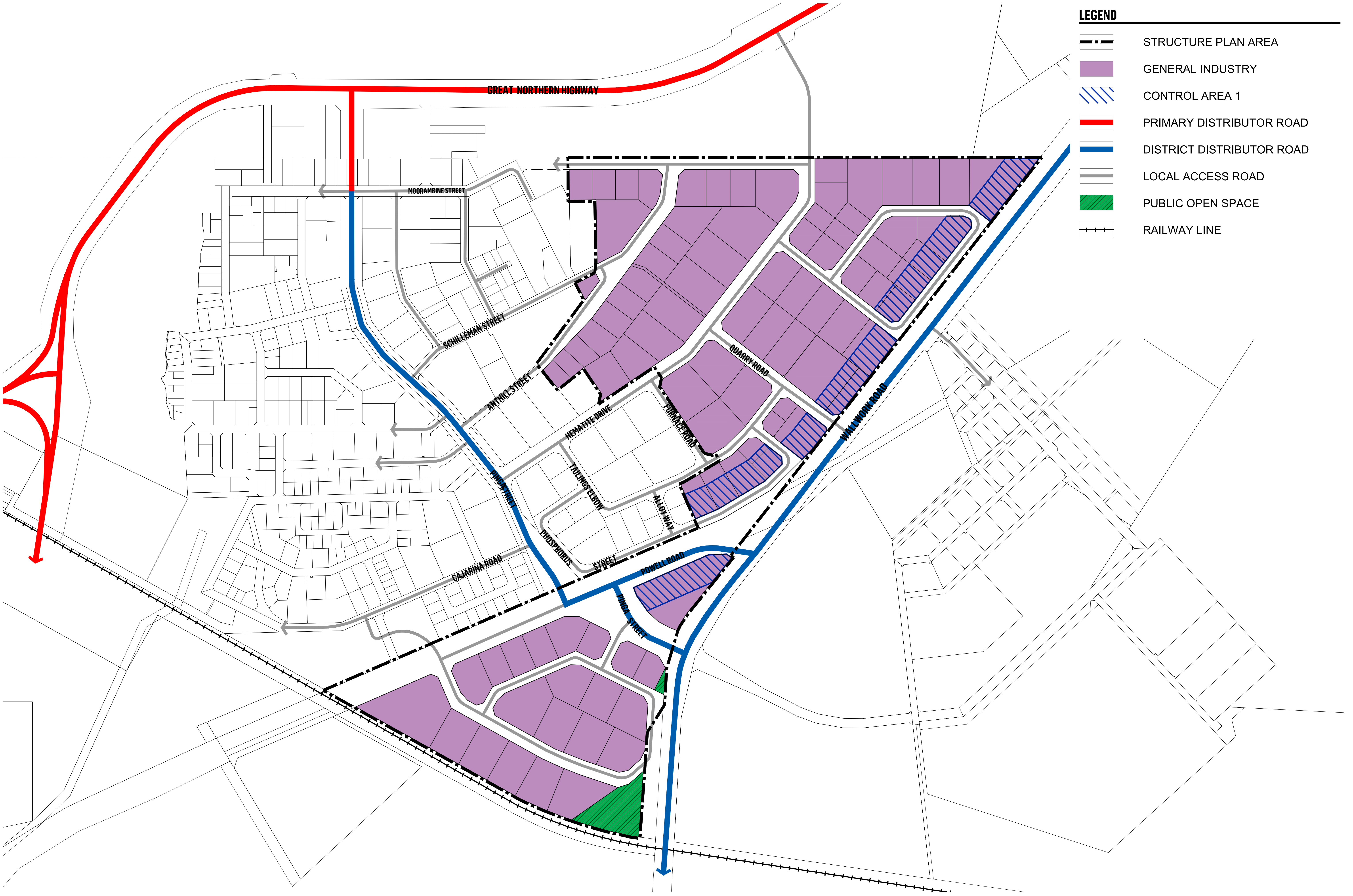
All new roads within the HJSP with the exception of Hematite Drive and Quarry Road are anticipated to carry less than 3,000 vehicles per day and as such should be classified as local access road. Hematite Drive and Quarry Road will carry more than 3,000 vehicles per day ultimately and as such these roads are recommended to be designated as local distributor roads.

It is estimated that Pinga Street will carry in the order of 4,000 vehicles per day at its northern end and 8,500 vehicles per day at its southern end with up to 10,200 vehicles per day (at its southern end) with the temporary closure of Powell Road, west of Pinga Street. Development of Stages 3 and 4 will likely see the southern end of Pinga Street carry in the order of 9,000 vehicles per day increasing to 10,000 vehicles per day with ultimate development of the HJSP. Pinga Street’s northern end will likely increase to 7,100 vehicles per day with development of stages 3 and 4 without the new Great Northern Highway connection, reducing to 4,900 vehicles per day at its northern end with the new Great Northern Highway connection. With full development of the HJSP traffic volumes are likely to range between 6,600 and 10,900 vehicles per day. This volume of traffic is more in line with that of a district distributor i.e. >6 - 7,000 vehicles per day.

HJSP is proposed to primarily comprise of 40m road reserves with the exception of Hematite Drive which will continue the existing 60m road reserve. These road reserve widths accommodate the space required for RAV vehicles to manoeuvre through the industrial estate as well as facilitating access in to and out of individual properties. There are a number of right angle bends incorporated within the Structure Plan. The ultimate design will need to demonstrate that the road reserve is adequate to accommodate swept paths of the design vehicle (RAV) at intersections and bends with larger than normal truncations likely to be required.

APPENDIX A

Structure Plan Layout



URBIS

Hedland Junction - Structure Plan Part II

Wedgefield Industrial Estate

Level 14, The Quadrant, 1 William Street | Perth WA 6000 Australia | +61 8 9346 0500 | URBIS Pty Ltd | ABN 50 105 256 228

DISCLAIMER

CLIENT

Development WA

1:12,500 @ A3

0 50 100 250m

PROJECT NO.
P0006040

DATE
17.03.22

DRAWING NO.
20

REVISION
b

APPENDIX B

Intersection Turn Counts

Project: Pinga St Survey

Intersection: Pinga St / GNH

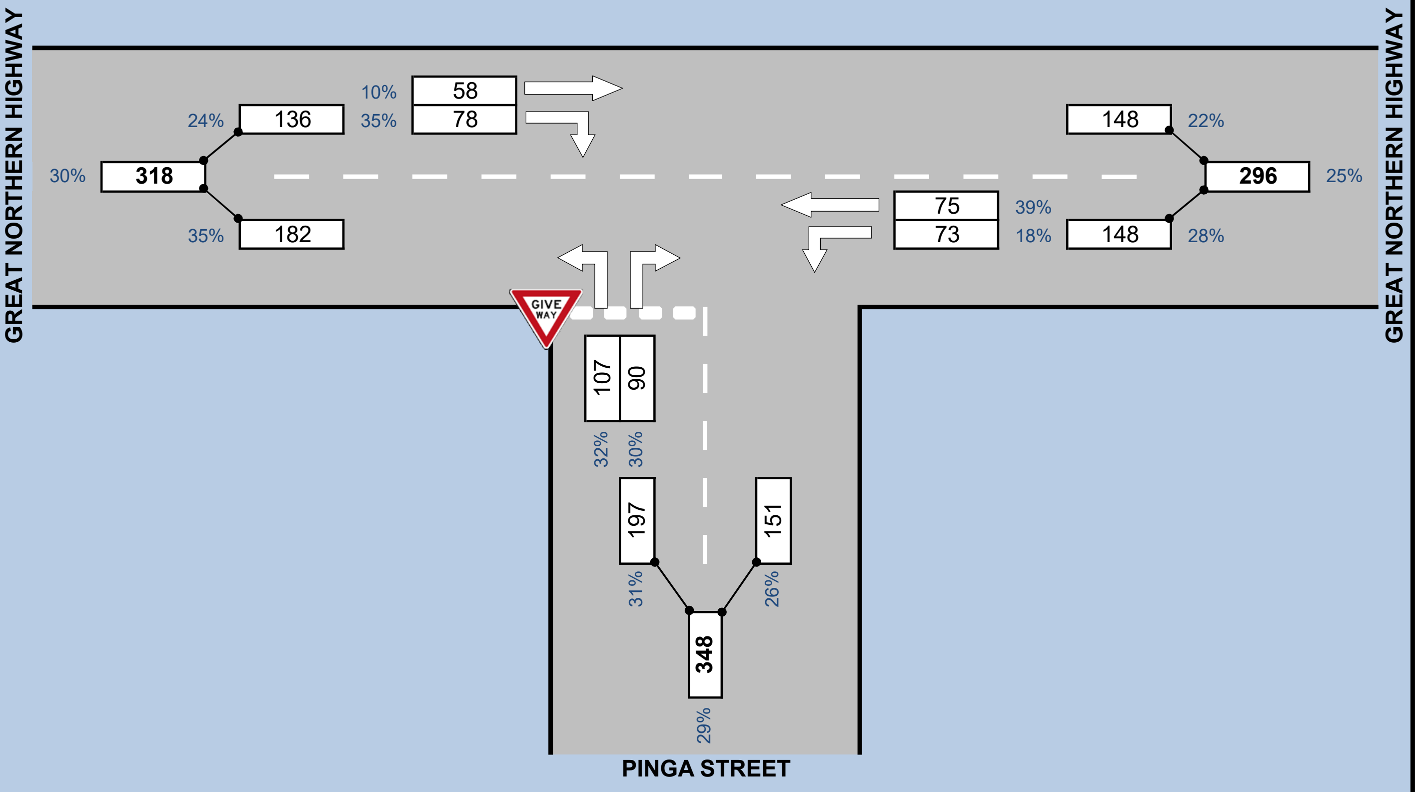
Date: Tue 30th November 2021

Weather: Fine

Survey Time: AM Peak Hour - 0700 - 0800

All Vehicles

(% Heavy Vehicles)

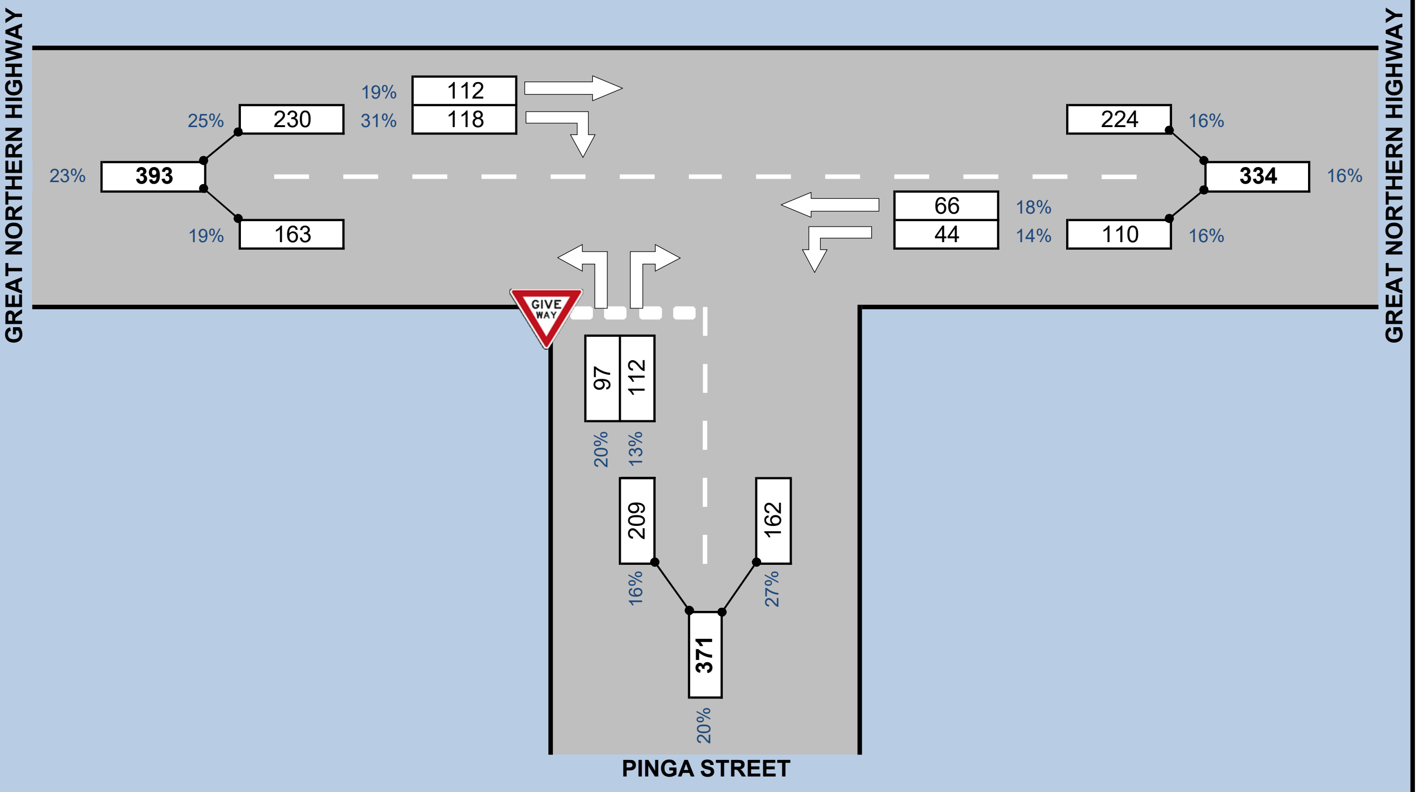


Project: Pinga St Survey
Intersection: Pinga St / GNH
Date: Tue 30th November 2021
Weather: Fine

Survey Time: PM Peak Hour - 1630 - 1730

All Vehicles

(% Heavy Vehicles)



Project:	Pinga St Survey	**Date:**	Tue 30th November 2021
Intersection:	Pinga St / Powell St EAST	**Weather:**	Fine

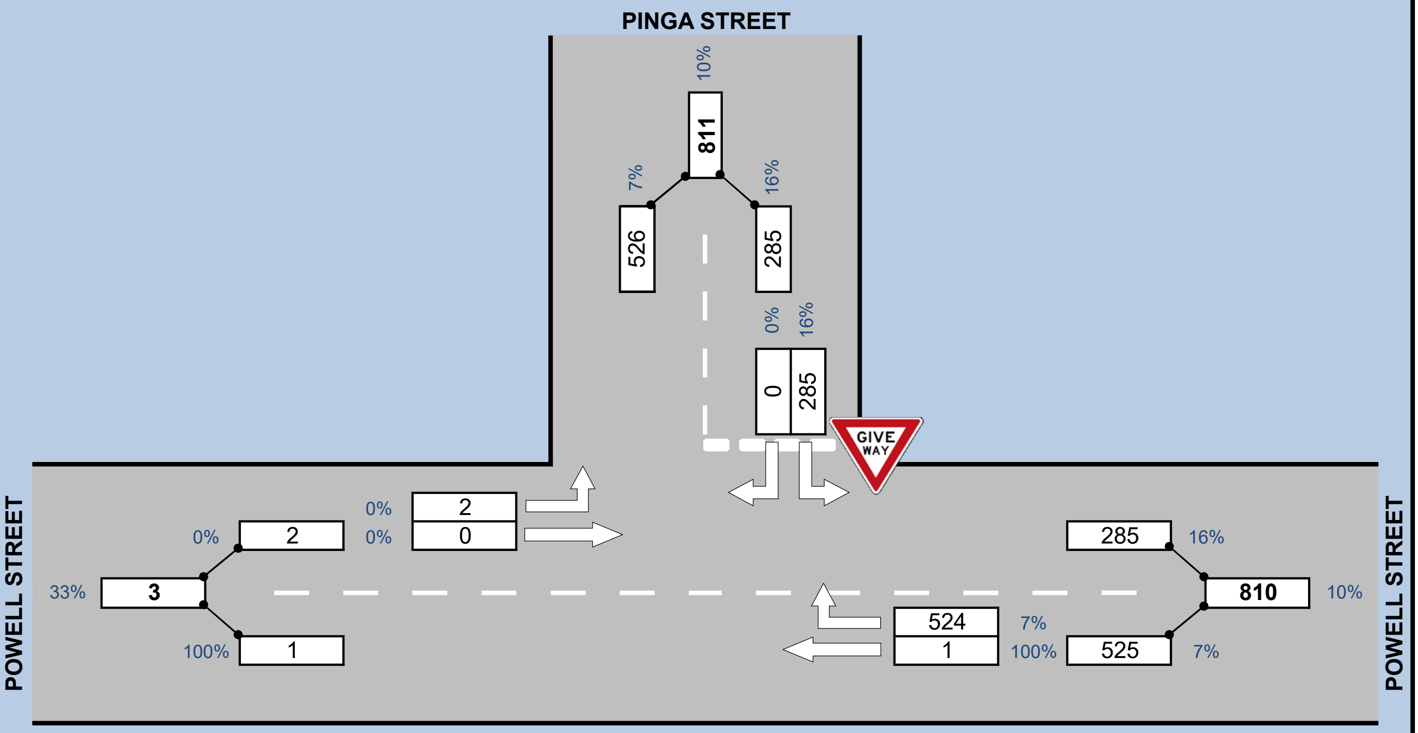
Survey Time: AM Peak Hour - 0630 - 0730

All Vehicles

(% Heavy Vehicles)

○ Class 2-5

○ Class 10-11



Project: Pinga St Survey
Intersection: Pinga St / Powell St EAST
Date: Tue 30th November 2021
Weather: Fine

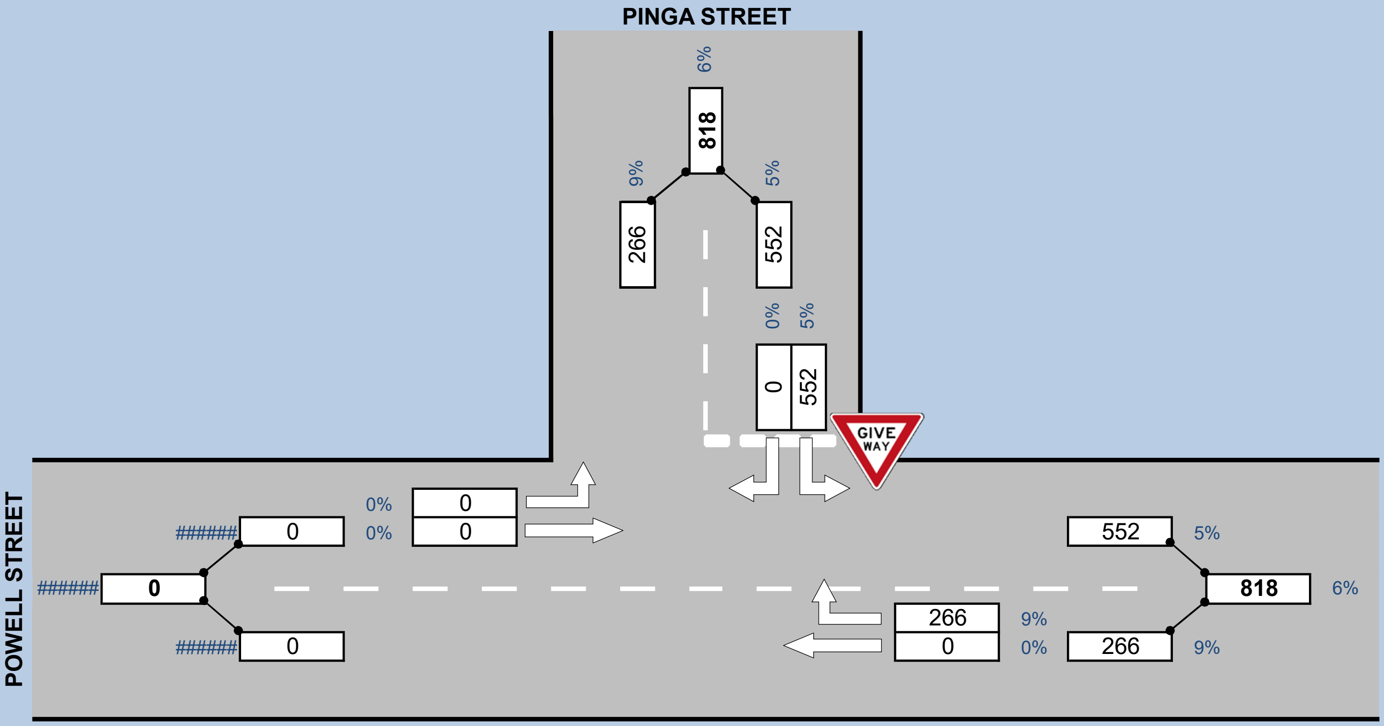
Survey Time: PM Peak Hour - 1630 - 1730

All Vehicles

(% Heavy Vehicles)

○ Class 2-5

○ Class 10-11



© Surveytech Australia 1300 10 10 66

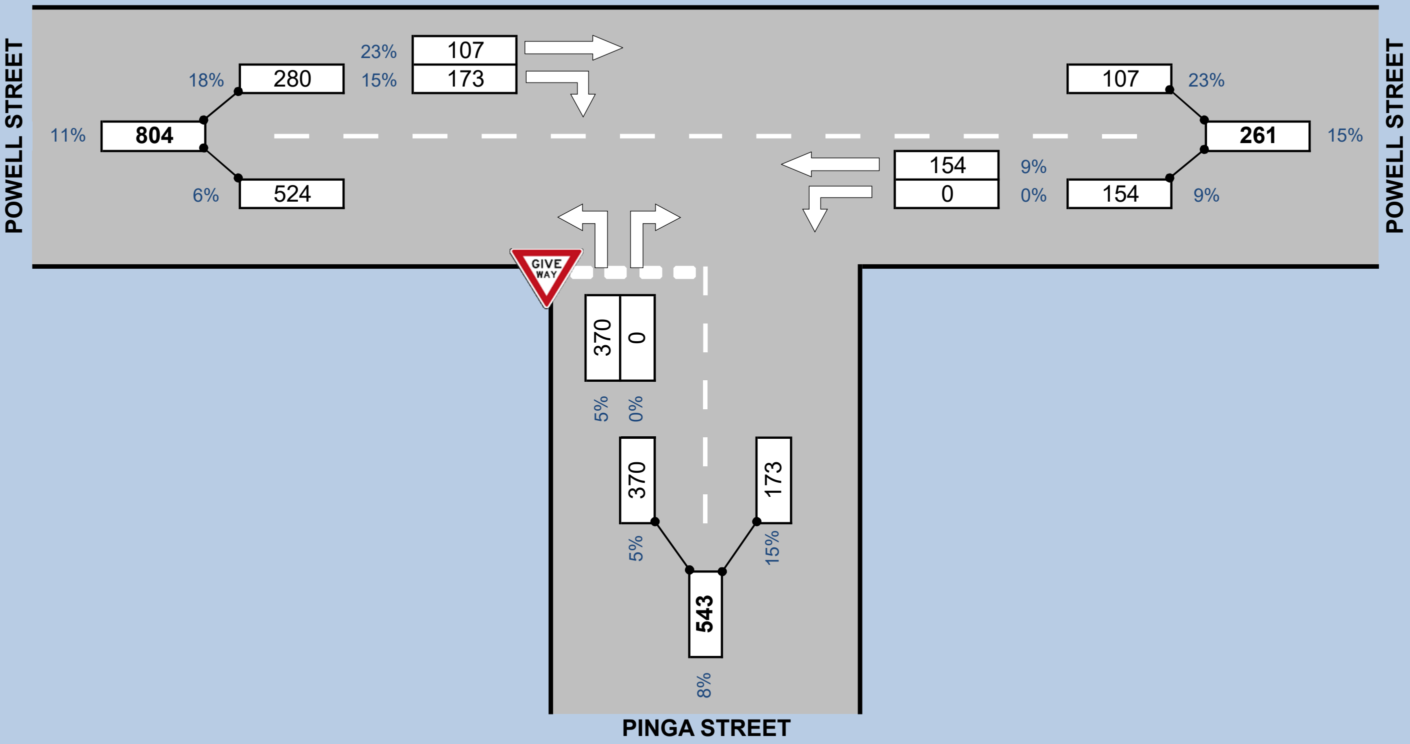
Project: Pinga St Survey
Intersection: Pinga St / Powell St EAST

Date: Tue 30th November 2021
Weather: Fine

Survey Time: 0630 - 0730

All Vehicles

(% Heavy Vehicles)

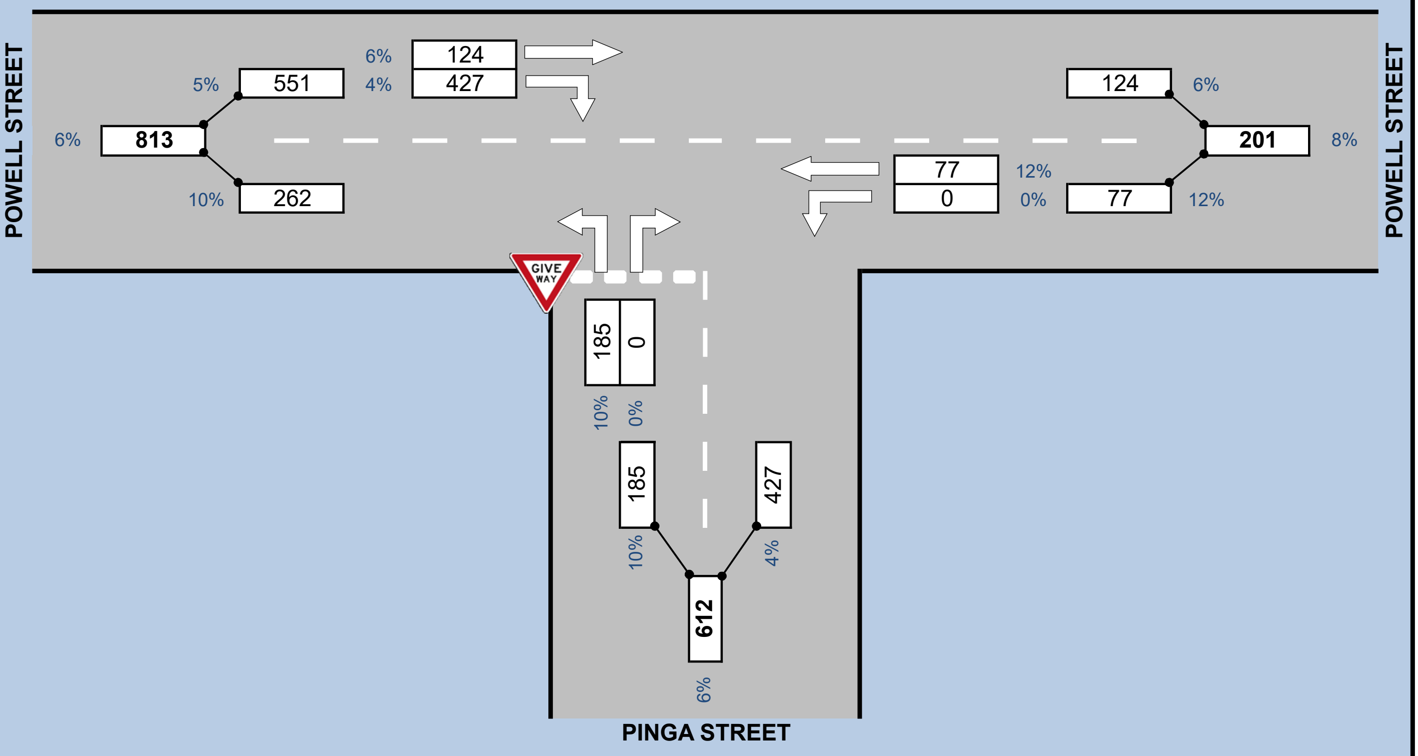


Project:	Pinga St Survey	**Date:**	Tue 30th November 2021
Intersection:	Pinga St / Powell St EAST	**Weather:**	Fine

Survey Time: PM Peak Hour - 1630 - 1730

All Vehicles

(% Heavy Vehicles)



Project :	Pinga St Survey	**Date :**	Tue 30th November 2021
Intersection:	Pinga St / Hematite Dr	**Weather :**	Fine

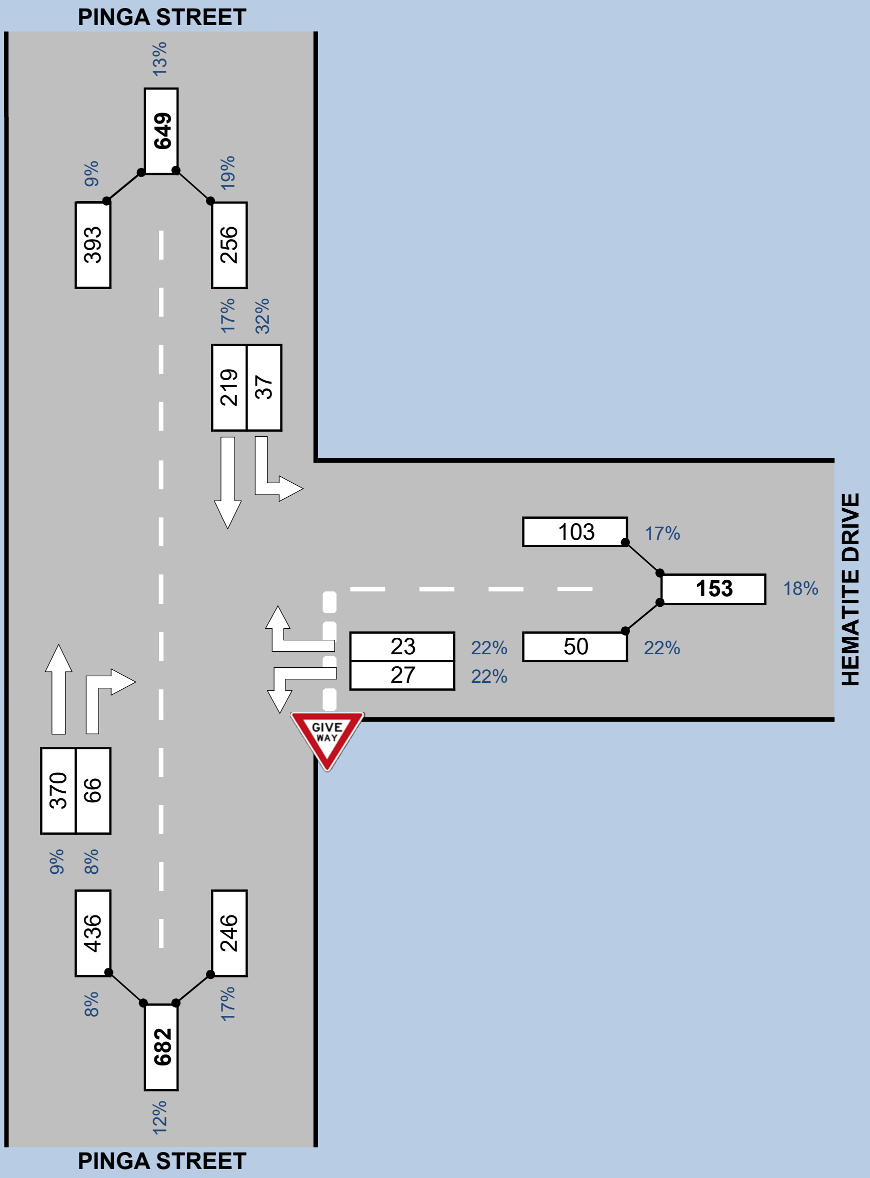
Survey Time: 0630 - 0730

All Vehicles

(% Heavy Vehicles)

○ Class 2-5

○ Class 10-11



Surveytech Australia 1300 10 10 66

Project :	Pinga St Survey	**Date :**	Tue 30th November 2021
Intersection:	Pinga St / Hematite Dr	**Weather :**	Fine

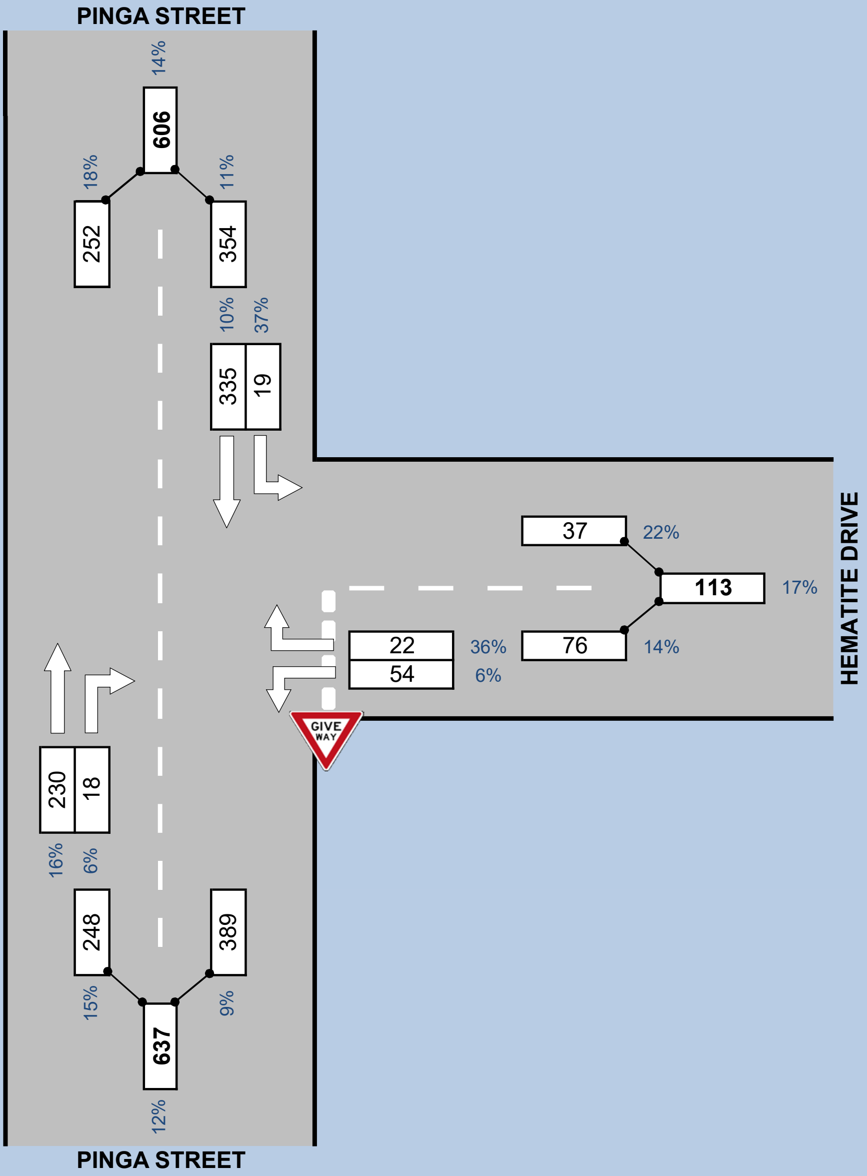
Survey Time: 1600 - 1700

All Vehicles

(% Heavy Vehicles)

○ Class 2-5

○ Class 10-11



APPENDIX C

SIDRA Detailed Results

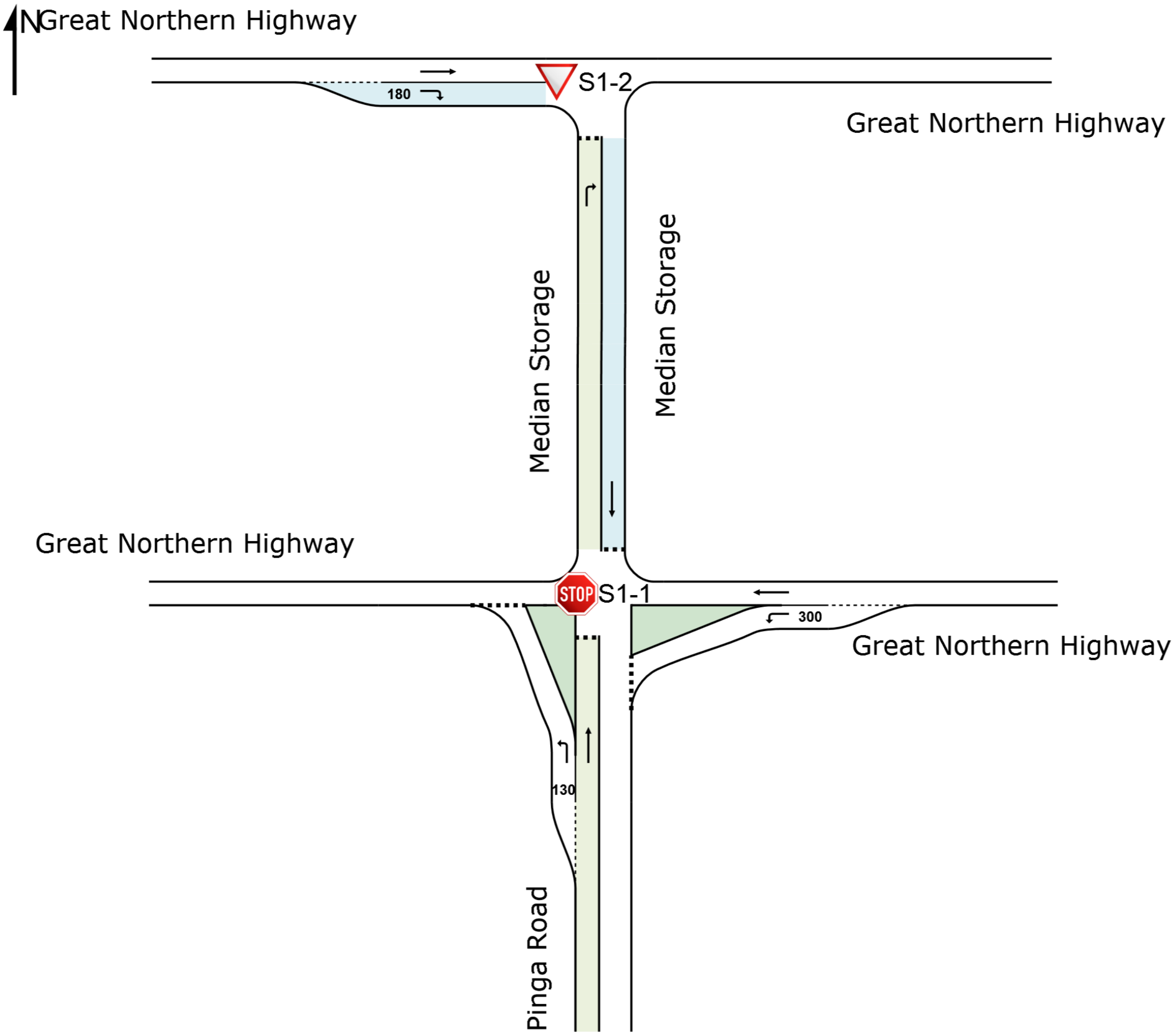
Scenario 1 – SIDRA Results

NETWORK LAYOUT

Network: SCTI-B [GNH Pinga St Am Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	GNH Pinga Am Existing - Stage 2
STOP S1-1	NA	GNH Pinga Am Existing - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Am Existing - Stage 2 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Am Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	ARRIVAL FLOWS [Total veh/h	ARRIVAL FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	95	30.0	95	30.0	0.092	0.2	LOS A	0.2	3.0	0.11	0.05	0.11	41.0
Approach		95	30.0	95	30.0	0.092	0.2	LOS A	0.2	3.0	0.11	0.05	0.11	41.0
West: Great Northern Highway														
2	T1	61	10.3	61	10.3	0.033	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	82	34.6	82	34.6	0.055	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		143	24.3	143	24.3	0.055	5.1	NA	0.0	0.0	0.00	0.45	0.00	69.9
All Vehicles		238	26.5	238	26.5	0.092	3.2	NA	0.2	3.0	0.05	0.29	0.05	56.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Am Existing - Stage 1 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Am Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	113	31.8	113	31.8	0.136	8.3	LOS A	0.6	9.5	0.33	0.59	0.33	53.3
2	T1	95	30.0	95	30.0	0.201	13.9	LOS B	0.9	12.3	0.58	0.86	0.58	46.5
Approach		207	31.0	207	31.0	0.201	10.8	LOS B	0.9	12.3	0.44	0.71	0.44	51.1
East: Great Northern Highway														
3	L2	77	17.8	77	17.8	0.075	8.4	LOS A	0.3	3.1	0.29	0.59	0.29	56.7
4	T1	79	38.7	79	38.7	0.051	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		156	28.4	156	28.4	0.075	4.2	LOS A	0.3	3.1	0.14	0.29	0.14	66.4
North: Median Storage														
5	T1	82	34.6	82	34.6	0.125	1.6	LOS A	0.5	9.1	0.33	0.22	0.33	38.5
Approach		82	34.6	82	34.6	0.125	1.6	LOS A	0.5	9.1	0.33	0.22	0.33	38.5
All Vehicles		445	30.7	445	30.7	0.201	6.8	NA	0.9	12.3	0.32	0.47	0.32	54.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-2 [GNH Pinga Pm Existing - Stage 2 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Pm Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	118	12.5	118	12.5	0.102	0.4	LOS A	0.2	2.6	0.18	0.11	0.18	46.9
Approach		118	12.5	118	12.5	0.102	0.4	LOS A	0.2	2.6	0.18	0.11	0.18	46.9
West: Great Northern Highway														
2	T1	118	18.8	118	18.8	0.068	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	124	31.4	124	31.4	0.082	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		242	25.2	242	25.2	0.082	4.6	NA	0.0	0.0	0.00	0.40	0.00	71.2
All Vehicles		360	21.1	360	21.1	0.102	3.2	NA	0.2	2.6	0.06	0.30	0.06	62.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Pm Existing - Stage 1 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Pm Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	102	19.6	102	19.6	0.111	7.6	LOS A	0.5	7.2	0.26	0.56	0.26	56.3
2	T1	118	12.5	118	12.5	0.196	11.9	LOS B	0.9	9.1	0.55	0.83	0.55	48.4
Approach		220	15.8	220	15.8	0.196	9.9	LOS A	0.9	9.1	0.41	0.71	0.41	53.2
East: Great Northern Highway														
3	L2	46	13.6	46	13.6	0.048	8.7	LOS A	0.2	1.9	0.35	0.61	0.35	57.6
4	T1	69	18.2	69	18.2	0.040	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		116	16.4	116	16.4	0.048	3.5	LOS A	0.2	1.9	0.14	0.24	0.14	69.2
North: Median Storage														
5	T1	124	31.4	124	31.4	0.167	1.1	LOS A	0.7	12.3	0.28	0.16	0.28	39.9
Approach		124	31.4	124	31.4	0.167	1.1	LOS A	0.7	12.3	0.28	0.16	0.28	39.9
All Vehicles		460	20.1	460	20.1	0.196	5.9	NA	0.9	12.3	0.31	0.44	0.31	54.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

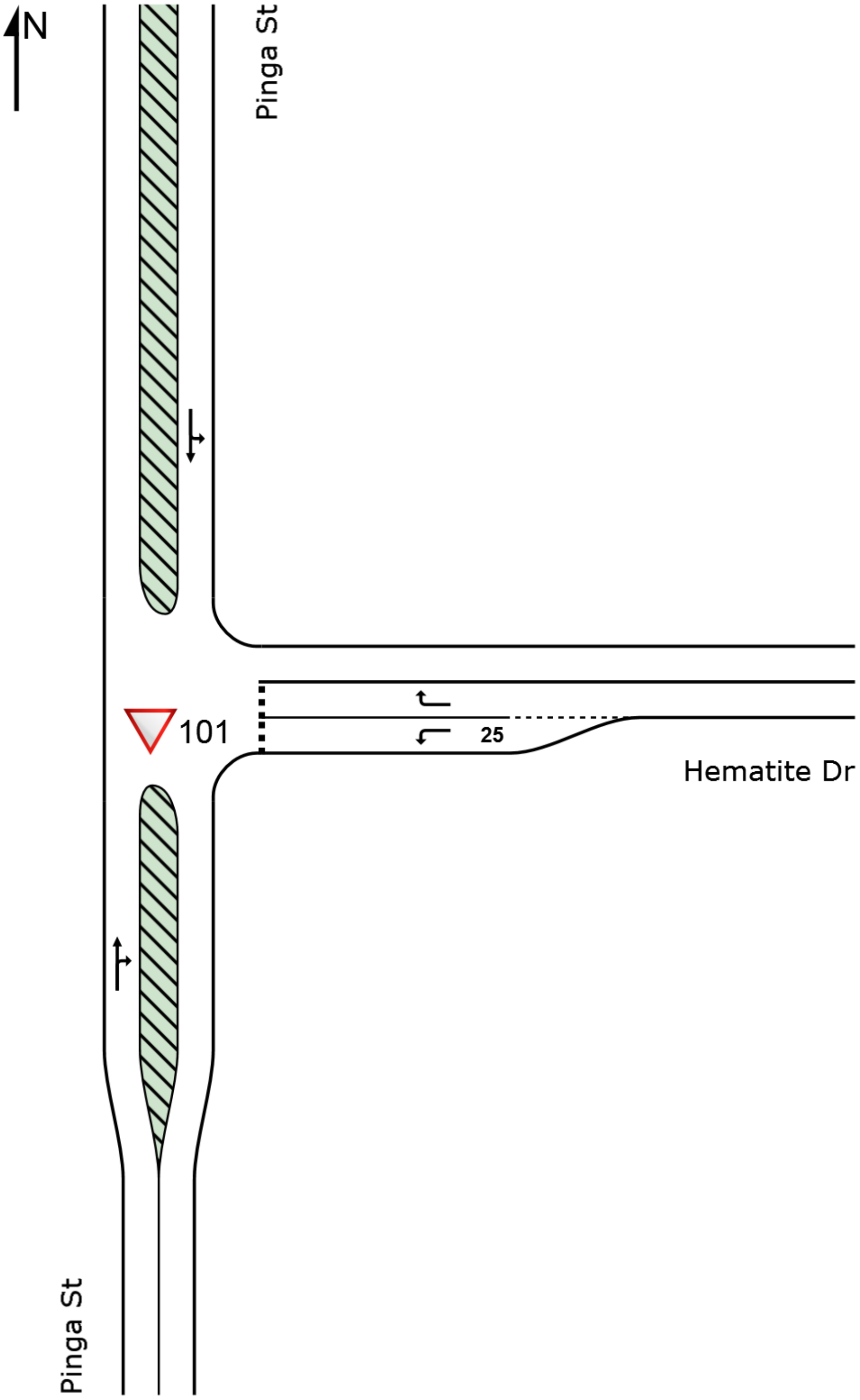
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	370	8.6	389	8.6	0.268	0.5	LOS A	0.7	5.9	0.18	0.11	0.18	75.3
6	R2	66	7.6	69	7.6	0.268	8.6	LOS A	0.7	5.9	0.18	0.11	0.18	54.1
Approach		436	8.5	459	8.5	0.268	1.7	NA	0.7	5.9	0.18	0.11	0.18	71.1
East: Hematite Dr														
7	L2	27	22.2	28	22.2	0.025	5.8	LOS A	0.1	0.9	0.34	0.54	0.34	44.3
9	R2	23	21.7	24	21.7	0.100	17.3	LOS C	0.3	4.4	0.74	0.89	0.74	40.1
Approach		50	22.0	53	22.0	0.100	11.1	LOS B	0.3	4.4	0.53	0.70	0.53	42.0
North: Pinga St														
10	L2	37	32.4	39	32.4	0.157	7.4	LOS A	0.0	0.0	0.00	0.11	0.00	60.5
11	T1	219	16.9	231	16.9	0.157	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.6
Approach		256	19.1	269	19.1	0.157	1.2	NA	0.0	0.0	0.00	0.11	0.00	73.0
All Vehicles		742	13.1	781	13.1	0.268	2.1	NA	0.7	5.9	0.14	0.15	0.14	68.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pinga Hematite Pm Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	230	16.1	242	16.1	0.154	0.4	LOS A	0.2	2.0	0.09	0.07	0.09	76.5
6	R2	18	5.6	19	5.6	0.154	8.8	LOS A	0.2	2.0	0.09	0.07	0.09	55.0
Approach		248	15.3	261	15.3	0.154	1.0	NA	0.2	2.0	0.09	0.07	0.09	74.4
East: Hematite Dr														
7	L2	54	5.6	57	5.6	0.052	6.0	LOS A	0.2	1.6	0.41	0.60	0.41	44.4
9	R2	22	36.4	23	36.4	0.166	28.7	LOS D	0.5	11.3	0.81	0.92	0.82	36.1
Approach		76	14.5	80	14.5	0.166	12.6	LOS B	0.5	11.3	0.53	0.69	0.53	41.2
North: Pinga St														
10	L2	19	36.8	20	36.8	0.206	7.6	LOS A	0.0	0.0	0.00	0.04	0.00	60.3
11	T1	335	9.9	353	9.9	0.206	0.1	LOS A	0.0	0.0	0.00	0.04	0.00	78.7
Approach		354	11.3	373	11.3	0.206	0.5	NA	0.0	0.0	0.00	0.04	0.00	77.0
All Vehicles		678	13.1	714	13.1	0.206	2.0	NA	0.5	11.3	0.09	0.12	0.09	69.0

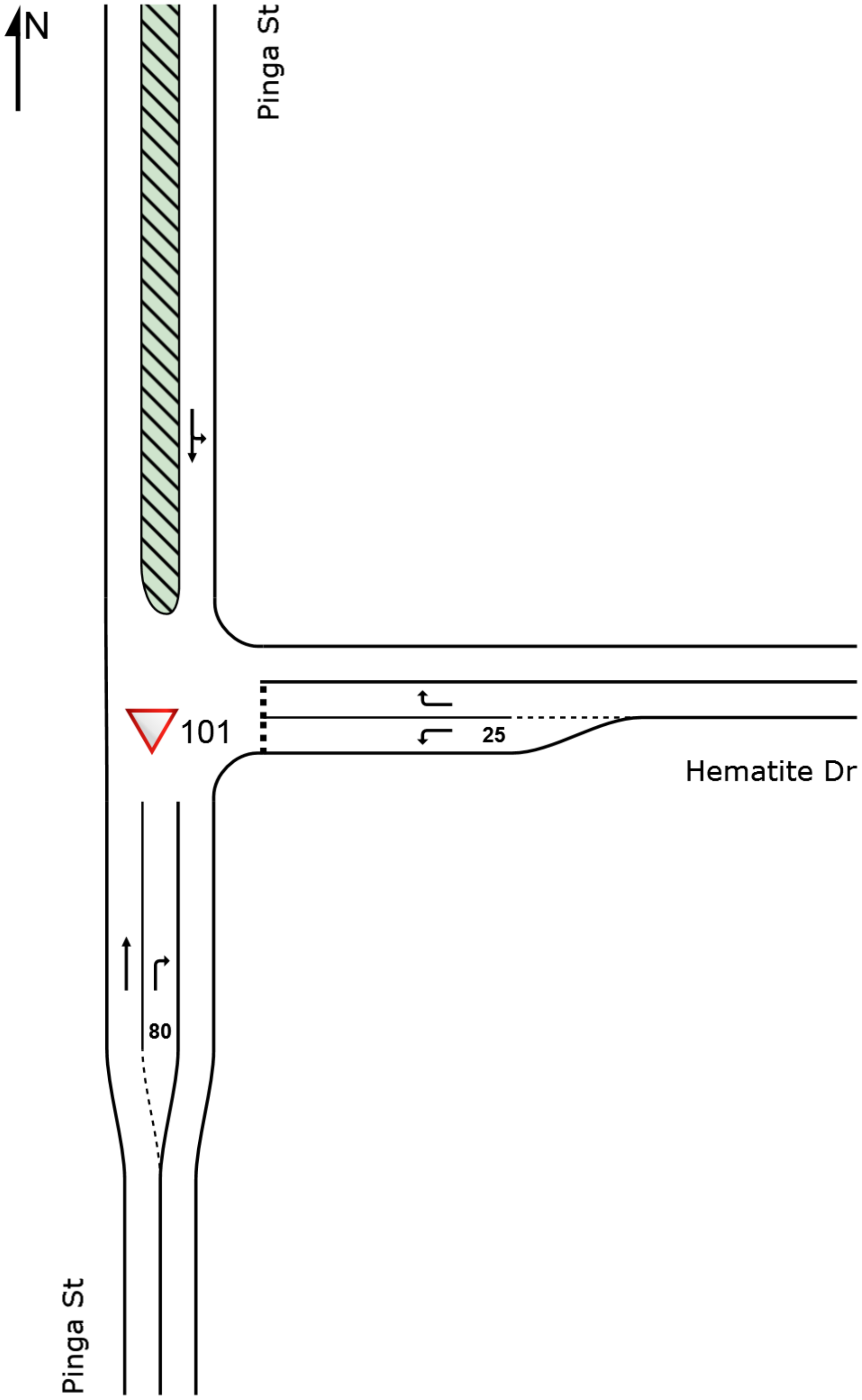
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Existing - Modified Layout (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Pinga Hematite Am Peak Existing - Modified Layout (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	370	8.6	389	8.6	0.213	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	66	7.6	69	7.6	0.056	8.1	LOS A	0.2	1.9	0.41	0.64	0.41	48.1
Approach		436	8.5	459	8.5	0.213	1.3	NA	0.2	1.9	0.06	0.11	0.06	72.1
East: Hematite Dr														
7	L2	27	22.2	28	22.2	0.025	5.8	LOS A	0.1	0.9	0.34	0.54	0.34	44.3
9	R2	23	21.7	24	21.7	0.143	25.5	LOS D	0.5	6.8	0.81	0.92	0.81	36.8
Approach		50	22.0	53	22.0	0.143	14.9	LOS B	0.5	6.8	0.56	0.71	0.56	40.0
North: Pinga St														
10	L2	37	32.4	39	32.4	0.157	7.4	LOS A	0.0	0.0	0.00	0.11	0.00	60.5
11	T1	219	16.9	231	16.9	0.157	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.6
Approach		256	19.1	269	19.1	0.157	1.2	NA	0.0	0.0	0.00	0.11	0.00	73.0
All Vehicles		742	13.1	781	13.1	0.213	2.2	NA	0.5	6.8	0.07	0.15	0.07	68.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Existing - Modified Layout (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total	HV]	DEMAND FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	230	16.1	242	16.1	0.138	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.5
6	R2	18	5.6	19	5.6	0.017	8.5	LOS A	0.1	0.6	0.46	0.64	0.46	47.9
Approach		248	15.3	261	15.3	0.138	0.7	NA	0.1	0.6	0.03	0.07	0.03	75.0
East: Hematite Dr														
7	L2	54	5.6	57	5.6	0.052	6.0	LOS A	0.2	1.6	0.41	0.60	0.41	44.4
9	R2	22	36.4	23	36.4	0.264	51.7	LOS F	0.9	20.2	0.89	0.99	0.99	29.4
Approach		76	14.5	80	14.5	0.264	19.3	LOS C	0.9	20.2	0.55	0.71	0.58	37.8
North: Pinga St														
10	L2	19	36.8	20	36.8	0.206	7.6	LOS A	0.0	0.0	0.00	0.04	0.00	60.3
11	T1	335	9.9	353	9.9	0.206	0.1	LOS A	0.0	0.0	0.00	0.04	0.00	78.7
Approach		354	11.3	373	11.3	0.206	0.5	NA	0.0	0.0	0.00	0.04	0.00	77.0
All Vehicles		678	13.1	714	13.1	0.264	2.7	NA	0.9	20.2	0.07	0.12	0.08	67.9

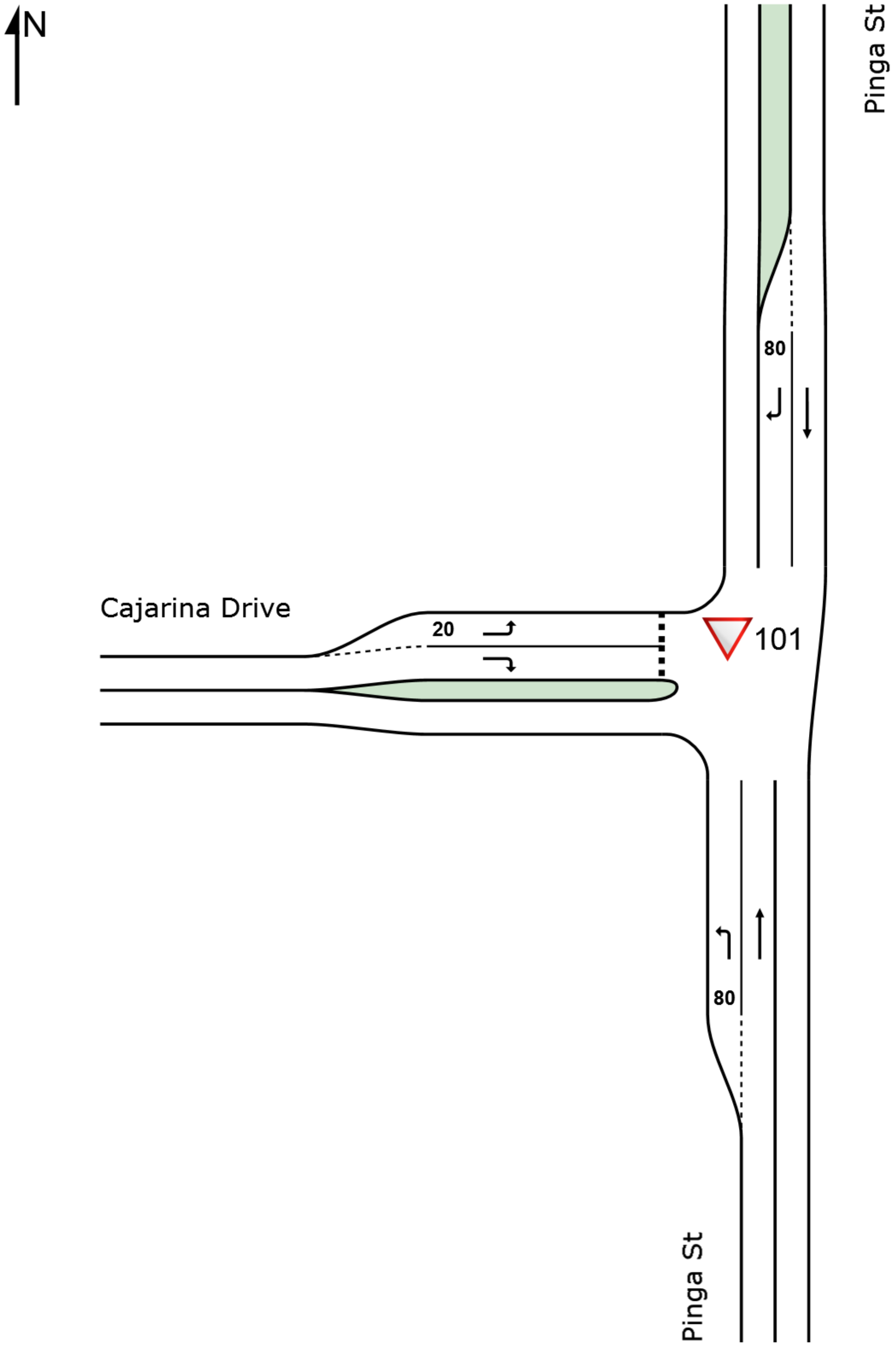
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Cajarina Rd Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Cajarina Rd Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance															
Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St															
10	L2	122	3.3	128	3.3	0.071	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.5
11	T1	402	7.0	423	7.0	0.227	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
Approach		524	6.1	552	6.1	0.227	1.7	NA	0.0	0.0	0.00	0.15	0.00	72.7
North: Pinga St															
5	T1	226	14.2	238	14.2	0.134	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	20	55.0	21	55.0	0.072	17.4	LOS C	0.3	4.2	0.67	0.87	0.67	40.8
Approach		246	17.5	259	17.5	0.134	1.4	NA	0.3	4.2	0.05	0.07	0.05	72.1
West: Cajarina Drive															
7	L2	28	42.9	29	42.9	0.089	13.2	LOS B	0.3	5.3	0.59	0.81	0.59	40.8
9	R2	56	16.1	59	16.1	0.200	16.5	LOS C	0.7	6.2	0.75	0.90	0.78	37.9
Approach		84	25.0	88	25.0	0.200	15.4	LOS C	0.7	6.2	0.70	0.87	0.72	38.8
All Vehicles		854	11.2	899	11.2	0.227	2.9	NA	0.7	6.2	0.08	0.20	0.09	65.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Cajarina Rd PM Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
10	L2	38	10.5	40	10.5	0.023	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	57.6
11	T1	228	10.1	240	10.1	0.131	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
Approach		266	10.2	280	10.2	0.131	1.1	NA	0.0	0.0	0.00	0.10	0.00	74.0
North: Pinga St														
5	T1	385	7.3	405	7.3	0.218	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	4	80.0	4	80.0	0.014	14.4	LOS B	0.0	1.3	0.54	0.68	0.54	42.0
Approach		389	8.0	409	8.0	0.218	0.2	NA	0.0	1.3	0.01	0.01	0.01	78.9
West: Cajarina Drive														
7	L2	16	93.8	17	93.8	0.077	17.5	LOS C	0.3	8.9	0.55	0.77	0.55	39.0
9	R2	170	1.2	179	1.2	0.448	15.9	LOS C	2.3	17.0	0.76	1.00	1.08	38.3
Approach		186	9.1	196	9.1	0.448	16.0	LOS C	2.3	17.0	0.74	0.98	1.04	38.4
All Vehicles		841	8.9	885	8.9	0.448	4.0	NA	2.3	17.0	0.17	0.25	0.23	59.7

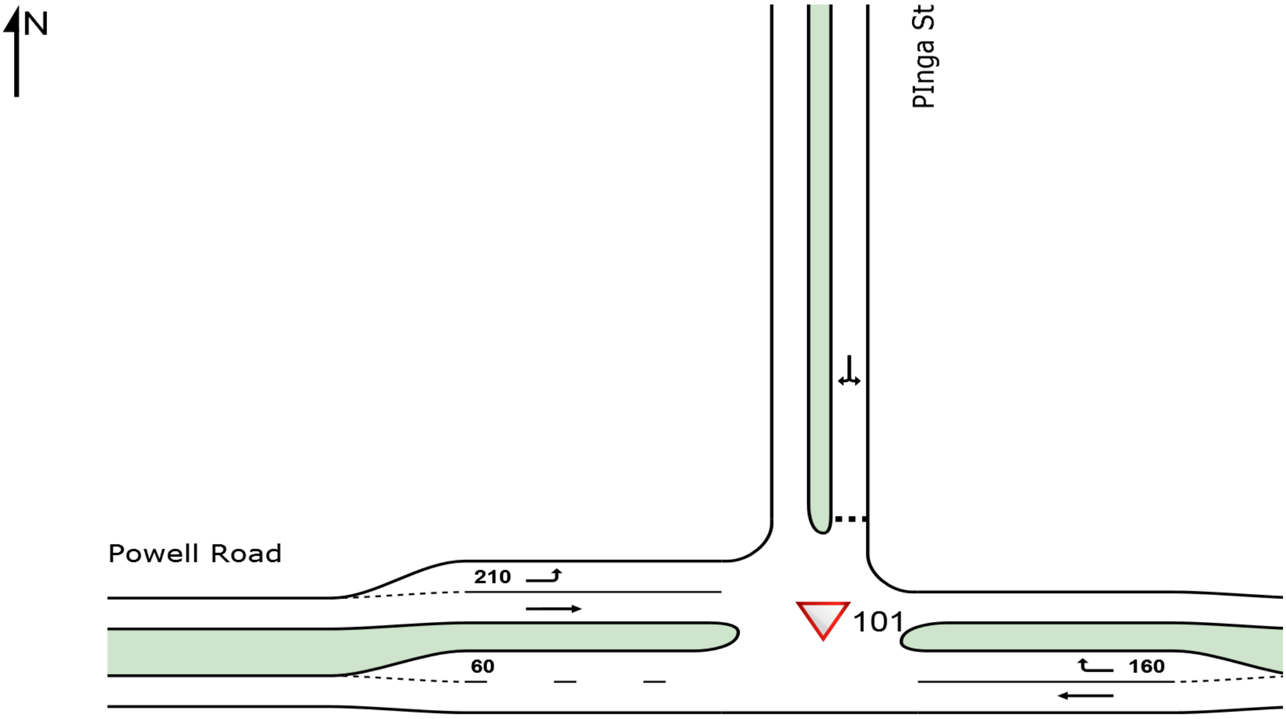
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Pinga Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Powell Pinga Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Powell Road														
5	T1	1	0.0	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
6	R2	524	6.1	552	6.1	0.397	6.7	LOS A	2.4	18.9	0.04	0.63	0.04	45.5
Approach		525	6.1	553	6.1	0.397	6.7	NA	2.4	18.9	0.04	0.63	0.04	45.5
North: PInga St														
7	L2	285	14.4	300	14.4	0.244	4.7	LOS A	1.1	9.2	0.01	0.52	0.01	42.6
9	R2	1	0.0	1	0.0	0.244	12.4	LOS B	1.1	9.2	0.01	0.52	0.01	45.4
Approach		286	14.3	301	14.3	0.244	4.7	LOS A	1.1	9.2	0.01	0.52	0.01	42.6
West: Powell Road														
10	L2	2	0.0	2	0.0	0.001	6.9	LOS A	0.0	0.0	0.00	0.63	0.00	61.9
11	T1	1	0.0	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		3	0.0	3	0.0	0.001	4.6	NA	0.0	0.0	0.00	0.42	0.00	66.5
All Vehicles		814	9.0	857	9.0	0.397	6.0	NA	2.4	18.9	0.03	0.59	0.03	44.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

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Project: S:\ACTIVE PROJECTS\21-11-159\DOCUMENTS\Sidra\Wedgefield.sip9

MOVEMENT SUMMARY

Site: 101 [Powell Pinga Pm Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Powell Road														
5	T1	1	0.0	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
6	R2	266	10.2	280	10.2	0.207	6.7	LOS A	1.0	8.1	0.02	0.63	0.02	45.4
Approach		267	10.1	281	10.1	0.207	6.7	NA	1.0	8.1	0.02	0.63	0.02	45.5
North: PInga St														
7	L2	552	4.5	581	4.5	0.448	4.6	LOS A	2.6	20.4	0.02	0.52	0.02	42.9
9	R2	1	0.0	1	0.0	0.448	8.7	LOS A	2.6	20.4	0.02	0.52	0.02	45.4
Approach		553	4.5	582	4.5	0.448	4.6	LOS A	2.6	20.4	0.02	0.52	0.02	42.9
West: Powell Road														
10	L2	1	0.0	1	0.0	0.001	6.9	LOS A	0.0	0.0	0.00	0.63	0.00	61.9
11	T1	1	0.0	1	0.0	0.001	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		2	0.0	2	0.0	0.001	3.5	NA	0.0	0.0	0.00	0.31	0.00	69.3
All Vehicles		822	6.3	865	6.3	0.448	5.3	NA	2.6	20.4	0.02	0.56	0.02	43.7

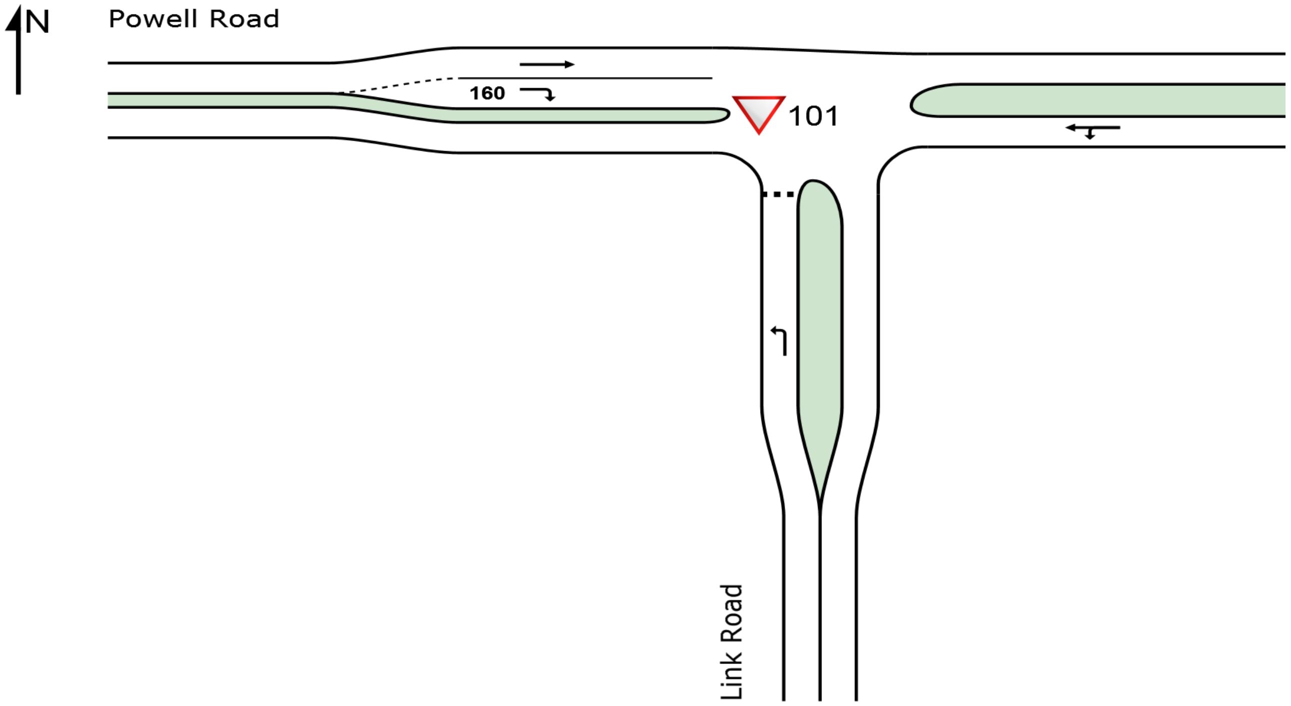
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Link Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Powell Link Am Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Link Road														
7	L2	370	5.1	389	5.1	0.285	5.4	LOS A	1.4	10.9	0.32	0.55	0.32	40.5
Approach		370	5.1	389	5.1	0.285	5.4	LOS A	1.4	10.9	0.32	0.55	0.32	40.5
East: Powell Road														
10	L2	1	0.0	1	0.0	0.089	6.9	LOS A	0.0	0.0	0.00	0.01	0.00	72.1
11	T1	154	9.1	162	9.1	0.089	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.4
Approach		155	9.0	163	9.0	0.089	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.3
West: Powell Road														
5	T1	107	23.4	113	23.4	0.067	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.7
6	R2	173	15.0	182	15.0	0.131	7.5	LOS A	0.6	5.5	0.31	0.62	0.31	43.0
Approach		280	18.2	295	18.2	0.131	4.6	NA	0.6	5.5	0.19	0.39	0.19	56.4
All Vehicles		805	10.4	847	10.4	0.285	4.1	NA	1.4	10.9	0.22	0.39	0.22	52.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Powell Link Pm Peak Existing (Site Folder: Existing Volumes)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Link Road														
7	L2	185	9.7	195	9.7	0.136	5.0	LOS A	0.6	4.9	0.20	0.51	0.20	40.0
Approach		185	9.7	195	9.7	0.136	5.0	LOS A	0.6	4.9	0.20	0.51	0.20	40.0
East: Powell Road														
10	L2	1	0.0	1	0.0	0.045	6.9	LOS A	0.0	0.0	0.00	0.02	0.00	71.9
11	T1	77	11.7	81	11.7	0.045	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	79.1
Approach		78	11.5	82	11.5	0.045	0.1	NA	0.0	0.0	0.00	0.02	0.00	79.0
West: Powell Road														
5	T1	124	6.5	131	6.5	0.070	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
6	R2	427	4.0	449	4.0	0.275	7.0	LOS A	1.6	11.9	0.23	0.60	0.23	43.9
Approach		551	4.5	580	4.5	0.275	5.4	NA	1.6	11.9	0.18	0.46	0.18	51.9
All Vehicles		814	6.4	857	6.4	0.275	4.8	NA	1.6	11.9	0.17	0.43	0.17	51.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

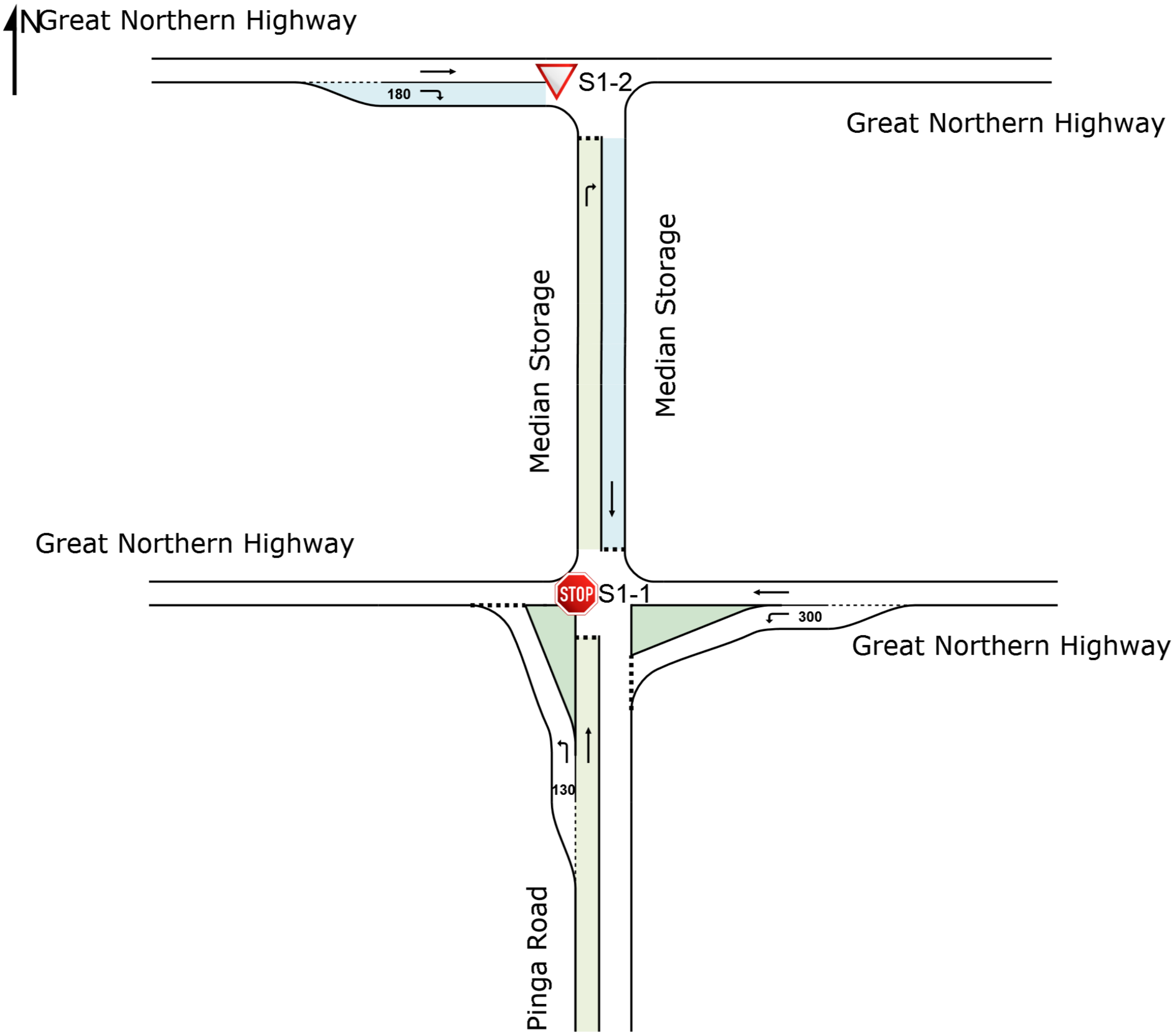
Scenario 2 – SIDRA Results

NETWORK LAYOUT

Network: SCTI-B [GNH Pinga St Am Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	GNH Pinga Am Existing - Stage 2
S1-1	NA	GNH Pinga Am Existing - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Am Existing - Stage 2 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Am Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	95	30.0	95	30.0	0.092	0.2	LOS A	0.2	3.0	0.11	0.05	0.11	41.0
Approach		95	30.0	95	30.0	0.092	0.2	LOS A	0.2	3.0	0.11	0.05	0.11	41.0
West: Great Northern Highway														
2	T1	61	10.3	61	10.3	0.033	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	82	34.6	82	34.6	0.055	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		143	24.3	143	24.3	0.055	5.1	NA	0.0	0.0	0.00	0.45	0.00	69.9
All Vehicles		238	26.5	238	26.5	0.092	3.2	NA	0.2	3.0	0.05	0.29	0.05	56.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Am Existing - Stage 1 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Am Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	113	31.8	113	31.8	0.136	8.3	LOS A	0.6	9.5	0.33	0.59	0.33	53.3
2	T1	95	30.0	95	30.0	0.201	13.9	LOS B	0.9	12.3	0.58	0.86	0.58	46.5
Approach		207	31.0	207	31.0	0.201	10.8	LOS B	0.9	12.3	0.44	0.71	0.44	51.1
East: Great Northern Highway														
3	L2	77	17.8	77	17.8	0.075	8.4	LOS A	0.3	3.1	0.29	0.59	0.29	56.7
4	T1	79	38.7	79	38.7	0.051	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		156	28.4	156	28.4	0.075	4.2	LOS A	0.3	3.1	0.14	0.29	0.14	66.4
North: Median Storage														
5	T1	82	34.6	82	34.6	0.125	1.6	LOS A	0.5	9.1	0.33	0.22	0.33	38.5
Approach		82	34.6	82	34.6	0.125	1.6	LOS A	0.5	9.1	0.33	0.22	0.33	38.5
All Vehicles		445	30.7	445	30.7	0.201	6.8	NA	0.9	12.3	0.32	0.47	0.32	54.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Pm Existing - Stage 2 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Pm Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	118	12.5	118	12.5	0.102	0.4	LOS A	0.2	2.6	0.18	0.11	0.18	46.9
Approach		118	12.5	118	12.5	0.102	0.4	LOS A	0.2	2.6	0.18	0.11	0.18	46.9
West: Great Northern Highway														
2	T1	118	18.8	118	18.8	0.068	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	124	31.4	124	31.4	0.082	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		242	25.2	242	25.2	0.082	4.6	NA	0.0	0.0	0.00	0.40	0.00	71.2
All Vehicles		360	21.1	360	21.1	0.102	3.2	NA	0.2	2.6	0.06	0.30	0.06	62.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Pm Existing - Stage 1 (Site Folder: Existing Volumes)]

Network: SCTI-B [GNH Pinga St Pm Peak Existing (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga Road														
1	L2	102	19.6	102	19.6	0.111	7.6	LOS A	0.5	7.2	0.26	0.56	0.26	56.3
2	T1	118	12.5	118	12.5	0.196	11.9	LOS B	0.9	9.1	0.55	0.83	0.55	48.4
Approach		220	15.8	220	15.8	0.196	9.9	LOS A	0.9	9.1	0.41	0.71	0.41	53.2
East: Great Northern Highway														
3	L2	46	13.6	46	13.6	0.048	8.7	LOS A	0.2	1.9	0.35	0.61	0.35	57.6
4	T1	69	18.2	69	18.2	0.040	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		116	16.4	116	16.4	0.048	3.5	LOS A	0.2	1.9	0.14	0.24	0.14	69.2
North: Median Storage														
5	T1	124	31.4	124	31.4	0.167	1.1	LOS A	0.7	12.3	0.28	0.16	0.28	39.9
Approach		124	31.4	124	31.4	0.167	1.1	LOS A	0.7	12.3	0.28	0.16	0.28	39.9
All Vehicles		460	20.1	460	20.1	0.196	5.9	NA	0.9	12.3	0.31	0.44	0.31	54.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

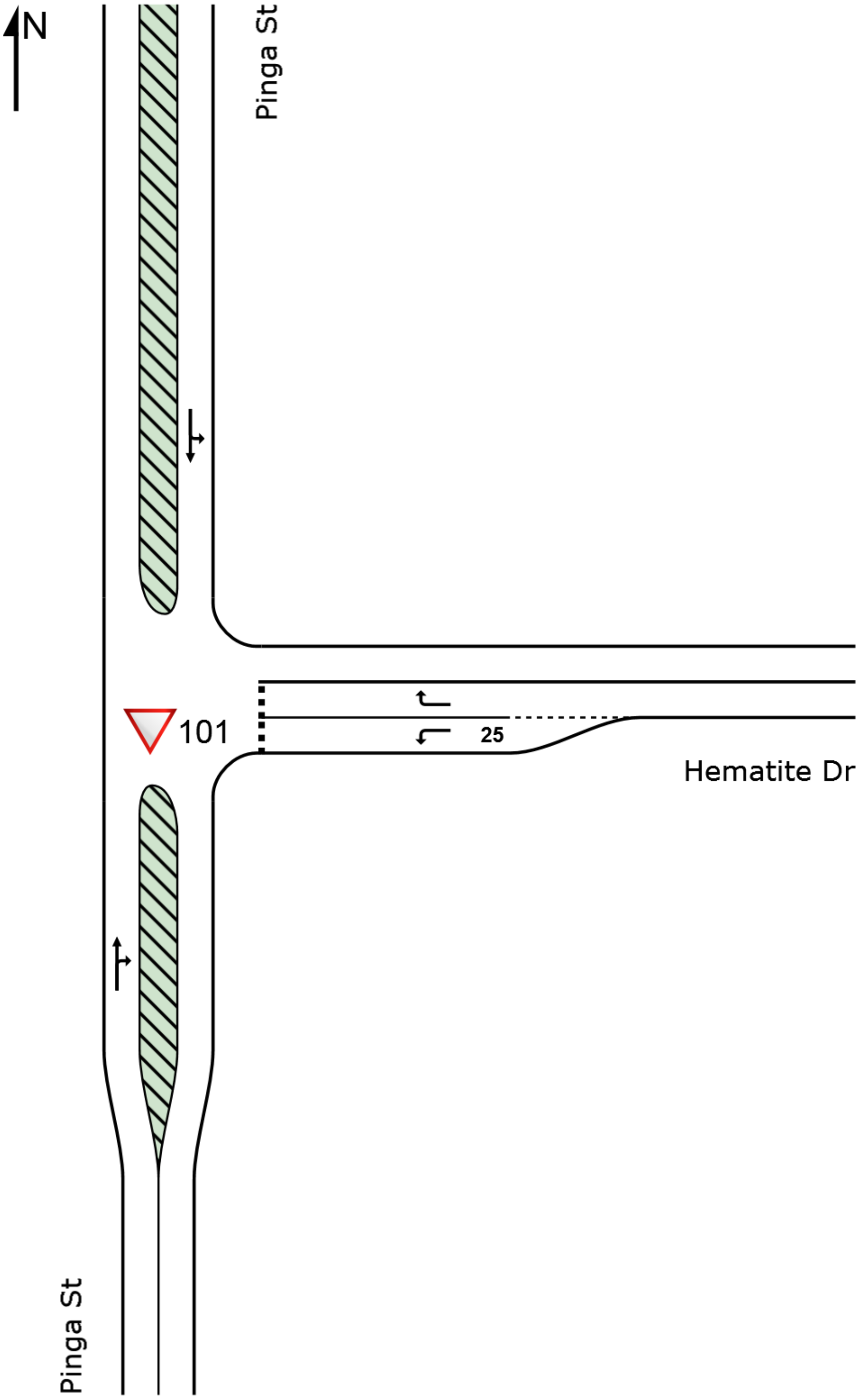
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Existing with Quarry/ Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Existing with Quarry/ Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	370	8.7	389	8.7	0.251	0.3	LOS A	0.5	4.2	0.13	0.08	0.13	76.4
6	R2	46	7.6	48	7.6	0.251	8.5	LOS A	0.5	4.2	0.13	0.08	0.13	54.6
Approach		416	8.5	438	8.5	0.251	1.2	NA	0.5	4.2	0.13	0.08	0.13	73.1
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.7	LOS A	0.1	0.5	0.34	0.53	0.34	44.3
9	R2	23	21.7	24	21.7	0.095	16.5	LOS C	0.3	4.2	0.72	0.88	0.72	40.5
Approach		39	21.9	41	21.9	0.095	12.1	LOS B	0.3	4.2	0.57	0.74	0.57	41.7
North: Pinga St														
10	L2	37	32.4	39	32.4	0.157	7.4	LOS A	0.0	0.0	0.00	0.11	0.00	60.5
11	T1	219	16.9	231	16.9	0.157	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.6
Approach		256	19.1	269	19.1	0.157	1.2	NA	0.0	0.0	0.00	0.11	0.00	73.0
All Vehicles		711	13.1	748	13.1	0.251	1.8	NA	0.5	4.2	0.11	0.13	0.11	69.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pinga Hematite Pm Peak Existing with Quarry/ Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	230	16.1	242	16.1	0.148	0.3	LOS A	0.1	1.3	0.06	0.05	0.06	77.2
6	R2	12	5.6	13	5.6	0.148	8.8	LOS A	0.1	1.3	0.06	0.05	0.06	55.4
Approach		242	15.6	255	15.6	0.148	0.7	NA	0.1	1.3	0.06	0.05	0.06	75.7
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.038	6.0	LOS A	0.1	1.2	0.41	0.59	0.41	44.4
9	R2	22	36.4	23	36.4	0.164	28.2	LOS D	0.5	11.1	0.80	0.92	0.81	36.3
Approach		62	16.5	65	16.5	0.164	13.9	LOS B	0.5	11.1	0.55	0.71	0.55	40.7
North: Pinga St														
10	L2	19	36.8	20	36.8	0.206	7.6	LOS A	0.0	0.0	0.00	0.04	0.00	60.3
11	T1	335	9.9	353	9.9	0.206	0.1	LOS A	0.0	0.0	0.00	0.04	0.00	78.7
Approach		354	11.3	373	11.3	0.206	0.5	NA	0.0	0.0	0.00	0.04	0.00	77.0
All Vehicles		658	13.4	693	13.4	0.206	1.8	NA	0.5	11.1	0.08	0.11	0.08	70.2

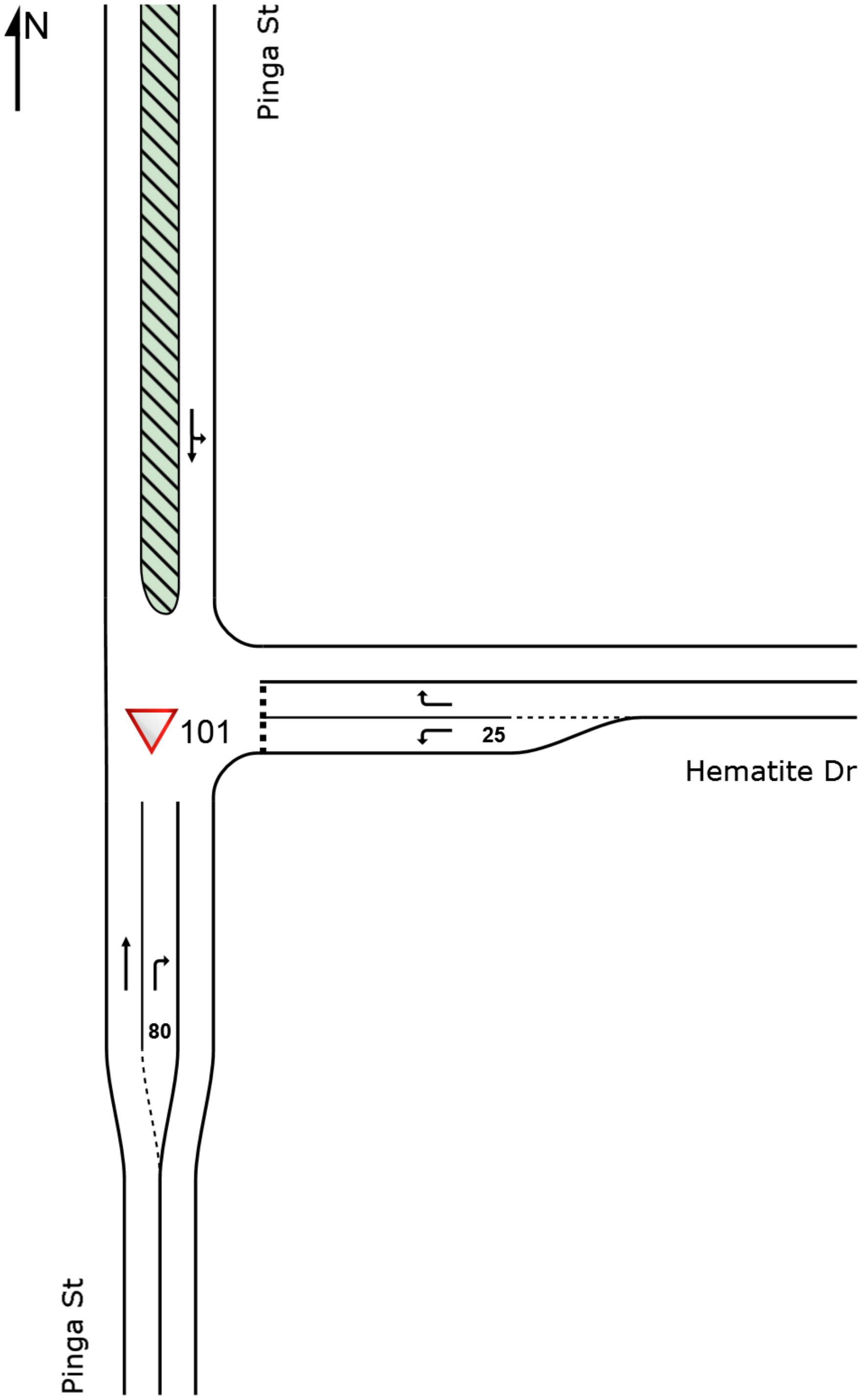
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Existing with Quarry/ Powell - Modified Layout (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Existing with Quarry/ Powell - Modified Layout (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total	HV]	DEMAND FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	370	8.7	389	8.7	0.212	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	46	7.6	48	7.6	0.039	8.1	LOS A	0.2	1.3	0.40	0.63	0.40	48.1
Approach		416	8.5	438	8.5	0.212	1.0	NA	0.2	1.3	0.04	0.08	0.04	73.9
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.7	LOS A	0.1	0.5	0.34	0.53	0.34	44.3
9	R2	23	21.7	24	21.7	0.137	24.5	LOS C	0.5	6.5	0.80	0.91	0.80	37.2
Approach		39	21.9	41	21.9	0.137	16.8	LOS C	0.5	6.5	0.61	0.76	0.61	39.4
North: Pinga St														
10	L2	37	32.4	39	32.4	0.157	7.4	LOS A	0.0	0.0	0.00	0.11	0.00	60.5
11	T1	219	16.9	231	16.9	0.157	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.6
Approach		256	19.1	269	19.1	0.157	1.2	NA	0.0	0.0	0.00	0.11	0.00	73.0
All Vehicles		711	13.1	748	13.1	0.212	1.9	NA	0.5	6.5	0.06	0.13	0.06	69.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Existing with Quarry/ Powell - Modified Layout (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	230	16.1	242	16.1	0.137	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.5
6	R2	12	5.6	13	5.6	0.011	8.4	LOS A	0.0	0.4	0.46	0.62	0.46	47.9
Approach		242	15.6	255	15.6	0.137	0.5	NA	0.0	0.4	0.02	0.05	0.02	76.1
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.038	6.0	LOS A	0.1	1.2	0.41	0.59	0.41	44.4
9	R2	22	36.4	23	36.4	0.259	50.6	LOS F	0.9	19.8	0.88	0.99	0.98	29.7
Approach		62	16.5	65	16.5	0.259	21.8	LOS C	0.9	19.8	0.58	0.73	0.61	36.8
North: Pinga St														
10	L2	19	36.8	20	36.8	0.206	7.6	LOS A	0.0	0.0	0.00	0.04	0.00	60.3
11	T1	335	9.9	353	9.9	0.206	0.1	LOS A	0.0	0.0	0.00	0.04	0.00	78.7
Approach		354	11.3	373	11.3	0.206	0.5	NA	0.0	0.0	0.00	0.04	0.00	77.0
All Vehicles		658	13.4	693	13.4	0.259	2.5	NA	0.9	19.8	0.06	0.11	0.07	69.0

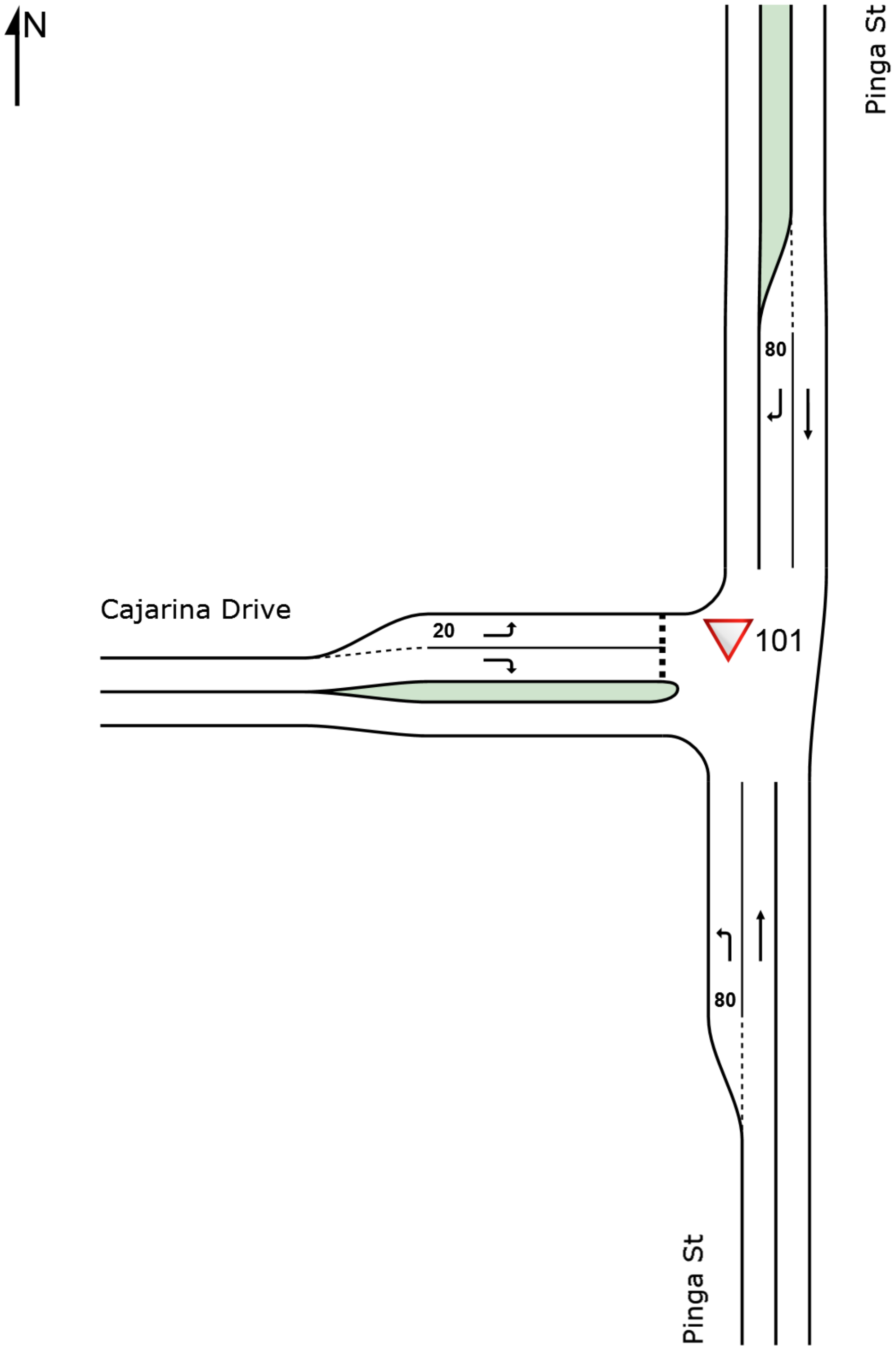
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Cajarina Rd Am Peak Existing with Quarry/ Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Cajarina Rd Am Peak Existing with Quarry/Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St														
10	L2	47	3.3	49	3.3	0.027	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.5
11	T1	382	7.0	402	7.0	0.216	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
Approach		429	6.6	452	6.6	0.216	0.8	NA	0.0	0.0	0.00	0.07	0.00	76.1
North: Pinga St														
5	T1	226	14.2	238	14.2	0.134	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	20	55.0	21	55.0	0.058	14.5	LOS B	0.2	3.5	0.59	0.80	0.59	42.6
Approach		246	17.5	259	17.5	0.134	1.2	NA	0.2	3.5	0.05	0.07	0.05	72.7
West: Cajarina Drive														
7	L2	28	42.9	29	42.9	0.084	12.6	LOS B	0.3	5.0	0.57	0.78	0.57	41.2
9	R2	25	16.1	26	16.1	0.080	14.1	LOS B	0.3	2.4	0.69	0.86	0.69	39.2
Approach		53	30.2	56	30.2	0.084	13.3	LOS B	0.3	5.0	0.63	0.82	0.63	40.2
All Vehicles		728	12.0	766	12.0	0.216	1.8	NA	0.3	5.0	0.06	0.12	0.06	69.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Cajarina Rd PM Peak Existing with Quarry/ Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
10	L2	9	10.5	9	10.5	0.005	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	57.6
11	T1	222	10.1	234	10.1	0.128	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
Approach		231	10.1	243	10.1	0.128	0.3	NA	0.0	0.0	0.00	0.03	0.00	77.9
North: Pinga St														
5	T1	385	7.3	405	7.3	0.218	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	4	80.0	4	80.0	0.012	13.1	LOS B	0.0	1.1	0.51	0.66	0.51	42.8
Approach		389	8.0	409	8.0	0.218	0.2	NA	0.0	1.1	0.01	0.01	0.01	78.9
West: Cajarina Drive														
7	L2	16	93.8	17	93.8	0.075	17.0	LOS C	0.3	8.7	0.55	0.76	0.55	39.3
9	R2	86	1.2	91	1.2	0.219	12.4	LOS B	0.8	6.2	0.67	0.86	0.70	40.3
Approach		102	15.7	107	15.7	0.219	13.1	LOS B	0.8	8.7	0.65	0.84	0.68	40.1
All Vehicles		722	9.8	760	9.8	0.219	2.0	NA	0.8	8.7	0.10	0.13	0.10	66.4

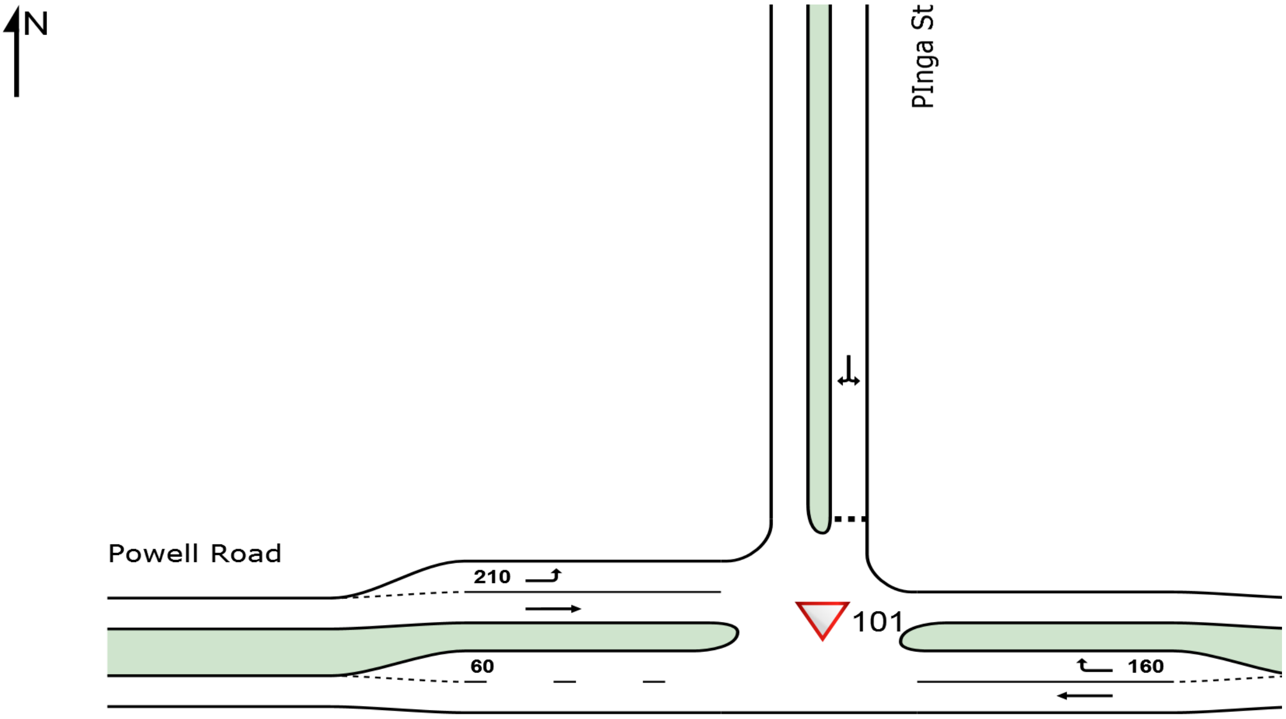
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Pinga Am Peak Existing with Quarry/Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Powell Pinga Am Peak Existing with Quarry/Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Powell Road														
5	T1	75	6.1	79	6.1	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
6	R2	429	6.1	452	6.1	0.336	6.9	LOS A	1.8	14.4	0.15	0.60	0.15	44.9
Approach		504	6.1	531	6.1	0.336	5.9	NA	1.8	14.4	0.13	0.51	0.13	49.5
North: PInga St														
7	L2	243	14.4	256	14.4	0.215	4.9	LOS A	0.9	7.8	0.12	0.50	0.12	42.1
9	R2	1	14.4	1	14.4	0.215	13.3	LOS B	0.9	7.8	0.12	0.50	0.12	44.8
Approach		244	14.4	257	14.4	0.215	4.9	LOS A	0.9	7.8	0.12	0.50	0.12	42.1
West: Powell Road														
10	L2	2	6.1	2	6.1	0.001	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.6
11	T1	31	14.4	33	14.4	0.018	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		33	13.9	35	13.9	0.018	0.4	NA	0.0	0.0	0.00	0.04	0.00	78.3
All Vehicles		781	9.0	822	9.0	0.336	5.3	NA	1.8	14.4	0.12	0.49	0.12	48.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Pm Peak Existing with Quarry Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Powell Road														
5	T1	29	10.2	31	10.2	0.017	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	232	10.2	244	10.2	0.197	7.2	LOS A	0.9	7.5	0.23	0.61	0.23	44.5
Approach		261	10.2	275	10.2	0.197	6.4	NA	0.9	7.5	0.20	0.54	0.20	47.8
North: PInga St														
7	L2	454	4.5	478	4.5	0.401	5.2	LOS A	2.1	16.1	0.26	0.52	0.26	41.8
9	R2	1	4.5	1	4.5	0.401	9.7	LOS A	2.1	16.1	0.26	0.52	0.26	44.6
Approach		455	4.5	479	4.5	0.401	5.2	LOS A	2.1	16.1	0.26	0.52	0.26	41.8
West: Powell Road														
10	L2	1	10.2	1	10.2	0.001	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	59.6
11	T1	84	4.5	88	4.5	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		85	4.6	89	4.6	0.047	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.6
All Vehicles		801	6.4	843	6.4	0.401	5.0	NA	2.1	16.1	0.21	0.48	0.21	47.0

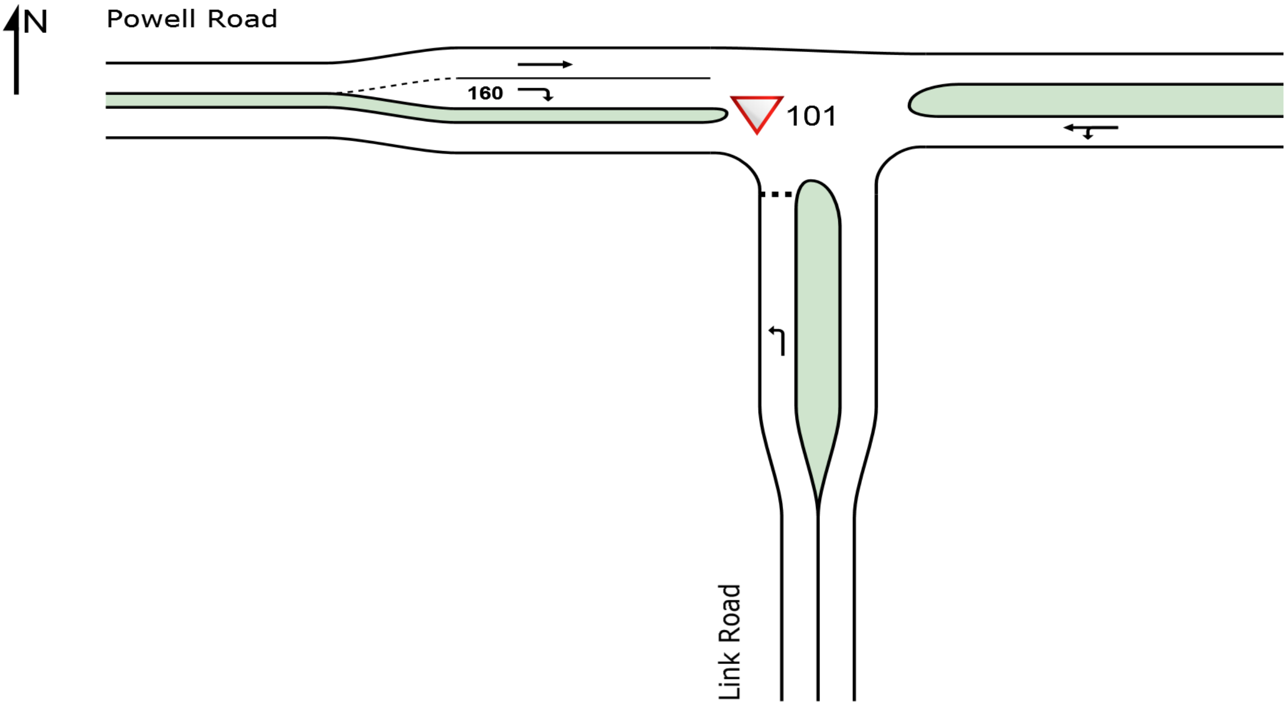
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Link Am Peak Existing with Quarry/Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Am Peak Existing with Quarry/Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Link Road														
7	L2	370	5.1	389	5.1	0.279	5.2	LOS A	1.4	10.7	0.30	0.54	0.30	40.6
Approach		370	5.1	389	5.1	0.279	5.2	LOS A	1.4	10.7	0.30	0.54	0.30	40.6
East: Powell Road														
10	L2	1	9.1	1	9.1	0.077	7.1	LOS A	0.0	0.0	0.00	0.01	0.00	70.2
11	T1	134	9.1	141	9.1	0.077	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.4
Approach		135	9.1	142	9.1	0.077	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.3
West: Powell Road														
5	T1	99	20.4	104	20.4	0.061	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	175	15.0	184	15.0	0.130	7.4	LOS A	0.6	5.5	0.29	0.61	0.29	43.2
Approach		274	17.0	288	17.0	0.130	4.7	NA	0.6	5.5	0.18	0.39	0.18	55.9
All Vehicles		779	10.0	820	10.0	0.279	4.2	NA	1.4	10.7	0.21	0.40	0.21	52.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Pm Peak Existing with Quarry/Powell (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Link Road														
7	L2	189	9.7	199	9.7	0.138	5.0	LOS A	0.6	5.0	0.19	0.51	0.19	40.0
Approach		189	9.7	199	9.7	0.138	5.0	LOS A	0.6	5.0	0.19	0.51	0.19	40.0
East: Powell Road														
10	L2	1	11.7	1	11.7	0.042	7.1	LOS A	0.0	0.0	0.00	0.02	0.00	69.5
11	T1	71	11.7	75	11.7	0.042	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	79.2
Approach		72	11.7	76	11.7	0.042	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.0
West: Powell Road														
5	T1	111	6.5	117	6.5	0.063	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
6	R2	427	4.0	449	4.0	0.274	7.0	LOS A	1.5	11.9	0.22	0.60	0.22	44.0
Approach		538	4.5	566	4.5	0.274	5.5	NA	1.5	11.9	0.18	0.47	0.18	51.3
All Vehicles		799	6.4	841	6.4	0.274	4.9	NA	1.5	11.9	0.16	0.44	0.16	50.8

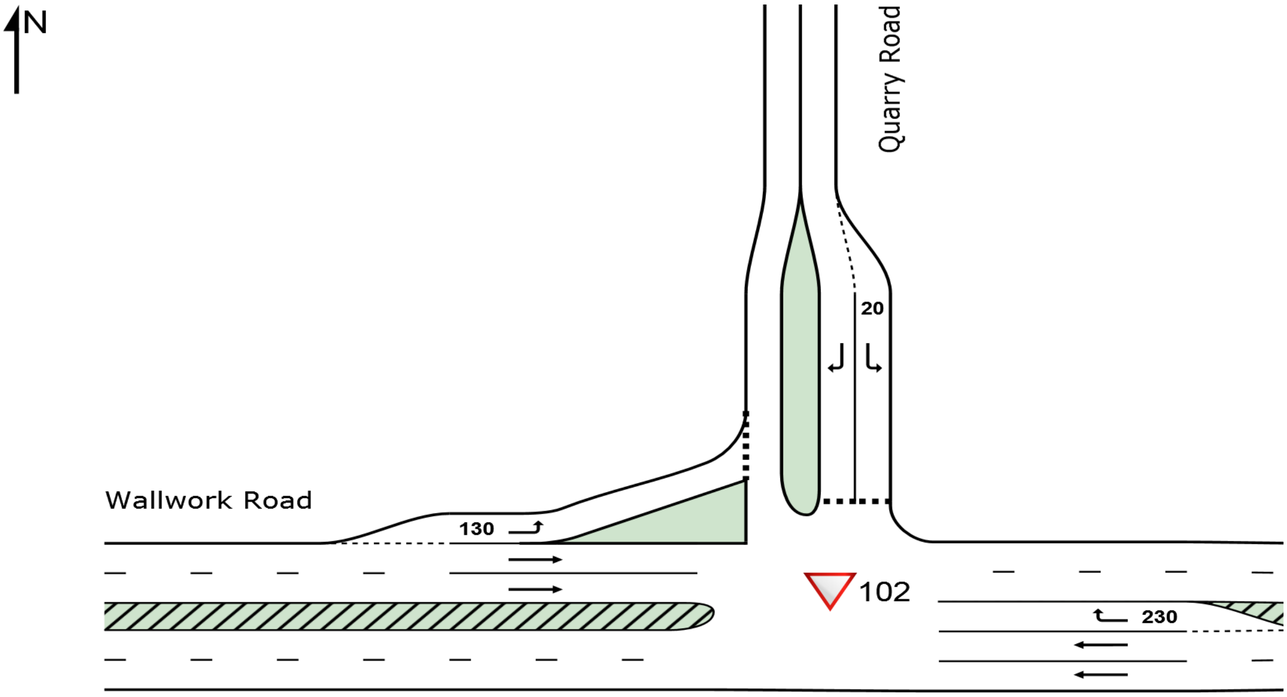
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 102 [Wallwork Rd Quarry Rd Am Existing - Not Staged (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Am Existing - Not Staged (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	337	7.0	355	7.0	0.095	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	20	7.6	21	7.6	0.024	9.0	LOS A	0.1	0.7	0.45	0.66	0.45	56.1
Approach		357	7.0	376	7.0	0.095	0.5	NA	0.1	0.7	0.03	0.04	0.03	78.6
North: Quarry Road														
1	L2	11	22.2	12	22.2	0.012	7.7	LOS A	0.0	0.4	0.30	0.58	0.30	50.5
3	R2	1	22.2	1	22.2	0.005	19.6	LOS C	0.0	0.1	0.73	0.77	0.73	41.1
Approach		12	22.2	13	22.2	0.012	8.7	LOS A	0.0	0.4	0.34	0.60	0.34	49.6
West: Wallwork Road														
4	L2	1	7.6	1	7.6	0.001	7.5	LOS A	0.0	0.0	0.08	0.58	0.08	59.0
5	T1	396	2.0	417	2.0	0.108	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		397	2.0	418	2.0	0.108	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		766	4.7	806	4.7	0.108	0.4	NA	0.1	0.7	0.02	0.03	0.02	78.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Pm Existing - Not Staged (Site Folder: Existing Volumes - Quarry Road and Powell Rd connected)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	512	3.0	539	3.0	0.141	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	6	5.6	6	5.6	0.009	10.2	LOS B	0.0	0.3	0.53	0.67	0.53	55.0
Approach		518	3.0	545	3.0	0.141	0.1	NA	0.0	0.3	0.01	0.01	0.01	79.6
North: Quarry Road														
1	L2	14	5.6	15	5.6	0.016	7.7	LOS A	0.1	0.4	0.36	0.61	0.36	55.6
3	R2	1	5.6	1	5.6	0.007	28.8	LOS D	0.0	0.2	0.84	0.89	0.84	38.4
Approach		15	5.6	16	5.6	0.016	9.1	LOS A	0.1	0.4	0.39	0.62	0.39	54.0
West: Wallwork Road														
4	L2	1	5.6	1	5.6	0.001	7.4	LOS A	0.0	0.0	0.04	0.59	0.04	59.5
5	T1	559	1.0	588	1.0	0.152	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		560	1.0	589	1.0	0.152	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
All Vehicles		1093	2.0	1151	2.0	0.152	0.2	NA	0.1	0.4	0.01	0.01	0.01	79.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

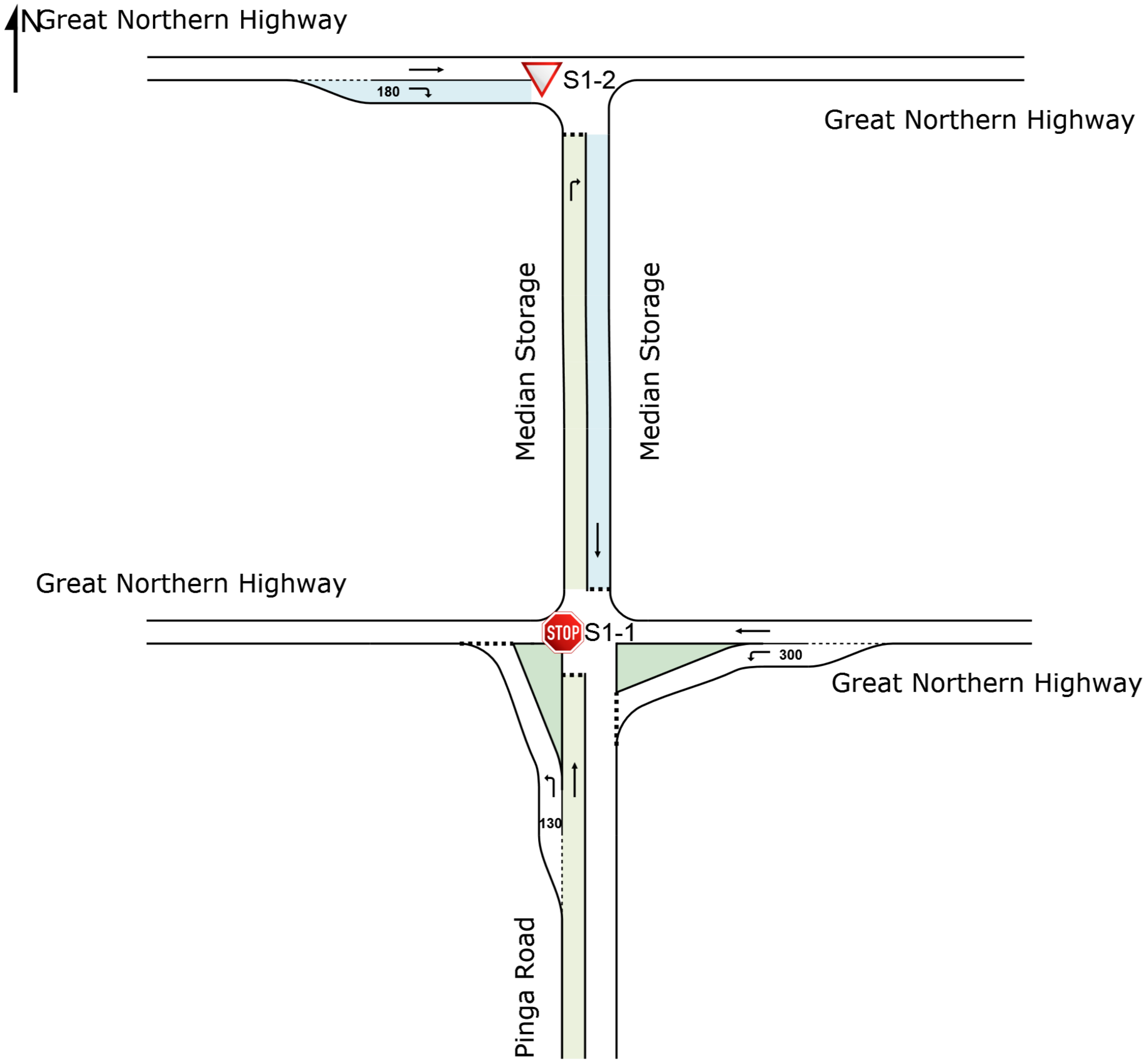
Scenario 3 – SIDRA Results

NETWORK LAYOUT

Network: N101 [GNH Pinga St Am Stage 3,4 No GNH (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	GNH Pinga Am Stage 3,4 No GNH - Stage 2
STOP S1-1	NA	GNH Pinga Am Stage 3,4 No GNH - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Am Stage 3,4 No GNH - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [GNH Pinga St Am Stage 3,4 No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	135	30.0	135	30.0	0.133	0.3	LOS A	0.3	4.6	0.14	0.07	0.14	40.9
Approach		135	30.0	135	30.0	0.133	0.3	LOS A	0.3	4.6	0.14	0.07	0.14	40.9
West: Great Northern Highway														
2	T1	78	10.3	78	10.3	0.043	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	149	34.6	149	34.6	0.115	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		227	26.3	227	26.3	0.115	5.9	NA	0.0	0.0	0.00	0.51	0.00	68.1
All Vehicles		362	27.7	362	27.7	0.133	3.8	NA	0.3	4.6	0.05	0.35	0.05	56.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Am Stage 3,4 No GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [GNH Pinga St Am Stage 3,4 No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	163	31.8	163	31.8	0.209	8.8	LOS A	0.9	15.4	0.40	0.63	0.40	53.0
2	T1	135	30.0	135	30.0	0.434	23.6	LOS C	2.4	33.1	0.76	1.01	1.07	37.3
Approach		298	31.0	298	31.0	0.434	15.5	LOS C	2.4	33.1	0.56	0.80	0.70	47.2
East: Great Northern Highway														
3	L2	144	17.8	144	17.8	0.164	9.4	LOS A	0.7	7.0	0.43	0.67	0.43	56.1
4	T1	101	38.7	101	38.7	0.065	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		245	26.4	245	26.4	0.164	5.6	LOS A	0.7	7.0	0.25	0.40	0.25	63.9
North: Median Storage														
5	T1	149	34.6	149	34.6	0.243	2.5	LOS A	1.0	19.4	0.41	0.32	0.41	37.9
Approach		149	34.6	149	34.6	0.243	2.5	LOS A	1.0	19.4	0.41	0.32	0.41	37.9
All Vehicles		693	30.1	693	30.1	0.434	9.2	NA	2.4	33.1	0.42	0.55	0.48	51.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Pm Stage 3,4 No GNH - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [GNH Pinga Pm Stage 3,3 No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	196	12.5	196	12.5	0.175	0.6	LOS A	0.4	4.7	0.22	0.15	0.22	46.7
Approach		196	12.5	196	12.5	0.175	0.6	LOS A	0.4	4.7	0.22	0.15	0.22	46.7
West: Great Northern Highway														
2	T1	151	18.8	151	18.8	0.087	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	185	31.4	185	31.4	0.144	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		336	25.7	336	25.7	0.144	4.9	NA	0.0	0.0	0.00	0.43	0.00	70.4
All Vehicles		532	20.8	532	20.8	0.175	3.3	NA	0.4	4.7	0.08	0.33	0.08	61.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Pm Stage 3,4 No GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [GNH Pinga Pm Stage 3,3 No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	146	19.6	146	19.6	0.165	7.9	LOS A	0.7	11.1	0.31	0.58	0.31	56.1
2	T1	196	12.5	196	12.5	0.425	17.4	LOS C	2.5	26.4	0.70	0.98	0.97	42.4
Approach		342	15.5	342	15.5	0.425	13.3	LOS B	2.5	26.4	0.53	0.81	0.69	49.7
East: Great Northern Highway														
3	L2	80	13.6	80	13.6	0.096	9.6	LOS A	0.4	3.8	0.44	0.68	0.44	57.2
4	T1	88	18.2	88	18.2	0.051	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		168	16.0	168	16.0	0.096	4.6	LOS A	0.4	3.8	0.21	0.32	0.21	67.2
North: Median Storage														
5	T1	185	31.4	185	31.4	0.260	1.5	LOS A	1.1	20.7	0.34	0.23	0.34	39.5
Approach		185	31.4	185	31.4	0.260	1.5	LOS A	1.1	20.7	0.34	0.23	0.34	39.5
All Vehicles		696	19.9	696	19.9	0.425	8.1	NA	2.5	26.4	0.40	0.54	0.48	51.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

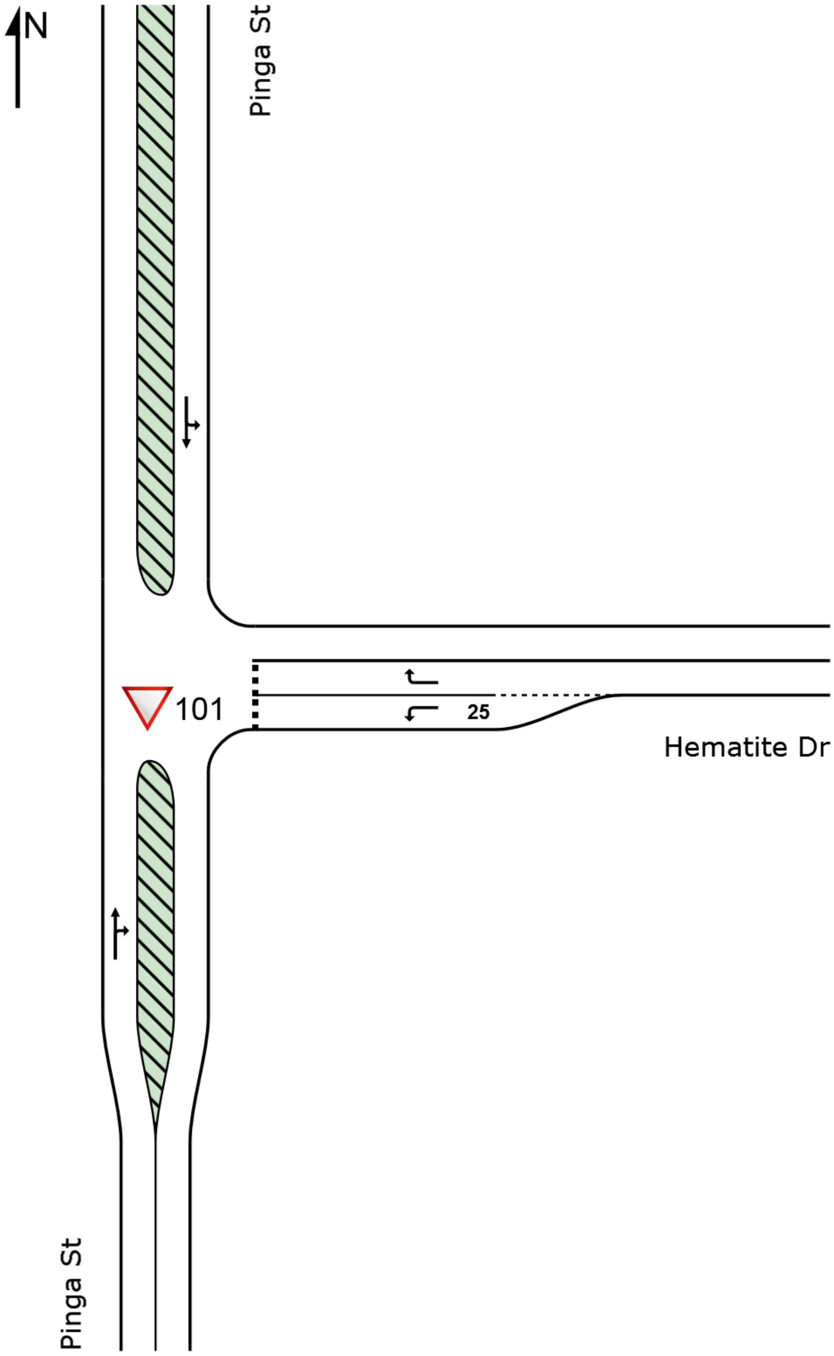
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 No GNH - Adjusted Heavies - 13% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 No GNH - Adjusted Heavies - 13% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	409	8.7	431	8.7	0.283	0.6	LOS A	0.7	5.7	0.17	0.08	0.17	76.1
6	R2	46	7.6	48	7.6	0.283	10.0	LOS B	0.7	5.7	0.17	0.08	0.17	54.5
Approach		455	8.5	479	8.5	0.283	1.6	NA	0.7	5.7	0.17	0.08	0.17	73.1
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.8	LOS A	0.1	0.5	0.35	0.53	0.35	44.2
9	R2	89	43.0	94	43.0	0.553	34.3	LOS D	2.2	34.6	0.90	1.13	1.35	33.8
Approach		105	39.8	111	39.8	0.553	30.0	LOS D	2.2	34.6	0.81	1.04	1.19	34.8
North: Pinga St														
10	L2	143	43.0	151	43.0	0.243	7.6	LOS A	0.0	0.0	0.00	0.25	0.00	55.9
11	T1	229	16.9	241	16.9	0.243	0.1	LOS A	0.0	0.0	0.00	0.25	0.00	73.3
Approach		372	26.9	392	26.9	0.243	3.0	NA	0.0	0.0	0.00	0.25	0.00	64.3
All Vehicles		932	19.4	981	19.4	0.553	5.3	NA	2.2	34.6	0.17	0.26	0.22	60.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Organisation: PORTER CONSULTING ENGINEERS | Licence: NETWORK / 1PC | Processed: Tuesday, 12 April 2022 6:57:23 PM
Project: S:\ACTIVE PROJECTS\21-11-159\DOCUMENTS\Sidra\Wedgefield.sip9

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stage 3,4 No GNH - Adjusted Heavies - 13% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total	HV]	DEMAND FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	244	16.1	257	16.1	0.158	0.3	LOS A	0.2	1.5	0.07	0.05	0.07	77.2
6	R2	12	5.6	13	5.6	0.158	9.7	LOS A	0.2	1.5	0.07	0.05	0.07	55.4
Approach		256	15.6	269	15.6	0.158	0.8	NA	0.2	1.5	0.07	0.05	0.07	75.8
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.038	6.1	LOS A	0.1	1.1	0.42	0.60	0.42	44.4
9	R2	110	43.0	116	43.0	0.461	22.4	LOS C	1.9	29.4	0.82	1.06	1.16	38.1
Approach		150	33.0	158	33.0	0.461	18.1	LOS C	1.9	29.4	0.72	0.94	0.96	39.3
North: Pinga St														
10	L2	94	43.0	99	43.0	0.280	7.7	LOS A	0.0	0.0	0.00	0.13	0.00	57.6
11	T1	367	9.9	386	9.9	0.280	0.1	LOS A	0.0	0.0	0.00	0.13	0.00	76.6
Approach		461	16.6	485	16.6	0.280	1.6	NA	0.0	0.0	0.00	0.13	0.00	70.8
All Vehicles		867	19.1	913	19.1	0.461	4.2	NA	1.9	29.4	0.15	0.25	0.19	62.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 No GNH - Adjusted Heavies - 18% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	409	8.7	431	8.7	0.284	0.7	LOS A	0.7	6.0	0.17	0.08	0.18	76.0
6	R2	46	7.6	48	7.6	0.284	10.2	LOS B	0.7	6.0	0.17	0.08	0.18	54.4
Approach		455	8.5	479	8.5	0.284	1.6	NA	0.7	6.0	0.17	0.08	0.18	73.0
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.8	LOS A	0.1	0.5	0.35	0.53	0.35	44.2
9	R2	89	48.0	94	48.0	0.712	52.7	LOS F	3.2	56.1	0.94	1.28	1.72	29.0
Approach		105	44.1	111	44.1	0.712	45.6	LOS E	3.2	56.1	0.85	1.17	1.51	30.2
North: Pinga St														
10	L2	143	48.0	151	48.0	0.246	7.6	LOS A	0.0	0.0	0.00	0.25	0.00	54.5
11	T1	229	16.9	241	16.9	0.246	0.1	LOS A	0.0	0.0	0.00	0.25	0.00	73.1
Approach		372	28.9	392	28.9	0.246	3.0	NA	0.0	0.0	0.00	0.25	0.00	63.4
All Vehicles		932	20.7	981	20.7	0.712	7.1	NA	3.2	56.1	0.18	0.27	0.26	58.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pinga Hematite Pm Peak Stage 3,4 No GNH - Adjusted Heavies - 18% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	244	16.1	257	16.1	0.158	0.4	LOS A	0.2	1.5	0.07	0.05	0.07	77.2
6	R2	12	5.6	13	5.6	0.158	9.7	LOS A	0.2	1.5	0.07	0.05	0.07	55.4
Approach		256	15.6	269	15.6	0.158	0.8	NA	0.2	1.5	0.07	0.05	0.07	75.8
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.038	6.1	LOS A	0.1	1.1	0.42	0.60	0.42	44.4
9	R2	110	48.0	116	48.0	0.572	30.0	LOS D	2.5	43.7	0.88	1.15	1.38	35.4
Approach		150	36.7	158	36.7	0.572	23.6	LOS C	2.5	43.7	0.76	1.00	1.13	37.0
North: Pinga St														
10	L2	94	48.0	99	48.0	0.282	7.8	LOS A	0.0	0.0	0.00	0.13	0.00	56.2
11	T1	367	9.9	386	9.9	0.282	0.1	LOS A	0.0	0.0	0.00	0.13	0.00	76.5
Approach		461	17.6	485	17.6	0.282	1.6	NA	0.0	0.0	0.00	0.13	0.00	70.2
All Vehicles		867	20.3	913	20.3	0.572	5.2	NA	2.5	43.7	0.15	0.26	0.22	60.7

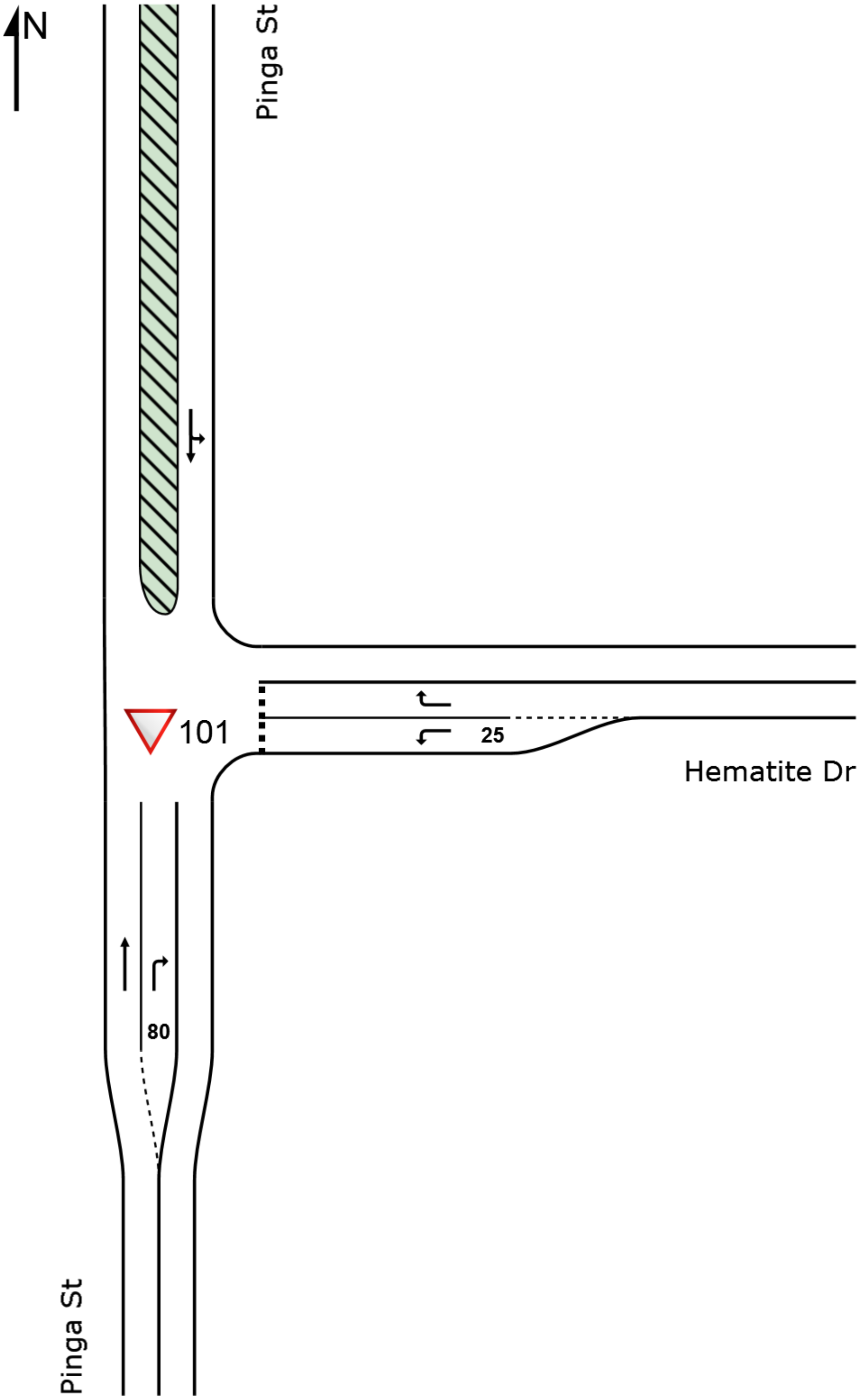
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 No GNH - Modified Layout Adjusted Heavies (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 No GNH - Modified Layout Adjusted Heavies 13% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	409	8.7	431	8.7	0.235	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	46	7.6	48	7.6	0.048	9.1	LOS A	0.2	1.6	0.51	0.70	0.51	47.6
Approach		455	8.5	479	8.5	0.235	1.0	NA	0.2	1.6	0.05	0.08	0.05	74.2
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.8	LOS A	0.1	0.5	0.35	0.53	0.35	44.2
9	R2	89	43.0	94	43.0	0.852	92.4	LOS F	5.2	80.4	0.98	1.53	2.34	22.0
Approach		105	39.8	111	39.8	0.852	79.2	LOS F	5.2	80.4	0.88	1.37	2.04	23.4
North: Pinga St														
10	L2	143	43.0	151	43.0	0.243	7.6	LOS A	0.0	0.0	0.00	0.25	0.00	55.9
11	T1	229	16.9	241	16.9	0.243	0.1	LOS A	0.0	0.0	0.00	0.25	0.00	73.3
Approach		372	26.9	392	26.9	0.243	3.0	NA	0.0	0.0	0.00	0.25	0.00	64.3
All Vehicles		932	19.4	981	19.4	0.852	10.6	NA	5.2	80.4	0.12	0.29	0.25	54.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stages 3,4 No GNH - Modified Layout Adjusted Heavies - 13% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	244	16.1	257	16.1	0.145	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.4
6	R2	12	5.6	13	5.6	0.013	9.1	LOS A	0.1	0.4	0.52	0.67	0.52	47.5
Approach		256	15.6	269	15.6	0.145	0.6	NA	0.1	0.4	0.02	0.05	0.02	76.1
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.037	6.0	LOS A	0.1	1.1	0.42	0.60	0.42	44.4
9	R2	110	43.0	116	43.0	0.640	39.8	LOS E	3.3	51.1	0.91	1.23	1.58	32.2
Approach		150	33.0	158	33.0	0.640	30.8	LOS D	3.3	51.1	0.78	1.06	1.27	34.3
North: Pinga St														
10	L2	94	43.0	99	43.0	0.280	7.7	LOS A	0.0	0.0	0.00	0.13	0.00	57.6
11	T1	367	9.9	386	9.9	0.280	0.1	LOS A	0.0	0.0	0.00	0.13	0.00	76.6
Approach		461	16.6	485	16.6	0.280	1.6	NA	0.0	0.0	0.00	0.13	0.00	70.8
All Vehicles		867	19.1	913	19.1	0.640	6.4	NA	3.3	51.1	0.14	0.27	0.23	59.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 No GNH - Modified Layout Adjusted Heavies -18% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov	Turn	INPUT		DEMAND		Deg.	Aver.	Level of	95% BACK OF		Prop.	Effective	Aver.	Aver.
ID		VOLUMES		FLOWS		Satn	Delay	Service	QUEUE		Que	Stop	No.	Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]		Rate	Cycles	
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	409	8.7	431	8.7	0.235	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	46	7.6	48	7.6	0.037	7.9	LOS A	0.2	1.3	0.37	0.61	0.37	48.2
Approach		455	8.5	479	8.5	0.235	0.9	NA	0.2	1.3	0.04	0.07	0.04	74.3
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.8	LOS A	0.1	0.5	0.35	0.53	0.35	44.2
9	R2	89	49.0	94	49.0	1.162	269.0	LOS F	14.6	258.1	1.00	2.49	4.71	10.5
Approach		105	44.9	111	44.9	1.162	228.9	LOS F	14.6	258.1	0.90	2.19	4.04	11.5
North: Pinga St														
10	L2	143	49.0	151	49.0	0.169	8.2	LOS A	0.8	13.7	0.20	0.56	0.20	53.4
11	T1	229	16.9	241	16.9	0.137	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.8
Approach		372	29.2	392	29.2	0.169	3.2	LOS A	0.8	13.7	0.08	0.22	0.08	64.8
All Vehicles		932	20.9	981	20.9	1.162	27.5	NA	14.6	258.1	0.15	0.37	0.50	41.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stages 3,4 No GNH - Modified Layout Adjusted Heavies - 18% (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	244	16.1	257	16.1	0.145	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.4
6	R2	12	5.6	13	5.6	0.013	9.2	LOS A	0.1	0.4	0.53	0.67	0.53	47.5
Approach		256	15.6	269	15.6	0.145	0.6	NA	0.1	0.4	0.02	0.05	0.02	76.1
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.037	6.0	LOS A	0.1	1.1	0.42	0.60	0.42	44.4
9	R2	110	48.0	116	48.0	0.814	67.6	LOS F	5.1	89.5	0.96	1.49	2.24	25.9
Approach		150	36.7	158	36.7	0.814	51.2	LOS F	5.1	89.5	0.82	1.25	1.76	28.5
North: Pinga St														
10	L2	94	48.0	99	48.0	0.282	7.8	LOS A	0.0	0.0	0.00	0.13	0.00	56.2
11	T1	367	9.9	386	9.9	0.282	0.1	LOS A	0.0	0.0	0.00	0.13	0.00	76.5
Approach		461	17.6	485	17.6	0.282	1.6	NA	0.0	0.0	0.00	0.13	0.00	70.2
All Vehicles		867	20.3	913	20.3	0.814	9.9	NA	5.1	89.5	0.15	0.30	0.31	55.4

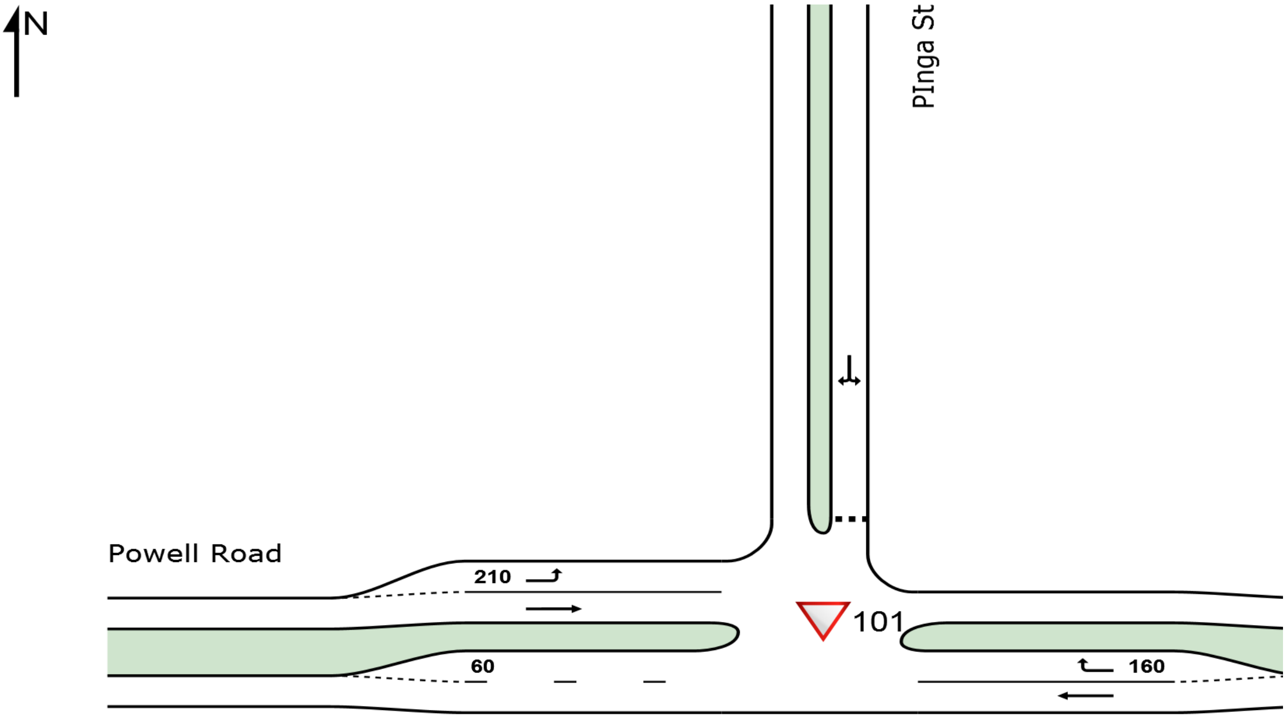
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Pinga Am Peak Stages 3,4 No GNH (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Am Peak Stages 3,4 No GNH (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Powell Road														
5	T1	75	6.1	79	6.1	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
6	R2	468	6.1	493	6.1	0.366	6.9	LOS A	2.1	16.4	0.16	0.60	0.16	44.9
Approach		543	6.1	572	6.1	0.366	5.9	NA	2.1	16.4	0.14	0.52	0.14	49.2
North: PInga St														
7	L2	253	14.4	266	14.4	0.224	4.9	LOS A	1.0	8.2	0.12	0.50	0.12	42.1
9	R2	1	14.4	1	14.4	0.224	14.5	LOS B	1.0	8.2	0.12	0.50	0.12	44.8
Approach		254	14.4	267	14.4	0.224	4.9	LOS A	1.0	8.2	0.12	0.50	0.12	42.1
West: Powell Road														
10	L2	1	6.1	1	6.1	0.001	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.6
11	T1	31	14.4	33	14.4	0.018	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		32	14.1	34	14.1	0.018	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.1
All Vehicles		829	9.0	873	9.0	0.366	5.4	NA	2.1	16.4	0.13	0.49	0.13	47.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Pm Peak Stages 3,4 No GNH (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Powell Road														
5	T1	29	10.2	31	10.2	0.017	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	246	10.2	259	10.2	0.209	7.2	LOS A	1.0	8.0	0.23	0.61	0.23	44.4
Approach		275	10.2	289	10.2	0.209	6.4	NA	1.0	8.0	0.21	0.55	0.21	47.7
North: PInga St														
7	L2	486	4.5	512	4.5	0.429	5.2	LOS A	2.3	17.9	0.27	0.53	0.27	41.7
9	R2	1	4.5	1	4.5	0.429	10.3	LOS B	2.3	17.9	0.27	0.53	0.27	44.6
Approach		487	4.5	513	4.5	0.429	5.2	LOS A	2.3	17.9	0.27	0.53	0.27	41.7
West: Powell Road														
10	L2	1	10.2	1	10.2	0.001	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	59.6
11	T1	84	4.5	88	4.5	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		85	4.6	89	4.6	0.047	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.6
All Vehicles		847	6.4	892	6.4	0.429	5.1	NA	2.3	17.9	0.22	0.48	0.22	46.8

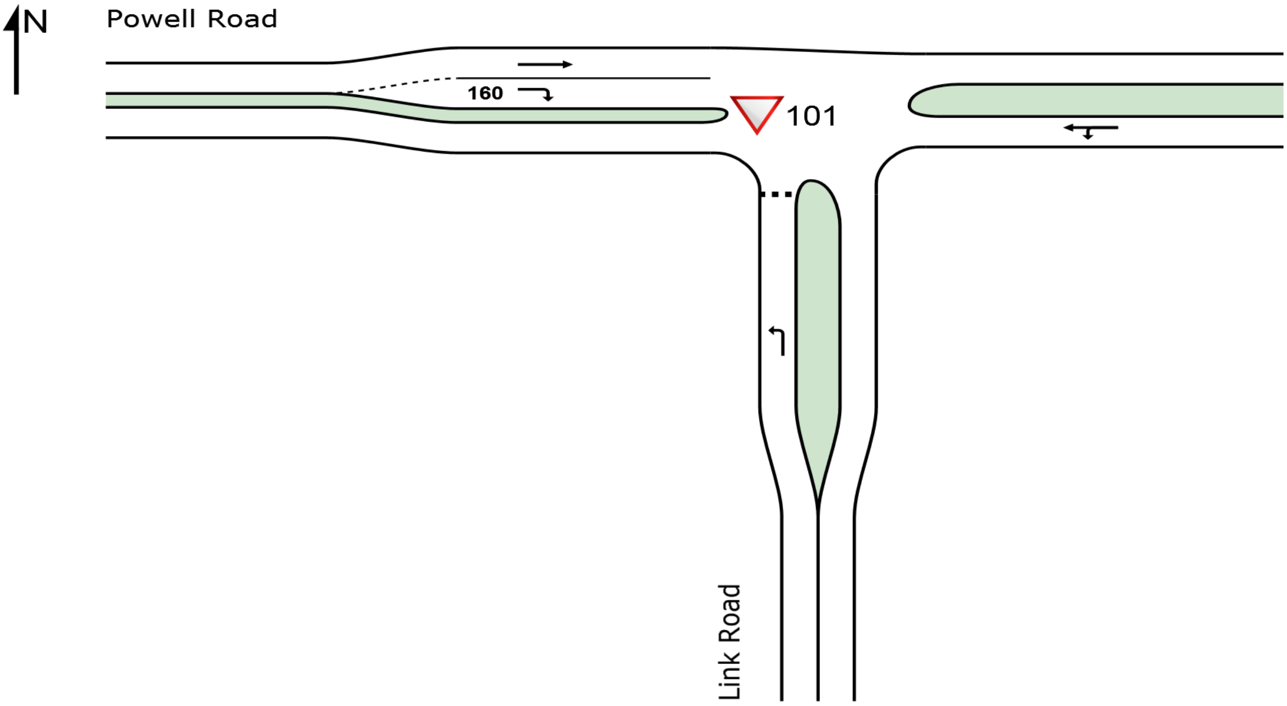
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101 [Powell Link Am Peak Stages 3,4, No GNH (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Am Peak Stages 3,4, No GNH (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Link Road														
7	L2	397	5.1	418	5.1	0.303	5.3	LOS A	1.5	11.8	0.32	0.55	0.32	40.5
Approach		397	5.1	418	5.1	0.303	5.3	LOS A	1.5	11.8	0.32	0.55	0.32	40.5
East: Powell Road														
10	L2	1	9.1	1	9.1	0.084	7.1	LOS A	0.0	0.0	0.00	0.01	0.00	70.2
11	T1	146	9.1	154	9.1	0.084	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.4
Approach		147	9.1	155	9.1	0.084	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.3
West: Powell Road														
5	T1	99	20.4	104	20.4	0.061	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	185	15.0	195	15.0	0.139	7.4	LOS A	0.7	5.9	0.31	0.62	0.31	43.1
Approach		284	16.9	299	16.9	0.139	4.8	NA	0.7	5.9	0.20	0.40	0.20	55.4
All Vehicles		828	9.9	872	9.9	0.303	4.2	NA	1.5	11.8	0.22	0.40	0.22	51.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Pm Peak Stages 3,4 No GNH (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Link Road														
7	L2	199	9.7	209	9.7	0.146	5.0	LOS A	0.6	5.3	0.20	0.51	0.20	40.0
Approach		199	9.7	209	9.7	0.146	5.0	LOS A	0.6	5.3	0.20	0.51	0.20	40.0
East: Powell Road														
10	L2	1	11.7	1	11.7	0.045	7.1	LOS A	0.0	0.0	0.00	0.02	0.00	69.5
11	T1	76	11.7	80	11.7	0.045	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	79.2
Approach		77	11.7	81	11.7	0.045	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.0
West: Powell Road														
5	T1	111	6.5	117	6.5	0.063	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
6	R2	459	4.0	483	4.0	0.296	7.0	LOS A	1.7	13.1	0.24	0.60	0.24	43.9
Approach		570	4.5	600	4.5	0.296	5.6	NA	1.7	13.1	0.19	0.48	0.19	50.8
All Vehicles		846	6.4	891	6.4	0.296	5.0	NA	1.7	13.1	0.17	0.45	0.17	50.5

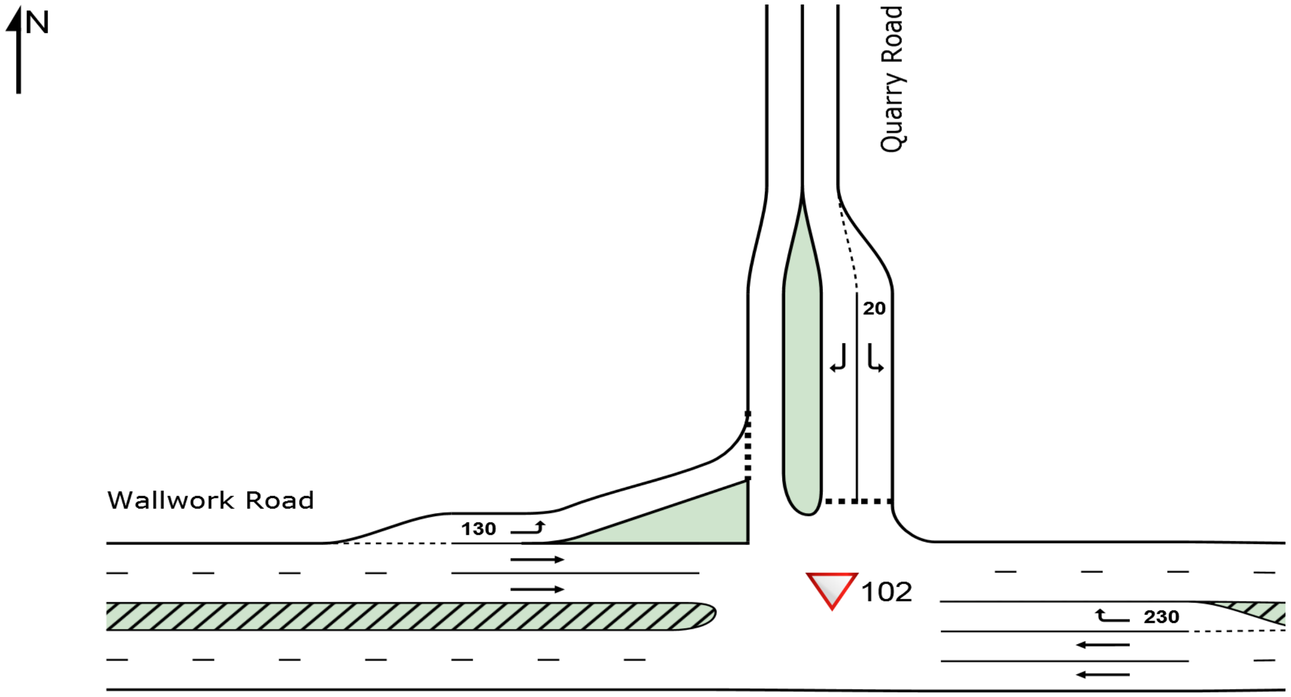
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 102 [Wallwork Rd Quarry Rd Am Stage 3,4 No GNH - Not Staged (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Am Stage 3,4 No GNH - Not Staged (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	376	7.0	396	7.0	0.107	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	77	15.0	81	15.0	0.104	9.9	LOS A	0.4	3.6	0.50	0.74	0.50	54.1
Approach		453	8.4	477	8.4	0.107	1.7	NA	0.4	3.6	0.09	0.13	0.09	75.4
North: Quarry Road														
1	L2	41	15.0	43	15.0	0.045	7.7	LOS A	0.2	1.4	0.33	0.61	0.33	52.6
3	R2	48	15.0	51	15.0	0.339	34.9	LOS D	1.2	10.6	0.88	1.00	1.06	34.0
Approach		89	15.0	94	15.0	0.339	22.4	LOS C	1.2	10.6	0.62	0.82	0.72	40.6
West: Wallwork Road														
4	L2	132	15.0	139	15.0	0.101	7.9	LOS A	0.4	3.8	0.20	0.57	0.20	57.2
5	T1	435	2.0	458	2.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		567	5.0	597	5.0	0.119	1.9	LOS A	0.4	3.8	0.05	0.13	0.05	74.6
All Vehicles		1109	7.2	1167	7.2	0.339	3.4	NA	1.2	10.6	0.11	0.18	0.12	71.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Pm Stage 3,4 GNH - Not Staged (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	575	3.0	605	3.0	0.158	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	28	15.0	29	15.0	0.042	10.7	LOS B	0.2	1.4	0.55	0.75	0.55	53.3
Approach		603	3.6	635	3.6	0.158	0.5	NA	0.2	1.4	0.03	0.03	0.03	78.6
North: Quarry Road														
1	L2	66	15.0	69	15.0	0.078	8.2	LOS A	0.3	2.5	0.40	0.66	0.40	52.3
3	R2	154	15.0	162	15.0	1.135	200.5	LOS F	19.0	167.2	1.00	2.25	6.31	10.5
Approach		220	15.0	232	15.0	1.135	142.8	LOS F	19.0	167.2	0.82	1.78	4.54	13.8
West: Wallwork Road														
4	L2	48	15.0	51	15.0	0.035	7.7	LOS A	0.1	1.2	0.10	0.57	0.10	57.7
5	T1	618	1.0	651	1.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		666	2.0	701	2.0	0.168	0.6	LOS A	0.1	1.2	0.01	0.04	0.01	78.3
All Vehicles		1489	4.6	1567	4.6	1.135	21.6	NA	19.0	167.2	0.13	0.30	0.68	51.7

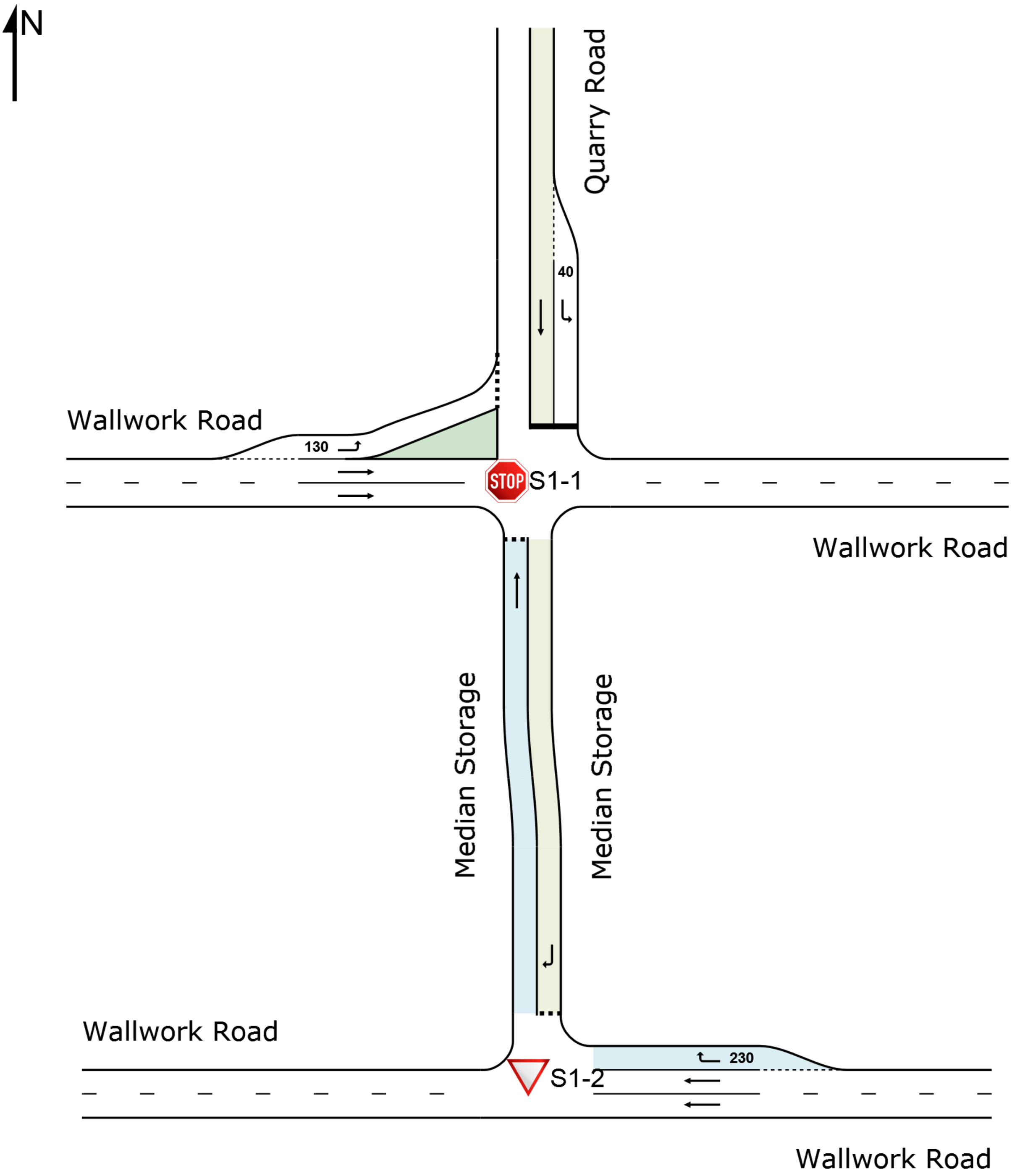
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4 No GNH (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	Wallwork Road Quarry Rd Am Stage 3,4 No GNH - Stage 2
STOP S1-1	NA	Wallwork Road Quarry Rd Am Stage 3,4 No GNH - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Quarry Rd Am Stage 3,4 No GNH - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4 No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total	HV]	ARRIVAL FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Wallwork Road														
2	T1	396	7.0	396	7.0	0.106	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	81	15.0	81	15.0	0.048	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		477	8.4	477	8.4	0.106	1.0	NA	0.0	0.0	0.00	0.11	0.00	58.9
North: Median Storage														
1	R2	51	15.0	51	15.0	0.055	2.8	LOS A	0.2	1.5	0.38	0.51	0.38	48.1
Approach		51	15.0	51	15.0	0.055	2.8	LOS A	0.2	1.5	0.38	0.51	0.38	48.1
All Vehicles		527	9.0	527	9.0	0.106	1.2	NA	0.2	1.5	0.04	0.15	0.04	58.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Am Stage 3,4 No GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4 No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage														
5	T1	81	15.0	81	15.0	0.093	2.8	LOS A	0.3	2.9	0.45	0.48	0.45	49.1
Approach		81	15.0	81	15.0	0.093	2.8	LOS A	0.3	2.9	0.45	0.48	0.45	49.1
North: Quarry Road														
1	L2	43	15.0	43	15.0	0.042	9.8	LOS A	0.2	1.5	0.34	0.88	0.34	50.9
2	T1	51	15.0	51	15.0	0.131	16.5	LOS C	0.5	4.4	0.65	1.01	0.65	40.8
Approach		94	15.0	94	15.0	0.131	13.4	LOS B	0.5	4.4	0.51	0.95	0.51	46.6
West: Wallwork Road														
3	L2	139	15.0	139	15.0	0.116	6.2	LOS A	0.5	4.3	0.21	0.52	0.21	53.0
4	T1	458	2.0	458	2.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		597	5.0	597	5.0	0.119	1.5	LOS A	0.5	4.3	0.05	0.12	0.05	58.1
All Vehicles		772	7.3	772	7.3	0.131	3.1	NA	0.5	4.4	0.15	0.26	0.15	56.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Quarry Rd Pm Stage 3,4 No GNH- Stage 2 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [Wallwork Rd Quarry Rd Pm Stage 3,4, No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
2	T1	605	3.0	605	3.0	0.158	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	29	15.0	29	15.0	0.018	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		635	3.6	635	3.6	0.158	0.3	NA	0.0	0.0	0.00	0.03	0.00	59.7
North: Median Storage														
1	R2	162	15.0	162	15.0	0.219	4.3	LOS A	0.8	6.6	0.51	0.69	0.51	46.3
Approach		162	15.0	162	15.0	0.219	4.3	LOS A	0.8	6.6	0.51	0.69	0.51	46.3
All Vehicles		797	5.9	797	5.9	0.219	1.1	NA	0.8	6.6	0.10	0.16	0.10	57.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Pm Stage 3,4 No GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening No GNH)]

Network: N101 [Wallwork Rd Quarry Rd Pm Stage 3,4, No GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total	HV]	ARRIVAL FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage														
5	T1	29	15.0	29	15.0	0.042	3.9	LOS A	0.1	1.3	0.52	0.54	0.52	47.7
Approach		29	15.0	29	15.0	0.042	3.9	LOS A	0.1	1.3	0.52	0.54	0.52	47.7
North: Quarry Road														
1	L2	69	15.0	69	15.0	0.077	10.4	LOS B	0.3	2.6	0.43	0.90	0.43	50.5
2	T1	162	15.0	162	15.0	0.514	24.8	LOS C	2.8	24.3	0.81	1.15	1.26	34.7
Approach		232	15.0	232	15.0	0.514	20.5	LOS C	2.8	24.3	0.69	1.08	1.01	40.5
West: Wallwork Road														
3	L2	51	15.0	51	15.0	0.040	5.9	LOS A	0.2	1.4	0.11	0.51	0.11	53.3
4	T1	651	1.0	651	1.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		701	2.0	701	2.0	0.168	0.5	LOS A	0.2	1.4	0.01	0.04	0.01	59.4
All Vehicles		962	5.5	962	5.5	0.514	5.4	NA	2.8	24.3	0.19	0.30	0.26	54.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

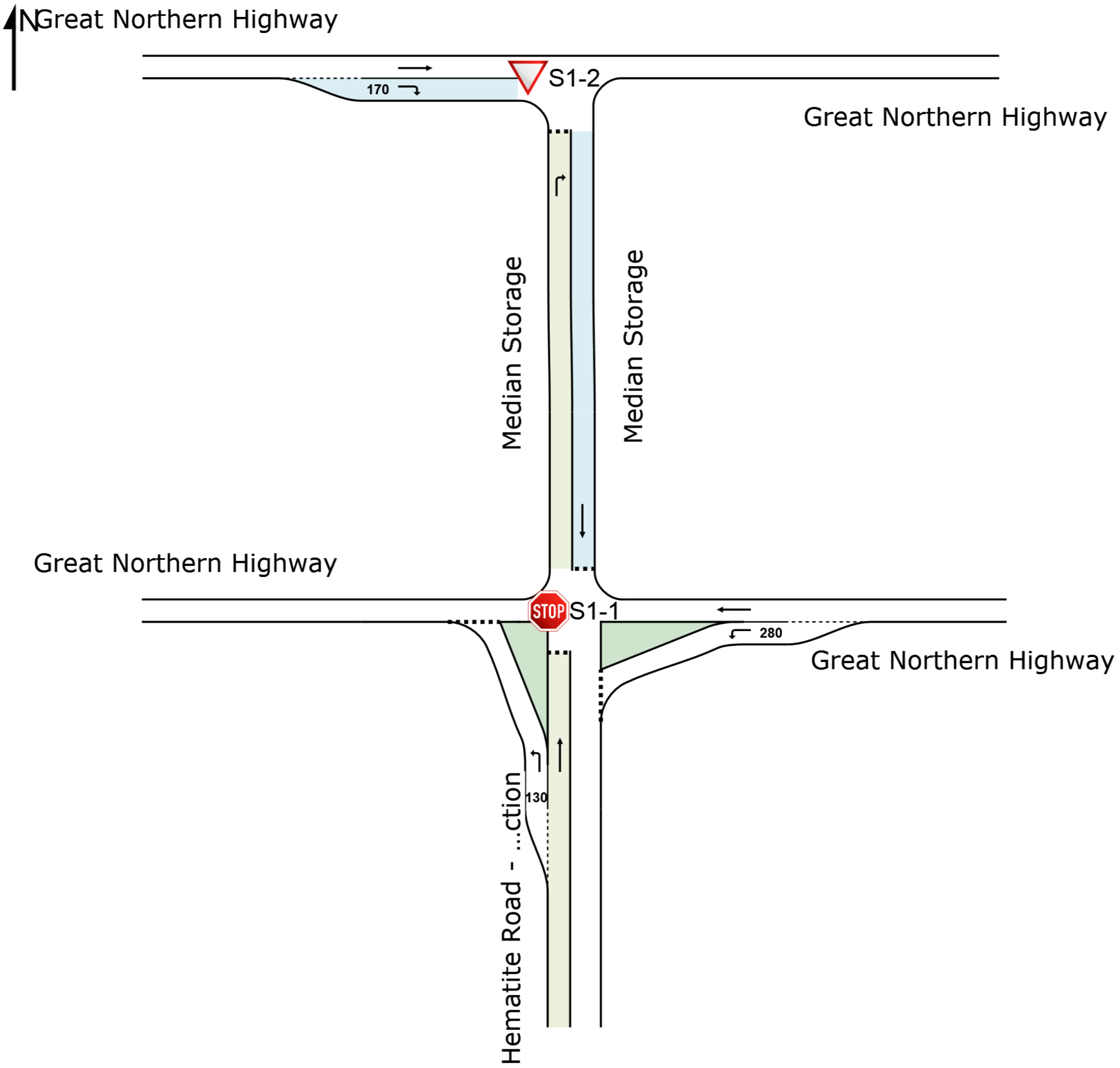
Scenario 4 – SIDRA Results

NETWORK LAYOUT

Network: N101 [New Connection GNH am Stage 3,4 (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	New Connection GNH Am Stage 3,4 - Stage 2
STOP S1-1	NA	New Connection GNH Am Stage 3,4 - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [New Connection GNH Am Stage 3,4 - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [New Connection GNH am Stage 3,4 (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	72	30.0	72	30.0	0.075	0.5	LOS A	0.2	2.5	0.19	0.12	0.19	40.7
Approach		72	30.0	72	30.0	0.075	0.5	LOS A	0.2	2.5	0.19	0.12	0.19	40.7
West: Great Northern Highway														
2	T1	147	10.3	147	10.3	0.081	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	20	34.6	20	34.6	0.013	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		167	13.2	167	13.2	0.081	1.1	NA	0.0	0.0	0.00	0.09	0.00	78.2
All Vehicles		239	18.3	239	18.3	0.081	0.9	NA	0.2	2.5	0.06	0.10	0.06	66.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [New Connection GNH Am Stage 3,4 - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [New Connection GNH am Stage 3,4 (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Hematite Road - New Connection														
1	L2	15	31.8	15	31.8	0.022	9.4	LOS A	0.1	1.4	0.43	0.61	0.43	52.6
2	T1	72	30.0	72	30.0	0.164	14.5	LOS B	0.7	9.6	0.59	0.87	0.59	45.7
Approach		86	30.3	86	30.3	0.164	13.7	LOS B	0.7	9.6	0.56	0.82	0.56	47.5
East: Great Northern Highway														
3	L2	105	17.8	105	17.8	0.090	7.8	LOS A	0.4	3.8	0.13	0.57	0.13	57.3
4	T1	151	38.7	151	38.7	0.097	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		256	30.1	256	30.1	0.097	3.2	LOS A	0.4	3.8	0.05	0.23	0.05	68.7
North: Median Storage														
5	T1	20	34.6	20	34.6	0.038	3.2	LOS A	0.1	2.5	0.44	0.33	0.44	37.3
Approach		20	34.6	20	34.6	0.038	3.2	LOS A	0.1	2.5	0.44	0.33	0.44	37.3
All Vehicles		362	30.4	362	30.4	0.164	5.7	NA	0.7	9.6	0.19	0.38	0.19	62.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-2 [New Connection GNH Pm Stage 3,4 - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [New Connection GNH Pm Stage 3,4 (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	115	12.5	115	12.5	0.113	0.9	LOS A	0.3	2.9	0.28	0.22	0.28	46.3
Approach		115	12.5	115	12.5	0.113	0.9	LOS A	0.3	2.9	0.28	0.22	0.28	46.3
West: Great Northern Highway														
2	T1	242	18.8	242	18.8	0.139	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	18	31.4	18	31.4	0.012	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		260	19.6	260	19.6	0.139	0.6	NA	0.0	0.0	0.00	0.05	0.00	78.9
All Vehicles		375	17.4	375	17.4	0.139	0.7	NA	0.3	2.9	0.09	0.11	0.09	69.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [New Connection GNH Pm Stage 3,4 - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [New Connection GNH Pm Stage 3,4 (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Henatite Rd New Connection														
1	L2	14	19.6	14	19.6	0.016	8.1	LOS A	0.1	1.0	0.33	0.56	0.33	56.1
2	T1	115	12.5	115	12.5	0.161	10.5	LOS B	0.7	7.6	0.46	0.76	0.46	50.4
Approach		128	13.3	128	13.3	0.161	10.2	LOS B	0.7	7.6	0.44	0.74	0.44	51.4
East: Great Northern Highway														
3	L2	58	13.6	58	13.6	0.049	7.7	LOS A	0.2	2.0	0.11	0.57	0.11	58.6
4	T1	120	18.2	120	18.2	0.069	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		178	16.7	178	16.7	0.069	2.5	LOS A	0.2	2.0	0.04	0.19	0.04	71.4
North: Median Storage														
5	T1	18	31.4	18	31.4	0.027	1.6	LOS A	0.1	1.7	0.33	0.20	0.33	39.4
Approach		18	31.4	18	31.4	0.027	1.6	LOS A	0.1	1.7	0.33	0.20	0.33	39.4
All Vehicles		324	16.1	324	16.1	0.161	5.5	NA	0.7	7.6	0.21	0.41	0.21	62.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

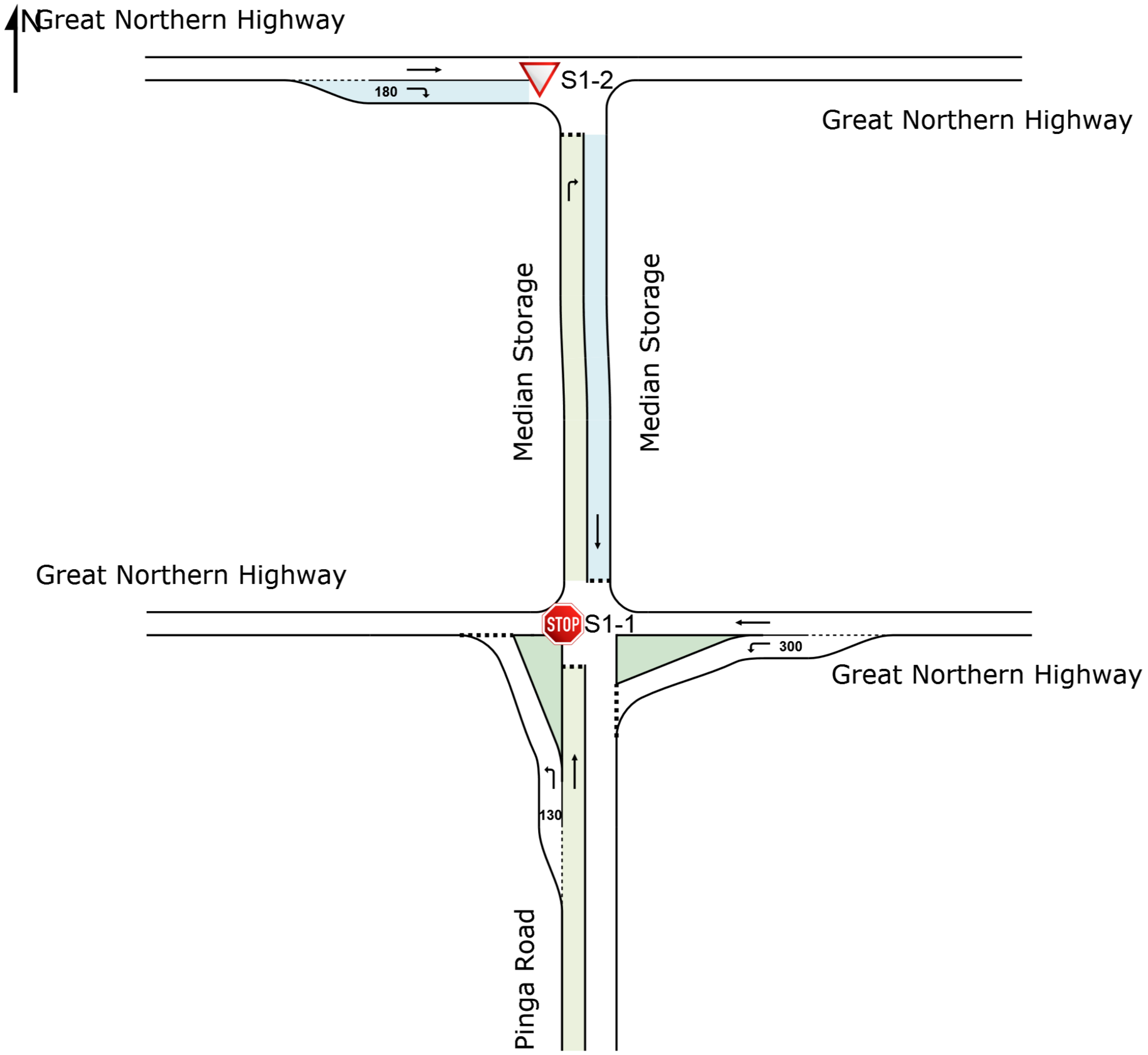
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [GNH Pinga Am Stage 3,4, with GNH (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	GNH Pinga Am Stage 3,4 with GNH - Stage 2
STOP S1-1	NA	GNH Pinga Am Stage 3,4 with GNH - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Am Stage 3,4 with GNH - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [GNH Pinga Am Stage 3,4, with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	69	30.0	69	30.0	0.070	0.3	LOS A	0.2	2.3	0.15	0.08	0.15	40.9
Approach		69	30.0	69	30.0	0.070	0.3	LOS A	0.2	2.3	0.15	0.08	0.15	40.9
West: Great Northern Highway														
2	T1	98	10.3	98	10.3	0.054	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	129	34.6	129	34.6	0.095	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		227	24.2	227	24.2	0.095	5.1	NA	0.0	0.0	0.00	0.44	0.00	70.0
All Vehicles		297	25.5	297	25.5	0.095	4.0	NA	0.2	2.3	0.03	0.36	0.03	62.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Am Stage 3,4 with GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [GNH Pinga Am Stage 3,4, with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	147	31.8	147	31.8	0.197	9.1	LOS A	0.9	14.1	0.42	0.65	0.42	52.8
2	T1	69	30.0	69	30.0	0.195	17.2	LOS C	0.8	11.1	0.64	0.92	0.64	42.9
Approach		217	31.2	217	31.2	0.197	11.7	LOS B	0.9	14.1	0.49	0.73	0.49	50.6
East: Great Northern Highway														
3	L2	49	17.8	49	17.8	0.054	9.0	LOS A	0.2	2.1	0.37	0.62	0.37	56.4
4	T1	116	38.7	116	38.7	0.074	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		165	32.4	165	32.4	0.074	2.7	LOS A	0.2	2.1	0.11	0.19	0.11	71.0
North: Median Storage														
5	T1	129	34.6	129	34.6	0.221	2.8	LOS A	0.9	17.0	0.43	0.35	0.43	37.6
Approach		129	34.6	129	34.6	0.221	2.8	LOS A	0.9	17.0	0.43	0.35	0.43	37.6
All Vehicles		512	32.5	512	32.5	0.221	6.5	NA	0.9	17.0	0.35	0.46	0.35	53.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Pm Stage 3,4 with GNH - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [GNH Pinga Pm Stage 3,4 with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	92	12.5	92	12.5	0.083	0.6	LOS A	0.1	0.8	0.22	0.15	0.22	46.7
Approach		92	12.5	92	12.5	0.083	0.6	LOS A	0.1	0.8	0.22	0.15	0.22	46.7
West: Great Northern Highway														
2	T1	168	18.8	168	18.8	0.097	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	167	31.4	167	31.4	0.125	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		336	25.0	336	25.0	0.125	4.4	NA	0.0	0.0	0.00	0.39	0.00	71.5
All Vehicles		427	22.3	427	22.3	0.125	3.6	NA	0.1	0.8	0.05	0.34	0.05	65.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Pm Stage 3,4 with GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [GNH Pinga Pm Stage 3,4 with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	134	19.6	134	19.6	0.155	8.1	LOS A	0.3	4.1	0.34	0.59	0.34	56.0
2	T1	92	12.5	92	12.5	0.185	13.7	LOS B	0.3	3.3	0.60	0.89	0.60	46.2
Approach		225	16.7	225	16.7	0.185	10.4	LOS B	0.3	4.1	0.45	0.71	0.45	53.2
East: Great Northern Highway														
3	L2	32	13.6	32	13.6	0.036	9.2	LOS A	0.1	0.6	0.40	0.63	0.40	57.4
4	T1	102	18.2	102	18.2	0.059	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		134	17.1	134	17.1	0.059	2.2	LOS A	0.1	0.6	0.10	0.15	0.10	73.1
North: Median Storage														
5	T1	167	31.4	167	31.4	0.242	1.8	LOS A	0.4	7.6	0.36	0.26	0.36	39.3
Approach		167	31.4	167	31.4	0.242	1.8	LOS A	0.4	7.6	0.36	0.26	0.36	39.3
All Vehicles		526	21.5	526	21.5	0.242	5.6	NA	0.4	7.6	0.33	0.42	0.33	54.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 With GNH - Adjusted Heavies (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	409	8.7	431	8.7	0.275	0.4	LOS A	0.5	4.5	0.13	0.08	0.13	76.5
6	R2	46	7.6	48	7.6	0.275	8.8	LOS A	0.5	4.5	0.13	0.08	0.13	54.7
Approach		455	8.5	479	8.5	0.275	1.2	NA	0.5	4.5	0.13	0.08	0.13	73.5
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.8	LOS A	0.1	0.5	0.35	0.53	0.35	44.2
9	R2	39	43.0	41	43.0	0.209	22.3	LOS C	0.7	10.3	0.80	0.94	0.85	38.1
Approach		55	37.0	58	37.0	0.209	17.5	LOS C	0.7	10.3	0.67	0.82	0.71	39.4
North: Pinga St														
10	L2	52	43.0	55	43.0	0.176	7.6	LOS A	0.0	0.0	0.00	0.13	0.00	57.3
11	T1	229	16.9	241	16.9	0.176	0.1	LOS A	0.0	0.0	0.00	0.13	0.00	76.2
Approach		281	21.7	296	21.7	0.176	1.5	NA	0.0	0.0	0.00	0.13	0.00	70.8
All Vehicles		791	15.2	833	15.2	0.275	2.5	NA	0.7	10.3	0.12	0.15	0.12	67.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stage 3,4 With GNH - Adjusted Heavies (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St														
5	T1	244	16.1	257	16.1	0.158	0.3	LOS A	0.2	1.5	0.07	0.05	0.07	77.2
6	R2	12	5.6	13	5.6	0.158	9.3	LOS A	0.2	1.5	0.07	0.05	0.07	55.4
Approach		256	15.6	269	15.6	0.158	0.7	NA	0.2	1.5	0.07	0.05	0.07	75.8
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.040	6.2	LOS A	0.2	1.2	0.43	0.61	0.43	44.4
9	R2	31	43.0	33	43.0	0.141	18.5	LOS C	0.4	6.8	0.75	0.89	0.75	39.7
Approach		71	21.9	75	21.9	0.141	11.6	LOS B	0.4	6.8	0.57	0.73	0.57	41.9
North: Pinga St														
10	L2	43	43.0	45	43.0	0.243	7.7	LOS A	0.0	0.0	0.00	0.07	0.00	58.3
11	T1	367	9.9	386	9.9	0.243	0.1	LOS A	0.0	0.0	0.00	0.07	0.00	78.1
Approach		410	13.3	432	13.3	0.243	0.9	NA	0.0	0.0	0.00	0.07	0.00	74.7
All Vehicles		737	14.9	776	14.9	0.243	1.9	NA	0.4	6.8	0.08	0.13	0.08	69.3

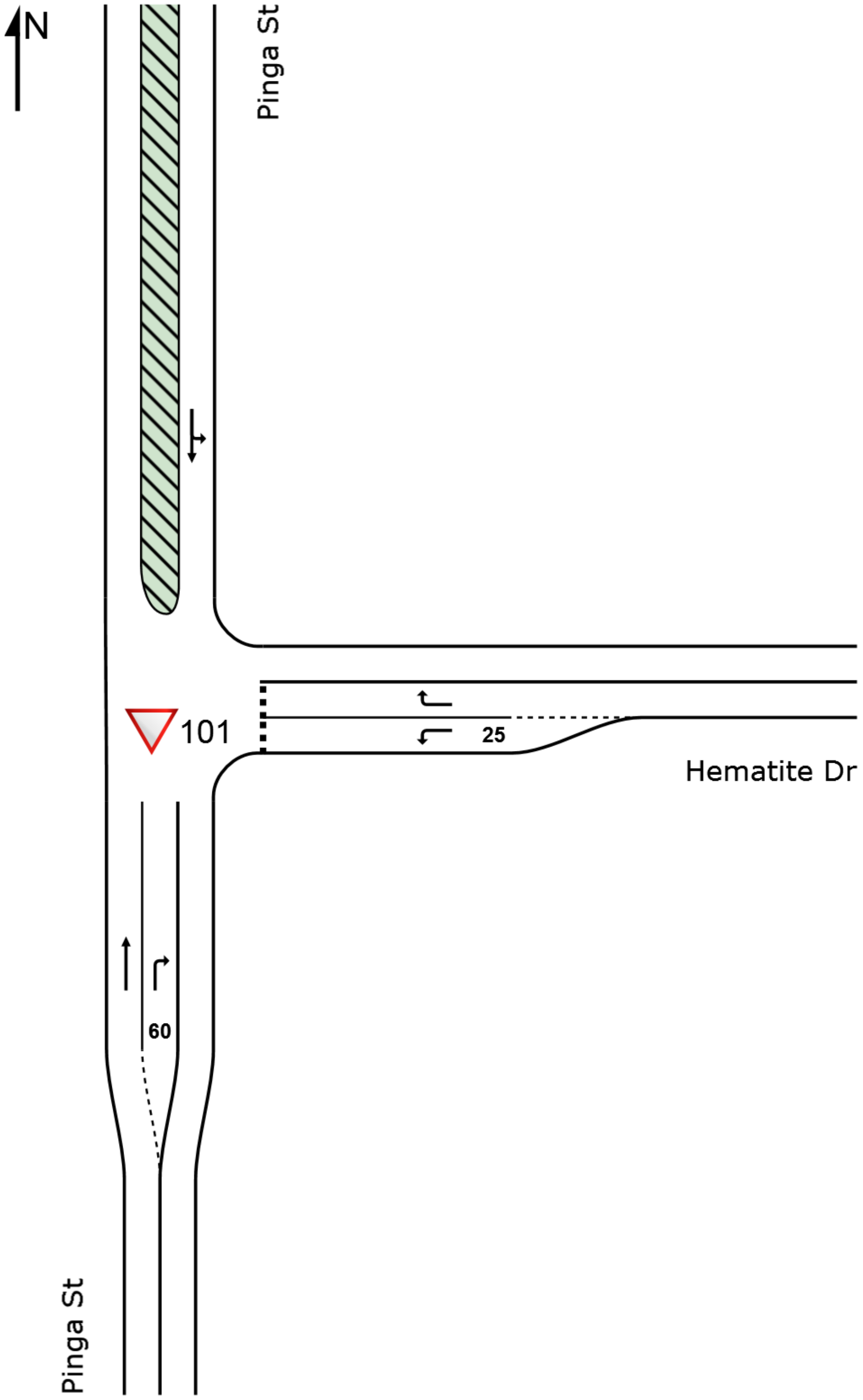
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 With GNH - Modified Layout Adjusted Heavies (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 With GNH - Modified Layout Adjusted Heavies (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	409	8.7	431	8.7	0.235	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	46	7.6	48	7.6	0.040	8.3	LOS A	0.2	1.4	0.43	0.64	0.43	48.0
Approach		455	8.5	479	8.5	0.235	0.9	NA	0.2	1.4	0.04	0.08	0.04	74.3
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.015	5.8	LOS A	0.1	0.5	0.35	0.53	0.35	44.2
9	R2	39	43.0	41	43.0	0.312	37.5	LOS E	1.1	17.7	0.87	1.01	1.03	32.9
Approach		55	37.0	58	37.0	0.312	28.2	LOS D	1.1	17.7	0.72	0.87	0.83	35.0
North: Pinga St														
10	L2	52	43.0	55	43.0	0.176	7.6	LOS A	0.0	0.0	0.00	0.13	0.00	57.3
11	T1	229	16.9	241	16.9	0.176	0.1	LOS A	0.0	0.0	0.00	0.13	0.00	76.2
Approach		281	21.7	296	21.7	0.176	1.5	NA	0.0	0.0	0.00	0.13	0.00	70.8
All Vehicles		791	15.2	833	15.2	0.312	3.0	NA	1.1	17.7	0.08	0.15	0.08	66.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stage 3,4 With GNH - Modified Layout Adjusted Heavies (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	244	16.1	257	16.1	0.145	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.4
6	R2	12	5.6	13	5.6	0.012	8.8	LOS A	0.1	0.4	0.49	0.65	0.49	47.8
Approach		256	15.6	269	15.6	0.145	0.5	NA	0.1	0.4	0.02	0.05	0.02	76.2
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.040	6.2	LOS A	0.2	1.2	0.43	0.61	0.43	44.4
9	R2	31	43.0	33	43.0	0.211	29.5	LOS D	0.7	11.4	0.83	0.95	0.89	35.4
Approach		71	21.9	75	21.9	0.211	16.4	LOS C	0.7	11.4	0.61	0.76	0.63	39.4
North: Pinga St														
10	L2	43	43.0	45	43.0	0.243	7.7	LOS A	0.0	0.0	0.00	0.07	0.00	58.3
11	T1	367	9.9	386	9.9	0.243	0.1	LOS A	0.0	0.0	0.00	0.07	0.00	78.1
Approach		410	13.3	432	13.3	0.243	0.9	NA	0.0	0.0	0.00	0.07	0.00	74.7
All Vehicles		737	14.9	776	14.9	0.243	2.2	NA	0.7	11.4	0.07	0.13	0.07	68.6

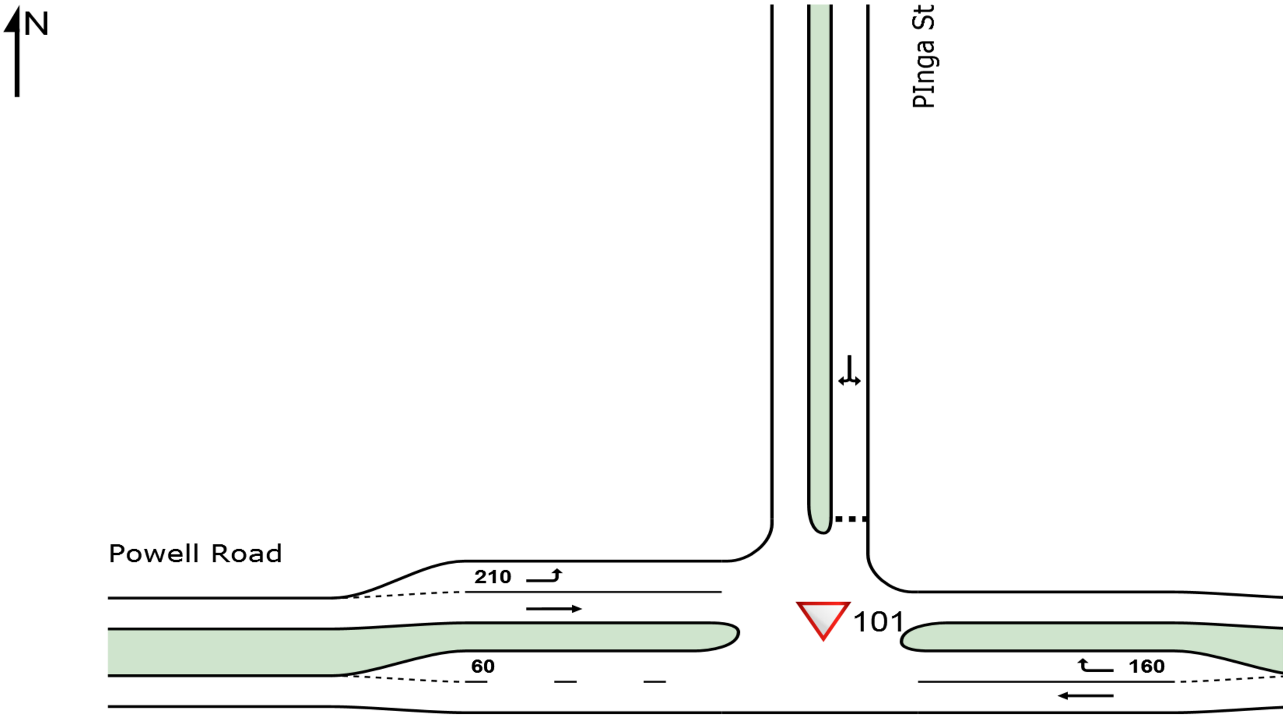
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Pinga Am Peak Stages 3,4 With GNH (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Am Peak Stages 3,4 With GNH (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Powell Road														
5	T1	75	6.1	79	6.1	0.042	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
6	R2	468	6.1	493	6.1	0.366	6.9	LOS A	2.1	16.4	0.16	0.60	0.16	44.9
Approach		543	6.1	572	6.1	0.366	5.9	NA	2.1	16.4	0.14	0.52	0.14	49.2
North: PInga St														
7	L2	253	14.4	266	14.4	0.224	4.9	LOS A	1.0	8.2	0.12	0.50	0.12	42.1
9	R2	1	14.4	1	14.4	0.224	14.5	LOS B	1.0	8.2	0.12	0.50	0.12	44.8
Approach		254	14.4	267	14.4	0.224	4.9	LOS A	1.0	8.2	0.12	0.50	0.12	42.1
West: Powell Road														
10	L2	1	6.1	1	6.1	0.001	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.6
11	T1	31	14.4	33	14.4	0.018	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		32	14.1	34	14.1	0.018	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.1
All Vehicles		829	9.0	873	9.0	0.366	5.4	NA	2.1	16.4	0.13	0.49	0.13	47.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Pm Peak Stages 3,4 With GNH (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Powell Road														
5	T1	29	10.2	31	10.2	0.017	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	246	10.2	259	10.2	0.209	7.2	LOS A	1.0	8.0	0.23	0.61	0.23	44.4
Approach		275	10.2	289	10.2	0.209	6.4	NA	1.0	8.0	0.21	0.55	0.21	47.7
North: PInga St														
7	L2	486	4.5	512	4.5	0.429	5.2	LOS A	2.3	17.9	0.27	0.53	0.27	41.7
9	R2	1	4.5	1	4.5	0.429	10.3	LOS B	2.3	17.9	0.27	0.53	0.27	44.6
Approach		487	4.5	513	4.5	0.429	5.2	LOS A	2.3	17.9	0.27	0.53	0.27	41.7
West: Powell Road														
10	L2	1	10.2	1	10.2	0.001	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	59.6
11	T1	84	4.5	88	4.5	0.047	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		85	4.6	89	4.6	0.047	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.6
All Vehicles		847	6.4	892	6.4	0.429	5.1	NA	2.3	17.9	0.22	0.48	0.22	46.8

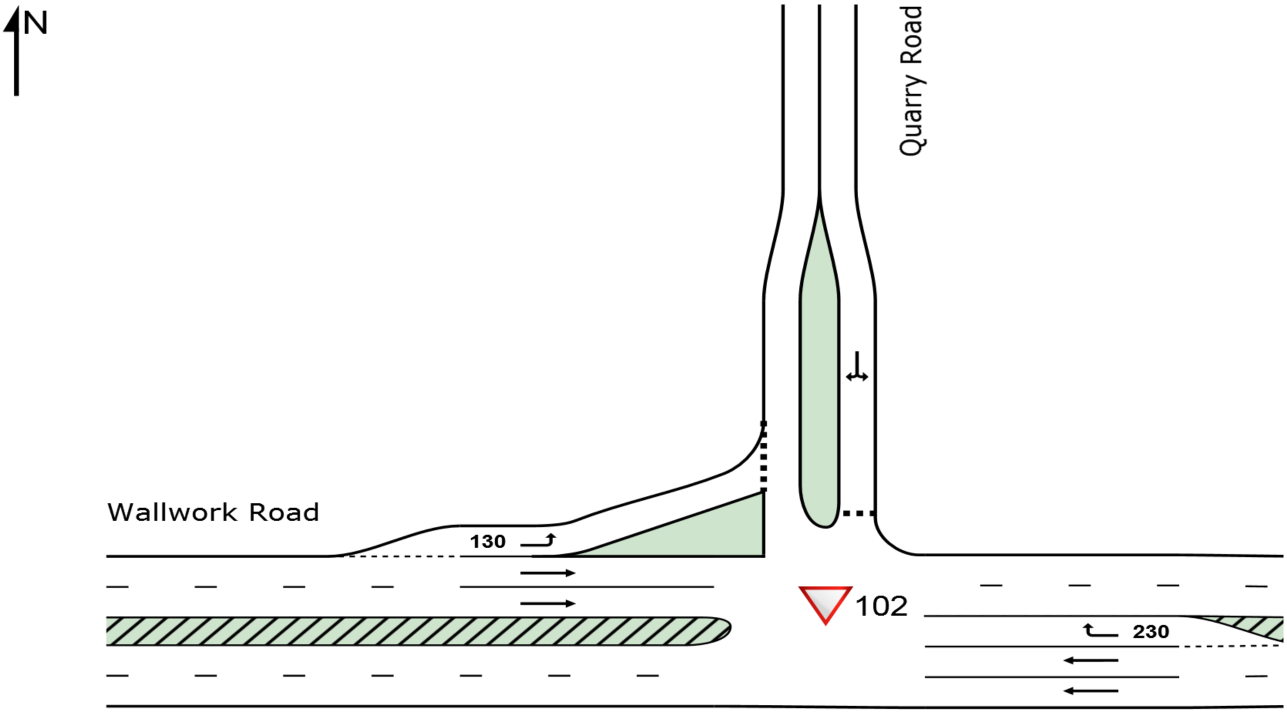
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 102 [Wallwork Rd Quarry Rd Am Stage 3,4 With GNH - Not Staged (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Am Stage 3,4 With GNH - Not Staged (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Wallwork Road														
11	T1	376	7.0	396	7.0	0.107	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	67	15.0	71	15.0	0.090	9.8	LOS A	0.4	3.1	0.50	0.73	0.50	53.9
Approach		443	8.2	466	8.2	0.107	1.5	NA	0.4	3.1	0.08	0.11	0.08	75.8
North: Quarry Road														
1	L2	36	15.0	38	15.0	0.371	11.1	LOS B	1.5	13.2	0.68	0.87	0.89	39.2
3	R2	48	15.0	51	15.0	0.371	34.9	LOS D	1.5	13.2	0.68	0.87	0.89	39.2
Approach		84	15.0	88	15.0	0.371	24.7	LOS C	1.5	13.2	0.68	0.87	0.89	39.2
West: Wallwork Road														
4	L2	132	15.0	139	15.0	0.100	7.8	LOS A	0.4	3.7	0.18	0.57	0.18	57.3
5	T1	435	2.0	458	2.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		567	5.0	597	5.0	0.119	1.8	LOS A	0.4	3.7	0.04	0.13	0.04	74.7
All Vehicles		1094	7.1	1152	7.1	0.371	3.5	NA	1.5	13.2	0.10	0.18	0.12	71.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Pm Stage 3,4 With GNH - Not Staged (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	575	3.0	605	3.0	0.158	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	24	15.0	25	15.0	0.036	10.5	LOS B	0.1	1.2	0.55	0.75	0.55	53.1
Approach		599	3.5	631	3.5	0.158	0.4	NA	0.1	1.2	0.02	0.03	0.02	78.8
North: Quarry Road														
1	L2	57	15.0	60	15.0	1.195	218.4	LOS F	30.9	271.6	1.00	2.98	8.33	9.1
3	R2	154	15.0	162	15.0	1.195	244.2	LOS F	30.9	271.6	1.00	2.98	8.33	9.1
Approach		211	15.0	222	15.0	1.195	237.2	LOS F	30.9	271.6	1.00	2.98	8.33	9.1
West: Wallwork Road														
4	L2	48	15.0	51	15.0	0.035	7.6	LOS A	0.1	1.2	0.09	0.57	0.09	57.8
5	T1	618	1.0	651	1.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		666	2.0	701	2.0	0.168	0.6	LOS A	0.1	1.2	0.01	0.04	0.01	78.3
All Vehicles		1476	4.5	1554	4.5	1.195	34.3	NA	30.9	271.6	0.15	0.46	1.20	43.3

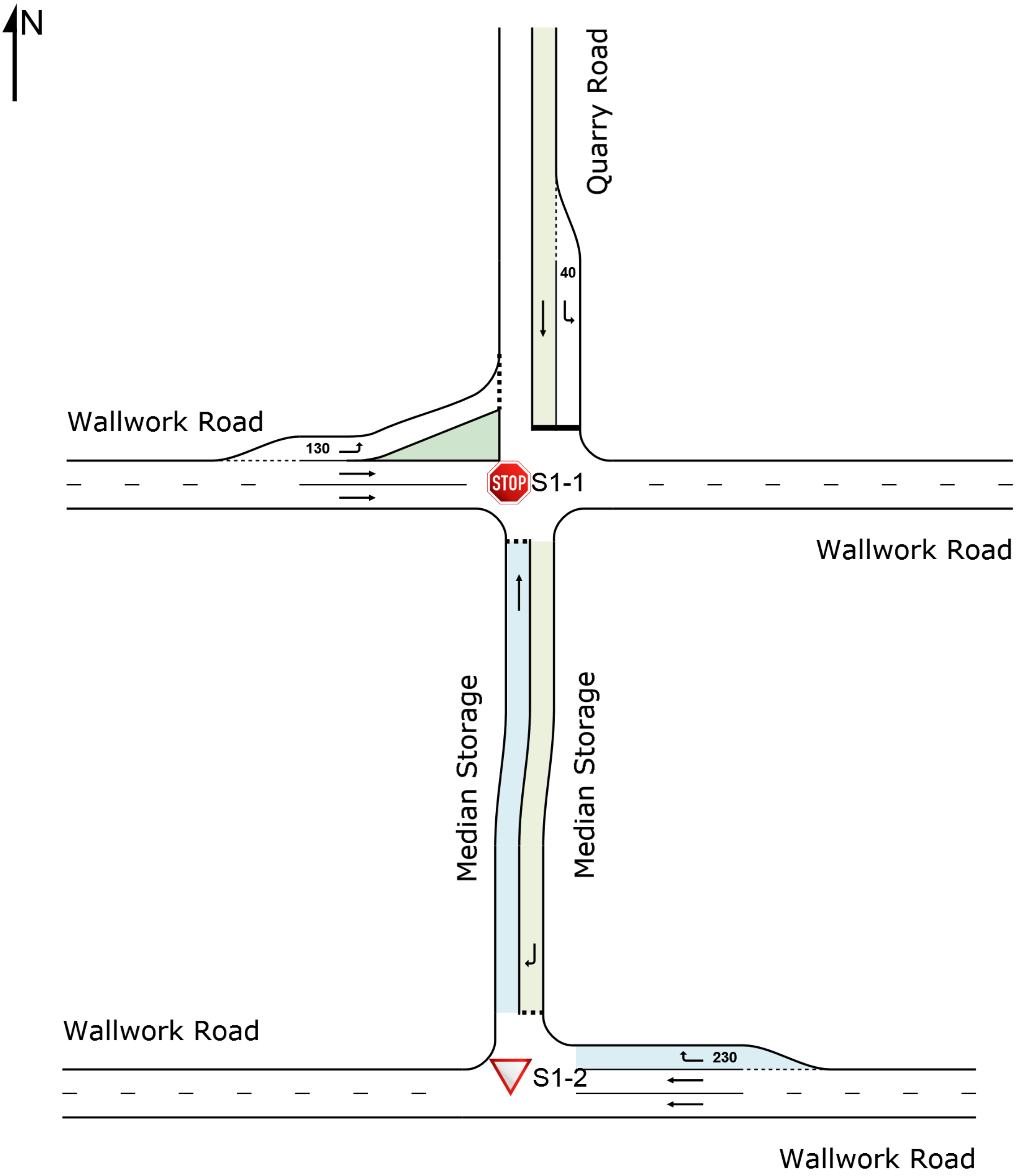
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4, with GNH (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	Wallwork Road Quarry Rd Am Stage 3,4 with GNH - Stage 2
STOP S1-1	NA	Wallwork Road Quarry Rd Am Stage 3,4 with GNH - Stage 1

MOVEMENT SUMMARY

Site: S1-2 [Wallwork Road Quarry Rd Am Stage 3,4 with GNH - Stage 2 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4, with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
2	T1	396	7.0	396	7.0	0.106	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	71	15.0	71	15.0	0.042	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		466	8.2	466	8.2	0.106	0.9	NA	0.0	0.0	0.00	0.10	0.00	59.0
North: Median Storage														
1	R2	51	15.0	51	15.0	0.055	2.8	LOS A	0.2	1.5	0.38	0.51	0.38	48.1
Approach		51	15.0	51	15.0	0.055	2.8	LOS A	0.2	1.5	0.38	0.51	0.38	48.1
All Vehicles		517	8.9	517	8.9	0.106	1.1	NA	0.2	1.5	0.04	0.14	0.04	58.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Am Stage 3,4 with GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4, with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage														
5	T1	71	15.0	71	15.0	0.081	2.7	LOS A	0.3	2.5	0.45	0.47	0.45	49.1
Approach		71	15.0	71	15.0	0.081	2.7	LOS A	0.3	2.5	0.45	0.47	0.45	49.1
North: Quarry Road														
1	L2	38	15.0	38	15.0	0.037	9.8	LOS A	0.1	1.3	0.34	0.88	0.34	50.9
2	T1	51	15.0	51	15.0	0.128	16.3	LOS C	0.5	4.3	0.65	1.01	0.65	41.0
Approach		88	15.0	88	15.0	0.128	13.5	LOS B	0.5	4.3	0.52	0.96	0.52	46.4
West: Wallwork Road														
3	L2	139	15.0	139	15.0	0.115	6.1	LOS A	0.5	4.3	0.20	0.52	0.20	53.0
4	T1	458	2.0	458	2.0	0.119	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		597	5.0	597	5.0	0.119	1.5	LOS A	0.5	4.3	0.05	0.12	0.05	58.2
All Vehicles		756	7.1	756	7.1	0.128	3.0	NA	0.5	4.3	0.14	0.25	0.14	56.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Quarry Rd Pm Stage 3,4 with GNH- Stage 2 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

▭ Network: N101 [Wallwork Rd Quarry Rd Pm Stage 3,4 with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
2	T1	605	3.0	605	3.0	0.158	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	25	15.0	25	15.0	0.015	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		631	3.5	631	3.5	0.158	0.3	NA	0.0	0.0	0.00	0.03	0.00	59.7
North: Median Storage														
1	R2	162	15.0	162	15.0	0.219	4.3	LOS A	0.8	6.6	0.51	0.69	0.51	46.3
Approach		162	15.0	162	15.0	0.219	4.3	LOS A	0.8	6.6	0.51	0.69	0.51	46.3
All Vehicles		793	5.8	793	5.8	0.219	1.1	NA	0.8	6.6	0.11	0.16	0.11	57.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Pm Stage 3,4 with GNH - Stage 1 (Site Folder: Stages 2,3,4 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Pm Stage 3,4 with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total	HV]	ARRIVAL FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage														
5	T1	25	15.0	25	15.0	0.036	3.8	LOS A	0.1	1.1	0.52	0.53	0.52	47.7
Approach		25	15.0	25	15.0	0.036	3.8	LOS A	0.1	1.1	0.52	0.53	0.52	47.7
North: Quarry Road														
1	L2	60	15.0	60	15.0	0.066	10.4	LOS B	0.3	2.3	0.42	0.90	0.42	50.5
2	T1	162	15.0	162	15.0	0.510	24.6	LOS C	2.7	24.1	0.81	1.15	1.25	34.8
Approach		222	15.0	222	15.0	0.510	20.8	LOS C	2.7	24.1	0.70	1.08	1.02	40.1
West: Wallwork Road														
3	L2	51	15.0	51	15.0	0.040	5.9	LOS A	0.2	1.4	0.10	0.51	0.10	53.4
4	T1	651	1.0	651	1.0	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		701	2.0	701	2.0	0.168	0.5	LOS A	0.2	1.4	0.01	0.04	0.01	59.4
All Vehicles		948	5.4	948	5.4	0.510	5.3	NA	2.7	24.1	0.18	0.29	0.26	54.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

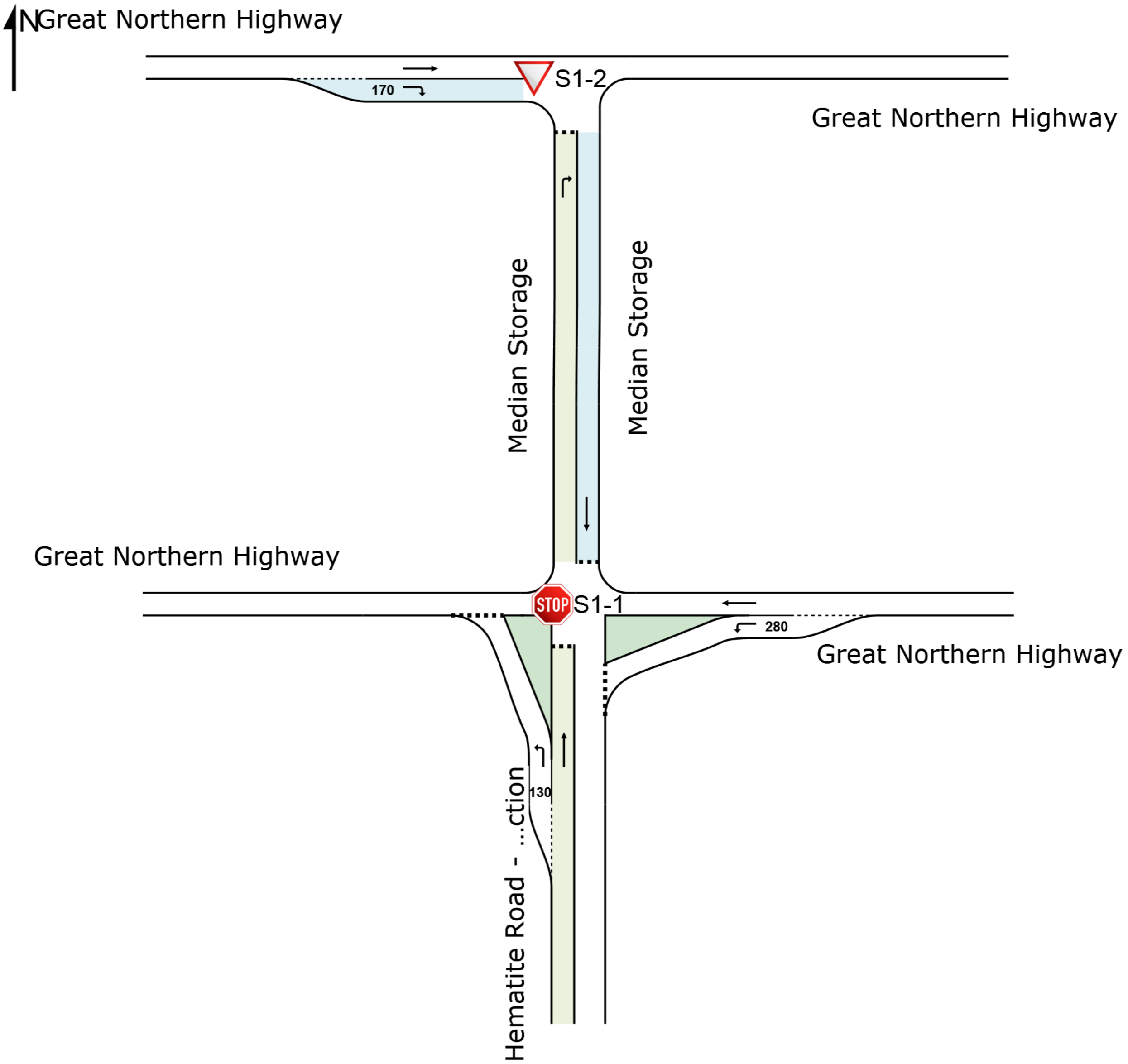
Scenario 5 – SIDRA Results

NETWORK LAYOUT

Network: N101 [New Connection GNH Am Stage 3,4, Powell (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	New Connection GNH Am Stage 3,4 Powell - Stage 2
S1-1	NA	New Connection GNH Am Stage 3,4 Powell - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [New Connection GNH Am Stage 3,4 Powell - Stage 2 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [New Connection GNH Am Stage 3,4, Powell (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	72	30.0	72	30.0	0.075	0.6	LOS A	0.2	2.5	0.19	0.12	0.19	40.7
Approach		72	30.0	72	30.0	0.075	0.6	LOS A	0.2	2.5	0.19	0.12	0.19	40.7
West: Great Northern Highway														
2	T1	151	10.3	151	10.3	0.082	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	20	34.6	20	34.6	0.013	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		171	13.2	171	13.2	0.082	1.1	NA	0.0	0.0	0.00	0.09	0.00	78.2
All Vehicles		242	18.2	242	18.2	0.082	0.9	NA	0.2	2.5	0.06	0.10	0.06	66.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [New Connection GNH Am Stage 3,4 Powell - Stage 1 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [New Connection GNH Am Stage 3,4, Powell (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Hematite Road - New Connection														
1	L2	15	31.8	15	31.8	0.022	9.5	LOS A	0.1	1.4	0.44	0.62	0.44	52.5
2	T1	72	30.0	72	30.0	0.169	14.9	LOS B	0.7	9.9	0.60	0.88	0.60	45.3
Approach		86	30.3	86	30.3	0.169	14.0	LOS B	0.7	9.9	0.57	0.83	0.57	47.2
East: Great Northern Highway														
3	L2	105	17.8	105	17.8	0.090	7.8	LOS A	0.4	3.8	0.13	0.57	0.13	57.3
4	T1	158	38.7	158	38.7	0.101	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		263	30.3	263	30.3	0.101	3.1	LOS A	0.4	3.8	0.05	0.23	0.05	69.0
North: Median Storage														
5	T1	20	34.6	20	34.6	0.039	3.5	LOS A	0.1	2.6	0.45	0.34	0.45	37.2
Approach		20	34.6	20	34.6	0.039	3.5	LOS A	0.1	2.6	0.45	0.34	0.45	37.2
All Vehicles		369	30.6	369	30.6	0.169	5.7	NA	0.7	9.9	0.19	0.38	0.19	62.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-2 [New Connection GNH Pm Stage 3,4 Powell - Stage 2 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [New Connection GNH Pm Stage 3,4 Powell (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	115	12.5	115	12.5	0.114	1.0	LOS A	0.3	2.9	0.29	0.23	0.29	46.2
Approach		115	12.5	115	12.5	0.114	1.0	LOS A	0.3	2.9	0.29	0.23	0.29	46.2
West: Great Northern Highway														
2	T1	252	18.8	252	18.8	0.145	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	18	31.4	18	31.4	0.012	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		269	19.6	269	19.6	0.145	0.6	NA	0.0	0.0	0.00	0.05	0.00	78.9
All Vehicles		384	17.5	384	17.5	0.145	0.7	NA	0.3	2.9	0.09	0.11	0.09	69.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [New Connection GNH Pm Stage 3,4 Powell- Stage 1 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [New Connection GNH Pm Stage 3,4 Powell (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Henatite Rd New Connection														
1	L2	14	19.6	14	19.6	0.017	8.1	LOS A	0.1	1.0	0.33	0.56	0.33	56.0
2	T1	115	12.5	115	12.5	0.161	10.4	LOS B	0.7	7.6	0.45	0.76	0.45	50.4
Approach		128	13.3	128	13.3	0.161	10.2	LOS B	0.7	7.6	0.44	0.74	0.44	51.4
East: Great Northern Highway														
3	L2	53	13.6	53	13.6	0.044	7.7	LOS A	0.2	1.8	0.11	0.57	0.11	58.6
4	T1	121	18.2	121	18.2	0.069	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		174	16.8	174	16.8	0.069	2.3	LOS A	0.2	1.8	0.03	0.17	0.03	72.0
North: Median Storage														
5	T1	18	31.4	18	31.4	0.027	1.7	LOS A	0.1	1.7	0.33	0.20	0.33	39.4
Approach		18	31.4	18	31.4	0.027	1.7	LOS A	0.1	1.7	0.33	0.20	0.33	39.4
All Vehicles		320	16.2	320	16.2	0.161	5.4	NA	0.7	7.6	0.21	0.40	0.21	63.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

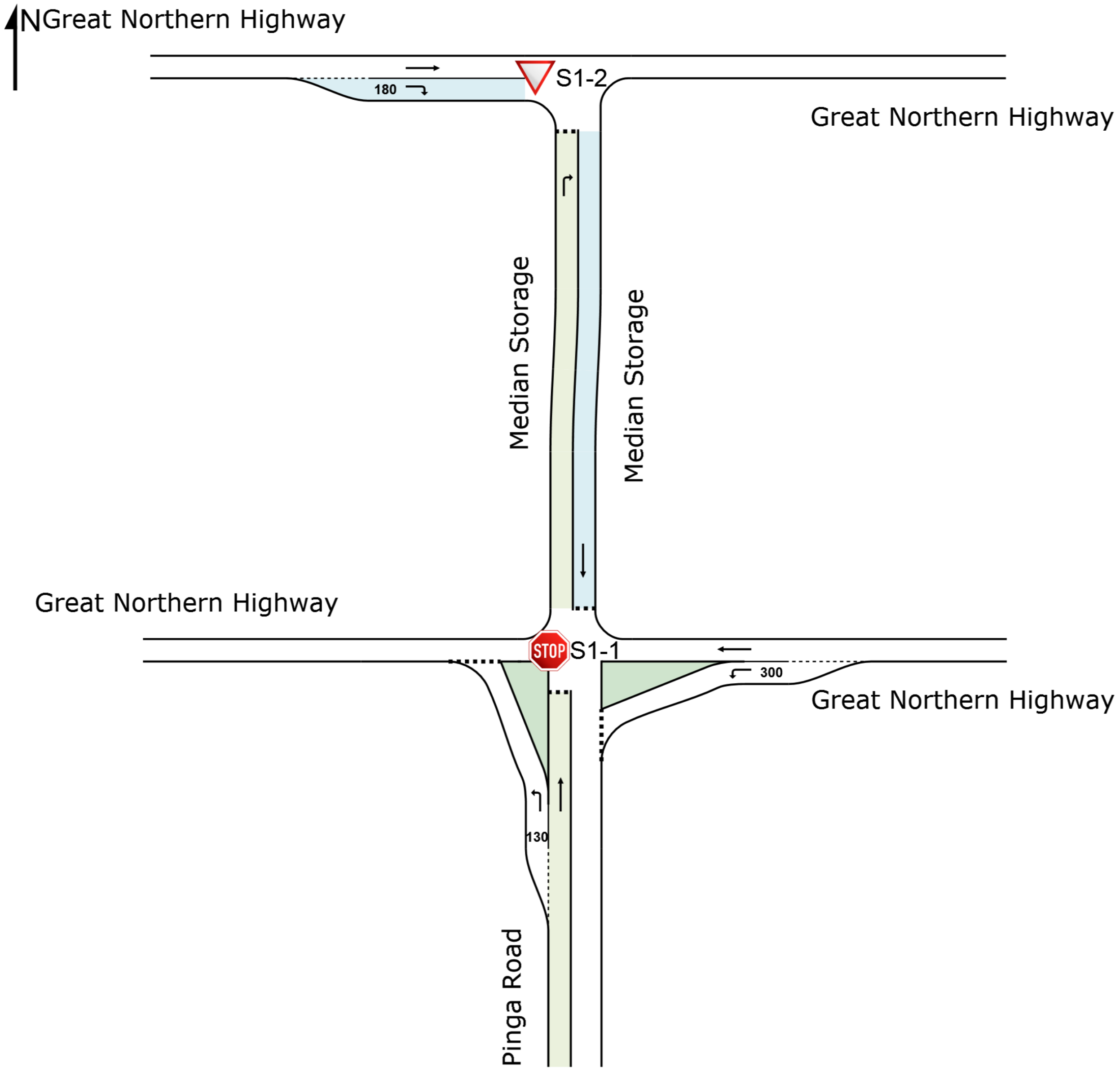
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [GNH Pinga Am Stage 3,4, Powell with GNH (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	CCG ID	Site Name
▽S1-2	NA	GNH Pinga Am Stage 3,4 Powell with GNH - Stage 2
STOP S1-1	NA	GNH Pinga Am Stage 3,4 Powell with GNH - Stage 1

MOVEMENT SUMMARY

Site: S1-2 [GNH Pinga Am Stage 3,4 Powell with GNH - Stage 2 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [GNH Pinga Am Stage 3,4, Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	73	30.0	73	30.0	0.073	0.3	LOS A	0.2	2.4	0.15	0.08	0.15	40.9
Approach		73	30.0	73	30.0	0.073	0.3	LOS A	0.2	2.4	0.15	0.08	0.15	40.9
West: Great Northern Highway														
2	T1	98	10.3	98	10.3	0.054	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
3	R2	176	34.6	176	34.6	0.152	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		274	25.9	274	25.9	0.152	5.8	NA	0.0	0.0	0.00	0.50	0.00	68.4
All Vehicles		346	26.8	346	26.8	0.152	4.6	NA	0.2	2.4	0.03	0.41	0.03	61.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Am Stage 3,4 Powell with GNH - Stage 1 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [GNH Pinga Am Stage 3,4, Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	ARRIVAL FLOWS [Total veh/h	ARRIVAL FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	183	31.8	183	31.8	0.245	9.2	LOS A	1.1	18.3	0.44	0.65	0.44	52.7
2	T1	73	30.0	73	30.0	0.249	21.0	LOS C	1.1	14.7	0.72	0.95	0.79	39.3
Approach		256	31.3	256	31.3	0.249	12.6	LOS B	1.1	18.3	0.52	0.74	0.54	49.9
East: Great Northern Highway														
3	L2	57	17.8	57	17.8	0.069	9.7	LOS A	0.3	2.7	0.44	0.67	0.44	56.0
4	T1	116	38.7	116	38.7	0.074	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		173	31.8	173	31.8	0.074	3.2	LOS A	0.3	2.7	0.14	0.22	0.14	70.1
North: Median Storage														
5	T1	176	34.6	176	34.6	0.300	3.1	LOS A	1.3	24.7	0.46	0.38	0.46	37.4
Approach		176	34.6	176	34.6	0.300	3.1	LOS A	1.3	24.7	0.46	0.38	0.46	37.4
All Vehicles		604	32.4	604	32.4	0.300	7.1	NA	1.3	24.7	0.40	0.49	0.40	52.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-2 [GNH Pinga Pm Stage 3,4 Powell with GNH - Stage 2 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [GNH Pinga Pm Stage 3,4, Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	101	12.5	101	12.5	0.092	0.6	LOS A	0.2	2.3	0.22	0.15	0.22	46.7
Approach		101	12.5	101	12.5	0.092	0.6	LOS A	0.2	2.3	0.22	0.15	0.22	46.7
West: Great Northern Highway														
2	T1	168	18.8	168	18.8	0.097	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	209	31.4	209	31.4	0.179	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		378	25.7	378	25.7	0.179	5.0	NA	0.0	0.0	0.00	0.43	0.00	70.3
All Vehicles		479	22.9	479	22.9	0.179	4.0	NA	0.2	2.3	0.05	0.37	0.05	65.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Pm Stage 3,4 Powell with GNH - Stage 1 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [GNH Pinga Pm Stage 3,4, Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total	HV]	ARRIVAL FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga Road														
1	L2	164	19.6	164	19.6	0.191	8.1	LOS A	0.9	13.1	0.35	0.60	0.35	56.0
2	T1	101	12.5	101	12.5	0.235	15.6	LOS C	1.0	10.6	0.65	0.93	0.68	44.2
Approach		265	16.9	265	16.9	0.235	11.0	LOS B	1.0	13.1	0.46	0.72	0.47	52.7
East: Great Northern Highway														
3	L2	33	13.6	33	13.6	0.042	9.8	LOS A	0.2	1.6	0.46	0.67	0.46	57.0
4	T1	102	18.2	102	18.2	0.059	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		135	17.1	135	17.1	0.059	2.4	LOS A	0.2	1.6	0.11	0.16	0.11	72.8
North: Median Storage														
5	T1	209	31.4	209	31.4	0.303	1.9	LOS A	1.4	24.9	0.38	0.28	0.38	39.2
Approach		209	31.4	209	31.4	0.303	1.9	LOS A	1.4	24.9	0.38	0.28	0.38	39.2
All Vehicles		609	21.9	609	21.9	0.303	6.0	NA	1.4	24.9	0.36	0.45	0.36	52.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

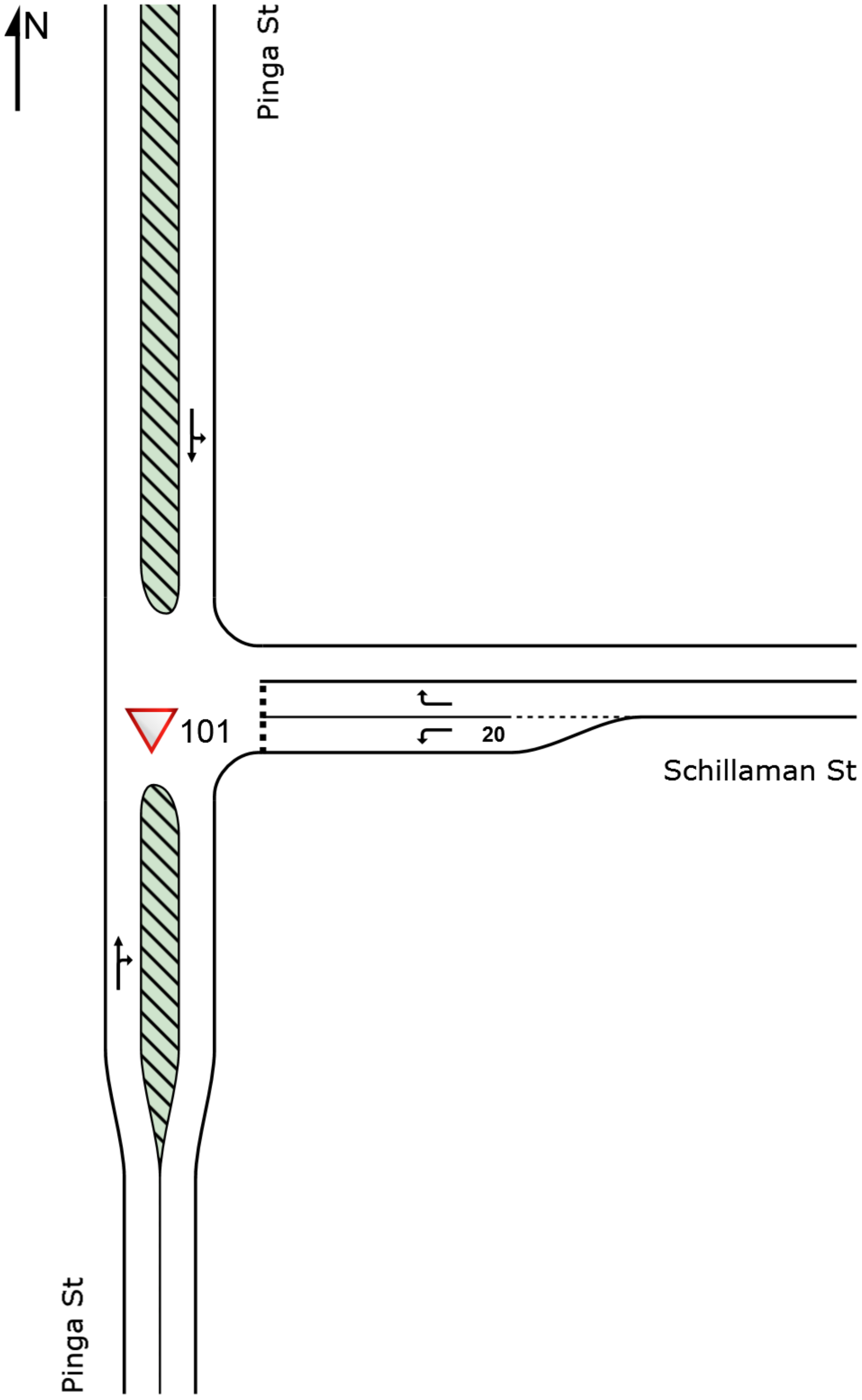
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Schillaman Am Peak Stage 3,4 Powell With GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Pinga Schillaman Am Peak Stage 3,4 Powell With GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	414	8.7	436	8.7	0.322	1.0	LOS A	1.2	10.9	0.24	0.10	0.26	75.0
6	R2	70	30.0	74	30.0	0.322	10.5	LOS B	1.2	10.9	0.24	0.10	0.26	53.6
Approach		484	11.7	509	11.7	0.322	2.4	NA	1.2	10.9	0.24	0.10	0.26	70.9
East: Schillaman St														
7	L2	18	30.0	19	30.0	0.021	6.7	LOS A	0.1	0.8	0.42	0.58	0.42	44.3
9	R2	35	49.5	37	49.5	0.157	18.6	LOS C	0.5	6.0	0.78	0.91	0.78	39.2
Approach		53	42.9	56	42.9	0.157	14.5	LOS B	0.5	6.0	0.66	0.80	0.66	40.5
North: Pinga St														
10	L2	38	49.5	40	49.5	0.207	7.8	LOS A	0.0	0.0	0.00	0.09	0.00	56.2
11	T1	297	16.9	313	16.9	0.207	0.1	LOS A	0.0	0.0	0.00	0.09	0.00	77.5
Approach		335	20.6	353	20.6	0.207	1.0	NA	0.0	0.0	0.00	0.09	0.00	73.5
All Vehicles		872	17.0	918	17.0	0.322	2.6	NA	1.2	10.9	0.17	0.14	0.18	68.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Schillaman Pm Peak Stage 3,4 Powell With GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	289	16.1	304	16.1	0.203	0.5	LOS A	0.4	3.8	0.12	0.07	0.12	76.4
6	R2	25	30.0	26	30.0	0.203	10.1	LOS B	0.4	3.8	0.12	0.07	0.12	54.5
Approach		314	17.2	331	17.2	0.203	1.3	NA	0.4	3.8	0.12	0.07	0.12	74.0
East: Hematite Dr														
7	L2	55	30.0	58	30.0	0.065	7.0	LOS A	0.3	2.6	0.45	0.63	0.45	44.1
9	R2	51	49.5	54	49.5	0.167	14.4	LOS B	0.5	6.7	0.70	0.87	0.70	41.1
Approach		106	39.4	112	39.4	0.167	10.5	LOS B	0.5	6.7	0.57	0.75	0.57	42.4
North: Pinga St														
10	L2	27	49.5	28	49.5	0.215	7.8	LOS A	0.0	0.0	0.00	0.05	0.00	56.9
11	T1	338	9.9	356	9.9	0.215	0.1	LOS A	0.0	0.0	0.00	0.05	0.00	78.9
Approach		365	12.8	384	12.8	0.215	0.6	NA	0.0	0.0	0.00	0.05	0.00	76.1
All Vehicles		785	18.1	826	18.1	0.215	2.2	NA	0.5	6.7	0.13	0.15	0.13	67.3

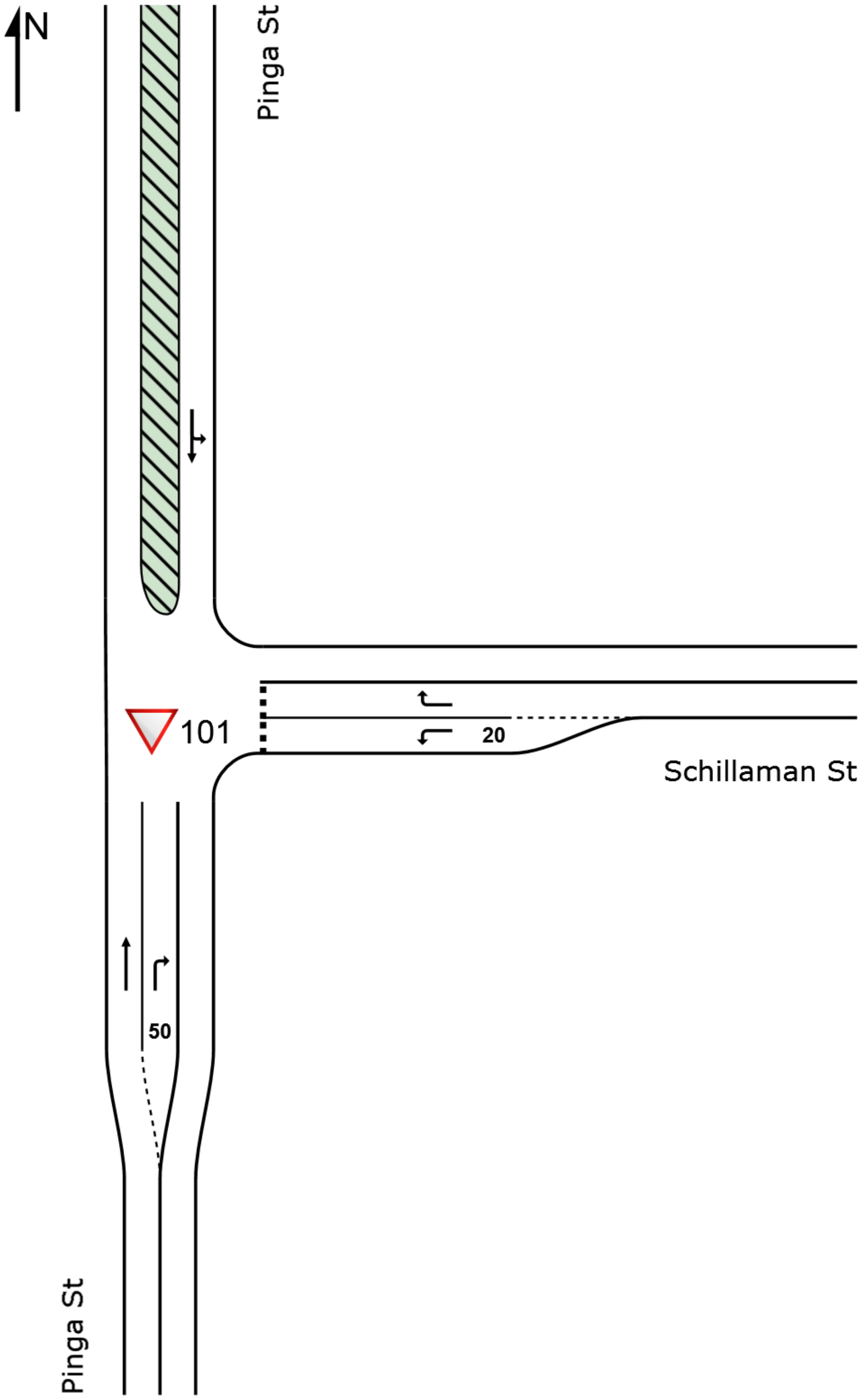
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Schillaman Am Peak Stage 3,4 Powell With GNH - Modified Layout (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Schillaman Am Peak Stage 3,4 Powell With GNH - Modified Layout (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	414	8.7	436	8.7	0.237	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	70	30.0	74	30.0	0.079	9.5	LOS A	0.3	3.5	0.50	0.70	0.50	47.1
Approach		484	11.7	509	11.7	0.237	1.4	NA	0.3	3.5	0.07	0.11	0.07	72.1
East: Schillaman St														
7	L2	18	30.0	19	30.0	0.021	6.7	LOS A	0.1	0.8	0.42	0.58	0.42	44.3
9	R2	35	49.5	37	49.5	0.227	28.9	LOS D	0.8	9.8	0.85	0.96	0.92	35.3
Approach		53	42.9	56	42.9	0.227	21.3	LOS C	0.8	9.8	0.71	0.83	0.75	37.5
North: Pinga St														
10	L2	38	49.5	40	49.5	0.207	7.8	LOS A	0.0	0.0	0.00	0.09	0.00	56.2
11	T1	297	16.9	313	16.9	0.207	0.1	LOS A	0.0	0.0	0.00	0.09	0.00	77.5
Approach		335	20.6	353	20.6	0.207	1.0	NA	0.0	0.0	0.00	0.09	0.00	73.5
All Vehicles		872	17.0	918	17.0	0.237	2.5	NA	0.8	9.8	0.08	0.15	0.09	68.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Schillaman Pm Peak Stage 3,4 Powell With GNH - Modified Layout (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	289	16.1	304	16.1	0.173	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.4
6	R2	25	30.0	26	30.0	0.029	9.4	LOS A	0.1	1.2	0.49	0.67	0.49	47.2
Approach		314	17.2	331	17.2	0.173	0.9	NA	0.1	1.2	0.04	0.07	0.04	74.5
East: Hematite Dr														
7	L2	55	30.0	58	30.0	0.065	7.0	LOS A	0.3	2.6	0.45	0.63	0.45	44.1
9	R2	51	49.5	54	49.5	0.239	22.0	LOS C	0.9	11.1	0.80	0.94	0.88	37.8
Approach		106	39.4	112	39.4	0.239	14.2	LOS B	0.9	11.1	0.62	0.78	0.66	40.4
North: Pinga St														
10	L2	27	49.5	28	49.5	0.215	7.8	LOS A	0.0	0.0	0.00	0.05	0.00	56.9
11	T1	338	9.9	356	9.9	0.215	0.1	LOS A	0.0	0.0	0.00	0.05	0.00	78.9
Approach		365	12.8	384	12.8	0.215	0.6	NA	0.0	0.0	0.00	0.05	0.00	76.1
All Vehicles		785	18.1	826	18.1	0.239	2.6	NA	0.9	11.1	0.10	0.16	0.10	66.7

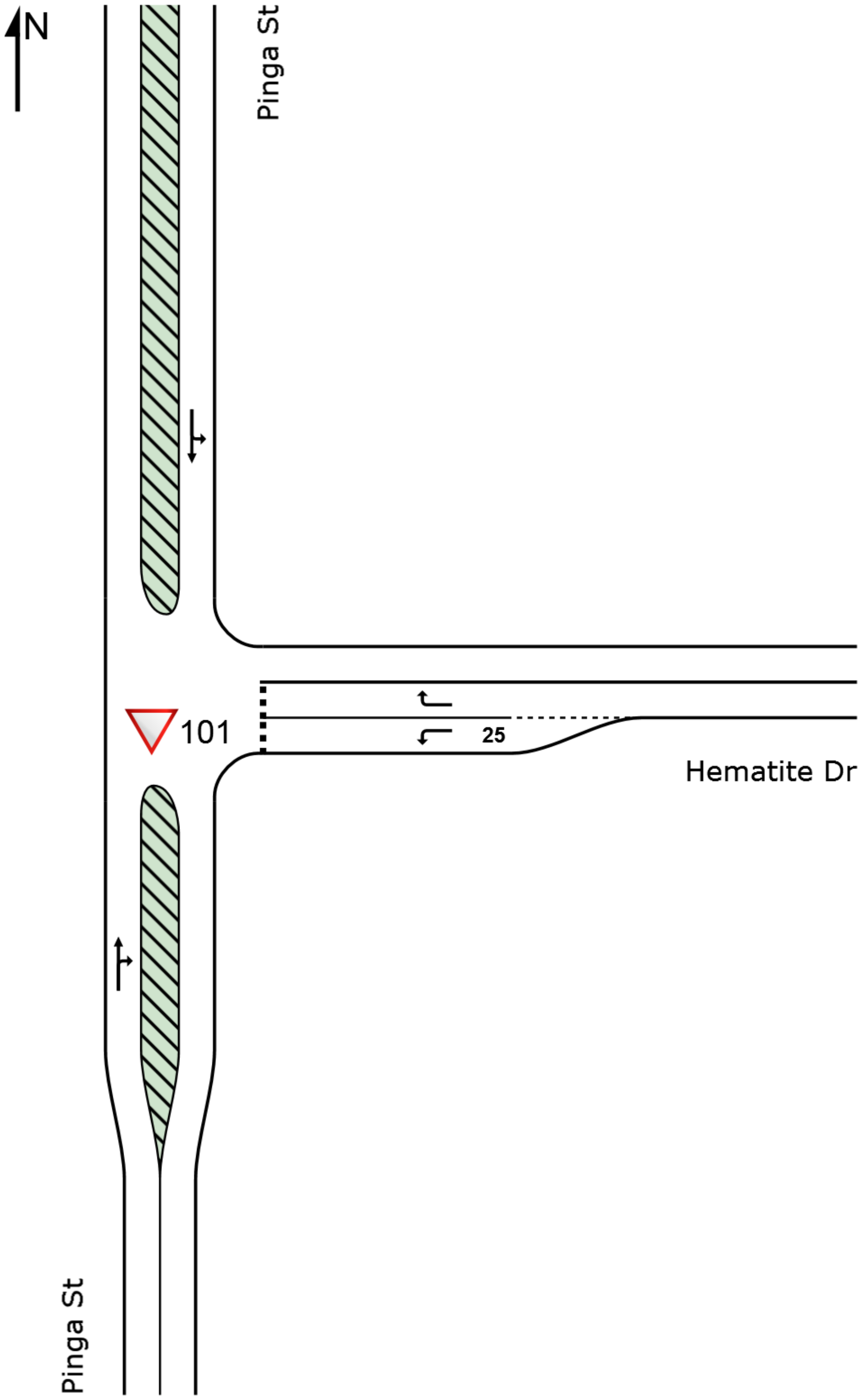
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 Powell With GNH Adjusted Heavies (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 Powell With GNH Adjusted Heavies (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total	HV]	DEMAND FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	445	8.7	468	8.7	0.298	0.4	LOS A	0.6	5.0	0.14	0.07	0.14	76.5
6	R2	46	7.6	48	7.6	0.298	9.3	LOS A	0.6	5.0	0.14	0.07	0.14	54.7
Approach		491	8.5	517	8.5	0.298	1.3	NA	0.6	5.0	0.14	0.07	0.14	73.7
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.016	6.1	LOS A	0.1	0.5	0.39	0.56	0.39	44.1
9	R2	39	42.0	41	42.0	0.254	27.7	LOS D	0.8	12.4	0.85	0.97	0.95	36.0
Approach		55	36.2	58	36.2	0.254	21.4	LOS C	0.8	12.4	0.71	0.85	0.79	37.7
North: Pinga St														
10	L2	52	43.0	55	43.0	0.206	7.6	LOS A	0.0	0.0	0.00	0.11	0.00	57.5
11	T1	280	16.9	295	16.9	0.206	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.5
Approach		332	21.0	349	21.0	0.206	1.3	NA	0.0	0.0	0.00	0.11	0.00	71.9
All Vehicles		878	15.0	924	15.0	0.298	2.5	NA	0.8	12.4	0.12	0.14	0.13	68.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stage 3,4 Powell With GNH Adjusted Heavies (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	283	16.1	298	16.1	0.182	0.3	LOS A	0.2	1.6	0.07	0.05	0.07	77.3
6	R2	12	5.6	13	5.6	0.182	9.8	LOS A	0.2	1.6	0.07	0.05	0.07	55.5
Approach		295	15.7	311	15.7	0.182	0.7	NA	0.2	1.6	0.07	0.05	0.07	76.1
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.042	6.5	LOS A	0.2	1.2	0.46	0.63	0.46	44.3
9	R2	31	43.0	33	43.0	0.173	22.5	LOS C	0.5	8.2	0.80	0.92	0.82	38.0
Approach		71	21.9	75	21.9	0.173	13.5	LOS B	0.5	8.2	0.61	0.76	0.61	40.9
North: Pinga St														
10	L2	43	43.0	45	43.0	0.266	7.7	LOS A	0.0	0.0	0.00	0.06	0.00	58.4
11	T1	408	9.9	429	9.9	0.266	0.1	LOS A	0.0	0.0	0.00	0.06	0.00	78.2
Approach		451	13.0	475	13.0	0.266	0.8	NA	0.0	0.0	0.00	0.06	0.00	75.1
All Vehicles		817	14.7	860	14.7	0.266	1.9	NA	0.5	8.2	0.08	0.12	0.08	69.8

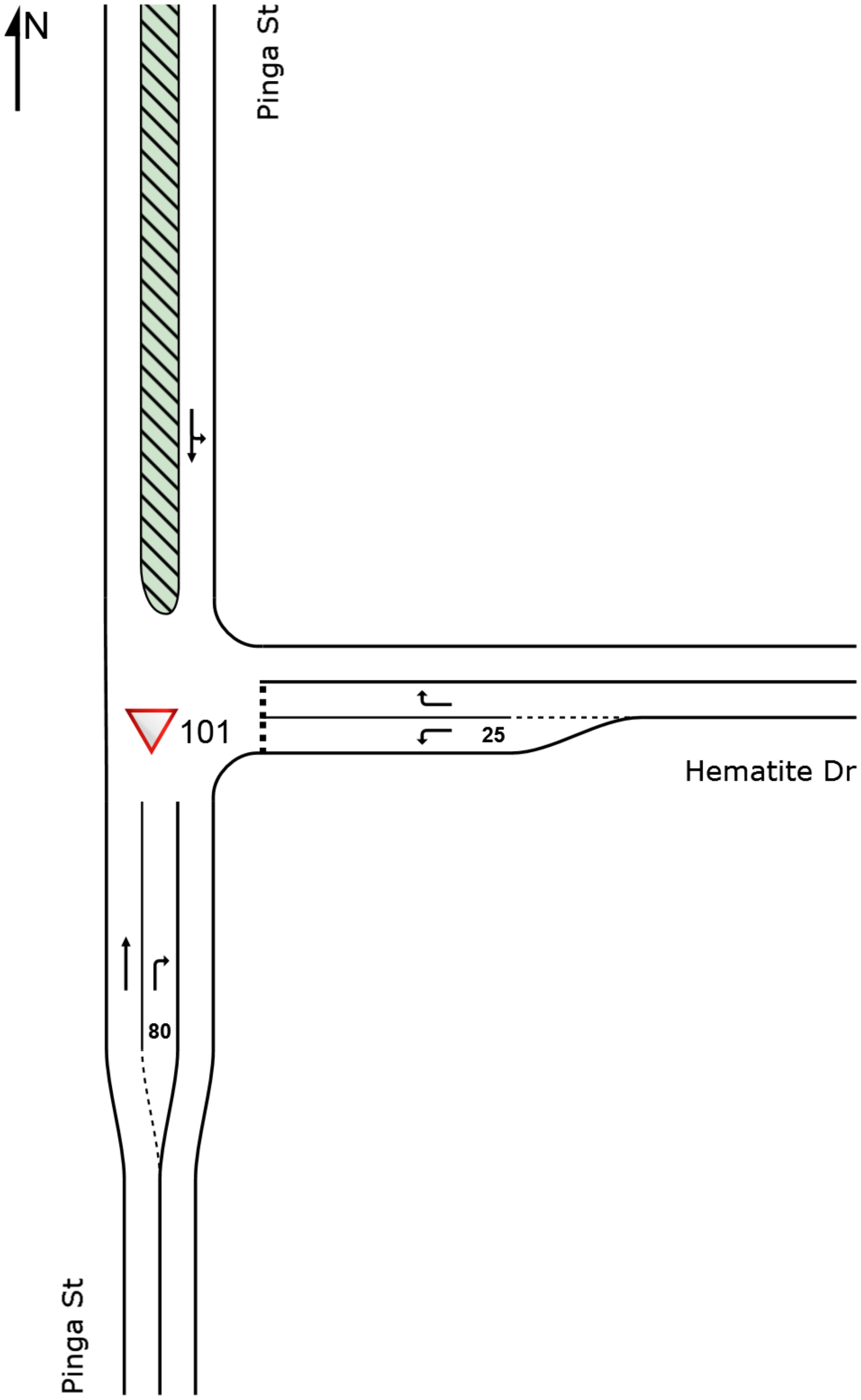
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 Powell With GNH Modified Layout Adjusted Heavies (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Stage 3,4 Powell With GNH Modified Layout Adjusted Heavies (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St														
5	T1	445	8.7	468	8.7	0.255	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	46	7.6	48	7.6	0.043	8.6	LOS A	0.2	1.5	0.46	0.66	0.46	47.9
Approach		491	8.5	517	8.5	0.255	0.9	NA	0.2	1.5	0.04	0.07	0.04	74.6
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.016	6.1	LOS A	0.1	0.5	0.39	0.56	0.39	44.1
9	R2	39	42.0	41	42.0	0.395	49.9	LOS E	1.4	21.8	0.91	1.05	1.14	29.5
Approach		55	36.2	58	36.2	0.395	37.2	LOS E	1.4	21.8	0.76	0.91	0.92	32.1
North: Pinga St														
10	L2	52	43.0	55	43.0	0.206	7.6	LOS A	0.0	0.0	0.00	0.11	0.00	57.5
11	T1	280	16.9	295	16.9	0.206	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.5
Approach		332	21.0	349	21.0	0.206	1.3	NA	0.0	0.0	0.00	0.11	0.00	71.9
All Vehicles		878	15.0	924	15.0	0.395	3.3	NA	1.4	21.8	0.07	0.14	0.08	67.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Stage 3,4 Powell With GNH Modified Layout -Adjusted Heavies (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
5	T1	283	16.1	298	16.1	0.169	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.4
6	R2	12	5.6	13	5.6	0.013	9.1	LOS A	0.1	0.4	0.52	0.66	0.52	47.6
Approach		295	15.7	311	15.7	0.169	0.5	NA	0.1	0.4	0.02	0.05	0.02	76.4
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.042	6.5	LOS A	0.2	1.2	0.46	0.63	0.46	44.3
9	R2	31	43.0	33	43.0	0.270	39.0	LOS E	0.9	14.6	0.88	0.99	0.99	32.4
Approach		71	21.9	75	21.9	0.270	20.7	LOS C	0.9	14.6	0.64	0.79	0.69	37.4
North: Pinga St														
10	L2	43	43.0	45	43.0	0.266	7.7	LOS A	0.0	0.0	0.00	0.06	0.00	58.4
11	T1	408	9.9	429	9.9	0.266	0.1	LOS A	0.0	0.0	0.00	0.06	0.00	78.2
Approach		451	13.0	475	13.0	0.266	0.8	NA	0.0	0.0	0.00	0.06	0.00	75.1
All Vehicles		817	14.7	860	14.7	0.270	2.4	NA	0.9	14.6	0.06	0.12	0.07	68.9

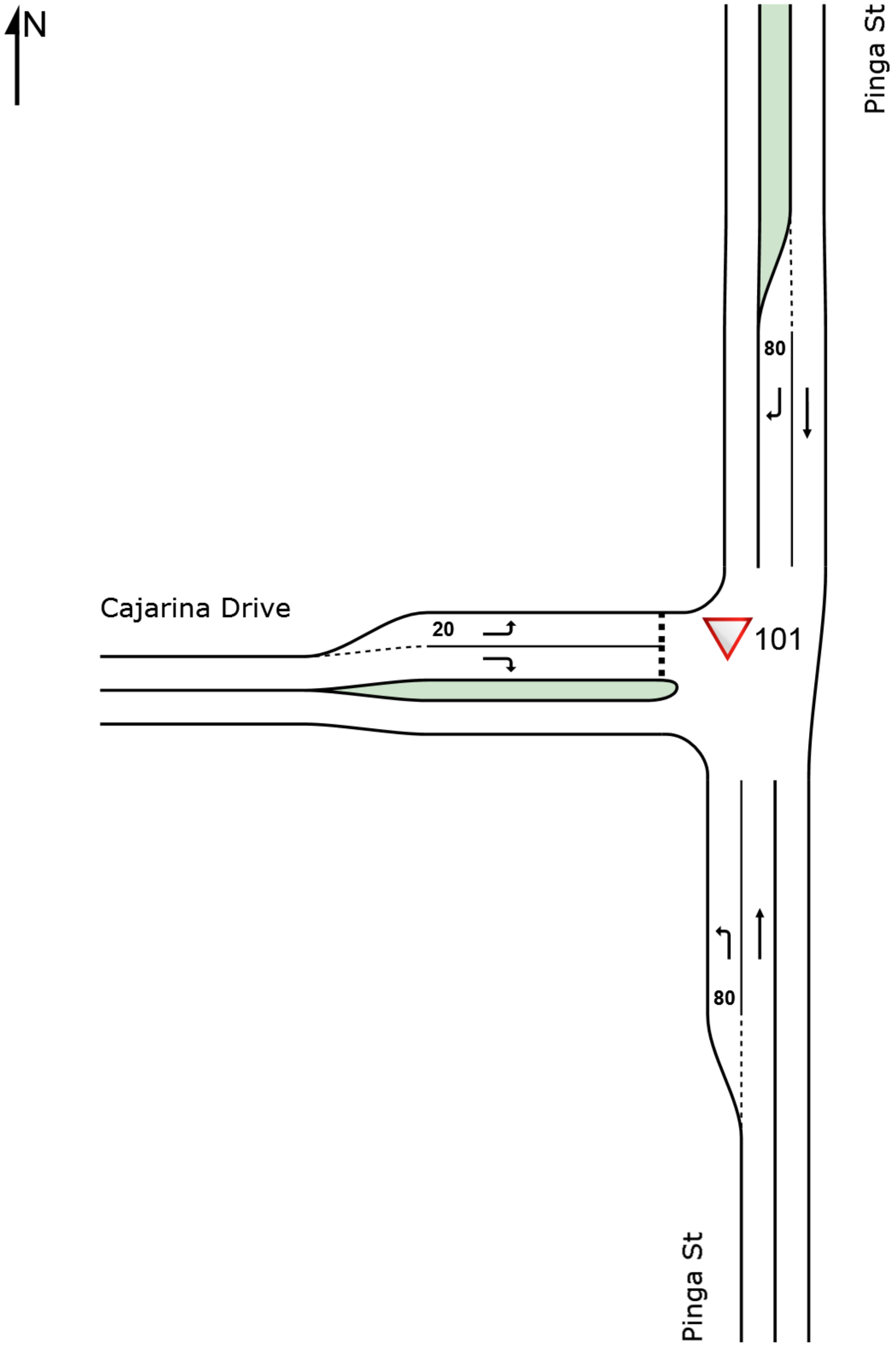
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Cajarina Rd Am Peak Stage 3,4, Powell (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Pinga Cajarina Rd Am Peak Stage 3,4, Powell (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St														
10	L2	47	3.3	49	3.3	0.027	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.5
11	T1	446	7.0	469	7.0	0.252	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
Approach		493	6.6	519	6.6	0.252	0.7	NA	0.0	0.0	0.00	0.06	0.00	76.5
North: Pinga St														
5	T1	265	14.2	279	14.2	0.158	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	42	78.0	44	78.0	0.396	48.6	LOS E	1.6	49.2	0.87	1.04	1.12	27.7
Approach		307	22.9	323	22.9	0.396	6.7	NA	1.6	49.2	0.12	0.14	0.15	59.1
West: Cajarina Drive														
7	L2	39	60.0	41	60.0	0.237	26.1	LOS D	0.9	21.3	0.76	0.93	0.84	31.4
9	R2	25	16.1	26	16.1	0.113	19.4	LOS C	0.4	3.2	0.79	0.90	0.79	36.4
Approach		64	42.8	67	42.8	0.237	23.5	LOS C	0.9	21.3	0.77	0.92	0.82	33.2
All Vehicles		864	15.1	909	15.1	0.396	4.5	NA	1.6	49.2	0.10	0.15	0.12	62.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Cajarina Rd PM Peak Stage 3,4, Powell (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
10	L2	9	10.5	9	10.5	0.005	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	57.6
11	T1	246	10.1	259	10.1	0.141	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
Approach		255	10.1	268	10.1	0.141	0.3	NA	0.0	0.0	0.00	0.03	0.00	78.0
North: Pinga St														
5	T1	447	7.3	471	7.3	0.254	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	15	88.0	16	88.0	0.078	20.8	LOS C	0.3	10.6	0.61	0.82	0.61	38.1
Approach		462	9.9	486	9.9	0.254	0.7	NA	0.3	10.6	0.02	0.03	0.02	76.0
West: Cajarina Drive														
7	L2	45	99.0	47	99.0	0.305	29.3	LOS D	1.3	52.3	0.70	0.92	0.83	28.9
9	R2	86	1.2	91	1.2	0.273	15.9	LOS C	1.1	8.0	0.76	0.93	0.87	38.3
Approach		131	34.8	138	34.8	0.305	20.5	LOS C	1.3	52.3	0.74	0.92	0.86	34.5
All Vehicles		848	13.8	893	13.8	0.305	3.7	NA	1.3	52.3	0.12	0.17	0.14	61.2

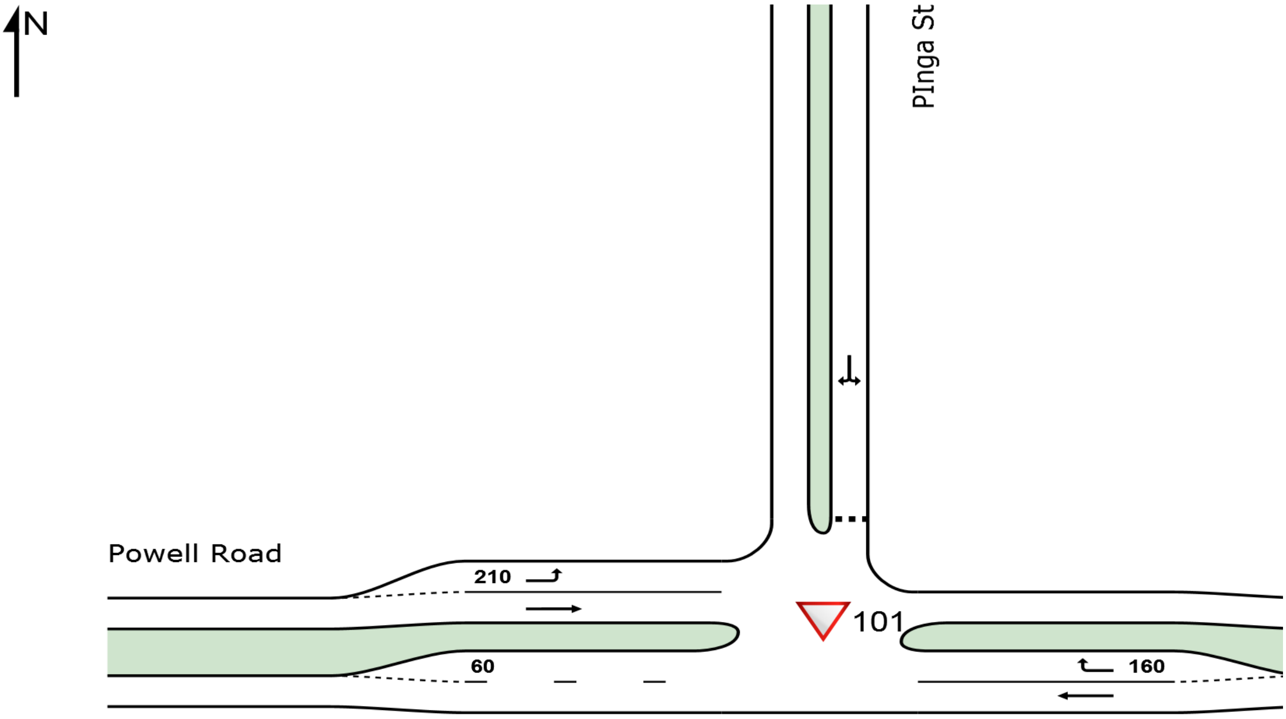
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Pinga Am Peak Stages 3,4 Powell with GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Am Peak Stages 3,4 Powell with GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Powell Road														
5	T1	118	6.1	124	6.1	0.067	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
6	R2	481	6.1	506	6.1	0.400	7.3	LOS A	2.3	18.0	0.29	0.61	0.29	44.3
Approach		599	6.1	631	6.1	0.400	5.9	NA	2.3	18.0	0.23	0.49	0.23	50.5
North: PInga St														
7	L2	267	14.4	281	14.4	0.292	5.2	LOS A	1.3	10.9	0.23	0.53	0.23	41.5
9	R2	14	14.4	15	14.4	0.292	18.3	LOS C	1.3	10.9	0.23	0.53	0.23	44.4
Approach		281	14.4	296	14.4	0.292	5.8	LOS A	1.3	10.9	0.23	0.53	0.23	41.7
West: Powell Road														
10	L2	13	6.1	14	6.1	0.008	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.6
11	T1	76	14.4	80	14.4	0.045	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		89	13.2	94	13.2	0.045	1.0	NA	0.0	0.0	0.00	0.09	0.00	76.0
All Vehicles		969	9.2	1020	9.2	0.400	5.4	NA	2.3	18.0	0.21	0.46	0.21	49.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
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Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Powell Pinga Pm Peak Stages 3,4 Powell With GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Powell Road														
5	T1	49	10.2	52	10.2	0.028	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	250	10.2	263	10.2	0.234	7.7	LOS A	1.1	8.9	0.34	0.64	0.34	43.9
Approach		299	10.2	315	10.2	0.234	6.4	NA	1.1	8.9	0.29	0.54	0.29	49.0
North: PInga St														
7	L2	501	4.5	527	4.5	0.510	6.4	LOS A	3.7	28.5	0.43	0.63	0.49	40.8
9	R2	15	4.5	16	4.5	0.510	13.4	LOS B	3.7	28.5	0.43	0.63	0.49	43.9
Approach		516	4.5	543	4.5	0.510	6.6	LOS A	3.7	28.5	0.43	0.63	0.49	41.0
West: Powell Road														
10	L2	4	10.2	4	10.2	0.002	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	59.6
11	T1	164	4.5	173	4.5	0.091	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		168	4.7	177	4.7	0.091	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.2
All Vehicles		983	6.3	1035	6.3	0.510	5.4	NA	3.7	28.5	0.31	0.50	0.35	48.7

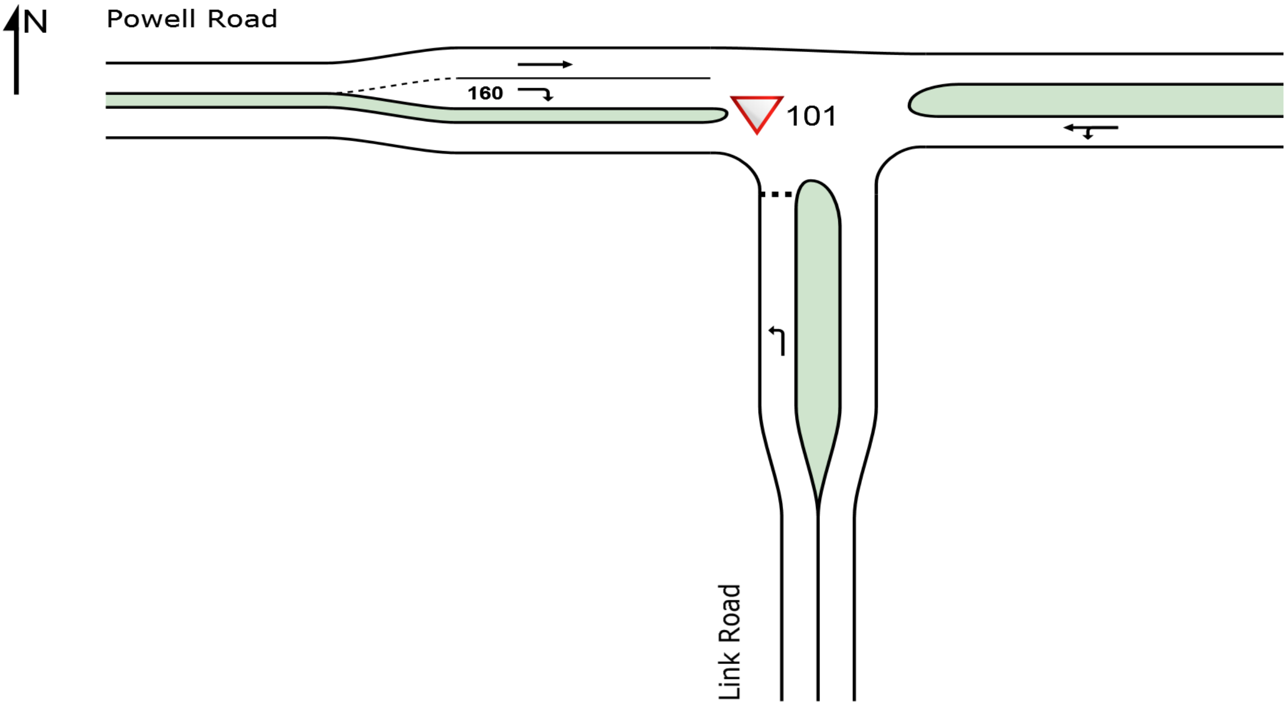
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Link Am Peak Stages 3,4, Powell with GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



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MOVEMENT SUMMARY

Site: 101 [Powell Link Am Peak Stages 3,4, Powell with GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Link Road														
7	L2	410	5.1	432	5.1	0.328	5.6	LOS A	1.6	12.8	0.37	0.58	0.37	40.2
Approach		410	5.1	432	5.1	0.328	5.6	LOS A	1.6	12.8	0.37	0.58	0.37	40.2
East: Powell Road														
10	L2	1	9.1	1	9.1	0.108	7.1	LOS A	0.0	0.0	0.00	0.01	0.00	70.2
11	T1	188	9.1	198	9.1	0.108	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.4
Approach		189	9.1	199	9.1	0.108	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.4
West: Powell Road														
5	T1	144	20.4	152	20.4	0.089	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	199	15.0	209	15.0	0.157	7.7	LOS A	0.8	6.6	0.36	0.63	0.36	42.8
Approach		343	17.3	361	17.3	0.157	4.5	NA	0.8	6.6	0.21	0.37	0.21	57.8
All Vehicles		942	10.3	992	10.3	0.328	4.1	NA	1.6	12.8	0.24	0.39	0.24	53.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Pm Peak Stages 3,4 Powell with GNH (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Link Road														
7	L2	203	9.7	214	9.7	0.152	5.1	LOS A	0.7	5.5	0.23	0.52	0.23	39.9
Approach		203	9.7	214	9.7	0.152	5.1	LOS A	0.7	5.5	0.23	0.52	0.23	39.9
East: Powell Road														
10	L2	1	11.7	1	11.7	0.056	7.1	LOS A	0.0	0.0	0.00	0.02	0.00	69.5
11	T1	96	11.7	101	11.7	0.056	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	79.2
Approach		97	11.7	102	11.7	0.056	0.1	NA	0.0	0.0	0.00	0.02	0.00	79.1
West: Powell Road														
5	T1	191	6.5	201	6.5	0.108	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	474	4.0	499	4.0	0.312	7.1	LOS A	1.8	13.9	0.27	0.60	0.27	43.7
Approach		665	4.7	700	4.7	0.312	5.1	NA	1.8	13.9	0.20	0.43	0.20	53.9
All Vehicles		965	6.5	1016	6.5	0.312	4.6	NA	1.8	13.9	0.18	0.41	0.18	53.1

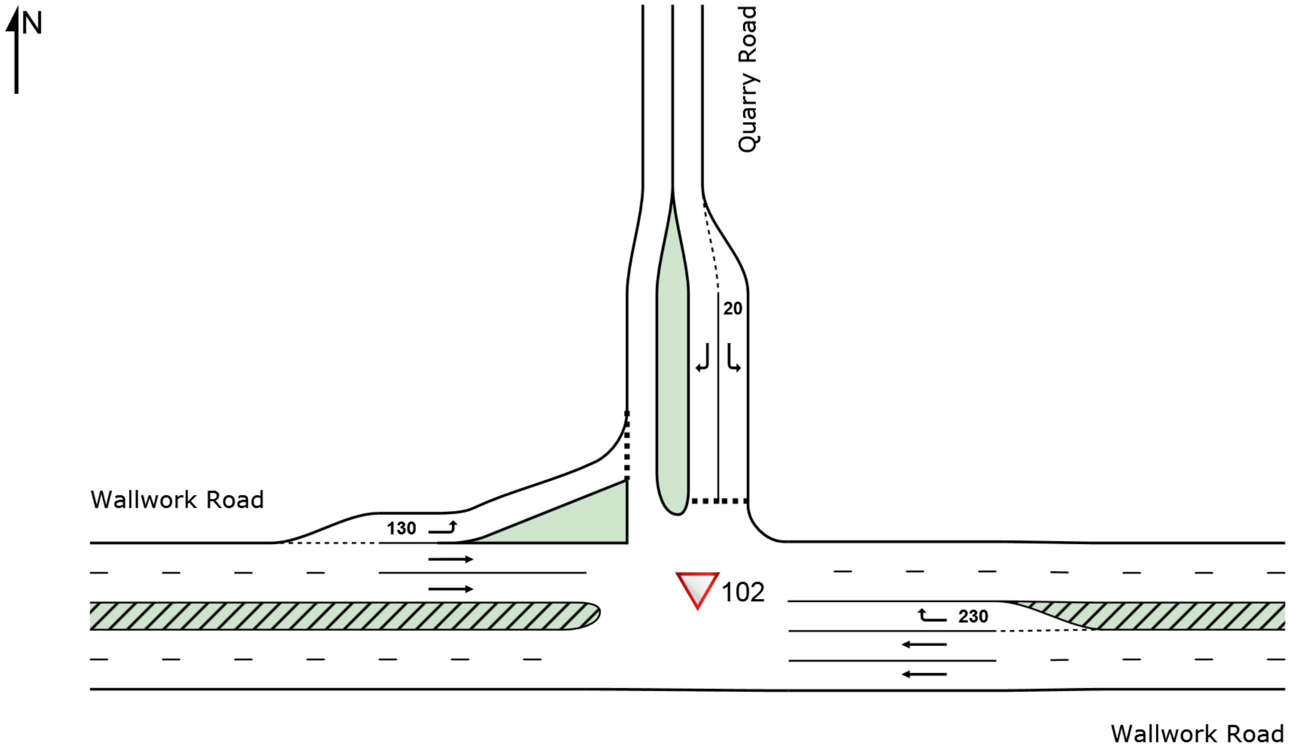
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 102 [Wallwork Rd Quarry Rd Am Stage 3,4 Powell With GNH - Not Staged (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 102 [Wallwork Rd Quarry Rd Am Stage 3,4 Powell With GNH - Not Staged (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Wallwork Road														
11	T1	461	7.0	485	7.0	0.131	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	67	15.0	71	15.0	0.096	10.3	LOS B	0.4	3.3	0.52	0.75	0.52	53.7
Approach		528	8.0	556	8.0	0.131	1.3	NA	0.4	3.3	0.07	0.10	0.07	76.4
North: Quarry Road														
1	L2	36	15.0	38	15.0	0.041	7.8	LOS A	0.1	1.3	0.35	0.62	0.35	52.5
3	R2	48	15.0	51	15.0	0.442	47.5	LOS E	1.6	13.7	0.92	1.03	1.18	29.1
Approach		84	15.0	88	15.0	0.442	30.5	LOS D	1.6	13.7	0.67	0.85	0.82	36.0
West: Wallwork Road														
4	L2	132	15.0	139	15.0	0.100	7.8	LOS A	0.4	3.7	0.18	0.57	0.18	57.3
5	T1	480	2.0	505	2.0	0.131	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		612	4.8	644	4.8	0.131	1.7	LOS A	0.4	3.7	0.04	0.12	0.04	75.1
All Vehicles		1224	6.9	1288	6.9	0.442	3.5	NA	1.6	13.7	0.09	0.16	0.10	71.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 102 [Wallwork Rd Quarry Rd Pm Stage 3,4 Powell With GNH - Not Staged (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	 HV] %	DEMAND FLOWS [Total veh/h	 HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	 Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	615	3.0	647	3.0	0.169	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
12	R2	24	15.0	25	15.0	0.040	11.3	LOS B	0.1	1.3	0.57	0.77	0.57	52.6
Approach		639	3.5	673	3.5	0.169	0.5	NA	0.1	1.3	0.02	0.03	0.02	78.8
North: Quarry Road														
1	L2	57	15.0	60	15.0	0.070	8.5	LOS A	0.2	2.2	0.42	0.67	0.42	52.0
3	R2	154	15.0	162	15.0	1.364	390.2	LOS F	32.9	289.3	1.00	2.86	9.06	5.9
Approach		211	15.0	222	15.0	1.364	287.1	LOS F	32.9	289.3	0.84	2.27	6.72	7.7
West: Wallwork Road														
4	L2	48	15.0	51	15.0	0.035	7.6	LOS A	0.1	1.2	0.09	0.57	0.09	57.8
5	T1	698	1.0	735	1.0	0.190	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		746	1.9	785	1.9	0.190	0.5	LOS A	0.1	1.2	0.01	0.04	0.01	78.5
All Vehicles		1596	4.3	1680	4.3	1.364	38.4	NA	32.9	289.3	0.12	0.33	0.90	41.2

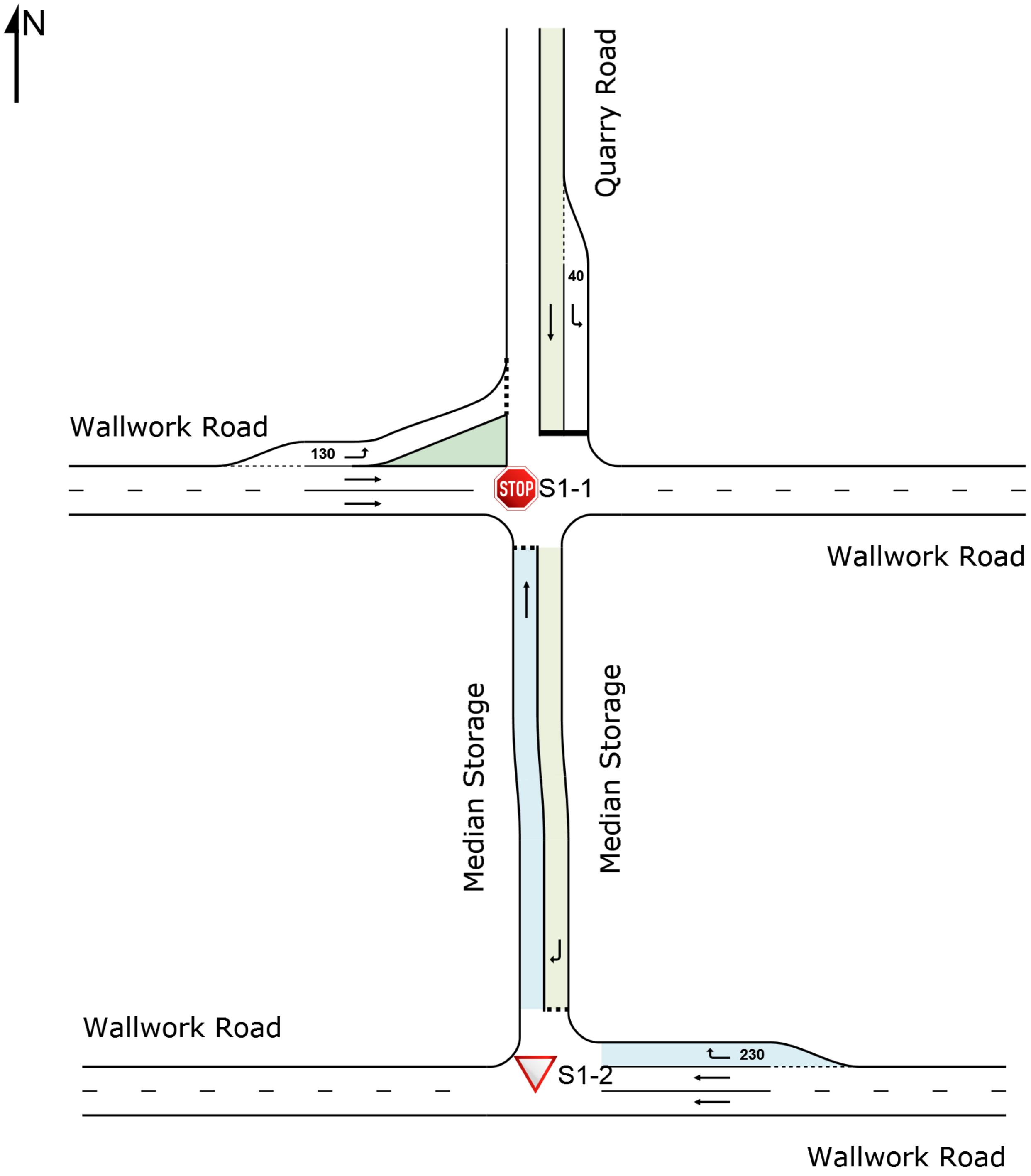
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4 Powell with GNH (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	Wallwork Road Quarry Rd Am Stage 3,4 Powell with GNH - Stage 2
S1-1	NA	Wallwork Road Quarry Rd Am Stage 3,4 Powell with GNH - Stage 1

MOVEMENT SUMMARY

Site: S1-2 [Wallwork Road Quarry Rd Am Stage 3,4 Powell with GNH - Stage 2 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4 Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
2	T1	485	7.0	485	7.0	0.130	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	71	15.0	71	15.0	0.042	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		556	8.0	556	8.0	0.130	0.8	NA	0.0	0.0	0.00	0.08	0.00	59.2
North: Median Storage														
1	R2	51	15.0	51	15.0	0.061	3.3	LOS A	0.2	1.7	0.43	0.56	0.43	47.5
Approach		51	15.0	51	15.0	0.061	3.3	LOS A	0.2	1.7	0.43	0.56	0.43	47.5
All Vehicles		606	8.6	606	8.6	0.130	1.0	NA	0.2	1.7	0.04	0.12	0.04	58.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Am Stage 3,4 Powell with GNH - Stage 1 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Am Stage 3,4 Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage														
5	T1	71	15.0	71	15.0	0.085	3.0	LOS A	0.3	2.7	0.47	0.50	0.47	48.8
Approach		71	15.0	71	15.0	0.085	3.0	LOS A	0.3	2.7	0.47	0.50	0.47	48.8
North: Quarry Road														
1	L2	38	15.0	38	15.0	0.038	9.9	LOS A	0.1	1.3	0.36	0.88	0.36	50.8
2	T1	51	15.0	51	15.0	0.140	17.4	LOS C	0.5	4.7	0.68	1.01	0.68	40.1
Approach		88	15.0	88	15.0	0.140	14.2	LOS B	0.5	4.7	0.54	0.95	0.54	45.9
West: Wallwork Road														
3	L2	139	15.0	139	15.0	0.115	6.1	LOS A	0.5	4.3	0.20	0.52	0.20	53.0
4	T1	505	2.0	505	2.0	0.131	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		644	4.8	644	4.8	0.131	1.3	LOS A	0.5	4.3	0.04	0.11	0.04	58.3
All Vehicles		803	6.8	803	6.8	0.140	2.9	NA	0.5	4.7	0.14	0.24	0.14	56.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Quarry Rd Pm Stage 3,4 Powell with GNH- Stage 2 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Pm Stage 3,4 Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Wallwork Road														
2	T1	647	3.0	647	3.0	0.169	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	25	15.0	25	15.0	0.015	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		673	3.5	673	3.5	0.169	0.3	NA	0.0	0.0	0.00	0.02	0.00	59.7
North: Median Storage														
1	R2	162	15.0	162	15.0	0.229	4.7	LOS A	0.8	7.0	0.53	0.71	0.55	45.9
Approach		162	15.0	162	15.0	0.229	4.7	LOS A	0.8	7.0	0.53	0.71	0.55	45.9
All Vehicles		835	5.7	835	5.7	0.229	1.1	NA	0.8	7.0	0.10	0.16	0.11	57.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Pm Stage 3,4 Powell with GNH - Stage 1 (Site Folder: Stages 2,3,4,Powell 2026 Opening With GNH)]

Network: N101 [Wallwork Rd Quarry Rd Pm Stage 3,4 Powell with GNH (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total	HV]	ARRIVAL FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Median Storage														
5	T1	25	15.0	25	15.0	0.040	4.5	LOS A	0.1	1.2	0.55	0.58	0.55	46.9
Approach		25	15.0	25	15.0	0.040	4.5	LOS A	0.1	1.2	0.55	0.58	0.55	46.9
North: Quarry Road														
1	L2	60	15.0	60	15.0	0.070	10.7	LOS B	0.3	2.4	0.45	0.91	0.45	50.3
2	T1	162	15.0	162	15.0	0.612	31.0	LOS D	3.4	29.7	0.86	1.20	1.51	31.1
Approach		222	15.0	222	15.0	0.612	25.5	LOS D	3.4	29.7	0.75	1.12	1.22	37.1
West: Wallwork Road														
3	L2	51	15.0	51	15.0	0.040	5.9	LOS A	0.2	1.4	0.10	0.51	0.10	53.4
4	T1	735	1.0	735	1.0	0.190	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		785	1.9	785	1.9	0.190	0.4	LOS A	0.2	1.4	0.01	0.03	0.01	59.4
All Vehicles		1033	5.0	1033	5.0	0.612	5.9	NA	3.4	29.7	0.18	0.28	0.28	54.3

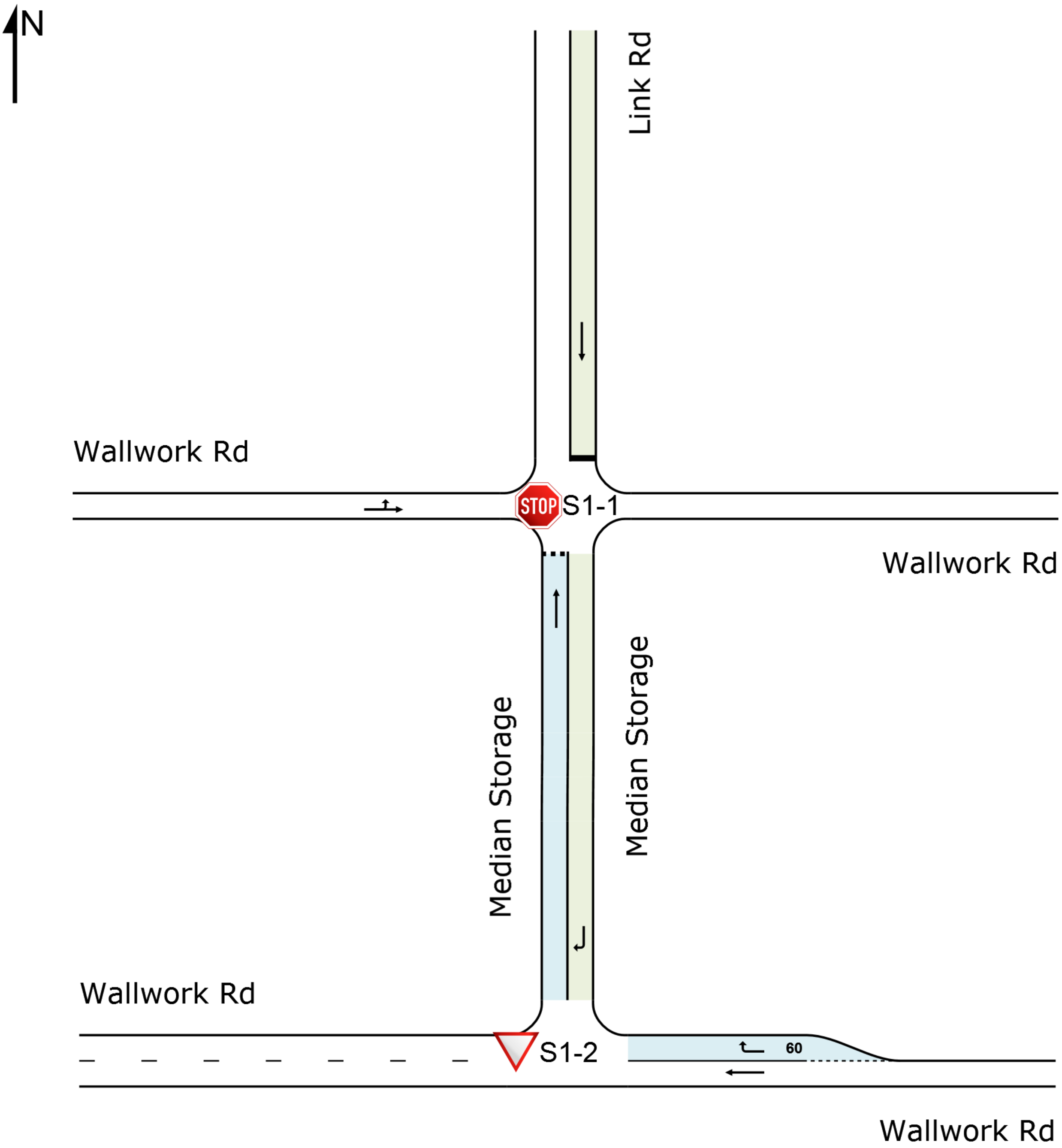
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: SCTI-C [Wallwork Rd Link Rd Am Existing (Network Folder: General)]

Staged Crossing at T Intersection Type C
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	Wallwork Road Link Rd AM Existing Stage 2
🛑S1-1	NA	Wallwork Road Link Rd Am Existing Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Link Rd AM Existing Stage 2 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Am Existing (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Rd														
2	T1	214	1.0	214	1.0	0.110	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	1	0.0	1	0.0	0.001	5.7	LOS A	0.0	0.0	0.00	0.63	0.00	50.6
Approach		215	1.0	215	1.0	0.110	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Median Storage														
1	R2	184	4.1	184	4.1	0.102	1.0	LOS A	0.0	0.0	0.00	0.29	0.00	22.3
Approach		184	4.1	184	4.1	0.102	1.0	NA	0.0	0.0	0.00	0.29	0.00	22.3
All Vehicles		399	2.4	399	2.4	0.110	0.5	NA	0.0	0.0	0.00	0.13	0.00	39.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Link Rd Am Existing Stage 1 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Am Existing (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
5	T1	1	0.0	1	0.0	0.001	0.9	LOS A	0.0	0.0	0.34	0.15	0.34	51.5
Approach		1	0.0	1	0.0	0.001	0.9	LOS A	0.0	0.0	0.34	0.15	0.34	51.5
North: Link Rd														
2	T1	184	4.1	184	4.1	0.436	18.4	LOS C	2.4	20.4	0.72	1.13	1.02	39.0
Approach		184	4.1	184	4.1	0.436	18.4	LOS C	2.4	20.4	0.72	1.13	1.02	39.0
West: Wallwork Rd														
3	L2	389	0.8	389	0.8	0.445	5.6	LOS A	3.0	21.8	0.02	0.32	0.02	55.5
4	T1	313	1.0	313	1.0	0.445	0.0	LOS A	3.0	21.8	0.02	0.32	0.02	57.0
Approach		702	0.9	702	0.9	0.445	3.1	NA	3.0	21.8	0.02	0.32	0.02	56.2
All Vehicles		887	1.5	887	1.5	0.445	6.3	NA	3.0	21.8	0.16	0.49	0.23	53.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Link Rd PM Existing Stage 2 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Pm Existing (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Rd														
2	T1	464	1.0	464	1.0	0.240	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	1	0.0	1	0.0	0.001	5.7	LOS A	0.0	0.0	0.00	0.63	0.00	50.6
Approach		465	1.0	465	1.0	0.240	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Median Storage														
1	R2	449	0.2	449	0.2	0.242	0.8	LOS A	0.0	0.0	0.00	0.24	0.00	20.7
Approach		449	0.2	449	0.2	0.242	0.8	NA	0.0	0.0	0.00	0.24	0.00	20.7
All Vehicles		915	0.6	915	0.6	0.242	0.4	NA	0.0	0.0	0.00	0.12	0.00	36.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Link Rd Pm Existing Stage 1 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Pm Existing (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
5	T1	1	0.0	1	0.0	0.001	1.4	LOS A	0.0	0.0	0.42	0.22	0.42	50.9
Approach		1	0.0	1	0.0	0.001	1.4	LOS A	0.0	0.0	0.42	0.22	0.42	50.9
North: Link Rd														
2	T1	449	0.2	449	0.2	0.923	40.2	LOS E	15.7	114.8	0.95	1.93	3.86	26.8
Approach		449	0.2	449	0.2	0.923	40.2	LOS E	15.7	114.8	0.95	1.93	3.86	26.8
West: Wallwork Rd														
3	L2	199	2.2	199	2.2	0.394	5.6	LOS A	1.8	13.5	0.01	0.17	0.01	56.7
4	T1	472	1.0	472	1.0	0.394	0.0	LOS A	1.8	13.5	0.01	0.17	0.01	58.4
Approach		671	1.3	671	1.3	0.394	1.7	NA	1.8	13.5	0.01	0.17	0.01	57.9
All Vehicles		1121	0.9	1121	0.9	0.923	17.1	NA	15.7	114.8	0.39	0.88	1.56	44.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Link Rd AM 2026 2.5% Stage 2 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Am 2026 2.5% growth (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Rd														
2	T1	242	1.0	242	1.0	0.125	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	1	0.0	1	0.0	0.001	5.7	LOS A	0.0	0.0	0.00	0.63	0.00	50.6
Approach		243	1.0	243	1.0	0.125	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.9
North: Median Storage														
1	R2	184	4.1	184	4.1	0.102	1.0	LOS A	0.0	0.0	0.00	0.29	0.00	22.3
Approach		184	4.1	184	4.1	0.102	1.0	NA	0.0	0.0	0.00	0.29	0.00	22.3
All Vehicles		427	2.3	427	2.3	0.125	0.5	NA	0.0	0.0	0.00	0.13	0.00	40.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

🛑 Site: S1-1 [Wallwork Road Link Rd Am 2026 2.5% Stage 1 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Am 2026 2.5% growth (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
5	T1	1	0.0	1	0.0	0.001	1.1	LOS A	0.0	0.0	0.36	0.17	0.36	51.4
Approach		1	0.0	1	0.0	0.001	1.1	LOS A	0.0	0.0	0.36	0.17	0.36	51.4
North: Link Rd														
2	T1	184	4.1	184	4.1	0.478	20.5	LOS C	2.7	22.7	0.76	1.15	1.14	37.4
Approach		184	4.1	184	4.1	0.478	20.5	LOS C	2.7	22.7	0.76	1.15	1.14	37.4
West: Wallwork Rd														
3	L2	389	0.8	389	0.8	0.466	5.6	LOS A	3.2	23.3	0.02	0.30	0.02	55.7
4	T1	354	1.0	354	1.0	0.466	0.0	LOS A	3.2	23.3	0.02	0.30	0.02	57.2
Approach		743	0.9	743	0.9	0.466	2.9	NA	3.2	23.3	0.02	0.30	0.02	56.4
All Vehicles		928	1.5	928	1.5	0.478	6.4	NA	3.2	23.3	0.17	0.47	0.24	53.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-2 [Wallwork Road Link Rd PM 2026 2.5% Stage 2 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Pm 2026 2.5% growth (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total	HV]	ARRIVAL FLOWS [Total	HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Wallwork Rd														
2	T1	525	1.0	525	1.0	0.271	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.8
3	R2	1	0.0	1	0.0	0.001	5.7	LOS A	0.0	0.0	0.00	0.63	0.00	50.6
Approach		526	1.0	526	1.0	0.271	0.1	NA	0.0	0.0	0.00	0.00	0.00	59.8
North: Median Storage														
1	R2	449	0.2	435	0.2	0.235	0.8	LOS A	0.0	0.0	0.00	0.24	0.00	20.7
Approach		449	0.2	435[N1]	0.2	0.235	0.8	NA	0.0	0.0	0.00	0.24	0.00	20.7
All Vehicles		976	0.6	962[N1]	0.7	0.271	0.4	NA	0.0	0.0	0.00	0.11	0.00	38.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

[N1] Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Link Rd Pm 2026 2.5% Stage 1 (Site Folder: Wallwork Road Link Rd)]

Network: SCTI-C [Wallwork Rd Link Rd Pm 2026 2.5% growth (Network Folder: General)]

Staged Crossing at T Intersection Type C
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
5	T1	1	0.0	1	0.0	0.001	1.7	LOS A	0.0	0.0	0.44	0.24	0.44	50.6
Approach		1	0.0	1	0.0	0.001	1.7	LOS A	0.0	0.0	0.44	0.24	0.44	50.6
North: Link Rd														
2	T1	449	0.2	449	0.2	1.033	86.0	LOS F	28.8	211.0	1.00	2.74	6.69	16.0
Approach		449	0.2	449	0.2	1.033	86.0	LOS F	28.8	211.0	1.00	2.74	6.69	16.0
West: Wallwork Rd														
3	L2	199	2.2	199	2.2	0.426	5.6	LOS A	1.9	14.3	0.01	0.16	0.01	56.9
4	T1	534	1.0	534	1.0	0.426	0.0	LOS A	1.9	14.3	0.01	0.16	0.01	58.5
Approach		733	1.3	733	1.3	0.426	1.5	NA	1.9	14.3	0.01	0.16	0.01	58.1
All Vehicles		1183	0.9	1183	0.9	1.033	33.6	NA	28.8	211.0	0.39	1.14	2.55	35.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

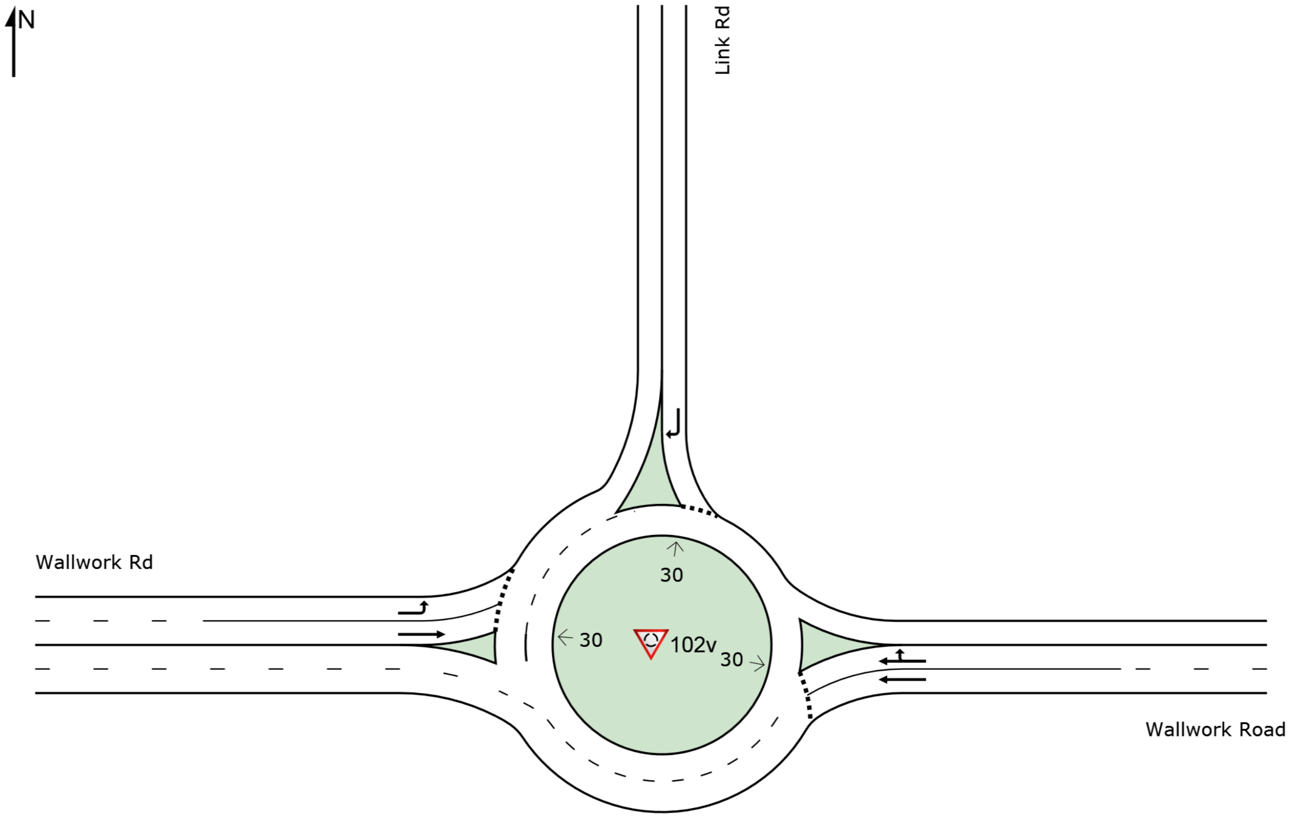
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 102v [Wallwork Road Link Rd AM 2026 2.5% - Conversion (Site Folder: Wallwork Road Link Rd)]

New Site
Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 102v [Wallwork Road Link Rd AM 2026 2.5% - Conversion (Site Folder: Wallwork Road Link Rd)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
5	T1	230	9.0	242	9.0	0.093	4.5	LOS A	0.6	4.7	0.42	0.43	0.42	56.0
6	R2	1	0.0	1	0.0	0.093	10.2	LOS B	0.6	4.5	0.43	0.44	0.43	55.1
Approach		231	9.0	243	9.0	0.093	4.5	LOS A	0.6	4.7	0.42	0.43	0.42	56.0
North: Link Rd														
9	R2	175	15.0	184	15.0	0.185	11.7	LOS B	1.1	9.2	0.55	0.69	0.55	49.3
Approach		175	15.0	184	15.0	0.185	11.7	LOS B	1.1	9.2	0.55	0.69	0.55	49.3
West: Wallwork Rd														
10	L2	370	5.1	389	5.1	0.222	3.6	LOS A	1.4	10.4	0.02	0.42	0.02	54.5
11	T1	336	3.0	354	3.0	0.232	3.6	LOS A	1.5	10.6	0.02	0.34	0.02	58.4
Approach		706	4.1	743	4.1	0.232	3.6	LOS A	1.5	10.6	0.02	0.38	0.02	56.7
All Vehicles		1112	6.8	1171	6.8	0.232	5.1	LOS A	1.5	10.6	0.19	0.44	0.19	55.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102v [Wallwork Road Link Rd Pm 2026 2.5% - Conversion (Site Folder: Wallwork Road Link Rd)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Wallwork Road														
5	T1	499	4.0	525	4.0	0.252	6.1	LOS A	2.0	14.7	0.71	0.60	0.71	54.6
6	R2	1	0.0	1	0.0	0.252	12.0	LOS B	1.8	13.4	0.71	0.64	0.71	53.1
Approach		500	4.0	526	4.0	0.252	6.1	LOS A	2.0	14.7	0.71	0.60	0.71	54.5
North: Link Rd														
9	R2	427	4.0	449	4.0	0.471	13.8	LOS B	3.6	26.4	0.77	0.83	0.80	48.1
Approach		427	4.0	449	4.0	0.471	13.8	LOS B	3.6	26.4	0.77	0.83	0.80	48.1
West: Wallwork Rd														
10	L2	189	9.7	199	9.7	0.150	3.6	LOS A	0.9	7.3	0.02	0.42	0.02	54.0
11	T1	507	3.0	534	3.0	0.301	3.6	LOS A	2.3	16.9	0.02	0.34	0.02	58.4
Approach		696	4.8	733	4.8	0.301	3.6	LOS A	2.3	16.9	0.02	0.36	0.02	57.4
All Vehicles		1623	4.3	1708	4.3	0.471	7.0	LOS A	3.6	26.4	0.43	0.56	0.44	54.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102v [Wallwork Road Link Rd AM 2026 2.5% - plus development (Site Folder: Wallwork Road Link Rd)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
5	T1	278	9.0	293	9.0	0.119	4.8	LOS A	0.8	6.1	0.48	0.47	0.48	55.6
6	R2	1	0.0	1	0.0	0.119	10.5	LOS B	0.8	5.8	0.50	0.49	0.50	54.6
Approach		279	9.0	294	9.0	0.119	4.8	LOS A	0.8	6.1	0.48	0.47	0.48	55.6
North: Link Rd														
9	R2	225	15.0	237	15.0	0.238	11.9	LOS B	1.5	12.3	0.57	0.70	0.57	49.2
Approach		225	15.0	237	15.0	0.238	11.9	LOS B	1.5	12.3	0.57	0.70	0.57	49.2
West: Wallwork Rd														
10	L2	507	5.1	534	5.1	0.304	3.6	LOS A	2.2	16.1	0.02	0.42	0.02	54.5
11	T1	336	3.0	354	3.0	0.238	3.6	LOS A	1.5	11.2	0.02	0.34	0.02	58.4
Approach		843	4.3	887	4.3	0.304	3.6	LOS A	2.2	16.1	0.02	0.39	0.02	56.4
All Vehicles		1347	7.0	1418	7.0	0.304	5.2	LOS A	2.2	16.1	0.21	0.46	0.21	55.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102v [Wallwork Road Link Rd Pm 2026 2.5% - plus development (Site Folder: Wallwork Road Link Rd)]

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov	Turn	INPUT		DEMAND		Deg.	Aver.	Level of	95% BACK OF		Prop.	Effective	Aver.	Aver.
ID		VOLUMES		FLOWS		Satn	Delay	Service	QUEUE		Que	Stop	No.	Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]		Rate	Cycles	
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
East: Wallwork Road														
5	T1	653	4.0	687	4.0	0.409	7.6	LOS A	3.7	27.6	0.90	0.75	0.90	53.6
6	R2	1	0.0	1	0.0	0.409	13.8	LOS B	3.3	24.4	0.90	0.82	0.90	51.9
Approach		654	4.0	688	4.0	0.409	7.7	LOS A	3.7	27.6	0.90	0.75	0.90	53.6
North: Link Rd														
9	R2	587	4.0	618	4.0	0.673	18.7	LOS B	8.2	60.2	0.90	1.05	1.26	44.4
Approach		587	4.0	618	4.0	0.673	18.7	LOS B	8.2	60.2	0.90	1.05	1.26	44.4
West: Wallwork Rd														
10	L2	239	9.7	252	9.7	0.185	3.6	LOS A	1.2	9.9	0.02	0.42	0.02	54.0
11	T1	555	3.0	584	3.0	0.330	3.6	LOS A	2.8	20.3	0.03	0.34	0.03	58.4
Approach		794	5.0	836	5.0	0.330	3.6	LOS A	2.8	20.3	0.02	0.37	0.02	57.3
All Vehicles		2035	4.4	2142	4.4	0.673	9.2	LOS A	8.2	60.2	0.56	0.69	0.66	52.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

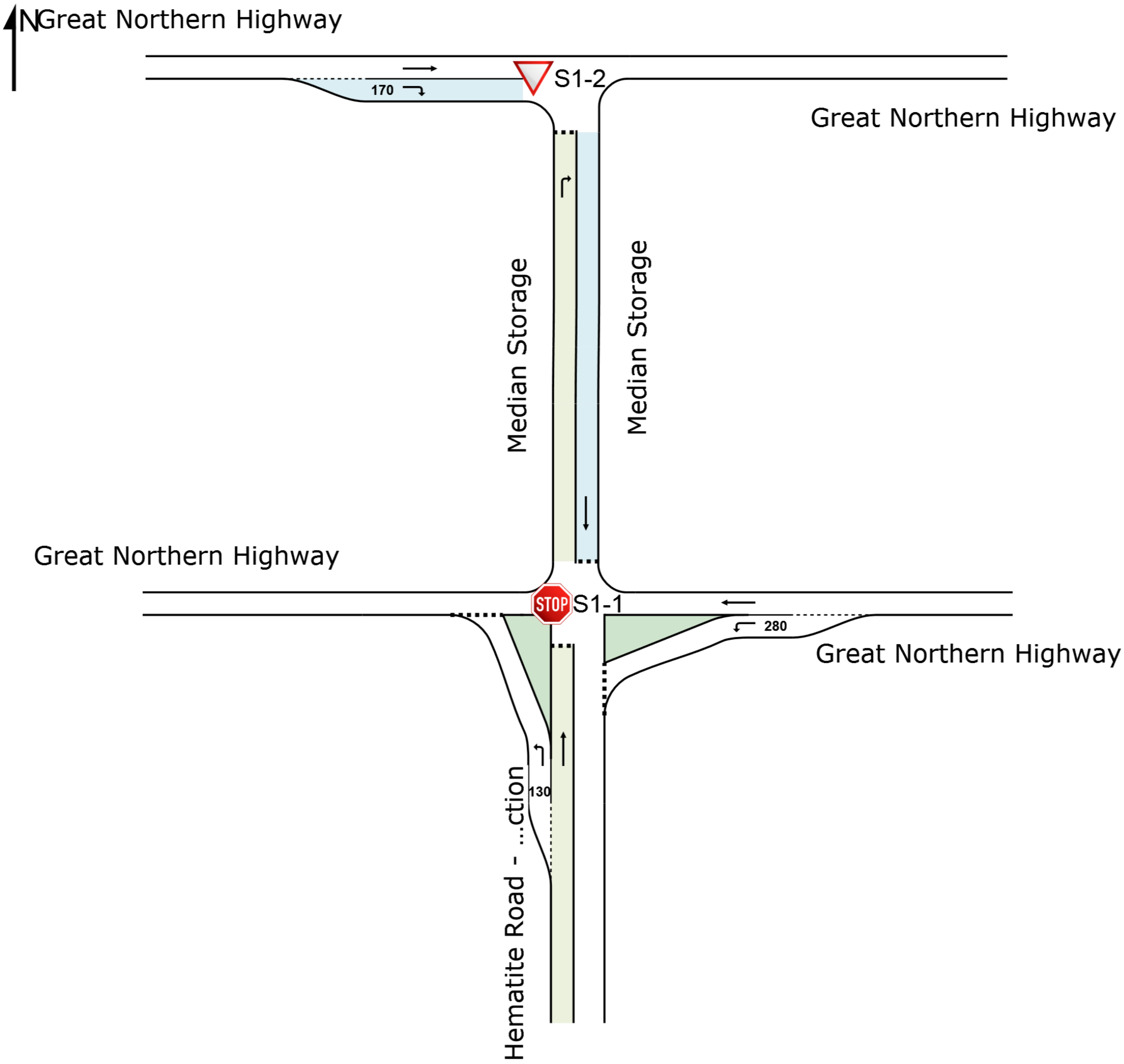
Scenario 6 – SIDRA Results

NETWORK LAYOUT

Network: N101 [New Connection GNH Am Ultimate (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	New Connection GNH Am Ultimate
STOP S1-1	NA	New Connection GNH Am Ultimate

MOVEMENT SUMMARY

▽ Site: S1-2 [New Connection GNH Am Ultimate (Site Folder: Ultimate Development 2039)]

Network: N101 [New Connection GNH Am Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	99	30.0	99	30.0	0.112	1.0	LOS A	0.3	3.8	0.26	0.20	0.26	40.4
Approach		99	30.0	99	30.0	0.112	1.0	LOS A	0.3	3.8	0.26	0.20	0.26	40.4
West: Great Northern Highway														
2	T1	236	10.3	236	10.3	0.129	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	47	34.6	47	34.6	0.032	9.0	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		283	14.4	283	14.4	0.129	1.5	NA	0.0	0.0	0.00	0.13	0.00	77.4
All Vehicles		382	18.4	382	18.4	0.129	1.4	NA	0.3	3.8	0.07	0.15	0.07	67.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

🛑 Site: S1-1 [New Connection GNH Am Ultimate (Site Folder: Ultimate Development 2039)]

Network: N101 [New Connection GNH Am Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Hematite Road - New Connection														
1	L2	36	31.8	36	31.8	0.080	13.0	LOS B	0.3	4.8	0.59	0.79	0.59	50.0
2	T1	99	30.0	99	30.0	0.447	31.2	LOS D	2.2	30.4	0.84	1.03	1.18	32.3
Approach		135	30.5	135	30.5	0.447	26.4	LOS D	2.2	30.4	0.77	0.97	1.02	37.9
East: Great Northern Highway														
3	L2	159	17.8	159	17.8	0.143	8.1	LOS A	0.6	6.3	0.22	0.58	0.22	56.9
4	T1	274	38.7	274	38.7	0.176	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		433	31.0	433	31.0	0.176	3.0	LOS A	0.6	6.3	0.08	0.21	0.08	69.5
North: Median Storage														
5	T1	47	34.6	47	34.6	0.144	8.6	LOS A	0.5	9.5	0.63	0.63	0.63	33.7
Approach		47	34.6	47	34.6	0.144	8.6	LOS A	0.5	9.5	0.63	0.63	0.63	33.7
All Vehicles		615	31.2	615	31.2	0.447	8.6	NA	2.2	30.4	0.28	0.41	0.33	59.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [New Connection GNH Pm Ultimate (Site Folder: Ultimate Development 2039)]

Network: N101 [New Connection GNH Pm Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	183	12.5	183	12.5	0.218	2.0	LOS A	0.6	6.0	0.41	0.41	0.41	45.1
Approach		183	12.5	183	12.5	0.218	2.0	LOS A	0.6	6.0	0.41	0.41	0.41	45.1
West: Great Northern Highway														
2	T1	397	18.8	397	18.8	0.228	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
3	R2	43	31.4	43	31.4	0.028	8.9	LOS A	0.0	0.0	0.00	0.78	0.00	59.0
Approach		440	20.0	440	20.0	0.228	0.9	NA	0.0	0.0	0.00	0.08	0.00	78.4
All Vehicles		623	17.8	623	17.8	0.228	1.2	NA	0.6	6.0	0.12	0.17	0.12	69.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [New Connection GNH Pm Ultimate (Site Folder: Ultimate Development 2039)]

Network: N101 [New Connection GNH Pm Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS		ARRIVAL FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Henatite Rd New Connection														
1	L2	32	19.6	32	19.6	0.047	9.5	LOS A	0.2	2.8	0.46	0.65	0.46	55.0
2	T1	183	12.5	183	12.5	0.353	14.9	LOS B	1.9	20.4	0.65	0.95	0.79	45.0
Approach		215	13.5	215	13.5	0.353	14.1	LOS B	1.9	20.4	0.62	0.91	0.74	47.2
East: Great Northern Highway														
3	L2	74	13.6	74	13.6	0.065	7.9	LOS A	0.3	2.6	0.19	0.57	0.19	58.2
4	T1	214	18.2	214	18.2	0.123	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		287	17.0	287	17.0	0.123	2.0	LOS A	0.3	2.6	0.05	0.15	0.05	72.9
North: Median Storage														
5	T1	43	31.4	43	31.4	0.082	3.7	LOS A	0.3	5.4	0.47	0.39	0.47	37.8
Approach		43	31.4	43	31.4	0.082	3.7	LOS A	0.3	5.4	0.47	0.39	0.47	37.8
All Vehicles		545	16.8	545	16.8	0.353	6.9	NA	1.9	20.4	0.31	0.46	0.36	60.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

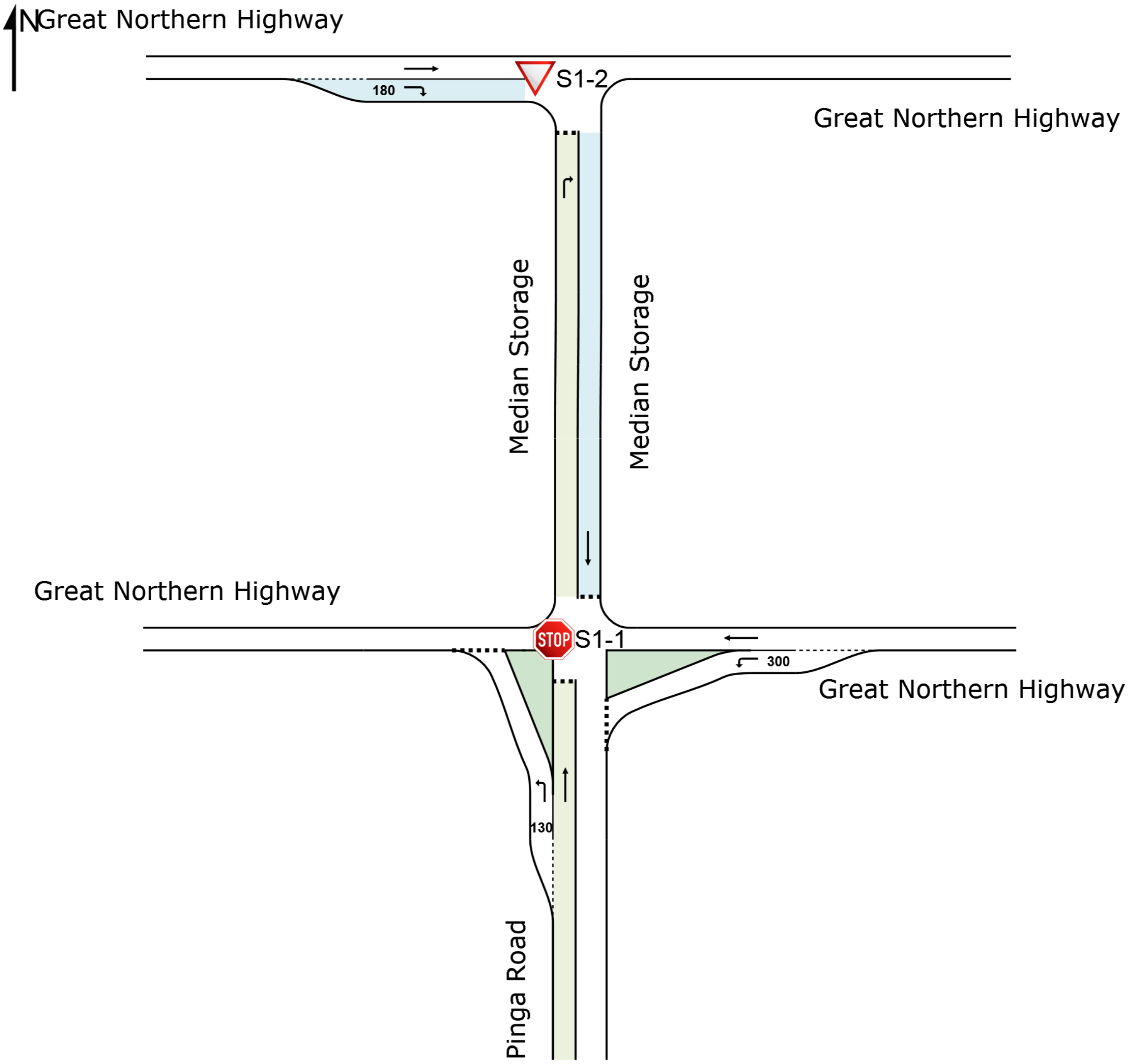
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [GNH Pinga Am Ultimate (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	GNH Pinga Am Ultimate - Stage 2
STOP S1-1	NA	GNH Pinga Am Ultimate- Stage 1

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Project: S:\ACTIVE PROJECTS\21-11-159\DOCUMENTS\Sidra\Wedgefield.sip9

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Am Ultimate - Stage 2 (Site Folder: Ultimate Development 2039)]

Network: N101 [GNH Pinga Am Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	88	30.0	88	30.0	0.096	0.8	LOS A	0.2	3.2	0.23	0.16	0.23	40.5
Approach		88	30.0	88	30.0	0.096	0.8	LOS A	0.2	3.2	0.23	0.16	0.23	40.5
West: Great Northern Highway														
2	T1	195	10.3	195	10.3	0.107	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	196	34.6	196	34.6	0.131	9.0	LOS A	0.8	16.2	0.00	0.78	0.00	59.0
Approach		391	22.5	391	22.5	0.131	4.5	NA	0.8	16.2	0.00	0.39	0.00	71.4
All Vehicles		479	23.9	479	23.9	0.131	3.8	NA	0.8	16.2	0.04	0.35	0.04	64.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Am Ultimate- Stage 1 (Site Folder: Ultimate Development 2039)]

Network: N101 [GNH Pinga Am Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	198	31.8	198	31.8	0.371	13.5	LOS B	2.0	32.5	0.63	0.91	0.80	49.7
2	T1	88	30.0	88	30.0	0.519	41.4	LOS E	2.5	34.4	0.89	1.06	1.33	27.4
Approach		286	31.2	286	31.2	0.519	22.1	LOS C	2.5	34.4	0.71	0.96	0.96	43.3
East: Great Northern Highway														
3	L2	64	17.8	64	17.8	0.082	10.0	LOS B	0.3	3.2	0.46	0.69	0.46	55.7
4	T1	225	38.7	225	38.7	0.145	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		289	34.0	289	34.0	0.145	2.2	LOS A	0.3	3.2	0.10	0.15	0.10	72.8
North: Median Storage														
5	T1	196	34.6	196	34.6	0.489	10.4	LOS B	1.9	37.3	0.67	1.02	1.02	32.7
Approach		196	34.6	196	34.6	0.489	10.4	LOS B	1.9	37.3	0.67	1.02	1.02	32.7
All Vehicles		772	33.1	772	33.1	0.519	11.7	NA	2.5	37.3	0.47	0.67	0.65	49.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [GNH Pinga Pm Ultimate - Stage 2 (Site Folder: Ultimate Development 2039)]

Network: N101 [GNH Pinga Pm Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
1	R2	113	12.5	113	12.5	0.123	1.4	LOS A	0.3	3.2	0.34	0.31	0.34	45.8
Approach		113	12.5	113	12.5	0.123	1.4	LOS A	0.3	3.2	0.34	0.31	0.34	45.8
West: Great Northern Highway														
2	T1	327	18.8	327	18.8	0.188	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
3	R2	228	31.4	228	31.4	0.150	8.9	LOS A	0.4	6.5	0.00	0.78	0.00	59.0
Approach		556	23.9	556	23.9	0.188	3.7	NA	0.4	6.5	0.00	0.32	0.00	73.1
All Vehicles		668	22.0	668	22.0	0.188	3.3	NA	0.4	6.5	0.06	0.32	0.06	68.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [GNH Pinga Pm Ultimate - Stage 1 (Site Folder: Ultimate Development 2039)]

Network: N101 [GNH Pinga Pm Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga Road														
1	L2	178	19.6	178	19.6	0.256	9.9	LOS A	1.1	17.4	0.51	0.72	0.51	54.8
2	T1	113	12.5	113	12.5	0.363	22.3	LOS C	1.7	18.0	0.78	0.99	1.00	38.1
Approach		291	16.8	291	16.8	0.363	14.7	LOS B	1.7	18.0	0.61	0.83	0.70	49.6
East: Great Northern Highway														
3	L2	40	13.6	40	13.6	0.054	10.2	LOS B	0.2	2.0	0.48	0.69	0.48	56.7
4	T1	199	18.2	199	18.2	0.114	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
Approach		239	17.4	239	17.4	0.114	1.7	LOS A	0.2	2.0	0.08	0.12	0.08	74.8
North: Median Storage														
5	T1	228	31.4	228	31.4	0.418	5.5	LOS A	2.0	37.3	0.57	0.71	0.73	36.5
Approach		228	31.4	228	31.4	0.418	5.5	LOS A	2.0	37.3	0.57	0.71	0.73	36.5
All Vehicles		758	21.4	758	21.4	0.418	7.8	NA	2.0	37.3	0.43	0.57	0.52	53.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

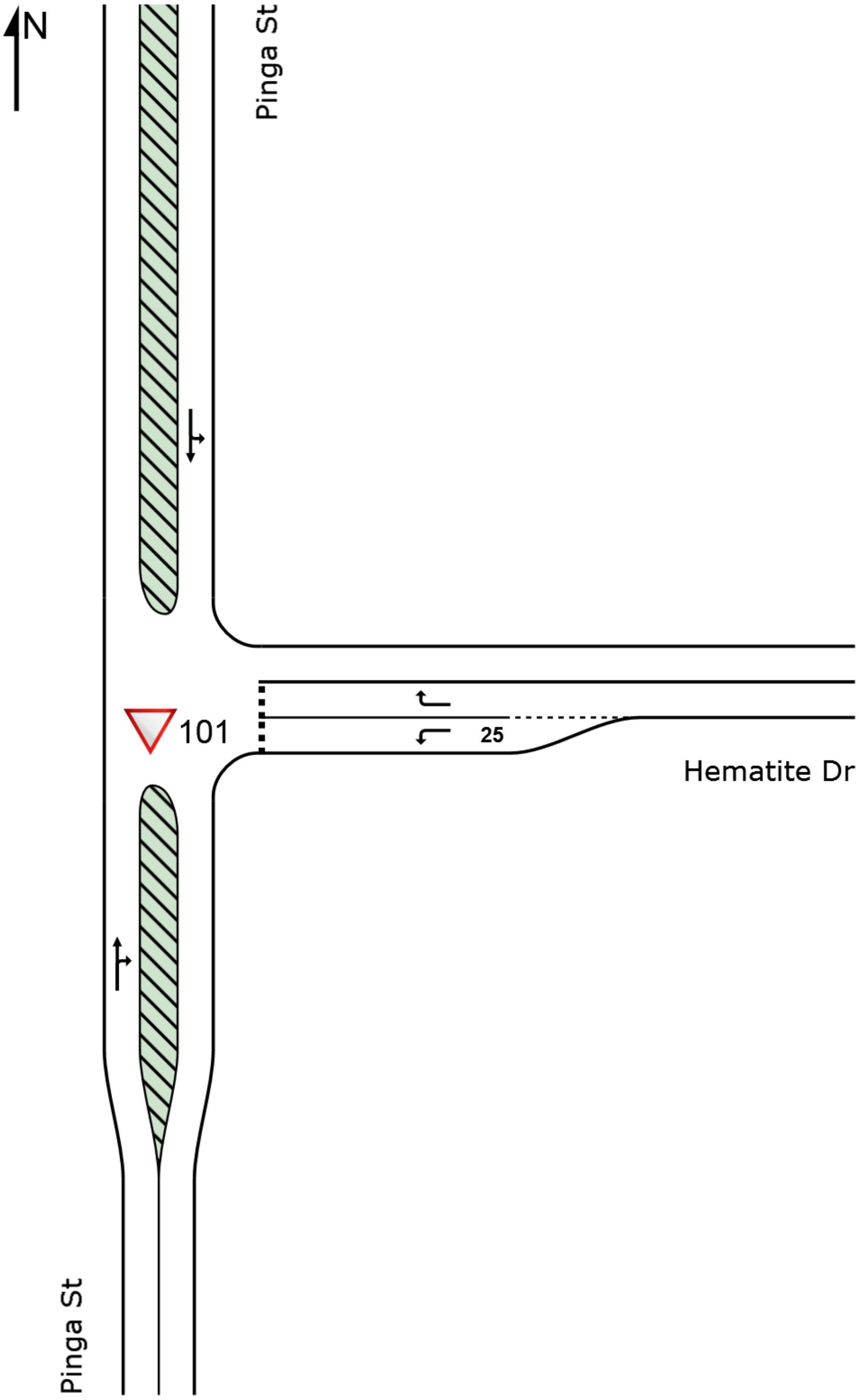
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	513	8.7	540	8.7	0.338	0.5	LOS A	0.7	6.0	0.13	0.07	0.15	76.7
6	R2	46	7.6	48	7.6	0.338	9.7	LOS A	0.7	6.0	0.13	0.07	0.15	54.8
Approach		559	8.6	588	8.6	0.338	1.2	NA	0.7	6.0	0.13	0.07	0.15	74.3
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.016	6.2	LOS A	0.1	0.6	0.41	0.56	0.41	44.1
9	R2	39	43.0	41	43.0	0.337	38.0	LOS E	1.1	16.8	0.90	1.02	1.06	32.7
Approach		55	37.0	58	37.0	0.337	28.7	LOS D	1.1	16.8	0.75	0.89	0.87	34.9
North: Pinga St														
10	L2	52	43.0	55	43.0	0.216	7.6	LOS A	0.0	0.0	0.00	0.11	0.00	57.5
11	T1	297	16.9	313	16.9	0.216	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.6
Approach		349	20.8	367	20.8	0.216	1.2	NA	0.0	0.0	0.00	0.11	0.00	72.2
All Vehicles		963	14.6	1014	14.6	0.338	2.8	NA	1.1	16.8	0.12	0.13	0.13	68.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St														
5	T1	308	16.1	324	16.1	0.198	0.4	LOS A	0.2	1.9	0.07	0.05	0.07	77.3
6	R2	12	5.6	13	5.6	0.198	10.4	LOS B	0.2	1.9	0.07	0.05	0.07	55.4
Approach		320	15.7	337	15.7	0.198	0.7	NA	0.2	1.9	0.07	0.05	0.07	76.2
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.046	6.8	LOS A	0.2	1.3	0.49	0.66	0.49	44.1
9	R2	31	43.0	33	43.0	0.215	28.4	LOS D	0.7	10.3	0.85	0.96	0.91	35.8
Approach		71	21.9	75	21.9	0.215	16.2	LOS C	0.7	10.3	0.65	0.79	0.67	39.5
North: Pinga St														
10	L2	43	43.0	45	43.0	0.298	7.7	LOS A	0.0	0.0	0.00	0.06	0.00	58.4
11	T1	463	9.9	487	9.9	0.298	0.1	LOS A	0.0	0.0	0.00	0.06	0.00	78.4
Approach		506	12.7	533	12.7	0.298	0.7	NA	0.0	0.0	0.00	0.06	0.00	75.6
All Vehicles		897	14.5	944	14.5	0.298	2.0	NA	0.7	10.3	0.07	0.11	0.08	70.1

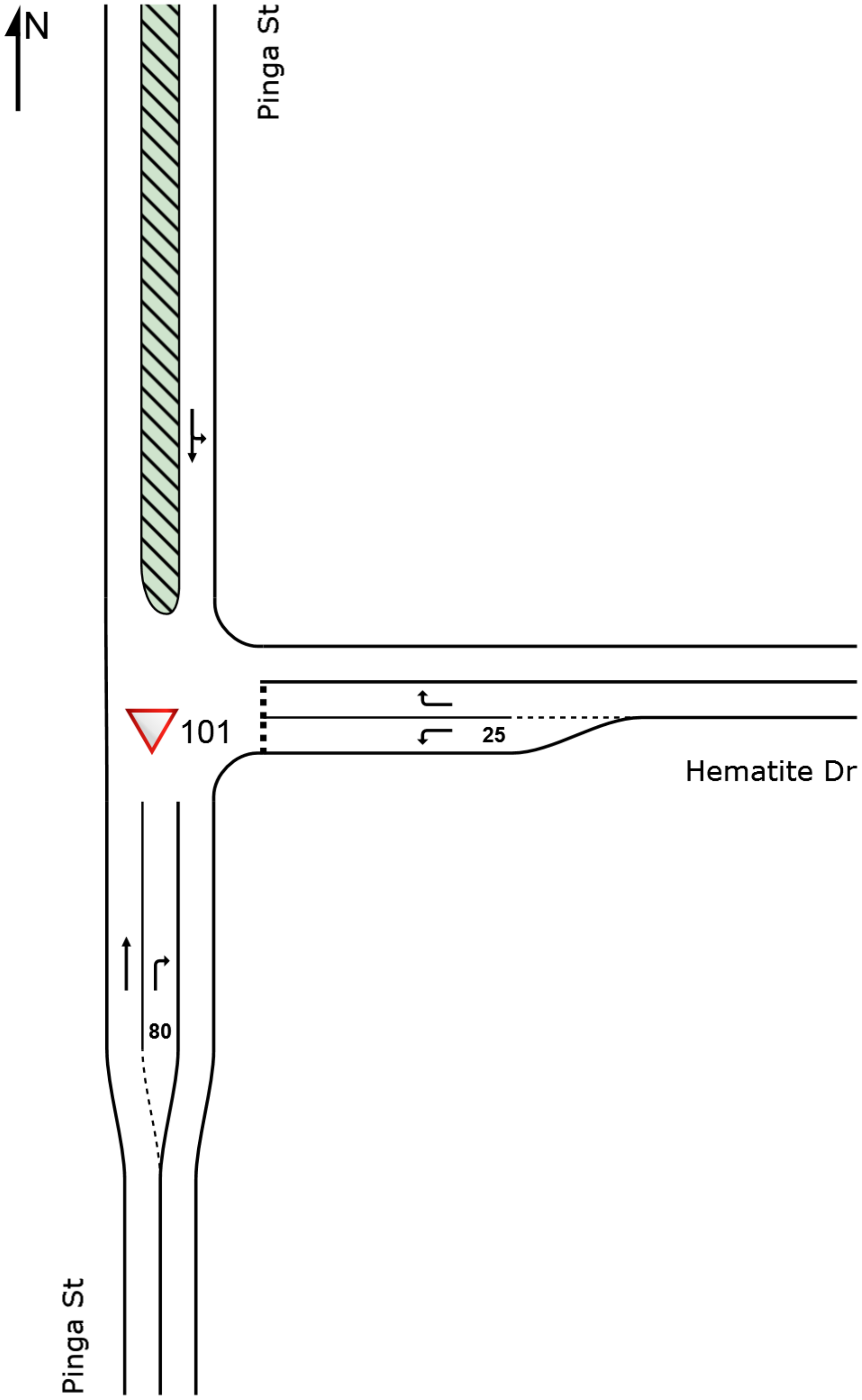
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Hematite Am Peak Ultimate 2039 - Modified Layout (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Am Peak Ultimate 2039 - Modified Layout (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
5	T1	513	8.7	540	8.7	0.294	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.1
6	R2	46	7.6	48	7.6	0.044	8.7	LOS A	0.2	1.5	0.48	0.67	0.48	47.9
Approach		559	8.6	588	8.6	0.294	0.8	NA	0.2	1.5	0.04	0.07	0.04	75.0
East: Hematite Dr														
7	L2	16	22.2	17	22.2	0.016	6.2	LOS A	0.1	0.6	0.41	0.56	0.41	44.1
9	R2	39	43.0	41	43.0	0.546	78.0	LOS F	2.0	31.2	0.95	1.11	1.30	24.1
Approach		55	37.0	58	37.0	0.546	57.1	LOS F	2.0	31.2	0.79	0.95	1.04	27.0
North: Pinga St														
10	L2	52	43.0	55	43.0	0.216	7.6	LOS A	0.0	0.0	0.00	0.11	0.00	57.5
11	T1	297	16.9	313	16.9	0.216	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	76.6
Approach		349	20.8	367	20.8	0.216	1.2	NA	0.0	0.0	0.00	0.11	0.00	72.2
All Vehicles		963	14.6	1014	14.6	0.546	4.2	NA	2.0	31.2	0.07	0.13	0.08	66.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Hematite Pm Peak Ultimate 2039 - Modified Layout (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Pinga St														
5	T1	308	16.1	324	16.1	0.185	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	78.4
6	R2	12	5.6	13	5.6	0.014	9.5	LOS A	0.1	0.5	0.55	0.68	0.55	47.2
Approach		320	15.7	337	15.7	0.185	0.5	NA	0.1	0.5	0.02	0.05	0.02	76.5
East: Hematite Dr														
7	L2	40	5.6	42	5.6	0.046	6.8	LOS A	0.2	1.3	0.49	0.66	0.49	44.1
9	R2	31	43.0	33	43.0	0.352	53.3	LOS F	1.2	19.0	0.92	1.03	1.09	28.8
Approach		71	21.9	75	21.9	0.352	27.1	LOS D	1.2	19.0	0.68	0.82	0.75	34.8
North: Pinga St														
10	L2	43	43.0	45	43.0	0.298	7.7	LOS A	0.0	0.0	0.00	0.06	0.00	58.4
11	T1	463	9.9	487	9.9	0.298	0.1	LOS A	0.0	0.0	0.00	0.06	0.00	78.4
Approach		506	12.7	533	12.7	0.298	0.7	NA	0.0	0.0	0.00	0.06	0.00	75.6
All Vehicles		897	14.5	944	14.5	0.352	2.7	NA	1.2	19.0	0.06	0.11	0.07	68.8

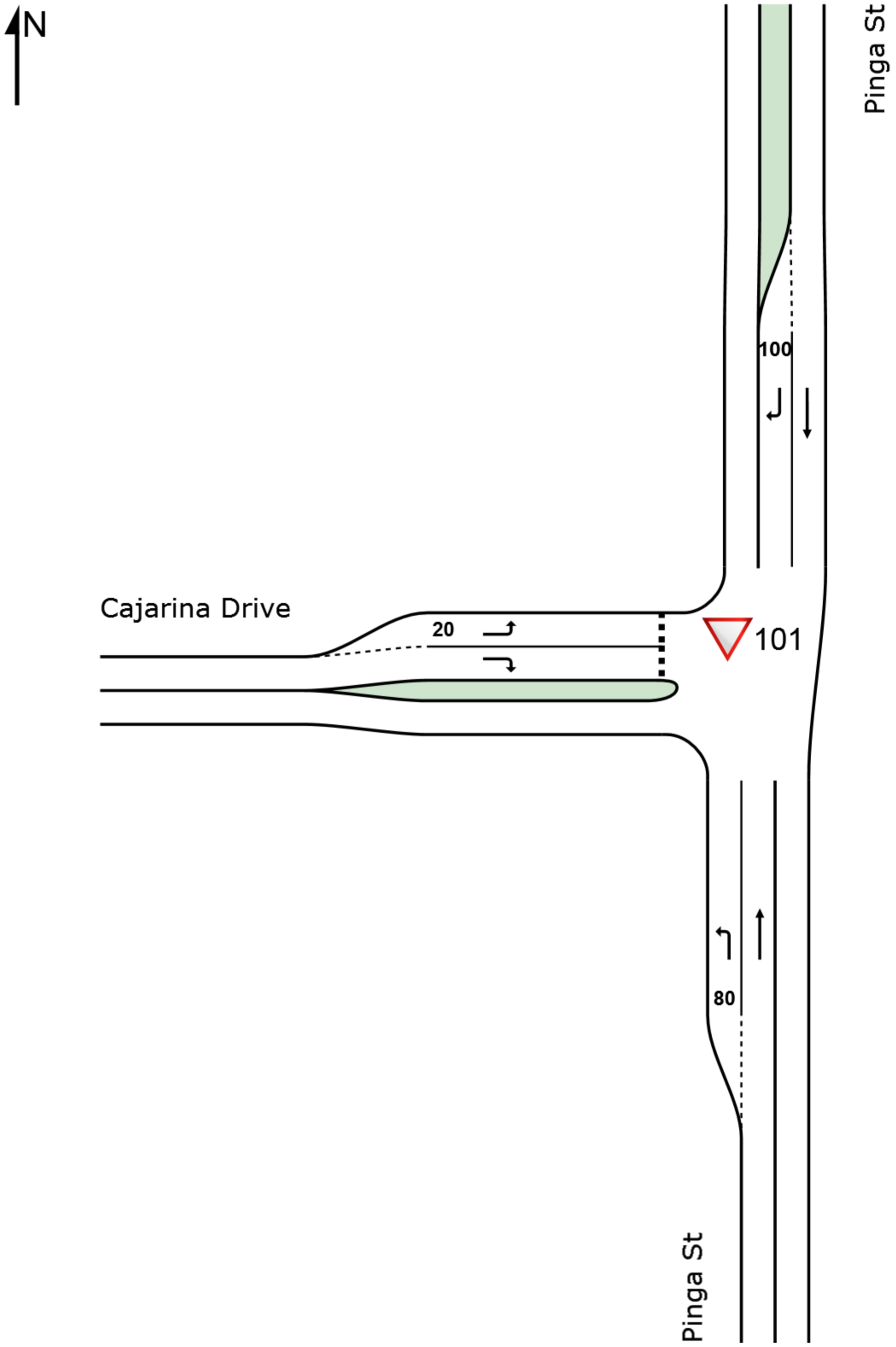
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Pinga Cajarina Rd Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 101 [Pinga Cajarina Rd Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Pinga St														
10	L2	47	3.3	49	3.3	0.027	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.5
11	T1	514	7.0	541	7.0	0.290	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.7
Approach		561	6.7	591	6.7	0.290	0.6	NA	0.0	0.0	0.00	0.06	0.00	76.9
North: Pinga St														
5	T1	282	14.2	297	14.2	0.168	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	42	78.0	44	78.0	0.533	72.8	LOS F	2.2	67.3	0.92	1.11	1.32	22.3
Approach		324	22.4	341	22.4	0.533	9.4	NA	2.2	67.3	0.12	0.14	0.17	54.8
West: Cajarina Drive														
7	L2	39	60.0	41	60.0	0.307	35.4	LOS E	1.1	27.9	0.83	0.99	0.99	28.4
9	R2	25	16.1	26	16.1	0.139	23.3	LOS C	0.5	3.9	0.83	0.92	0.83	34.7
Approach		64	42.8	67	42.8	0.307	30.6	LOS D	1.1	27.9	0.83	0.97	0.93	30.6
All Vehicles		949	14.5	999	14.5	0.533	5.7	NA	2.2	67.3	0.10	0.15	0.12	60.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Pinga Cajarina Rd PM Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Pinga St														
10	L2	9	10.5	9	10.5	0.005	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	57.6
11	T1	271	10.1	285	10.1	0.156	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
Approach		280	10.1	295	10.1	0.156	0.3	NA	0.0	0.0	0.00	0.03	0.00	78.1
North: Pinga St														
5	T1	502	7.3	528	7.3	0.286	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	15	88.0	16	88.0	0.087	23.2	LOS C	0.3	11.5	0.65	0.86	0.65	36.9
Approach		517	9.6	544	9.6	0.286	0.7	NA	0.3	11.5	0.02	0.03	0.02	76.2
West: Cajarina Drive														
7	L2	45	99.0	47	99.0	0.342	34.4	LOS D	1.4	59.5	0.74	0.96	0.93	27.5
9	R2	86	1.2	91	1.2	0.322	19.3	LOS C	1.3	9.6	0.81	0.97	0.98	36.6
Approach		131	34.8	138	34.8	0.342	24.5	LOS C	1.4	59.5	0.79	0.97	0.96	32.9
All Vehicles		928	13.3	977	13.3	0.342	3.9	NA	1.4	59.5	0.12	0.16	0.15	61.2

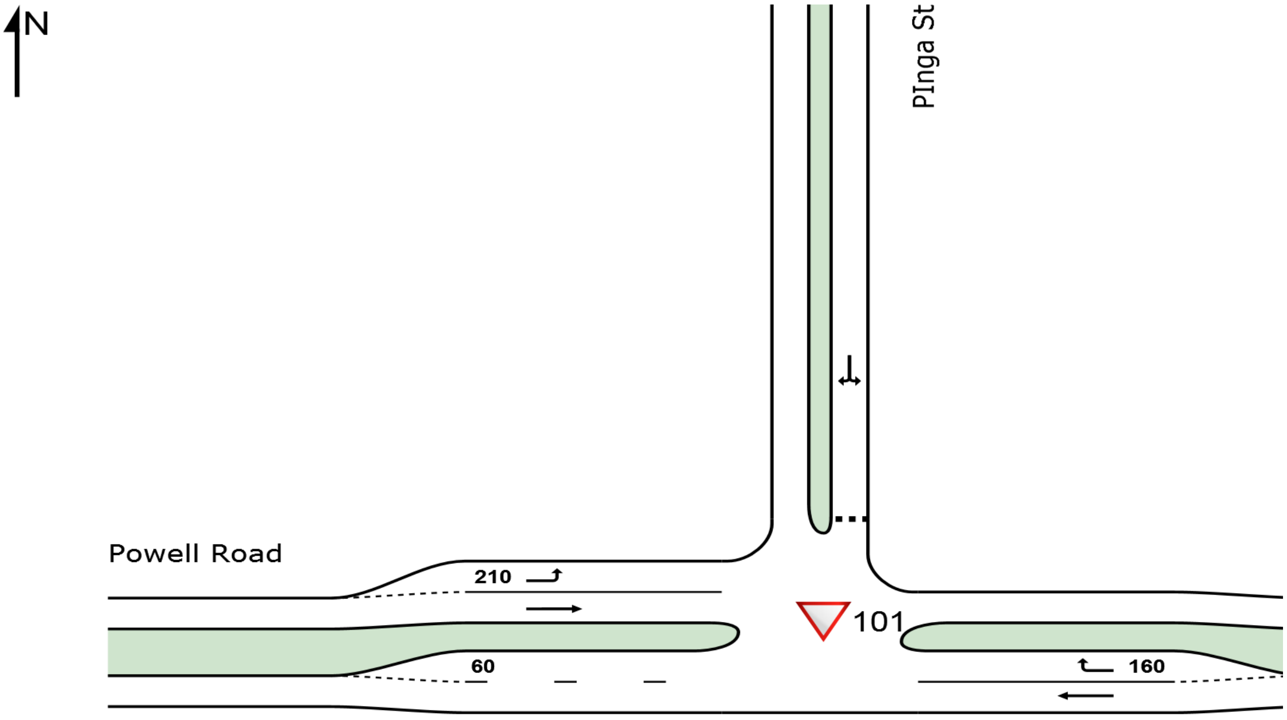
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Pinga Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Powell Road														
5	T1	118	6.1	124	6.1	0.067	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.8
6	R2	548	6.1	577	6.1	0.456	7.4	LOS A	2.8	22.1	0.31	0.61	0.31	44.2
Approach		666	6.1	701	6.1	0.456	6.1	NA	2.8	22.1	0.26	0.50	0.26	49.7
North: PInga St														
7	L2	284	14.4	299	14.4	0.315	5.2	LOS A	1.4	11.9	0.23	0.53	0.23	41.3
9	R2	14	14.4	15	14.4	0.315	21.5	LOS C	1.4	11.9	0.23	0.53	0.23	44.3
Approach		298	14.4	314	14.4	0.315	5.9	LOS A	1.4	11.9	0.23	0.53	0.23	41.5
West: Powell Road														
10	L2	13	6.1	14	6.1	0.008	7.0	LOS A	0.0	0.0	0.00	0.63	0.00	60.6
11	T1	76	14.4	80	14.4	0.045	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		89	13.2	94	13.2	0.045	1.0	NA	0.0	0.0	0.00	0.09	0.00	76.0
All Vehicles		1053	9.0	1108	9.0	0.456	5.6	NA	2.8	22.1	0.23	0.48	0.23	49.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
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NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Pinga Pm Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
East: Powell Road														
5	T1	49	10.2	52	10.2	0.028	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	276	10.2	291	10.2	0.258	7.7	LOS A	1.2	10.0	0.35	0.65	0.35	43.9
Approach		325	10.2	342	10.2	0.258	6.6	NA	1.2	10.0	0.30	0.55	0.30	48.6
North: PInga St														
7	L2	556	4.5	585	4.5	0.564	6.8	LOS A	4.9	37.6	0.46	0.66	0.56	40.4
9	R2	15	4.5	16	4.5	0.564	15.3	LOS C	4.9	37.6	0.46	0.66	0.56	43.6
Approach		571	4.5	601	4.5	0.564	7.0	LOS A	4.9	37.6	0.46	0.66	0.56	40.5
West: Powell Road														
10	L2	4	10.2	4	10.2	0.002	7.1	LOS A	0.0	0.0	0.00	0.63	0.00	59.6
11	T1	164	4.5	173	4.5	0.091	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	80.0
Approach		168	4.7	177	4.7	0.091	0.2	NA	0.0	0.0	0.00	0.02	0.00	79.2
All Vehicles		1064	6.3	1120	6.3	0.564	5.8	NA	4.9	37.6	0.34	0.52	0.39	47.9

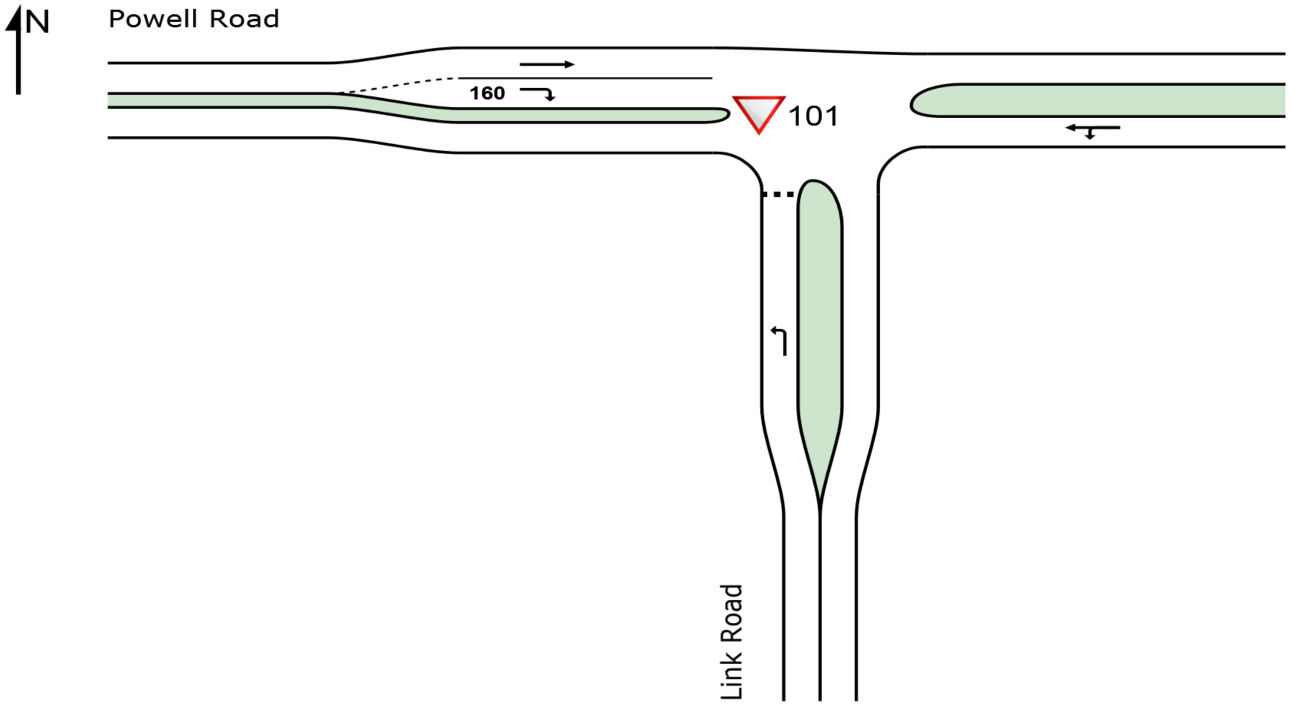
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 101 [Powell Link Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Am Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Link Road														
7	L2	503	5.1	529	5.1	0.411	5.9	LOS A	2.3	17.9	0.43	0.61	0.44	40.0
Approach		503	5.1	529	5.1	0.411	5.9	LOS A	2.3	17.9	0.43	0.61	0.44	40.0
East: Powell Road														
10	L2	1	9.1	1	9.1	0.120	7.1	LOS A	0.0	0.0	0.00	0.01	0.00	70.2
11	T1	209	9.1	220	9.1	0.120	0.1	LOS A	0.0	0.0	0.00	0.01	0.00	79.4
Approach		210	9.1	221	9.1	0.120	0.1	NA	0.0	0.0	0.00	0.01	0.00	79.4
West: Powell Road														
5	T1	144	20.4	152	20.4	0.089	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	79.5
6	R2	233	15.0	245	15.0	0.188	7.8	LOS A	0.9	8.1	0.39	0.65	0.39	42.7
Approach		377	17.1	397	17.1	0.188	4.8	NA	0.9	8.1	0.24	0.40	0.24	56.3
All Vehicles		1090	10.0	1147	10.0	0.411	4.4	NA	2.3	17.9	0.28	0.42	0.28	52.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 101 [Powell Link Pm Peak Ultimate 2039 (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Link Road														
7	L2	233	9.7	245	9.7	0.176	5.1	LOS A	0.8	6.5	0.24	0.52	0.24	39.8
Approach		233	9.7	245	9.7	0.176	5.1	LOS A	0.8	6.5	0.24	0.52	0.24	39.8
East: Powell Road														
10	L2	1	11.7	1	11.7	0.061	7.1	LOS A	0.0	0.0	0.00	0.02	0.00	69.5
11	T1	104	11.7	109	11.7	0.061	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	79.2
Approach		105	11.7	111	11.7	0.061	0.1	NA	0.0	0.0	0.00	0.02	0.00	79.1
West: Powell Road														
5	T1	191	6.5	201	6.5	0.108	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	79.9
6	R2	568	4.0	598	4.0	0.377	7.2	LOS A	2.3	17.9	0.31	0.61	0.31	43.6
Approach		759	4.6	799	4.6	0.377	5.4	NA	2.3	17.9	0.23	0.45	0.23	52.5
All Vehicles		1097	6.4	1155	6.4	0.377	4.8	NA	2.3	17.9	0.21	0.43	0.21	52.0

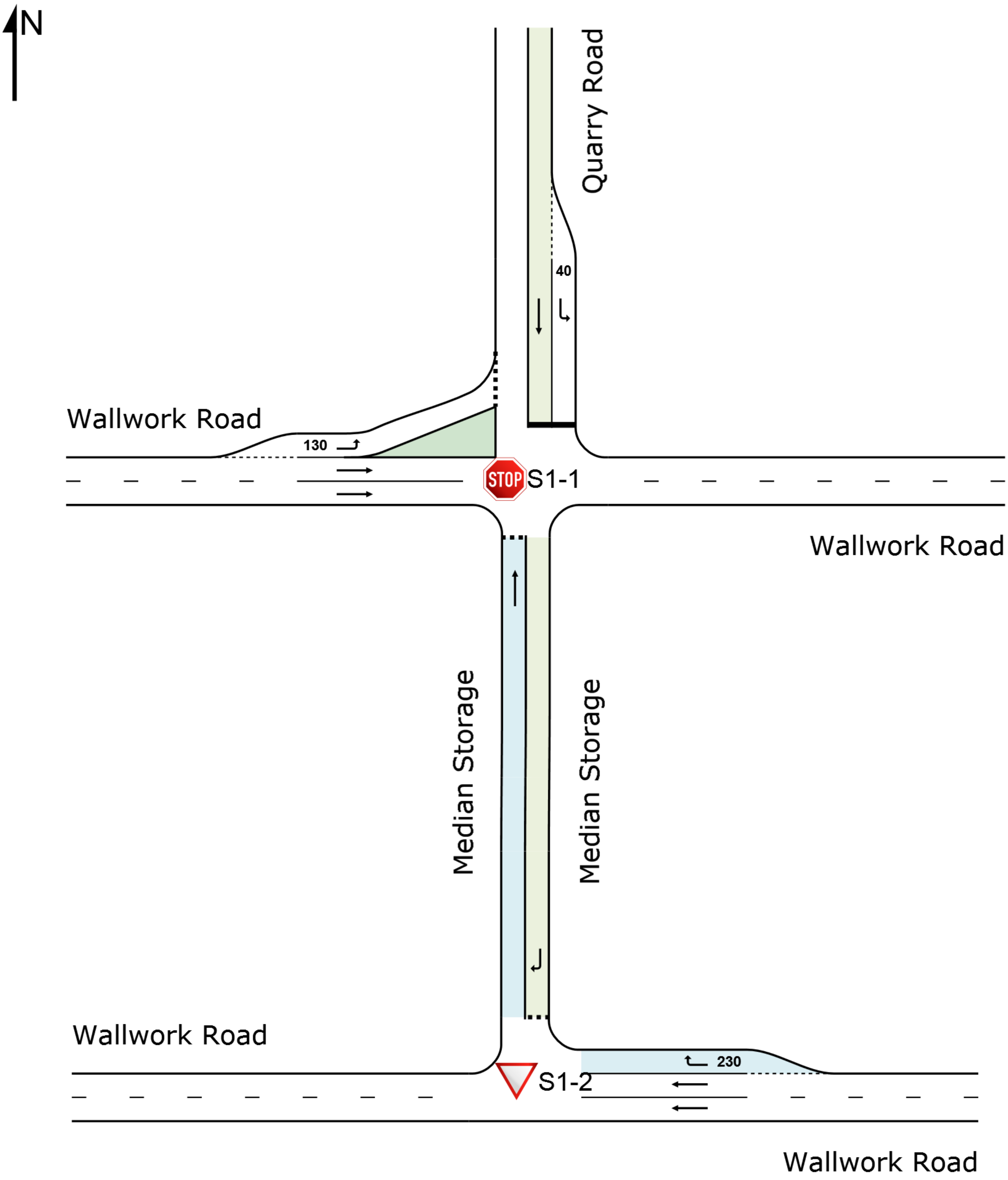
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

NETWORK LAYOUT

Network: N101 [Wallwork Rd Quarry Rd Am Ultimate (Network Folder: General)]

New Network
Network Category: (None)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
▽S1-2	NA	Wallwork Road Quarry Rd Am Ultimate - Stage 2
STOP S1-1	NA	Wallwork Road Quarry Rd Am Ultimate - Stage 1

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Quarry Rd Am Ultimate - Stage 2 (Site Folder: Ultimate Development 2039)]

Network: N101 [Wallwork Rd Quarry Rd Am Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
2	T1	598	7.0	598	7.0	0.160	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	85	15.0	85	15.0	0.051	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		683	8.0	683	8.0	0.160	0.8	NA	0.0	0.0	0.00	0.08	0.00	59.2
North: Median Storage														
1	R2	76	15.0	76	15.0	0.103	4.1	LOS A	0.3	2.9	0.49	0.64	0.49	46.6
Approach		76	15.0	76	15.0	0.103	4.1	LOS A	0.3	2.9	0.49	0.64	0.49	46.6
All Vehicles		759	8.7	759	8.7	0.160	1.1	NA	0.3	2.9	0.05	0.13	0.05	58.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Am Ultimate - Stage 1 (Site Folder: Ultimate Development 2039)]

Network: N101 [Wallwork Rd Quarry Rd Am Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
5	T1	85	15.0	85	15.0	0.120	4.0	LOS A	0.4	3.8	0.54	0.60	0.54	47.5
Approach		85	15.0	85	15.0	0.120	4.0	LOS A	0.4	3.8	0.54	0.60	0.54	47.5
North: Quarry Road														
1	L2	46	15.0	46	15.0	0.051	10.4	LOS B	0.2	1.7	0.42	0.89	0.42	50.6
2	T1	76	15.0	76	15.0	0.298	25.0	LOS C	1.2	10.8	0.81	1.05	0.96	34.6
Approach		122	15.0	122	15.0	0.298	19.4	LOS C	1.2	10.8	0.66	0.99	0.75	41.8
West: Wallwork Road														
3	L2	207	15.0	207	15.0	0.174	6.3	LOS A	0.8	6.9	0.23	0.53	0.23	52.9
4	T1	639	2.0	639	2.0	0.166	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		846	5.2	846	5.2	0.174	1.6	LOS A	0.8	6.9	0.06	0.13	0.06	58.0
All Vehicles		1054	7.1	1054	7.1	0.298	3.8	NA	1.2	10.8	0.17	0.27	0.18	55.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: S1-2 [Wallwork Road Quarry Rd Pm Ultimate- Stage 2 (Site Folder: Ultimate Development 2039)]

Network: N101 [Wallwork Rd Quarry Rd Pm Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
2	T1	696	3.0	696	3.0	0.182	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
3	R2	31	15.0	31	15.0	0.018	5.9	LOS A	0.0	0.0	0.00	0.63	0.00	50.5
Approach		726	3.5	726	3.5	0.182	0.3	NA	0.0	0.0	0.00	0.03	0.00	59.7
North: Median Storage														
1	R2	242	15.0	203	15.0	0.303	5.5	LOS A	1.2	10.5	0.58	0.79	0.68	45.0
Approach		242	15.0	203 N1	15.0	0.303	5.5	LOS A	1.2	10.5	0.58	0.79	0.68	45.0
All Vehicles		968	6.4	929 N1	6.7	0.303	1.4	NA	1.2	10.5	0.13	0.19	0.15	57.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: S1-1 [Wallwork Road Quarry Rd Pm Ultiamte - Stage 1 (Site Folder: Ultimate Development 2039)]

Network: N101 [Wallwork Rd Quarry Rd Pm Ultimate (Network Folder: General)]

Staged Crossing at T Intersection Type B
Site Category: (None)
Stop (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	DEMAND FLOWS [Total veh/h	HV] %	ARRIVAL FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Median Storage														
5	T1	31	15.0	31	15.0	0.051	4.9	LOS A	0.2	1.5	0.57	0.62	0.57	46.5
Approach		31	15.0	31	15.0	0.051	4.9	LOS A	0.2	1.5	0.57	0.62	0.57	46.5
North: Quarry Road														
1	L2	74	15.0	74	15.0	0.089	10.9	LOS B	0.3	3.0	0.47	0.92	0.47	50.2
2	T1	242	15.0	242	15.0	1.201	233.9	LOS F	33.3	293.2	1.00	3.52	9.35	7.0
Approach		316	15.0	316	15.0	1.201	181.8	LOS F	33.3	293.2	0.88	2.91	7.28	10.3
West: Wallwork Road														
3	L2	76	15.0	76	15.0	0.060	5.9	LOS A	0.2	2.1	0.11	0.51	0.11	53.3
4	T1	776	1.0	776	1.0	0.200	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
Approach		852	2.3	852	2.3	0.200	0.6	LOS A	0.2	2.1	0.01	0.05	0.01	59.2
All Vehicles		1198	5.9	1198	5.9	1.201	48.5	NA	33.3	293.2	0.25	0.82	1.94	31.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Network Data dialog (Network tab).

Vehicle movement LOS values are based on average delay per movement.

Minor Road Approach LOS values are based on average delay for all vehicle movements.

NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.

Delay Model: SIDRA Standard (Geometric Delay is included).

Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).

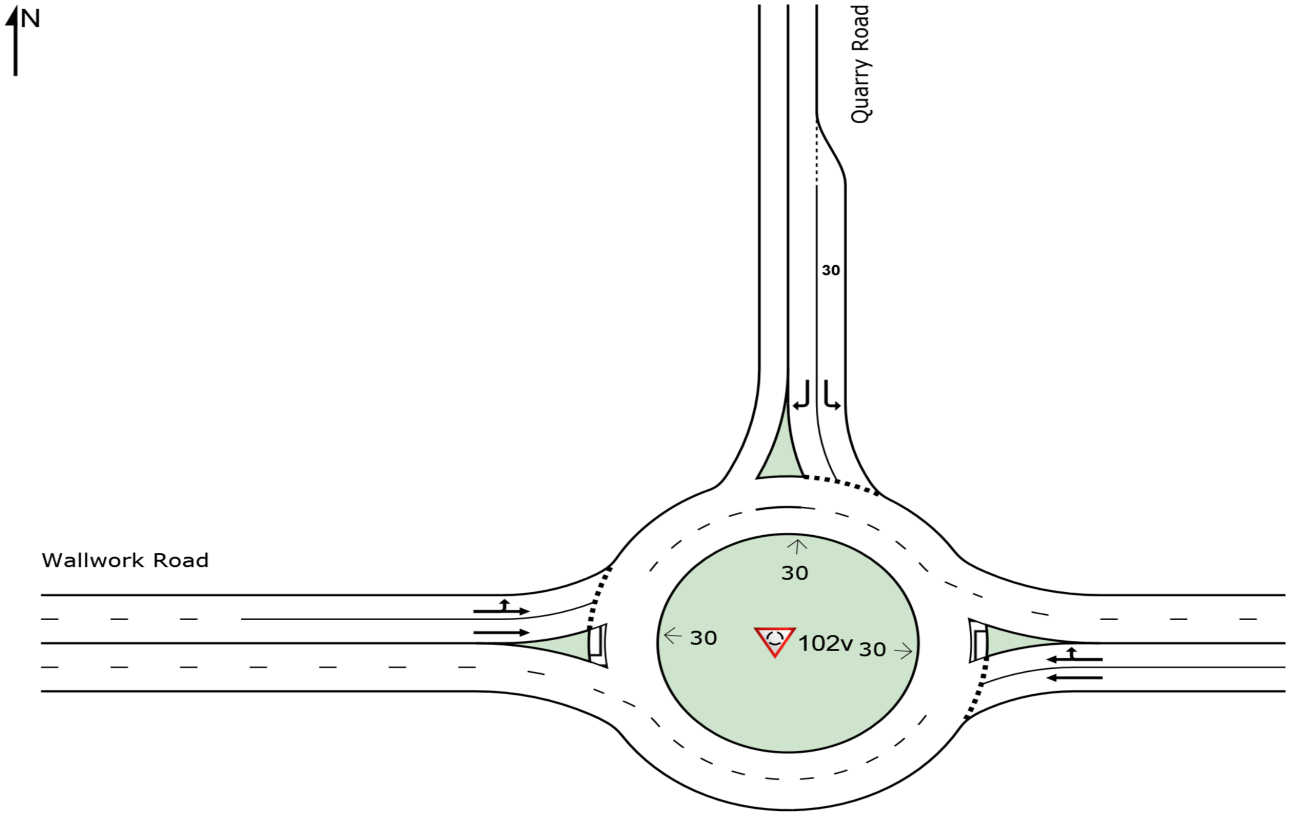
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 102v [Wallwork Rd Quarry Rd Am Ultimate (Site Folder: Ultimate Development 2039)]

Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 102v [Wallwork Rd Quarry Rd Am Ultimate (Site Folder: Ultimate Development 2039)]

Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] %	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	568	7.0	598	7.0	0.231	6.4	LOS A	1.7	13.6	0.30	0.48	0.30	66.0
12	R2	81	15.0	85	15.0	0.231	12.6	LOS B	1.7	13.6	0.32	0.53	0.32	60.3
Approach		649	8.0	683	8.0	0.231	7.2	LOS A	1.7	13.6	0.30	0.49	0.30	65.4
North: Quarry Road														
1	L2	44	15.0	46	15.0	0.065	7.8	LOS A	0.3	2.5	0.58	0.69	0.58	55.0
3	R2	72	15.0	76	15.0	0.084	13.1	LOS B	0.4	3.3	0.56	0.75	0.56	51.4
Approach		116	15.0	122	15.0	0.084	11.1	LOS B	0.4	3.3	0.56	0.73	0.56	52.6
West: Wallwork Road														
4	L2	197	15.0	207	15.0	0.282	6.1	LOS A	2.1	16.6	0.31	0.49	0.31	59.7
5	T1	607	2.0	639	2.0	0.282	6.5	LOS A	2.1	16.6	0.32	0.48	0.32	67.9
Approach		804	5.2	846	5.2	0.282	6.4	LOS A	2.1	16.6	0.32	0.48	0.32	66.2
All Vehicles		1569	7.1	1652	7.1	0.282	7.1	LOS A	2.1	16.6	0.33	0.50	0.33	64.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 102v [Wallwork Rd Quarry Rd Pm Ultimate (Site Folder: Ultimate Development 2039)]

Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
East: Wallwork Road														
11	T1	811	3.0	854	3.0	0.348	7.5	LOS A	2.8	21.6	0.59	0.59	0.59	65.3
12	R2	29	15.0	31	15.0	0.348	14.1	LOS B	2.7	20.7	0.60	0.62	0.60	59.0
Approach		840	3.4	884	3.4	0.348	7.7	LOS A	2.8	21.6	0.59	0.60	0.59	65.1
North: Quarry Road														
1	L2	70	15.0	74	15.0	0.142	10.2	LOS B	0.6	5.1	0.65	0.82	0.65	52.4
3	R2	230	15.0	242	15.0	0.293	14.2	LOS B	1.4	12.2	0.66	0.89	0.66	50.7
Approach		300	15.0	316	15.0	0.293	13.3	LOS B	1.4	12.2	0.66	0.87	0.66	51.1
West: Wallwork Road														
4	L2	72	15.0	76	15.0	0.309	5.8	LOS A	2.6	19.7	0.19	0.45	0.19	60.5
5	T1	890	1.0	937	1.0	0.309	6.1	LOS A	2.6	19.7	0.20	0.45	0.20	69.0
Approach		962	2.1	1013	2.1	0.309	6.1	LOS A	2.6	19.7	0.20	0.45	0.20	68.5
All Vehicles		2102	4.5	2213	4.5	0.348	7.8	LOS A	2.8	21.6	0.42	0.57	0.42	64.7

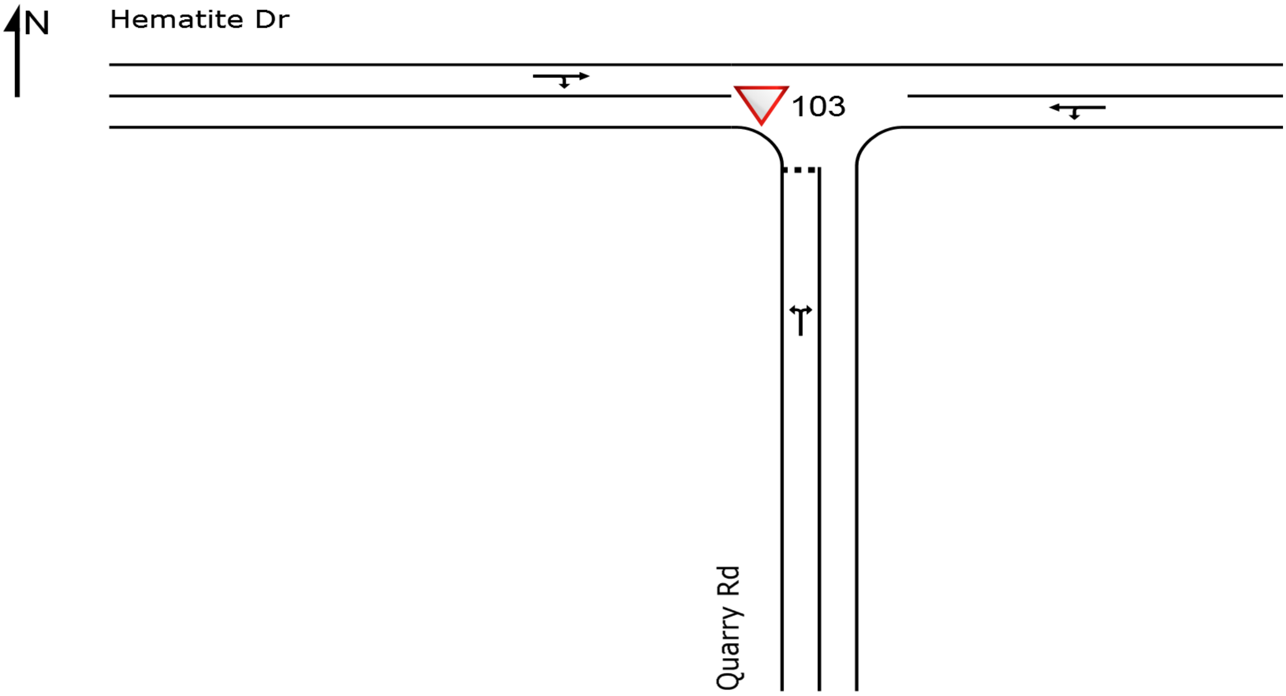
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 103 [Hematite Dr and Quarry Rd Am (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

▽ Site: 103 [Hematite Dr and Quarry Rd Am (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total	INPUT VOLUMES HV]	DEMAND FLOWS [Total	DEMAND FLOWS HV]	Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE [Veh.	95% BACK OF QUEUE Dist]	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Quarry Rd														
1	L2	33	34.5	35	34.5	0.396	8.6	LOS A	2.0	21.9	0.56	0.87	0.73	48.7
3	R2	195	34.5	205	34.5	0.396	11.3	LOS B	2.0	21.9	0.56	0.87	0.73	48.2
Approach		228	34.5	240	34.5	0.396	10.9	LOS B	2.0	21.9	0.56	0.87	0.73	48.2
East: Hematite Dr														
4	L2	81	34.5	85	34.5	0.166	6.0	LOS A	0.0	0.0	0.00	0.20	0.00	54.8
5	T1	158	43.0	166	43.0	0.166	0.1	LOS A	0.0	0.0	0.00	0.20	0.00	57.9
Approach		239	40.1	252	40.1	0.166	2.1	NA	0.0	0.0	0.00	0.20	0.00	56.8
West: Hematite Dr														
11	T1	84	43.0	88	43.0	0.075	0.6	LOS A	0.2	2.6	0.18	0.09	0.18	58.4
12	R2	14	34.5	15	34.5	0.075	8.2	LOS A	0.2	2.6	0.18	0.09	0.18	54.5
Approach		98	41.8	103	41.8	0.075	1.7	NA	0.2	2.6	0.18	0.09	0.18	57.8
All Vehicles		565	38.1	595	38.1	0.396	5.6	NA	2.0	21.9	0.26	0.45	0.32	53.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 103 [Hematite Dr and Quarry Rd Pm (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total veh/h	HV] %	[Total veh/h	HV] %	v/c	sec		[Veh. veh	Dist] m				km/h
South: Quarry Rd														
1	L2	12	34.5	13	34.5	0.163	6.6	LOS A	0.6	6.2	0.46	0.75	0.46	49.1
3	R2	71	34.5	75	34.5	0.163	10.9	LOS B	0.6	6.2	0.46	0.75	0.46	48.6
Approach		83	34.5	87	34.5	0.163	10.3	LOS B	0.6	6.2	0.46	0.75	0.46	48.6
East: Hematite Dr														
4	L2	210	34.5	221	34.5	0.201	6.0	LOS A	0.0	0.0	0.00	0.42	0.00	53.1
5	T1	76	43.0	80	43.0	0.201	0.1	LOS A	0.0	0.0	0.00	0.42	0.00	56.0
Approach		286	36.8	301	36.8	0.201	4.4	NA	0.0	0.0	0.00	0.42	0.00	53.8
West: Hematite Dr														
11	T1	162	43.0	171	43.0	0.157	1.0	LOS A	0.5	7.5	0.25	0.13	0.25	57.7
12	R2	36	34.5	38	34.5	0.157	8.8	LOS A	0.5	7.5	0.25	0.13	0.25	53.9
Approach		198	41.5	208	41.5	0.157	2.4	NA	0.5	7.5	0.25	0.13	0.25	57.0
All Vehicles		567	38.1	597	38.1	0.201	4.6	NA	0.6	7.5	0.15	0.37	0.15	54.0

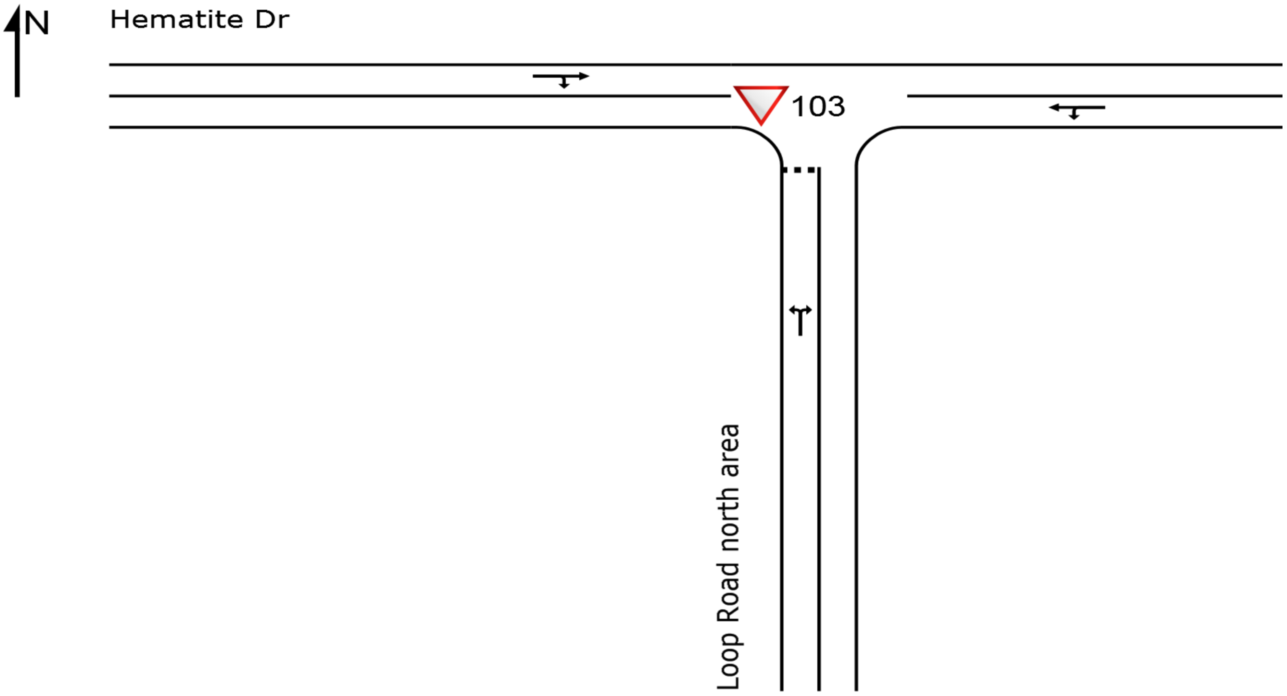
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

▽ Site: 103 [Hematite Dr and Loop Road north Am (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



MOVEMENT SUMMARY

Site: 103 [Hematite Dr and Loop Road north Am (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	INPUT VOLUMES HV] %	DEMAND FLOWS [Total veh/h	DEMAND FLOWS HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	95% BACK OF QUEUE Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Loop Road north area														
1	L2	40	34.5	42	34.5	0.245	7.2	LOS A	0.9	12.0	0.51	0.73	0.54	47.2
3	R2	52	43.0	55	43.0	0.245	18.2	LOS C	0.9	12.0	0.51	0.73	0.54	46.4
Approach		92	39.3	97	39.3	0.245	13.4	LOS B	0.9	12.0	0.51	0.73	0.54	46.7
East: Hematite Dr														
4	L2	84	43.0	88	43.0	0.142	6.1	LOS A	0.0	0.0	0.00	0.24	0.00	54.2
5	T1	115	43.0	121	43.0	0.142	0.0	LOS A	0.0	0.0	0.00	0.24	0.00	57.7
Approach		199	43.0	209	43.0	0.142	2.6	NA	0.0	0.0	0.00	0.24	0.00	56.2
West: Hematite Dr														
11	T1	176	43.0	185	43.0	0.236	1.5	LOS A	1.2	16.3	0.40	0.26	0.40	56.3
12	R2	102	34.5	107	34.5	0.236	8.3	LOS A	1.2	16.3	0.40	0.26	0.40	52.7
Approach		278	39.9	293	39.9	0.236	4.0	NA	1.2	16.3	0.40	0.26	0.40	54.9
All Vehicles		569	40.9	599	40.9	0.245	5.0	NA	1.2	16.3	0.28	0.33	0.28	53.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
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Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

▽ Site: 103 [Hematite Dr and Loop Road north Pm (Site Folder: Ultimate Development 2039)]

New Site
Site Category: (None)
Give-Way (Two-Way)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES		DEMAND FLOWS		Deg. Satn	Aver. Delay	Level of Service	95% BACK OF QUEUE		Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed
		[Total	HV]	[Total	HV]				[Veh.	Dist]				
		veh/h	%	veh/h	%	v/c	sec		veh	m				km/h
South: Loop Road North														
1	L2	114	34.5	120	34.5	0.358	9.6	LOS A	1.7	18.7	0.59	0.86	0.75	48.0
3	R2	73	34.5	77	34.5	0.358	16.0	LOS C	1.7	18.7	0.59	0.86	0.75	47.4
Approach		187	34.5	197	34.5	0.358	12.1	LOS B	1.7	18.7	0.59	0.86	0.75	47.8
East: Hematite Dr														
4	L2	55	34.5	58	34.5	0.198	6.0	LOS A	0.0	0.0	0.00	0.11	0.00	55.5
5	T1	231	43.0	243	43.0	0.198	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	58.7
Approach		286	41.4	301	41.4	0.198	1.2	NA	0.0	0.0	0.00	0.11	0.00	58.1
West: Hematite Dr														
11	T1	185	43.0	195	43.0	0.179	1.1	LOS A	0.6	8.8	0.26	0.12	0.26	57.6
12	R2	38	34.5	40	34.5	0.179	9.4	LOS A	0.6	8.8	0.26	0.12	0.26	53.8
Approach		223	41.6	235	41.6	0.179	2.5	NA	0.6	8.8	0.26	0.12	0.26	56.9
All Vehicles		696	39.6	733	39.6	0.358	4.6	NA	1.7	18.7	0.24	0.32	0.28	54.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

References

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Porter
Consulting Engineers

Level 2 Kishorn Court
58 Kishorn Road
Mount Pleasant 6153
Western Australia

PO Box 1036
Canning Bridge 6153
Western Australia

Tel: (08) 9315 9955
Email: office@portereng.com.au

www.portereng.com.au

APPENDIX E – INFRASTRUCTURE AND SERVICING STRATEGY

Porter
Consulting Engineers

SERVICING REPORT

HEDLAND JUNCTION, WEDGEFIELD

(2022 Structure Plan)

REPORT PREPARED FOR

DEVELOPMENTWA

Prepared by	**Porter Consulting Engineers**
Postal address	PO Box 1036 Canning Bridge WA 6153
Phone	(08) 9315 9955
Email	office@portereng.com.au

Date	February 2022
Our reference	R003.22
Job Number	21-04-049
Checked	R Thomson

HISTORY AND STATUS OF THE DOCUMENT

Revision	Date issued	Author	Issued to	Revision type
Rev A	10/02/2022	G Hall	DevelopmentWA / Urbis	Initial Draft

CONTENTS

1.0 INTRODUCTION

This Report has been prepared to support the revised Structure Plan proposed for the Hedland Junction development area in Wedgefield, in the Town of Port Hedland.

The first iteration of the Structure Plan (previously known as the Wedgefield Industrial Estate Structure Plan, or WIES) was endorsed in 2011, and addressed five zones comprising four Light Industrial Areas (LIA2, LIA3, LIA 4, & LIA5) and the Transport Development Area.

A minor revision was made in 2019 to remove one of the Control Areas that had been identified in the original structure planning. Reference to LIA2 was also removed (it having been fully developed by that time).

The current Structure Plan seeks to:

i. amend one of the Light Industrial zones to be part of the Transport Development Area, now referred to as "General Industry";
ii. provide a road reservation along the alignment of the existing overhead power lines; and
iii. remove the proposed road connection onto Wallwork Road (opposite Altitude Avenue).

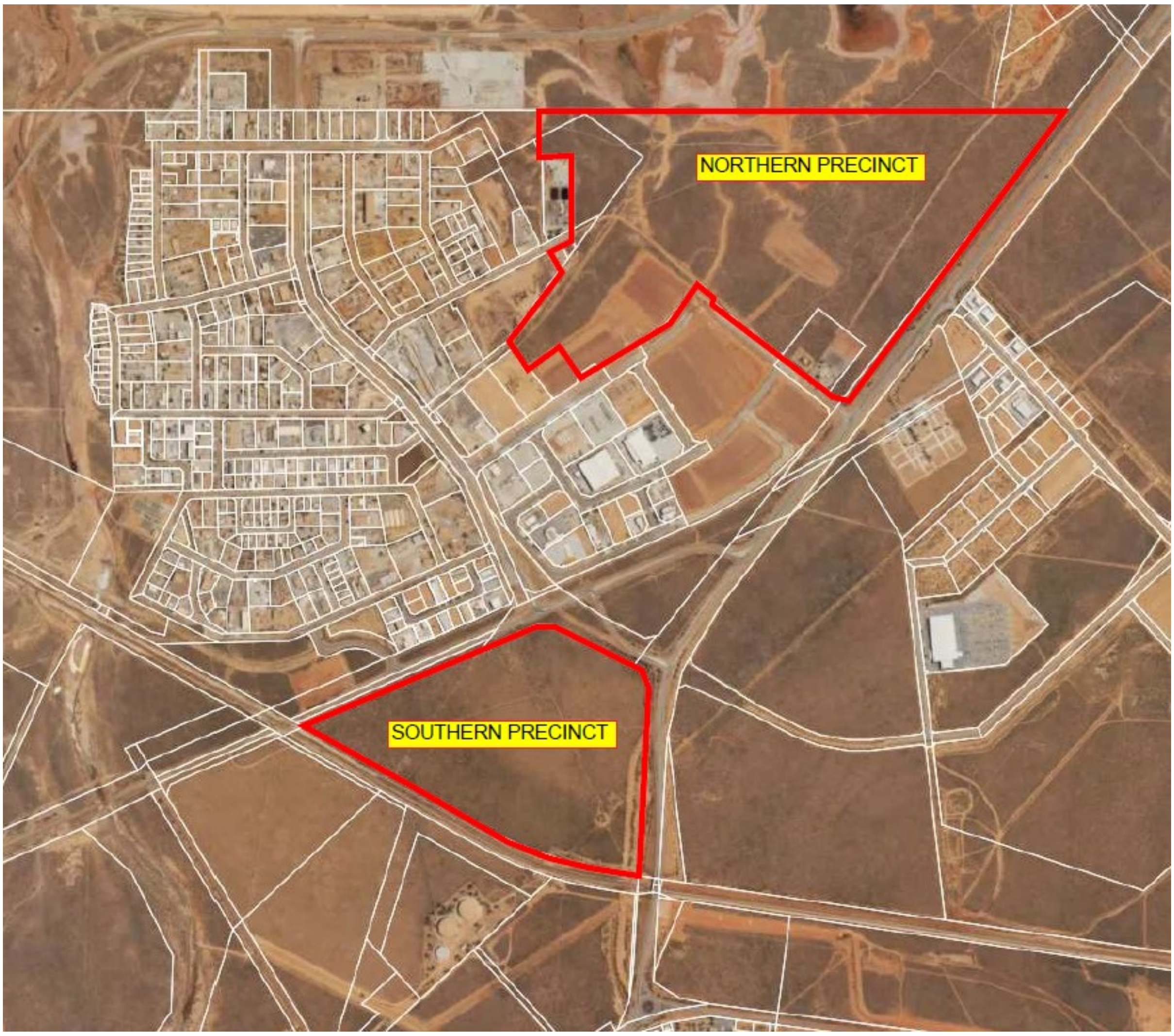


Figure 1 – Site Location

2.0 SITEWORKS

To the eye, the Structure Plan area can appear flat. Much of the existing developed area in Wedgefield is, sitting at around RL 6.0m AHD.

Levels rise slightly as you move south towards South Hedland, and the part of the Structure Plan area south of Powell Road (the 'Southern Precinct") sits at around RL 8.0m AHD. The main part of the Structure Plan area (i.e. the area west of Wallwork Road and north of Quarry Road – the "Northern Precinct") varies between RL 3.0m and RL 7.0m AHD.

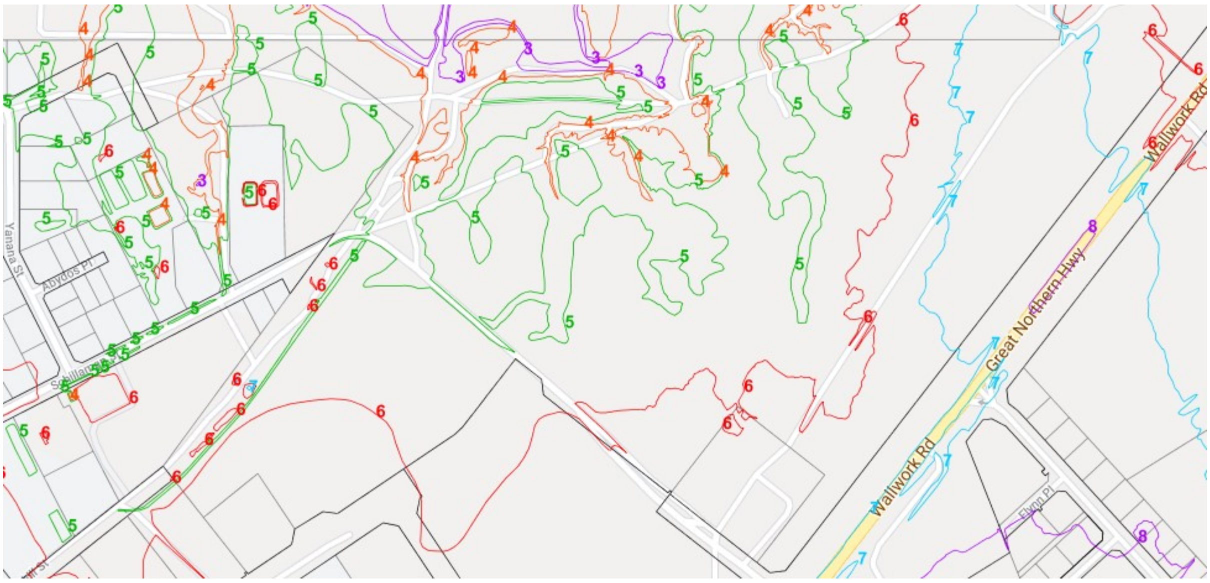


Figure 2 – Existing Topographic Levels

The soil profile is broadly consistent across the Structure Plan area, comprising a thin layer of topsoil over silty sand (pindan), with clayey sands appearing at depths of 2m or more. These soils have a low permeability therefore most of the rainfall becomes surface runoff, making its way overland towards the nearest waterway.

The Local Water Management Plan (JDA report J7157) provides the details of how stormwater runoff is proposed to be effectively managed but in broad terms the strategy requires:

i. filling of the proposed lots to minimum specified levels to ensure adequate protection from flood levels; and
ii. the provision of open drains to convey stormwater runoff away from the developed areas.

Proposed conveyance infrastructure has been sized on the presumption that the initial 'first flush' rainfall is retained within individual lots, typically in a landscaped swale along the road frontage.

The Southern Precinct does not require any significant fill in order to be free from flooding, but the Northern Precinct will require fill up to 3m in depth to achieve the minimum specified development levels. There are limited opportunities with which to win the required fill material locally, which means that large volumes of soil will need to be imported into the site to fully fill the overall site up to the required levels.

3.0 SERVICING

Lots created within the Structure Plan area would need access to water and power supply. Ideally access to telecommunications services would also be made available.

The Water Corporation is responsible for the management of wastewater in Port and South Hedland. Its current practice is not to acceptable wastewater flows from industrial land, and hence lots in the Wedgefield Industrial Area have their own onsite effluent disposal systems in place. The same practice would apply to the Structure Plan area, with systems being installed at the time of building development.

3.1 Water Supply

The Water Corporation is also responsible for the provision of potable water across Port and South Hedland, including the Wedgefield Industrial Area.

Wedgefield is supplied from the storage tanks located approximately 1km south of the intersection of Pinga Street and Powell Road, with the main feeder pipelines extending into the southern end of Pinga Street – with smaller connections located at Quarry Road and the western end of Cajarina Road.

Development of the Structure Plan area south of Powell Road (the "Southern Precinct") will require the relocation of the existing water mains to suit the proposed subdivision layout. As part of the relocation works, the Water Corporation has flagged they will want to replace the multiple small diameter mains with a single larger diameter (DN375/DN300) main.

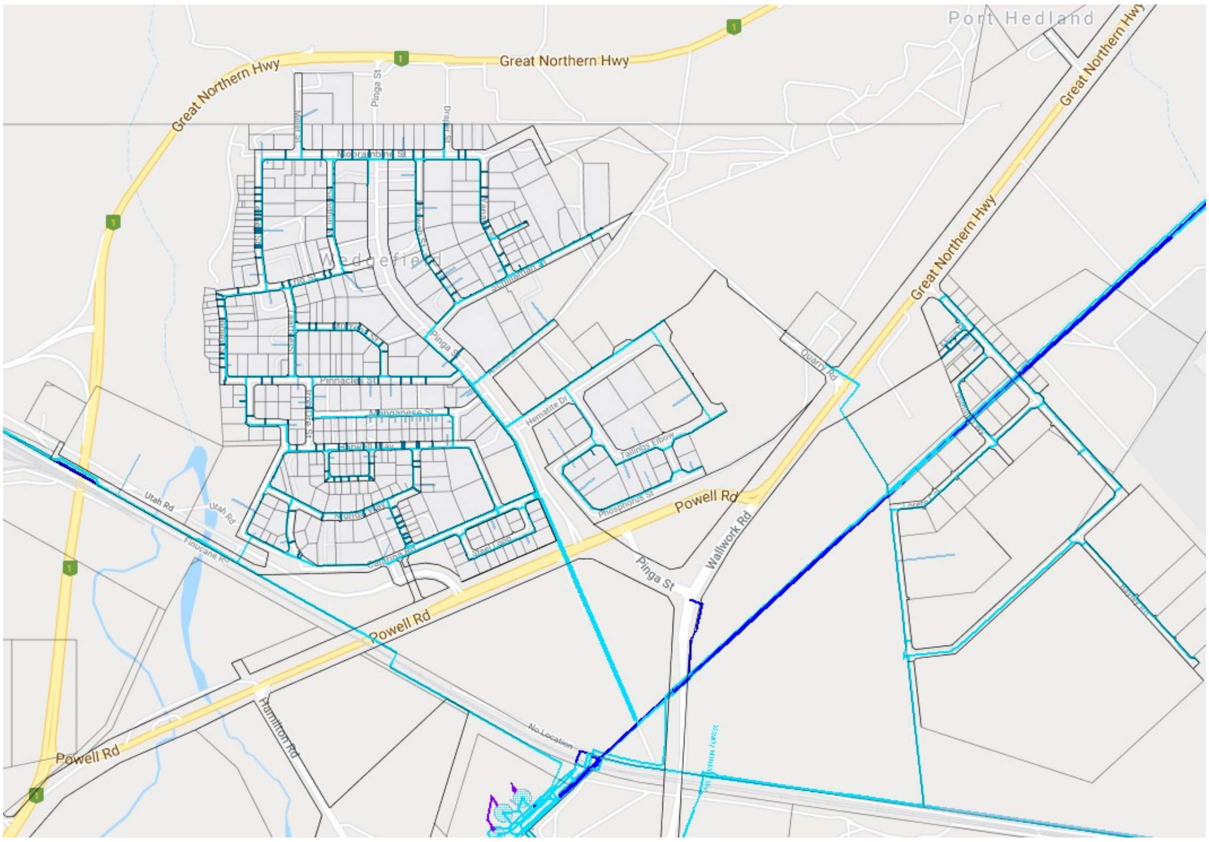


Figure 3 – Existing Water Corporation water supply infrastructure

The water supply infrastructure is also planned to be extended into the "Northern Precinct" of the Structure Plan area, from an existing DN250 main in Altitude Avenue.

3.2 Power Supply

Horizon Power is generally responsible for the supply of electricity in Port and South Hedland, though larger consumers have the ability to engage directly with the power generators where appropriate.

Horizon Power maintains 132kV overhead transmission lines that extend through the Wedgefield Industrial Area. These run along the edge of the Structure Plan area, heading along Anthill Street. These transmission lines will need to be protected in place, and access maintained. The revised Structure Plan proposes that a road reservation be established along the alignment of the transmission lines (whereas the previous Structure Plan proposed to have the power lines located in easements inside new lots). Stormwater planning has also been amended to ensure larger drains are kept away from this corridor, to avoid any unnecessary risk to the foundations around the transmission poles.

An underground high voltage cable also extends along Quarry Road and interconnects with the overhead transmission line at the end of Schillaman Street. This has been successfully accommodated within the construction of Quarry Road, with the section between Hematite Drive and Schillaman Street proposed to be protected within a service corridor (reserve).

Overhead distribution power lines also extend through the "Southern Precinct", but would be relocated underground as part of subdivision works in that location.

Figure 4 – Affected Horizon Power infrastructure

Previous discussions with Horizon Power have recognised that new lots within the Structure Plan area (like many of the existing developed sites in the Wedgefield area) are not likely to significant power requirements, and hence new infrastructure is typically designed to supply the equivalent of 100kVa per hectare (whereas a business or general industrial park elsewhere might be designed to supply 200kVa/ha).

3.3 Telecommunications

NBN is responsible for the provision of telecommunication services, and is servicing the Wedgefield Industrial Area using ‘in ground’ infrastructure. Suitable pit and pipe is typically installed at time of subdivision, with NBN to haul the cable as and when required.

4.0 MOVEMENT NETWORK

Pinga Street provides the main vehicle access into the Wedgefield Industrial Area, particularly for Restricted Access Vehicles (or RAVs), which can only access the industrial area from the Great Northern Highway Bypass. Wallwork Road provides access for smaller vehicles coming from or going to South or Port Hedland.

In terms of the “Northern Precinct” of the Structure Plan area, Hematite Drive provides connection to Pinga Street (for RAV access); and Quarry Road provides access to Wallwork Road. The Structure Plan proposes that Hematite Drive is eventually connected to an extension of Moorambine Street (along the northern boundary of the Structure Plan area) – and there is also the potential for Hematite Drive to be extended through to intersect directly with Great Northern Highway Bypass.

Powell Road is currently being altered to terminate at its intersection with Dalton Road, to remove the existing level crossing. A new roundabout being constructed at this intersection will align with the proposed vehicle access into the “Southern Precinct”.

New roadways are proposed to be 10m in width (providing for a 5m wide traffic lane in each direction), with local widening at intersections to accommodate the turning movements of larger vehicles.

The Town of Port Hedland also requires the provision of suitable pathways for pedestrians and cyclists. Presently, these are taking the form of a widening of the road pavement – in effect, being the equivalent of an on-road cycle lane.

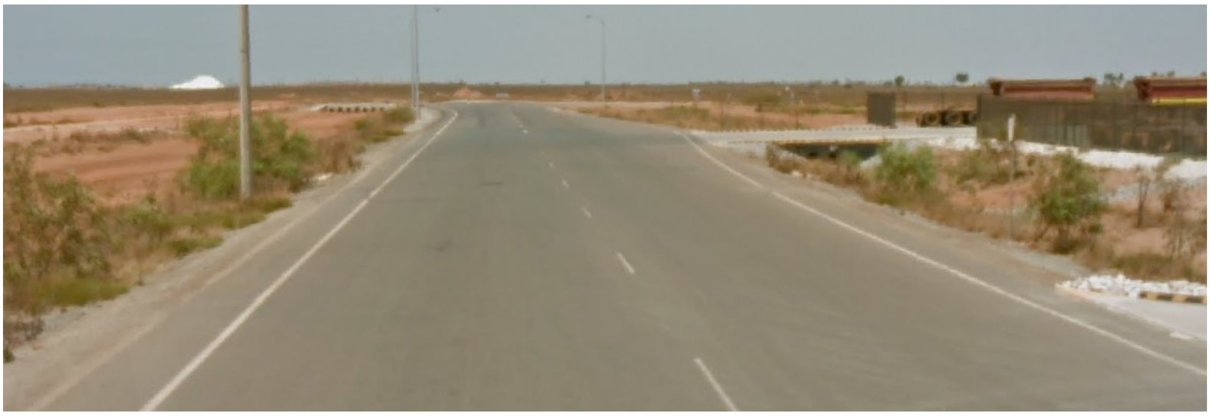
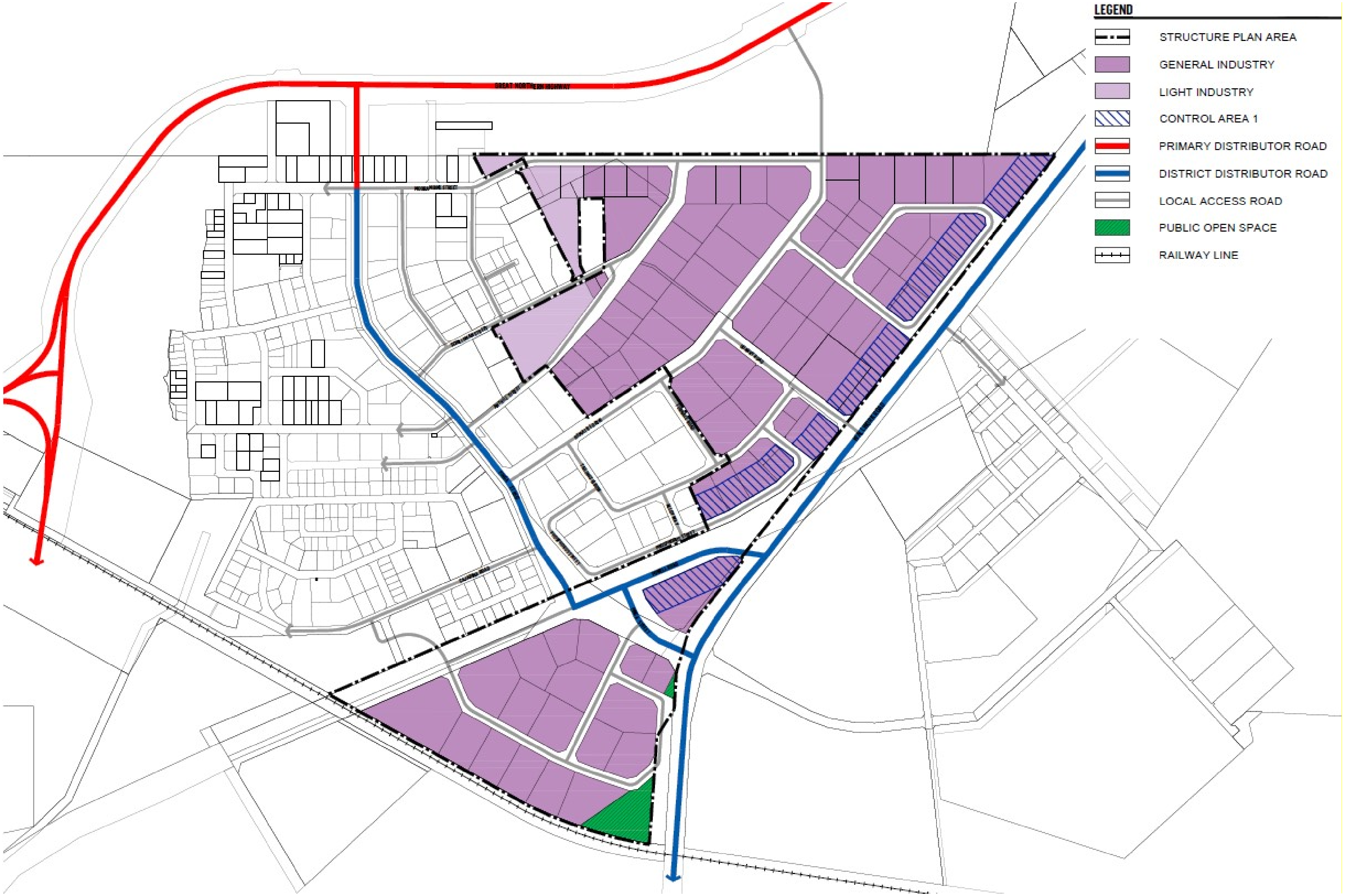


Figure 4 – Typical Road in Structure Plan area

Given the road reserves need to accommodate both the road pavement and open drainage channels, they will typically be either 40m or 60m wide (dependent on the size of the drainage channel required in particualr roads0.

APPENDIX A - Structure Plan


LEGEND
STRUCTURE PLAN AREA
GENERAL INDUSTRY
LIGHT INDUSTRY
CONTROL AREA 1
PRIMARY DISTRIBUTOR ROAD
DISTRICT DISTRIBUTOR ROAD
LOCAL ACCESS ROAD
PUBLIC OPEN SPACE
RAILWAY LINE
GREAT NORTHERN HIGHWAY

Porter
Consulting Engineers

Level 2 Kishorn Court
58 Kishorn Road
Mount Pleasant 6153
Western Australia

PO Box 1036
Canning Bridge 6153
Western Australia

Tel: (08) 9315 9955
Email: office@portereng.com.au

www.portereng.com.au

APPENDIX F – BUSHFIRE MANGEMENT PLAN

Bushfire Management Plan

Hedland Junction Structure Plan

Wedgefield Industrial Estate

Prepared for DevelopmentWA

By Urbaqua

October 2023

Disclaimer and Limitation

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This report is a qualitative assessment only, based on the scope of services defined by the Client, budgetary and time constraints imposed by the Client, the information supplied by the Client (and its agents), and the method consistent with the preceding. Urbaqua has not attempted to verify the accuracy or completeness of the information supplied.

This Bushfire Management Plan provides strategic assessment of the subject site only. A subsequent Bushfire Management Plan and/or Bushfire Attack Level (BAL) Assessment may be required to support future subdivision and development applications. The recommendations contained in this report are considered to be prudent minimum standards only, based on the author's experience as well as standards prescribed by relevant authorities. It is expressly stated that Urbaqua and the author do not guarantee that if such standards are complied with or if a property owner exercises prudence, that a building or property will not be damaged or that lives will not be lost in a bush fire.

Fire is an extremely unpredictable force of nature. Changing climatic factors (whether predictable or otherwise) either before or at the time of a fire can also significantly affect the nature of a fire and in a bushfire prone area it is not possible to completely guard against bushfire.

Further, the growth, planting or removal of vegetation; poor maintenance of any fire prevention measures; addition of structures not included in this report; or other activity can and will change the bushfire threat to all properties detailed in the report. The achievement of the level of implementation of fire precautions will depend on the actions of the landowner or occupiers of the land, over which Urbaqua has no control. If the proponent becomes concerned about changing factors then a Bushfire Management Plan should be requested.

Any person or organisation that relies upon or uses the document for purposes or reasons other than those agreed by Urbaqua and the Client without first obtaining the prior written consent of Urbaqua, does so entirely at their own risk and Urbaqua, denies all liability in tort, contract or otherwise for any loss, damage or injury of any kind whatsoever (whether in negligence or otherwise) that may be suffered as a consequence of relying on this Document for any purpose other than that agreed with the Client.

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EXECUTIVE SUMMARY

This bushfire management plan has been undertaken to support the subdivision of Lots 9001 and 9004 Great Northern Highway, Wedgefield in the Town of Port Hedland (Figure 1).

The subject land is identified as a bush fire prone area, designated by the Fire and Emergency Services (FES) Commissioner. This report has been prepared to meet the requirements of State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7) (2015) and the Guidelines for Planning in Bushfire Prone Areas (V1.4, WAPC, 2020).

A vegetation class and bushfire attack level (BAL) assessment was conducted for the subject land and adjacent areas for a minimum of 150 metres.

The BAL contour map suggests that parts of seven (7) of the proposed lots are likely to be subject to an extreme level of bushfire risk. Asset protection zones should be established on these lots to ensure that the potential radiant heat impact of a fire on any future development will not exceed 29kW/m² (BAL-29) and that a defendable space is provided for firefighting.

The proposal is to support future industrial development. Any development located within areas other than BAL-LOW should by supported by a Risk Management Plan for any flammable on-site hazards. There is no requirement for additional mitigation and/or construction methodologies to manage bushfire risk in accordance with AS 3959: Construction of buildings in bushfire prone areas. However, consideration should be given to the control of land use such that high risk land uses are not located within areas other than those that are assessed as BAL-LOW.

The bushfire mitigation and management strategies outlined in this management plan comply with the acceptable solutions of control for each of the Bushfire Protection Criteria detailed in Guidelines for Planning in Bushfire Prone Areas (2017). It is therefore considered that this bushfire management plan demonstrates compliance with the objectives and provisions of State Planning Policy 3.7: Planning in Bushfire Prone Areas.

CONTENTS

Figures

Tables

1 INTRODUCTION

DevelopmentWA has engaged Urbaqua to prepare a Bushfire management plan to support the preparation of the Hedland Junction Structure Plan for the Wedgefield Industrial Estate, Wedgefield (Figure 1) in the Town of Port Hedland (Figure 2).

Parts of the subject land are identified as a bush fire prone area, designated by the Fire and Emergency Services (FES) Commissioner (Figure 3). This report has been prepared to meet the requirements of State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7) (2015) and the Guidelines for Planning in Bushfire Prone Areas (V1.3, WAPC, 2017).

Any identified bushfire risk will be addressed as part of the future Subdivision and development approvals process, consistent with the requirements of State Planning Policy 3.7: Planning in Bushfire Prone Areas (SPP 3.7) (2015), the Building Code of Australia and Australian Standards (AS3959-2009): Construction of buildings in bushfire prone area where these apply.

1.1 Proposal details

The subject land is currently zoned ‘Industrial Development’ under the Town of Port Hedland Local Planning Scheme No. 7 and is known as the Hedland Junction Structure Plan area. It is located within the Wedgefield Industrial Area on the outskirts of South Hedland.

The assessment area includes the land within a 150m buffer of the subject land.

1.2 Bushfire management guidelines, specifications and minimum standards

Specifications or standards relevant to this bushfire management plan are derived from and consistent with:

- Fire and Emergency Services Act 1998;
- Bush Fires Act 1954;
- Planning and Development (Local Planning Scheme Amendment) Regulations 2015;
- State Planning Policy 3.7: Planning in Bushfire Prone Areas (WAPC, 2015);
- Guidelines for Planning for Bushfire Prone Areas and appendices, Version 1.4 (WAPC, 2020);
- Australian Standards (AS3959-2018): Construction of buildings in bushfire prone areas; and
- Town of Port Hedland Firebreaks Notice (Government Gazette, 2019)

The Town of Port Hedland Firebreaks Notice (Government Gazette, 2019) requires that

> “Where the area of land exceeds 2000 square metres, mineral earth breaks of five (5) metres in width are to be cleared of all flammable material immediately inside and along the boundaries of the land. Where there are buildings on the land additional mineral earth breaks five (5) metres in width are to be cleared immediately surrounding each building.”

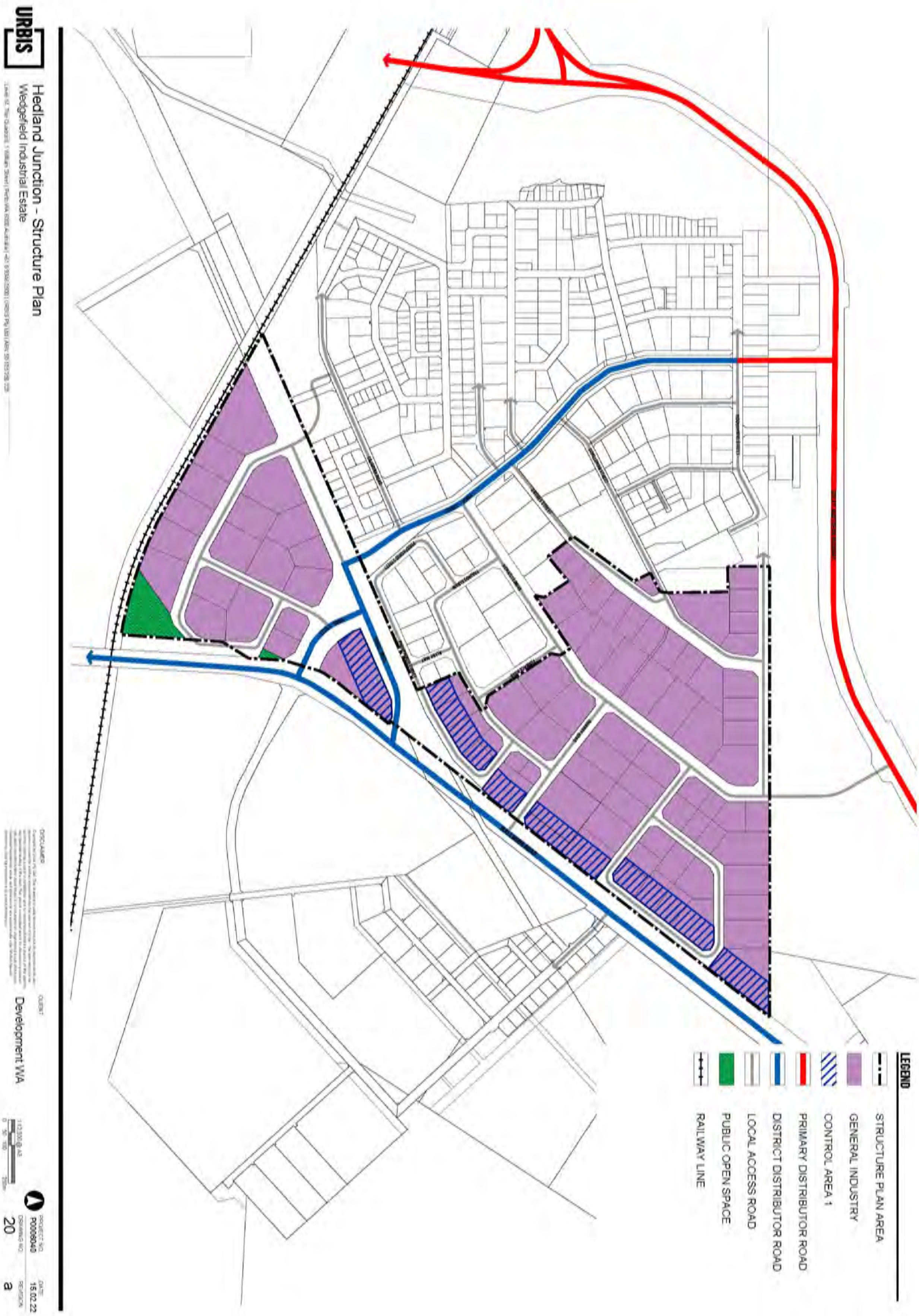
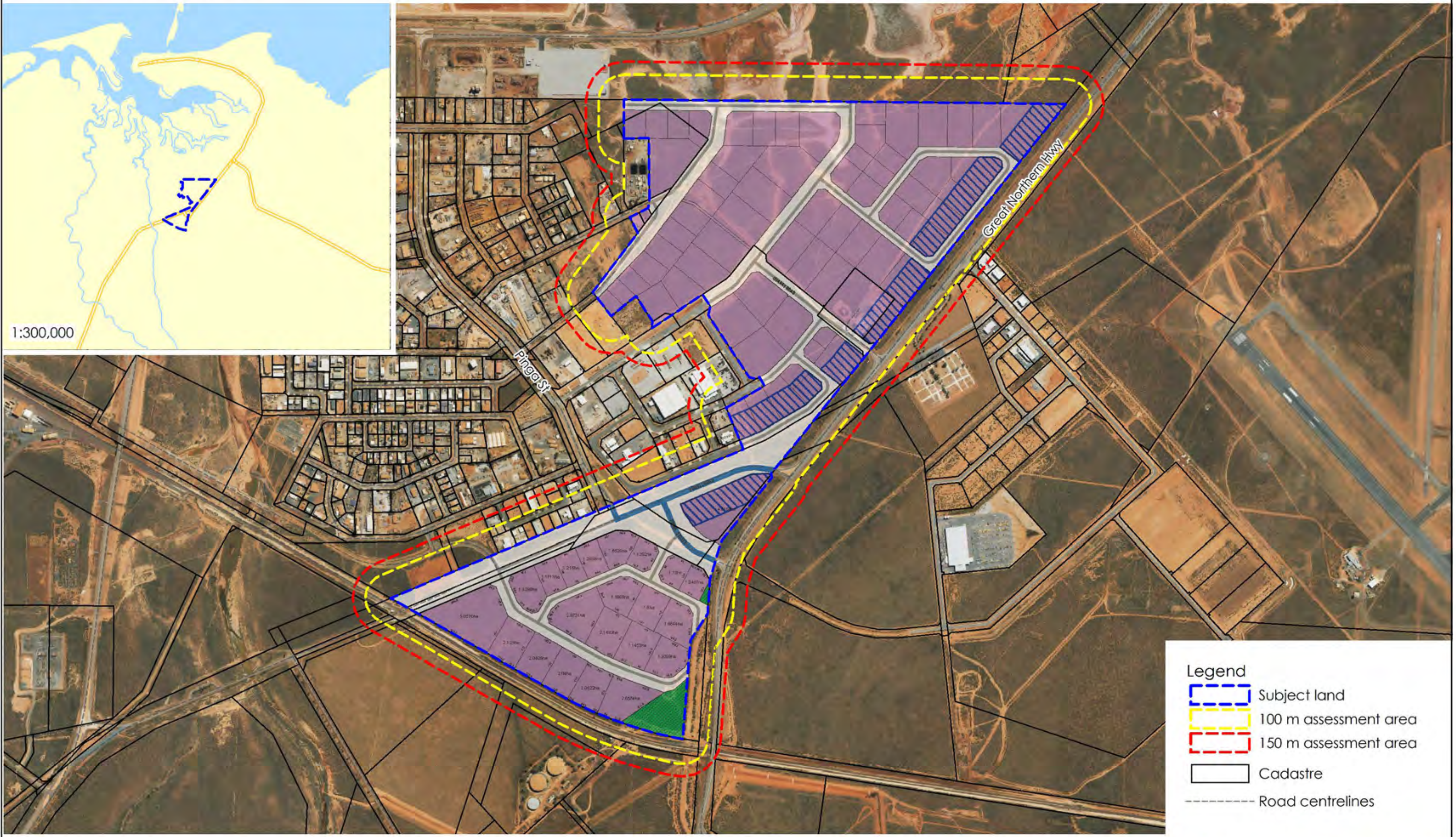


Figure 1: Proposed Hedland Junction Structure Plan (Source: Urbis)

DevelopmentWA - Wedgefield Bushfire Management Plan

Figure 2 - Location plan



Data source: Landgate, MRWA, DWER, Urbis, Created by: AT Projection: MGA2020: zone 50.

0 500
metres
Scale 1:20,000 @ A4

urbaqua
land and water solutions

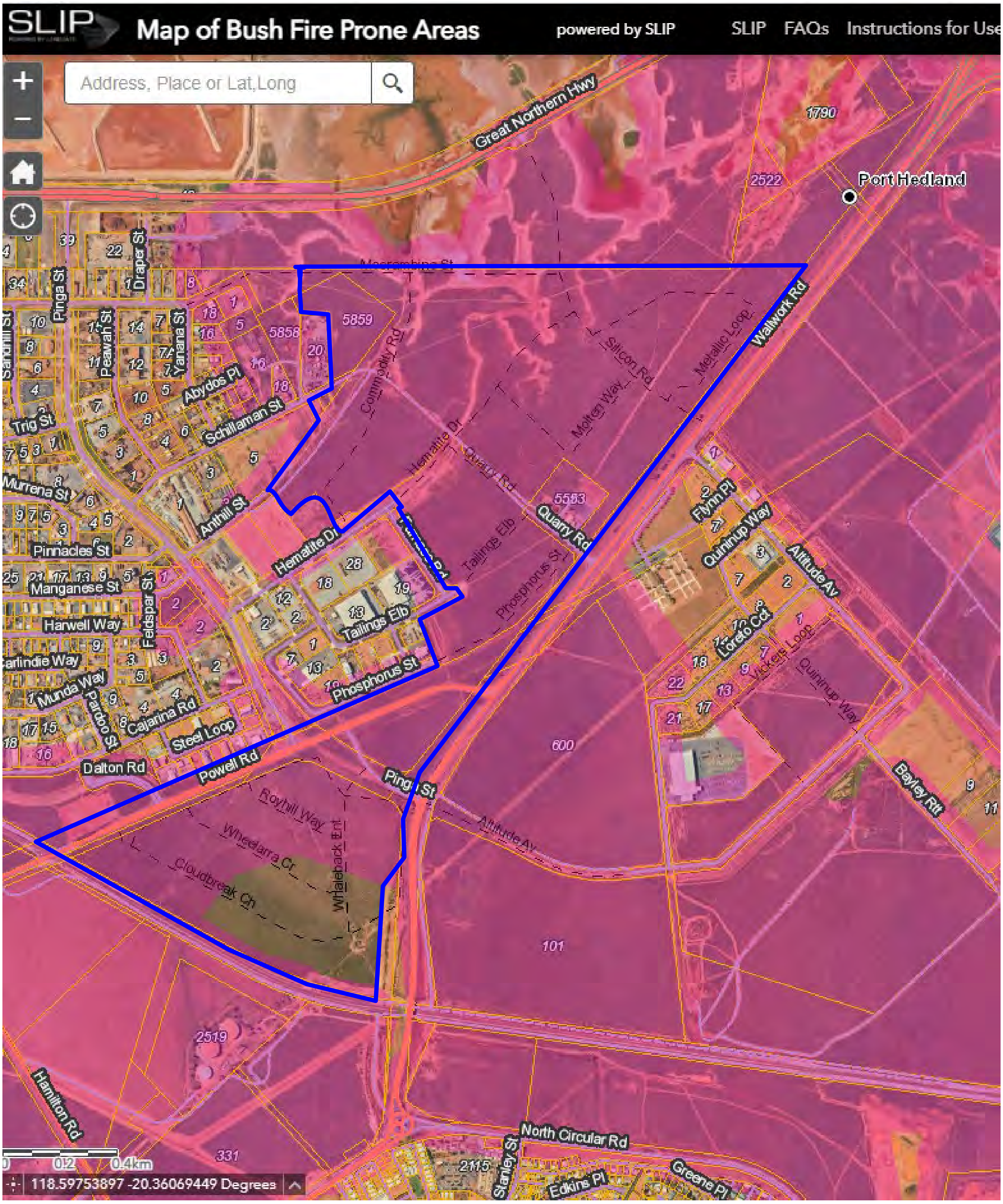


Figure 3: Map of Bushfire Prone Areas for the subject site (Source: DFES, 2021)

2 ENVIRONMENTAL CONSIDERATIONS

The assessment area includes the land within a 150m of the subject land. There are no areas of significant environmental value within the subject land or assessment area.

2.1 Native Vegetation – modification and clearing

All vegetation within the subject land will be cleared to permit development.

2.2 Re-vegetation/Landscape Plans

The design guidelines associated with the Structure Plan require a 3m vegetated strip along the front of properties to provide screening. As this is considerably less than 20m in width, this vegetation is not considered to represent a bushfire hazard.

The structure plan includes two areas of public open space. These have been provided for drainage management and will be maintained by the Town in a low threat state to facilitate this function.

The structure plan also includes a Landscape Plan (Appendix 1) which depicts the proposed landscape of the vegetated buffers along Great Northern Hwy, Powell Road and Wallwork Road. The proposed vegetation along Great Northern Hwy is reflected as Class G: Grassland, as it is greater than 20m in width, while the vegetation along Powell Road and Wallwork Road is less than 20m in width and will be managed in a low threat state by the local government and Main Roads WA. It is also noted that the proposed landscaping includes a 10m slashed and cleared access way abutting any proposed lot as shown in Figure 4.

Figure 4: Excerpt from Landscape streetscape plan (source: UDLA, 2023)

3 BUSHFIRE ASSESSMENT RESULTS

3.1 Assessment Inputs

In order to identify the potential bushfire risks, it is necessary to describe the bushfire problem associated with the subject land. The assessment takes into consideration the:

- the topography and slope of the subject land;
- type and classification of vegetation present on and adjacent to the subject land;
- distances between the classifiable vegetation; and
- current and proposed future land use.

3.1.1 Slope

The topography of the study area is relatively flat, sloping very gently from around 6mAHD in the south and east to 5mAHD in the northern portion of the site. Where the land is affected by natural drainage, the non-vegetated areas are around 4mAHD.

The effective slope (that is the slope that will affect the behaviour of an approaching bushfire) underneath the vegetation surrounding the property is either flat or marginally downslope. Slope is therefore not considered to be a major factor for this site.

3.1.2 Current and future land use

The site is largely undeveloped, remnant vegetation with some areas cleared for future industrial development and roads. The subject land is proposed to be developed for industrial use and will include the construction of additional local roads.

Land within 150m of the subject land comprises existing and future industrial development, roads and remnant vegetation.

The proposed future development is not considered to be classified as either "minor development" or "unavoidable development" as defined by State Planning Policy 3.7: Planning in Bushfire Prone Areas (WAPC, 2015).

High risk land use

State Planning Policy 3.7 defines High-risk land use as:

> "A land use which may lead to the potential ignition, prolonged duration and/or increased intensity of a bushfire. Such uses may also expose the community, fire fighters and the surrounding environment to dangerous, uncontrolled substances during a bushfire event. Examples of what constitutes a high-risk land use are provided in the Guidelines."

The Guidelines for Planning in Bushfire Prone Areas (WAPC, 2017) state high risk land uses may include, but are not limited to:

> service stations, landfill sites, bulk storage of hazardous materials, fuel depots and certain heavy industries as well as military bases, power generating land uses, saw-mills, highways and railways, among other uses meeting the definition."

The Guidelines for Planning in Bushfire Prone Areas state that:

> "The bushfire construction requirements of the Building Code of Australia only apply tocertain types of residential buildings (being Class 1, 2 or 3 buildings and/or Class 10a buildings or decks associated with a Class 1, 2 or 3 building) in designated bushfire prone areas. As such, AS 3959 does not apply to all buildings. Only vulnerable or high- risk land uses that fall within the relevant classes of buildings as set out in the Building Code of Australia will be required to comply with the bushfire construction requirements of the Building Code of Australia. As such, the planning process focuses on the location and siting of vulnerable and high risk land uses rather than the application of bushfire construction requirements."

Although it is unlikely that many high-risk land uses will be located within the proposal area, the Town is able to exercise its discretionary powers to refuse an application for a high risk land use within 100m of any classified vegetation.

It is therefore recommended that consideration is given to the control of land use such that high risk land uses are not located within 100m of any classified vegetation.

State Planning Policy 3.7, provision 6.6 is subsequently addressed through future development at individual lot scale requiring a Risk Management Plan for any flammable on-site hazards.

3.1.3 Vegetation types

Vegetation exists within 150m of the subject land which presents a bushfire hazard.

On the basis of a site visit on 16 December 2021, vegetation at the site was classified according to the descriptions provided in AS 3959 – 2018, and includes the following three vegetation types:

- Class G: Grassland – Tussock grassland (G22): All forms, including situations with shrubs and trees, if the overstorey foliage cover is less than 10%.
- Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.
- Low threat vegetation – AS3959 2.2.3.2(f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks.

The vegetation within the subject land and 150m surrounding is shown in Figure 4 and Table 1.

Table 1: Vegetation classification

Photo point		Vegetation class, type and description
1 Plot 21		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Salt affected floodway
2 Plot 19		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Downslope > 0 to 5
3 Plot 19		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Downslope > 0 to 5
4 Plot 2		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve

Photo point		Vegetation class, type and description
5 Plot 2		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve
6 Plot 3		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
7 Plot 1		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
8 Plot 2		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve

Photo point		Vegetation class, type and description
9 Plot 2		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve
10 Plot 2		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve
11 Plot 2		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve
12		Subject land: Drainage basin

Photo point		Vegetation class, type and description
13 Plot 2 And Plot 5		Plot 2 Foreground: Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Major road reserve Plot 5: Background: Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
14 Plot 6		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Cleared for development
15		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Bridge batter

Photo point		Vegetation class, type and description
16 Plot 6		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Bridge batter and drainage basin
17 Plot 8		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Railway reserve
18 Plot 7		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land

Photo point		Vegetation class, type and description
19 Plot 7		Foreground: Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Background: Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
20 Plot 9		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
21 Plot 11		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Cleared for development
22 Plot 10		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Downslope <5 degrees

Photo point		Vegetation class, type and description
23 Plot 10		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Downslope <5 degrees
24 Plot 13		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Road reserve
25 Plot 13		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Road reserve
26 Plot 13		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Road reserve

Photo point		Vegetation class, type and description
27 Plot 13		Low threat exclusion – AS3959 Clause 2.2.3.2 (f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and windbreaks. Managed grassland - Road reserve
280 Plot 14		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business
29 Plot 14		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business
30 Plot 14		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business

Photo point		Vegetation class, type and description
31		Subject land and drainage swale
32 Plot 12		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Cleared for development
33 Plot 14		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business
34 Plot 14		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Cleared for development

Photo point		Vegetation class, type and description
35 Plot 12		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business
36 Plot 14		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Cleared for development
37 Plot 15		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
38 Plot 16		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business

Photo point		Vegetation class, type and description
39 Plot 17		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
40 Plot 18		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business with front setback screening
41 Plot 18		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Industrial business
42 Plot 19		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land
43 Plot 19		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land

Photo point		Vegetation class, type and description
44 Plot 20		Low threat exclusion – AS3959 Clause 2.2.3.2 (e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops. Cleared hardstand area
45 Plot 19		Class G: Grassland – Tussock grassland (22) – all forms (except tussock moorlands), including situations with shrubs and trees, if the overstorey foliage cover is less than 10%. Includes pasture and cropland. Flat land

3.2 Assessment outputs

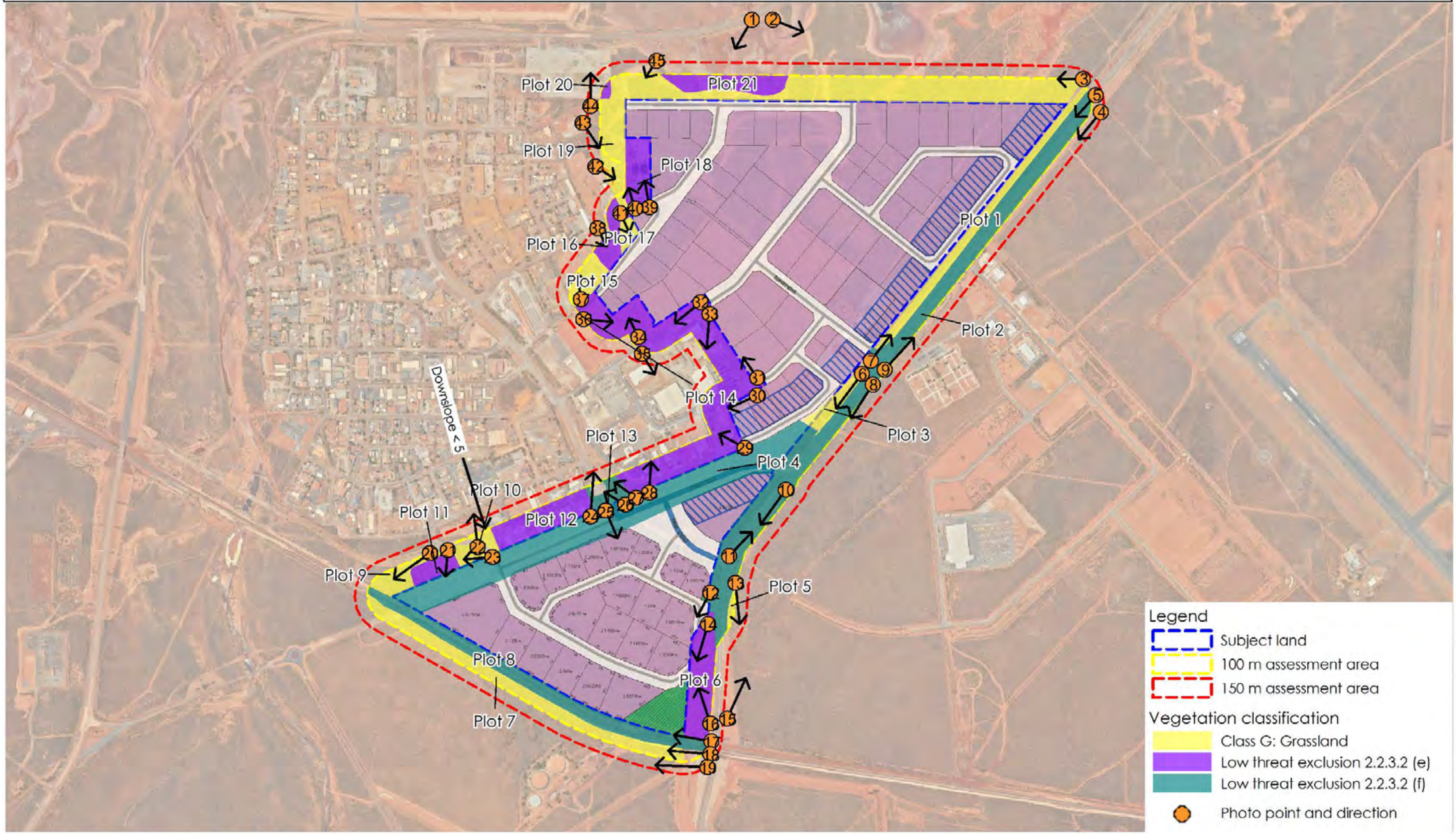
Plots 2, 4, 6, 8, 11, 12, 13, 14, 16, 18, 20 and 21 and are not considered to represent a bushfire risk as these areas contain no vegetation or vegetation which is actively managed in a low threat state.

Plots 5, 7, 9, 10, 15, 17, and 19 are remnant vegetation characteristic of the Pilbara region and are classified as G: Grassland.

Plots 1 and 3 are guided by the Wedgefield Industrial Estate_Streetscape Plan (Attachment 1) and will be managed accordingly by the Town and Main Roads WA as appropriate.

DevelopmentWA - Wedgefield Bushfire Management Plan

Figure 5 - Post-development vegetation classification



Data source: Landgate, MRWA, DWER, Urbis, Created by: AT, updated SS Projection: MGA2020: zone 50.

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3.2.1 Bushfire hazard level assessment

Consistent with Appendix 2 of the Guidelines for Planning in Bushfire Prone Areas (V1.3, WAPC, 2017), as this bushfire management plan is to support a local structure plan (strategic level document), a bushfire hazard level (BHL) assessment has been undertaken in accordance with Method 1 of AS3959: Construction of buildings in bushfire prone areas and Appendix 2 of Guidelines for Planning in Bushfire Prone Areas (V1.3, WAPC, 2017).

Table 2: Bushfire Hazard Level assessment of vegetation

Vegetation area/plot	Applied vegetation classification	Effective slope under the classified vegetation (Degrees)	Hazard level
1	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
2	Low threat Exclusion 2.2.3.2 (f)	N/A	Low
3	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
4	Low threat Exclusion 2.2.3.2 (f)	N/A	Low
5	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
6	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
7	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
8	Low threat Exclusion 2.2.3.2 (f)	N/A	Low
9	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
10	Class G: Grassland Tussock grassland (22)	Downslope > 0 to 5	Moderate
11	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
12	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
13	Low threat Exclusion 2.2.3.2 (f)	N/A	Low
14	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
15	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
16	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
17	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
18	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
19	Class G: Grassland Tussock grassland (22)	Upslope/flat	Moderate
20	Low threat Exclusion 2.2.3.2 (e)	N/A	Low
21	Low threat Exclusion 2.2.3.2 (e)	N/A	Low

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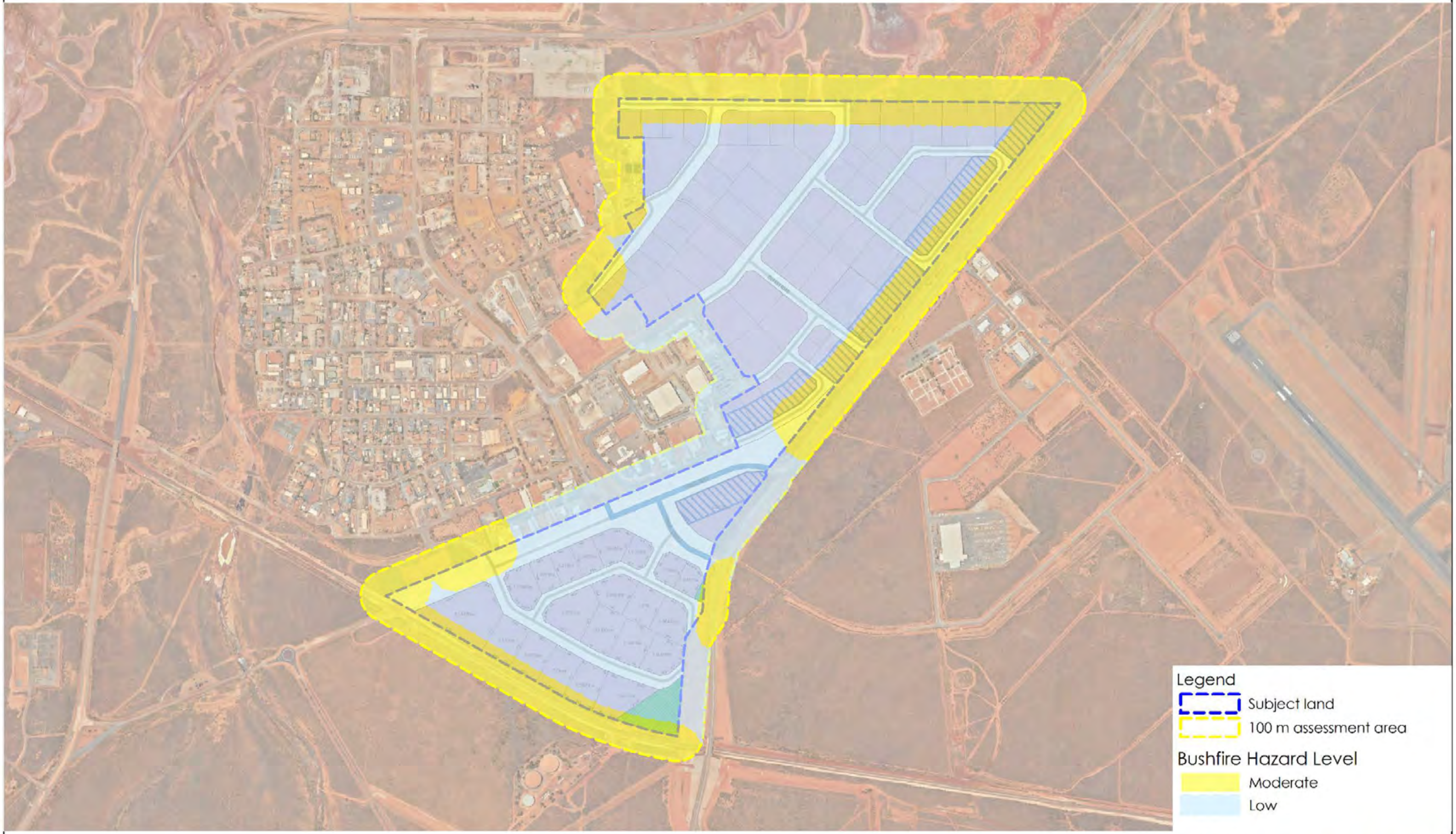

Figure 6 - Bushfire hazard level assessment

Data source: Landgate, MRWA, DWER, Urbis. Created by: AT Projection: MGA2020: zone 50.

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3.2.2 Bushfire Attach Level assessment

Consistent with the Guidelines for Planning in Bushfire Prone Areas (V1.3, WAPC, 2017), as this bushfire management plan is to support an application for subdivision where the lot layout is known, a Bushfire Attack Level (BAL) contour map has been created for the proposed development which shows indicative BAL ratings for the site (Figure 6). The BAL assessment has been undertaken in accordance with Method 1 of AS3959: Construction of buildings in bushfire prone areas and Appendix 3 of the Guidelines for Planning in Bushfire Prone Areas (V1.3, WAPC, 2017). The BAL contour map was prepared on the basis of FDI 80; the vegetation classification shown in Table 1 and slope shown on Figure 4. An excerpt from AS3959 is provided in Table 3.

Table 3: Excerpt from AS 3959, Table 2.4.3, Distance (m) of the site from the predominant vegetation class

FDI 80 (1090 K)	Vegetation classification and slope	
Bushfire attack levels (BALs)	Class G Grassland Upslopes and flat land	Class G Grassland Down>0 to 5 degreess
BAL-FZ	< 6m	< 7m
BAL-40	6-< 8	7-< 9
BAL-29	8-< 12	9-< 14
BAL-19	12-<17	14-<20
BAL-12.5	17-< 50	20-< 50
BAL-LOW	Beyond 50m	Beyond 50m

The BAL contour map suggests that parts of seven (7) of the proposed lots are likely to be subject to an extreme level of bushfire risk. These lots run along the northern boundary of the structure plan area where no perimeter road is proposed.

A further six (6) lots may be subject to moderate bushfire risk, however, due to the 10m slashed and cleared access way abutting the lots along Powell and Wallwork Roads and the Great Northern Hwy, the proposed landscaping does not result in a BAL of BAL-40 or BAL-FZ.

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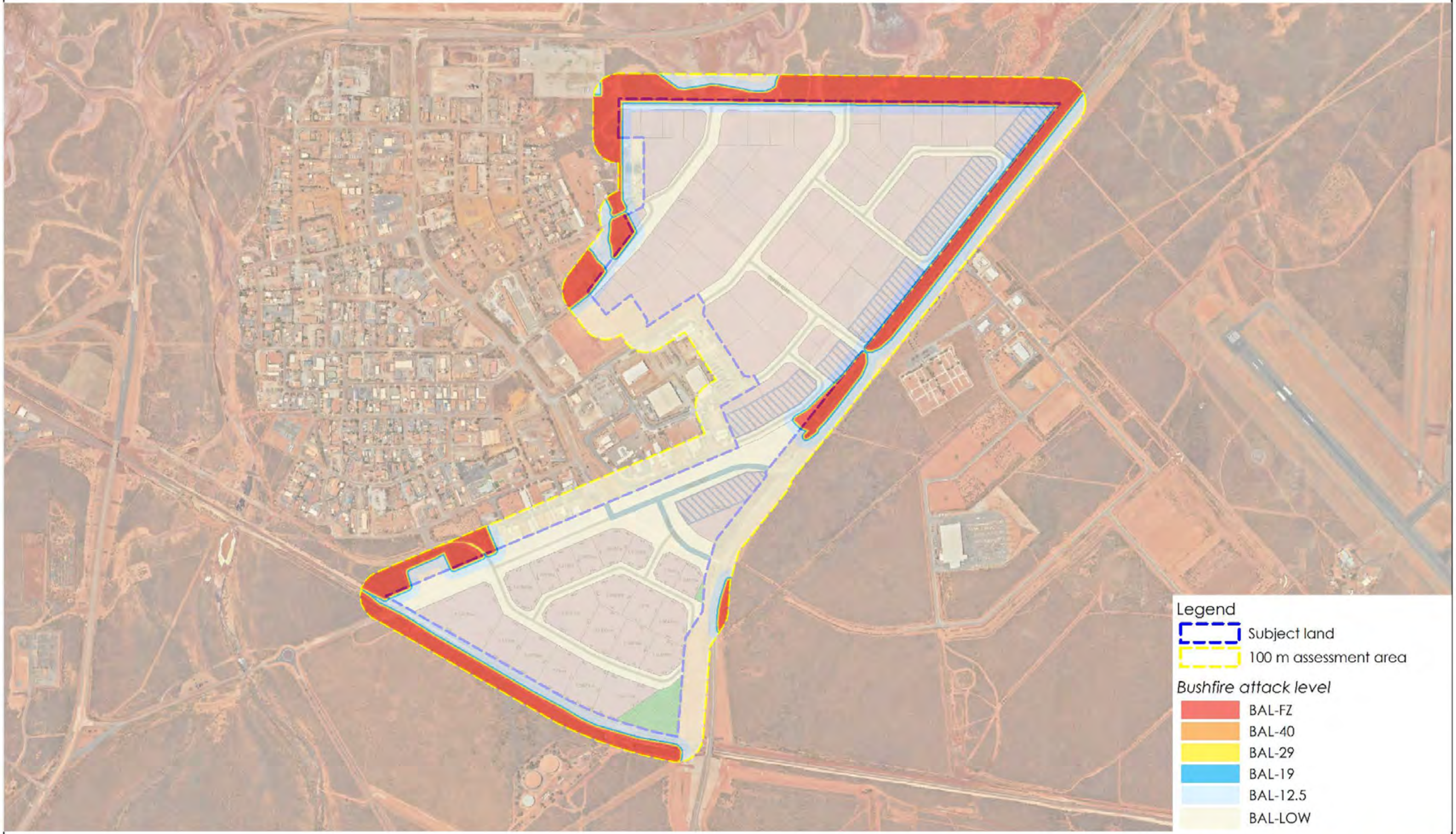
Figure 7 - Bushfire attack level (BAL) contours



Data source: Landgate, MRWA, DWER, Urbis, Created by: ASS Projection: MGA2020: zone 50.

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4 IDENTIFICATION OF BUSHFIRE HAZARD ISSUES

The objective of this bushfire management plan is to demonstrate compliance with the objectives and provisions of State Planning Policy (SPP) 3.7: Planning in Bushfire Prone Areas, as outlined below.

The subject land is adjacent to vegetation which has the potential to create a bushfire risk.

It is considered that the bushfire risk to the proposed subdivision can be adequately managed through location and zoning, appropriate siting and design of development, as well as the proposed vehicular access and water supply which will be provided as part of future development.

Bushfire hazard to the proposed future development is therefore considered to be low. This conclusion is substantiated further below.

4.1 Location, siting and design of development

Subsequent to development, the subject land will not contain any vegetation that is considered to be a bushfire hazard.

Although fire risk exists from vegetation adjacent to the subject land, many of the proposed lots are largely surrounded by a local road network which provides adequate separation between the proposed lots and the vegetation to reduce the risk to moderate or low. Sixty eight (68) of the proposed lots are not subject to any bushfire risk (BAL-LOW).

However, nineteen (19) proposed lots are subject to bushfire risk from the adjacent vegetation, seven of which are considered to be subject to an extreme level of risk. In order to meet the objectives of State Planning Policy 3.7: Planning in Bushfire Prone Areas, it is necessary to establish asset protection zones (APZ) on these proposed lots as indicated in Figure 6. The APZ is a defendable space within which firefighting operations can be undertaken to defend a building or structure.

An APZ of 8m is required to be established along the rear boundary of six (6) lots in north-west corner of structure plan area and the western boundary of the lot in the north-west corner of the structure plan area.

The APZs will be required to be managed to meet the following criteria:

- Fences: within the Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).
- Fine Fuel load: combustible dead vegetation matter less than 6 millimetres in thickness and should be managed and removed on a regular basis to maintain a low threat state; maintained at <2 tonnes per hectare (on average); and mulches should be non-combustible such as stone, gravel or crushed mineral earth

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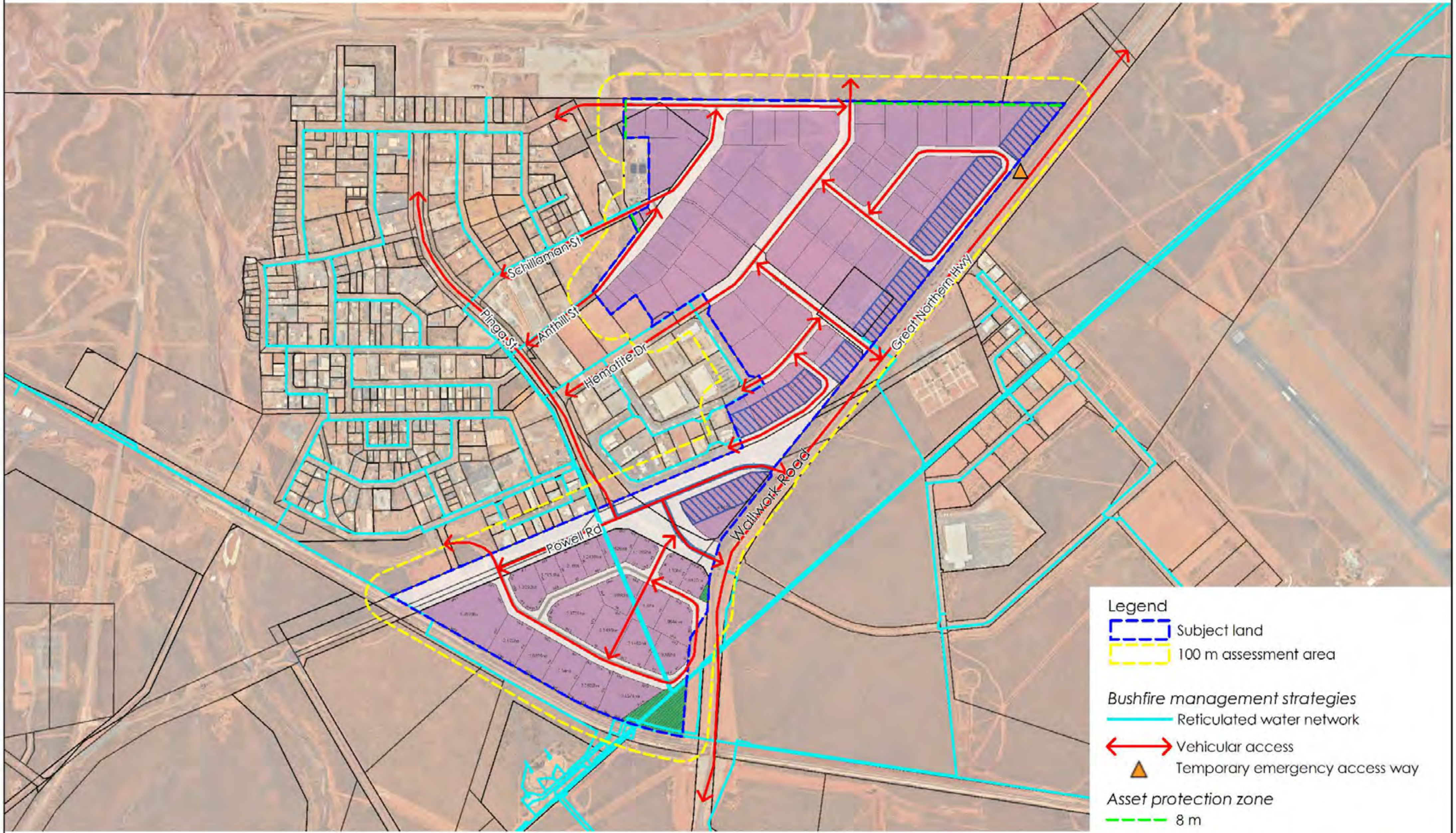
Figure 8 - Bushfire management strategies



Data source: Landgate, MRWA, DWER, Urbis, Created by: AT Projection: MGA2020: zone 50.

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- Trees (> 6 metres in height): trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% of the APZ area with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided that the total canopy cover within the APZ will not exceed 15 per cent and are not connected to the tree canopy outside the APZ. (Figure 8).
- Shrubs (0.5 metres to 6 metres in height): should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 6 metres in height are to be treated as trees.
- Ground covers (<0.5 metres in height): can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- Grass: should be managed to maintain a height of 100 millimetres or less. Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation.
- Defendable space: Within three metres of each wall or supporting post of a habitable building, the area is kept free from vegetation, but can include ground covers, grass and non-combustible mulches as prescribed above.

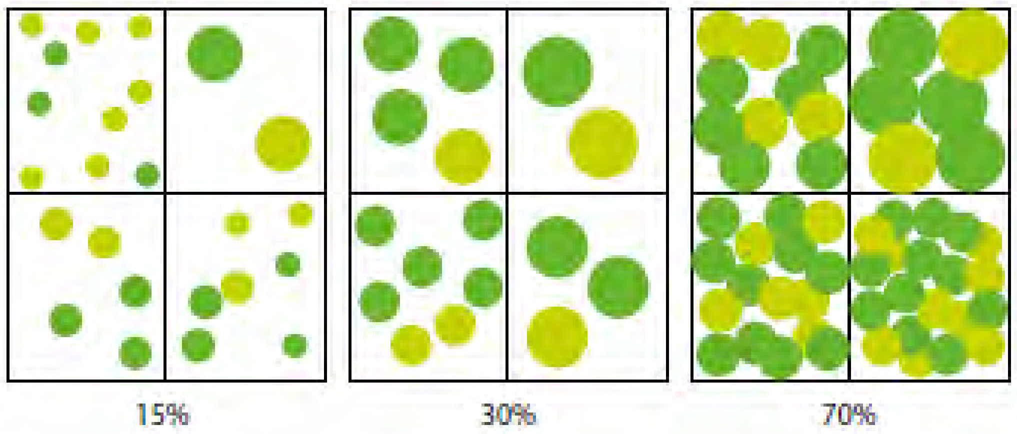


Figure 9: Tree canopy cover ranging from 15 to 70 percent at maturity (Source: WAPC, 2020)

The establishment of the APZs as stipulated above and shown on Figure 6 will ensure that any future development will not be subject to BAL-40 or BAL-FZ.

After construction of the proposed development, it is anticipated that the owners of all lots will provide a fire break consistent with the requirements of the Town of Port Hedland Fire Breaks Notice (2019) which requires that “Where the area of land exceeds 2000 square metres, mineral earth breaks of five (5) metres in width are to be cleared of all flammable material immediately inside and along the boundaries of the land. Where there are buildings on the land additional mineral earth breaks five (5) metres in width are to be cleared immediately surrounding each building.” It is therefore anticipated that once the firebreaks have been established, the APZs could be removed and the fire threat addressed through compliance with the 5m firebreak requirement.

The creation of APZs and management of fire risk consistent with the Town’s Fire Breaks Notice will ensure that this proposal does not result in the intensification of any development in areas that are subject to extreme hazard.

All habitable dwellings will be constructed to meet the requirements of AS3959 Construction of buildings in Bushfire Prone Areas where necessary.

4.2 Vehicular access

The main access to the subject land is provided by a network of regional roads which include Great Northern Highway, Wallwork Road and Powell Road. These also connect via Pinga St to the Great Northern Highway bypass to the north (Figure 9).

An internal road network is proposed which will provide for at least two different access and egress routes from each of the proposed lots. This includes the construction of a temporary emergency access way onto Great Northern Highway until further stages of the development are constructed. The emergency access way is to meet all the following requirements:

- requirements in Table 4, Column 2;
- provides a through connection to a public road;
- be no more than 500 metres in length; and
- must be signposted and if gated, gates must open the whole trafficable width and remain unlocked.

All roads and transport infrastructure will be designed and constructed to meet the requirements of the Guidelines for Planning in Bushfire Prone Areas (Version 1.4 WAPC, 2020) Appendix Four, Table 6, as replicated in Table 4.

Table 4: Vehicular access technical requirements (WAPC, 2020)

Technical Requirement	Public road	Emergency access way	Fire service access routes	Battle-axe and private driveways
Minimum trafficable surface (m)	In accordance with A3.1	4	6	6
Minimum horizontal clearance (m)	N/A	6	6	6
Minimum vertical clearance (m)	4.5			
Minimum weight capacity (t)	15			
Maximum grade unsealed road	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%)		
Maximum grade sealed road		1:7 (14.3%)		
Maximum average grade sealed road		1:10 (10%)		
Minimum inner radius of road curves (m)		8.5		

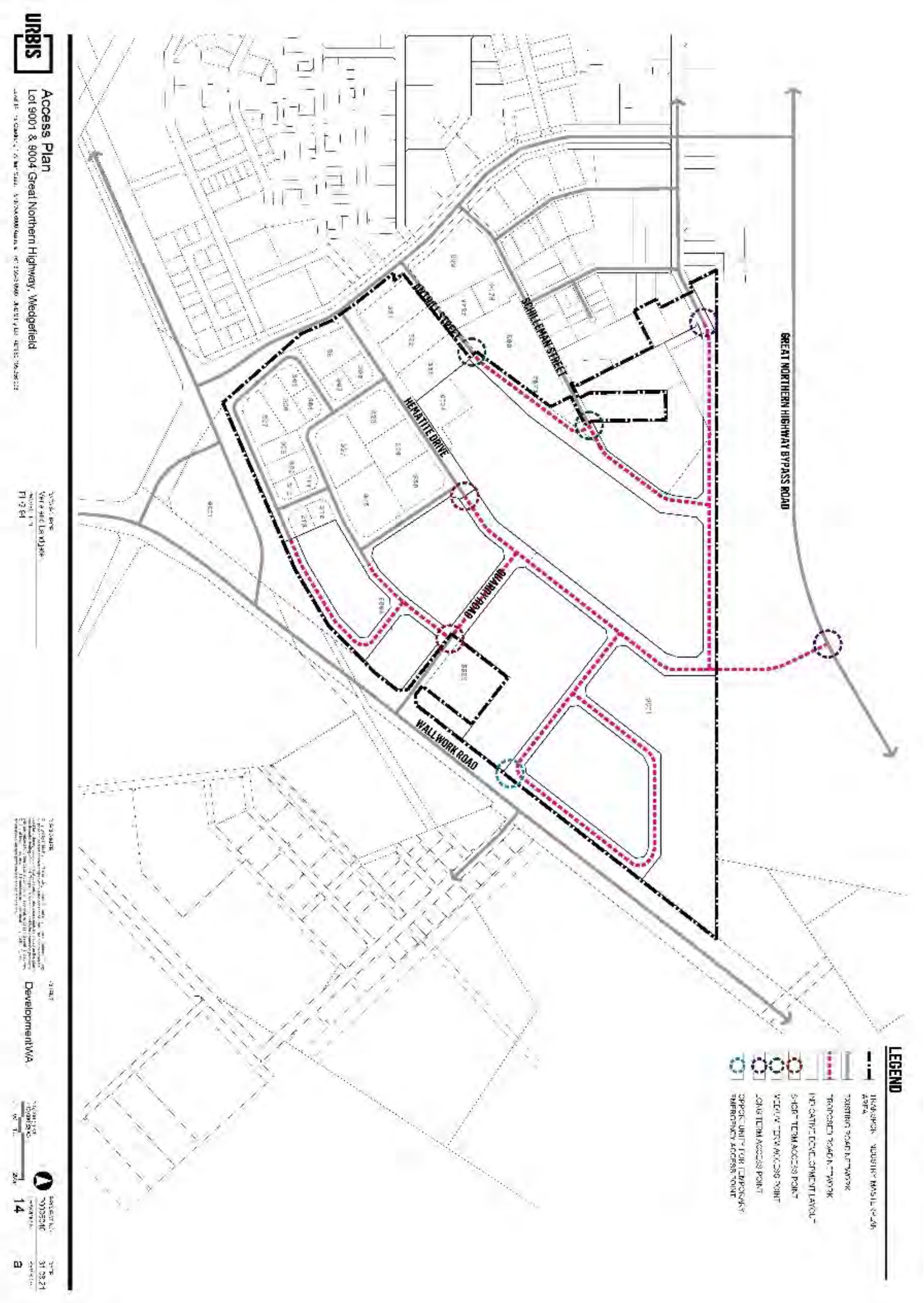


Figure 10: Access plan (Source: Urbis)

4.3 Water

The subject land has access to a reticulated water supply. This network, together with fire hydrants, will be extended and constructed throughout the proposed development area in accordance with the specifications of the Water Corporation and Department of Fire and Emergency Services (DFES).

New development will be required to meet the fire safety requirements of the Building Code of Australia, which include but are not limited to connection to adequate and reliable water supplies with access to an appropriately located fire hydrant.

Contractors or others carrying out building or other works at the site must not cover hydrants and/or the markings indicating their location. In the event activities occur that do result in hydrants or markings being covered, damaged, or removed, it will be the responsibility of the relevant contractor to rectify the situation.

5 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA

The subject land contains and is adjacent to an area of bushfire risk. Bushfire risk mitigation and management measures have been identified to reduce bushfire risk to achieve the objectives of SPP3.7. The bushfire risk mitigation strategies proposed comply with the acceptable solutions for each of the Bushfire Protection Criteria detailed in Guidelines for Planning in Bushfire Prone Areas (2020). They are summarised in Table 5.

5.1 Compliance Table

Compliance with the policy measures in SPP3.7 is summarised in the following table.

Table 5: Bushfire protection criteria assessment

Element	Acceptable solution	Compliance	
1. Location	A1.1 Development location	☑	Each of the proposed lots contains a large area not subject to bushfire risk. No development will be permitted in areas subject to BAL-40 or BAL-FZ.
2. Siting and design of development	A2.1 Asset Protection Zone	☑	Firebreaks and APZ established to ensure no development will be subject to BAL-40 or BAL-FZ.
3. Vehicular Access	A3.1 Public road	☑	All public roads will meet the requirements of Table 6 of Appendix 4 of the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2020)
	A3.2a Multiple access routes	☑	Short and long term public road access is provided in two different directions to at least two different suitable destinations with an all-weather surface at all times through establishment of an emergency access way.
	A3.2b Emergency access way	☑	The emergency access way will: meet the requirements in Table 6, Column 2; provide a through connection to a public road; be no more than 500 metres in length; and will be signposted and if gated, gates must open the whole trafficable width and remain unlocked.
	A3.3 Through-roads	☑	N/A – No no-through are proposed.
	A3.4a Perimeter roads	☑	N/A as the adjoining vegetation is Glass G: Grassland
	A3.4b Fire service access route	☑	The external road network provides acceptable access to all areas of Grassland vegetation by firefighting equipment
	A3.5 Battle-axe	☑	N/A – Not required for a structure plan
	A3.6 Private driveways	☑	N/A – Not required for a structure plan
4. Water	A4.1Identification of future water supply	☑	The development has access to reticulated water and fire hydrants which meet Water Corporation and DFES specifications. Any new development will be required to meet the requirements of the Building Code of Australia.

Element	Acceptable solution	Compliance	
	A4.2 Provision of water for firefighting purposes	☑	N/A – Not required for a structure plan

5.2 Bushfire management strategies

Appropriate asset protection zones (APZ) will be established through this bushfire management plan on seven (7) lots as indicated in Figure 7 to ensure no development occurs in an area subject to BAL-FZ or BAL-40. Activities and uses within the APZ will be maintained to the standards stated in section 4.2 by the landowner, until such time that the requirements of the Town of Port Hedland Firebreaks Notice is applied to the adjacent and new lots, removing the need for the APZs.

As the proposed development is for industrial use, there is no requirement for additional mitigation and/or construction methodologies to manage bushfire risk in accordance with AS 3959: Construction of buildings in bushfire prone areas. However, consideration should be given to the control of development such that high risk uses are not located within areas other than those that are assessed as BAL-LOW.

Any development located within areas other than BAL-LOW should by supported by a Risk Management Plan for any flammable on-site hazards.

6 RESPONSIBILITIES FOR IMPLEMENTATION AND MANAGEMENT OF THE BUSHFIRE MEASURES

The following management measures are recommended to support the proposed development. The measures aim to mitigate the inherent bushfire risk to life, property and the environment and achieve a suitable and effective bushfire management outcome for the site. This is achieved by meeting the acceptable solutions outlined in the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2020) as demonstrated in Section 5.

Implementation of this Plan will commence immediately and will be the responsibility of the landowner until such time as the development (lots) are sold and the responsibility is transferred to the new owners. Likely tasks that will be involved with implementation of this plan are described in Table 6, 7 and 8.

Although implementation of the following management measures is considered to mitigate bushfire risk, there is a need for individual landowners to protect their property in line with this bushfire management plan noting that, despite any management measures outlined in the bushfire management plan, during a bushfire event, fire appliances may not be available to protect each asset.

Table 6: Responsibilities of the developer prior to the issue of Titles

No.	Implementation Action	Subdivision Clearance
1	Construct public roads to the standards stated in the BMP.	☐
2	Install landscaping in accordance with the Wedgefield Industrial Estate_Streetscape plan (ULDA, 2023)	☐
3	Provide access to reticulated water and fire hydrants which meet Water Corporation and DFES specifications.	☐
4	Establish Asset Protection Zones on lots as indicated in Figure 7 to the requirements of this BMP.	☐

Table 7: Responsibilities of future landowners

No.	Implementation Action	Development
5	Construct any private driveways in areas other than BAL-LOW to the standards stated in the BMP.	☐
6	Maintain Asset Protection Zones on lots as indicated in Figure 7 to the requirements of this BMP until such time that the requirements of the Town of Port Hedland Fire Breaks Notice are met.	☐
7	Any development located within areas other than BAL-LOW to by supported by a Risk Management Plan for any flammable on-site hazards.	☐

Table 8: Responsibilities of the Town as part of future decision-making

No.	Implementation Action	Development
8	Ensure firebreaks are established and maintained on created and adjacent lots consistent withthe Town of Port Hedland Fire Breaks Notice	☐
9	Consider control of development such that high risk uses as defined in SPP 3.7 are not located within areas other than thosethat are assessed as BAL-LOW.	☐
10	Ensure design and construction of any private driveways meet requirements in the Guidelines and this Bushfire Management Plan	☐
11	Maintain streetscape landscape in accordance with the Wedgefield Industrial Estate_Streetscape plan (ULDA, 2023)	☐

6.1 Certification by Bushfire Consultant

I, Shelley Shepherd, certify that at the time of inspection, the BAL ratings contained within this BMP are correct. Implementation of actions 1 – 11 should be undertaken as part of any future subdivision or development approvals process, and the ongoing management of land by landowners.

Signature: Shepherd. Date:__5 October 2023__

BPAD 36558 Level 2 BPAD Practitioner

7 REFERENCES

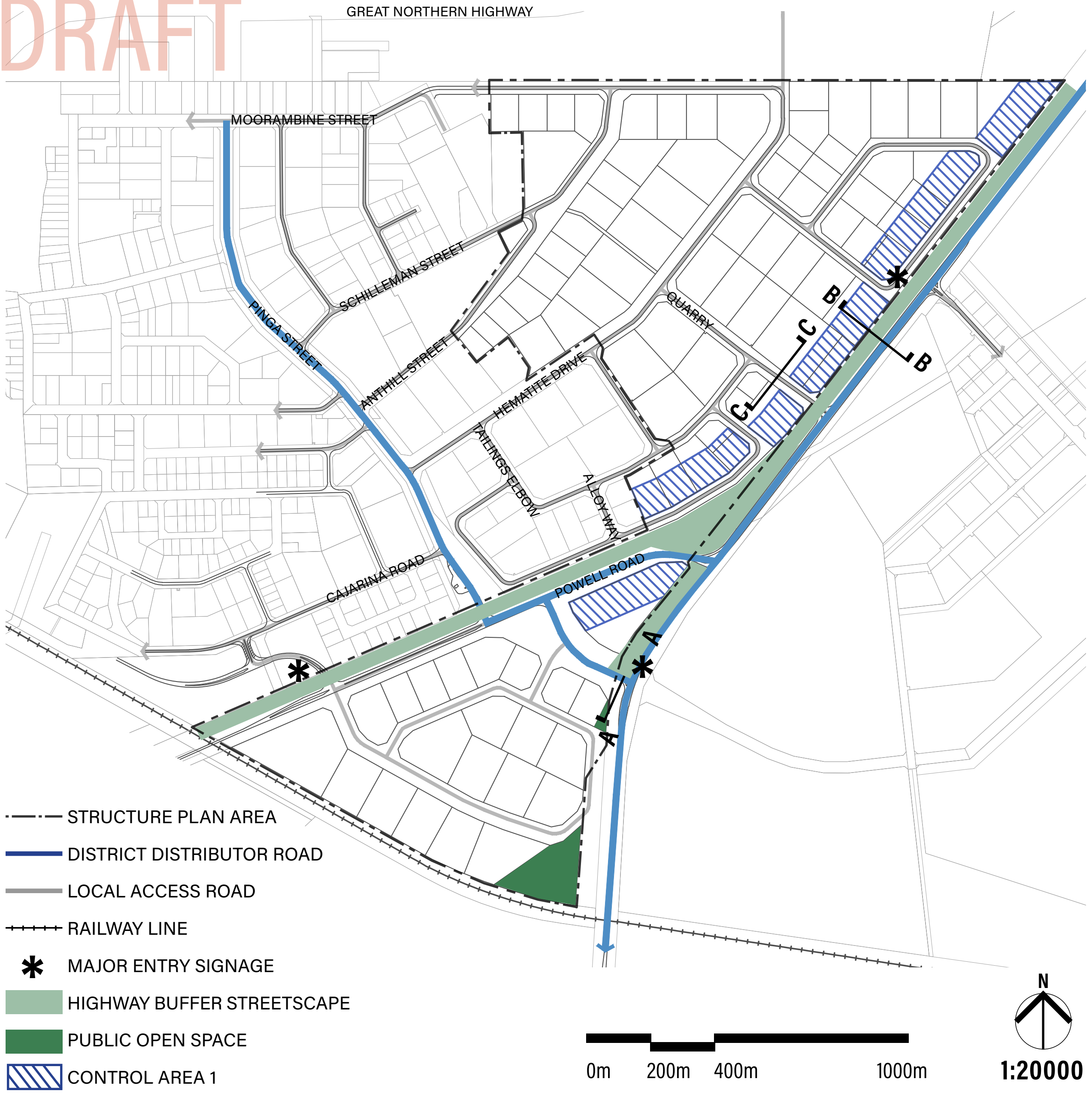
Government Gazette, 2019, Town of Port Hedland Fire Breaks Notice

Standards Australia Limited, 2018, Australian Standard 3959 – 2018 Construction of Buildings in Bushfire-Prone Areas (Amendment 4 – November 2018), SAI Global, NSW.

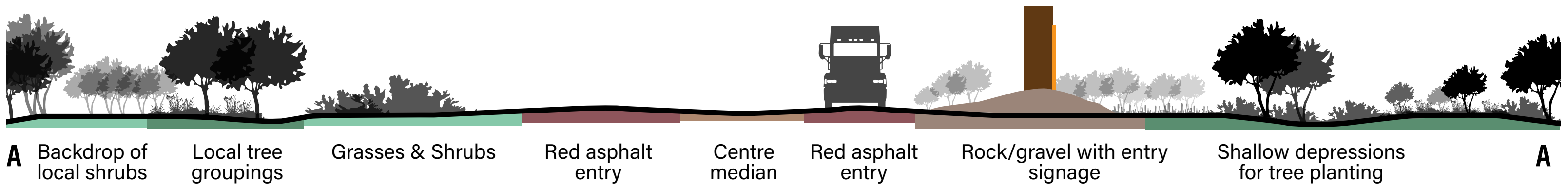
WAPC, 2015, State Planning Policy 3.7: Planning for Bushfire Prone Areas, Western Australian Planning Commission, Perth, WA

WAPC, 2020, Guidelines for Planning in Bushfire Prone Areas and appendices, Version 1.4, Western Australian Planning Commission, Perth, WA

APPENDIX 1: LANDSCAPE PLAN FOR STREETSCAPE

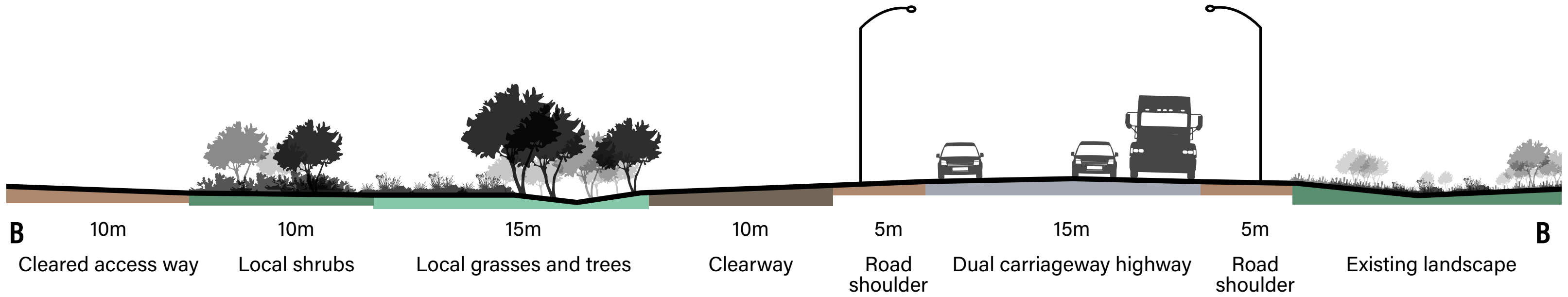


* All Landscape Buffers alongside road edges are managed by local authorities as appropriate.



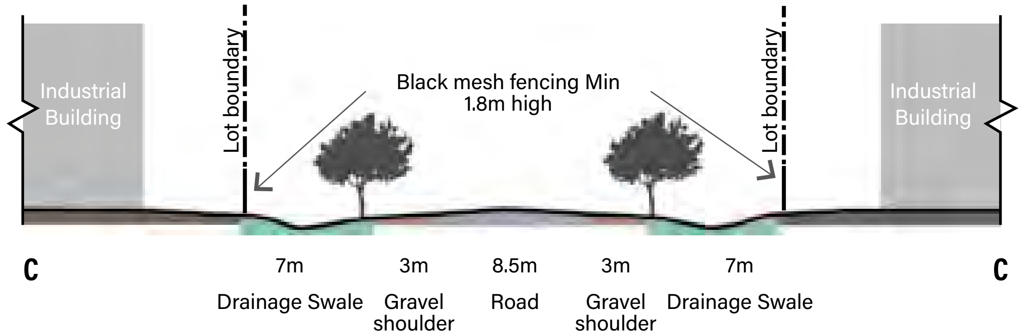
MAJOR ENTRY ELEVATION 1:400 @A3

A new mound rises behind the grass and is covered in local gravels/rocks. The shrubbery remains as a backdrop. The exposed and rocky mound is ideal for signage in the form of a steel blade. The other side of the road has a similar scenario only the mound is smaller and earlier to fit in with the lot and remains planted with grasses shrubs.



HIGHWAY BUFFER STREET SCAPE SECTION ELEVATION 1:400 @A3

Local shrubs & grasses divide two distinct areas. 1. A buffer of local shrubbery and a clear access way. 2. A series of depressions provides locations for groupings of local tree species. This clear planting strategy makes this design a usable seed bank for local projects.



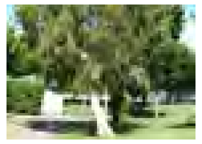
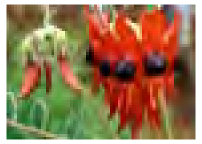
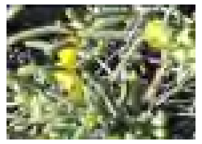
INTERNAL ROAD STREET SCAPE SECTION ELEVATION 1:400 @A3

A clean, low maintenance outcome with a simple swale system within the road reserve. Tree species may be used to identify different zones within the industrial area.

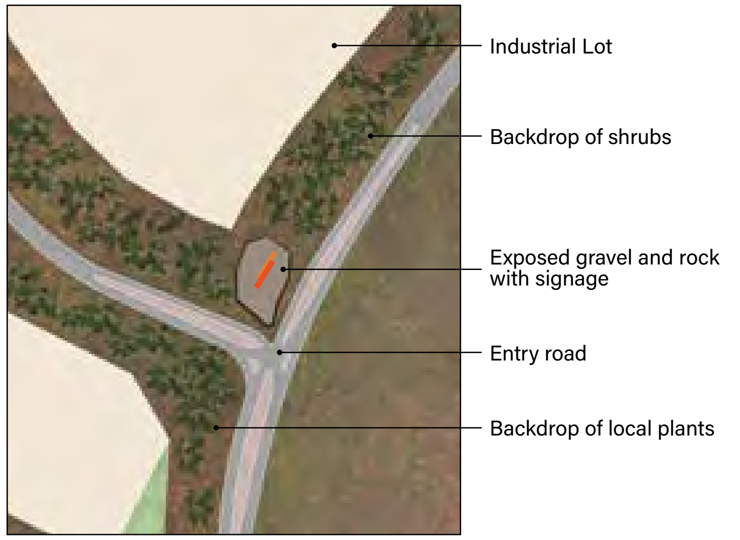
INDICATIVE PLANTING LIST

TREES	SHRUBS/GRASSES/GROUND-COVER	
Acacia eriopoda	*Acacia ampliceps*	*Plectrachne schinzii*
Brachychiton diversifolius	*Acacia colei*	*Ptilotus calostachyus*
Corymbia deserticola	*Acacia coriacea*	*Ptilotus exaltatus*
Corymbia opaca	*Acacia wickhamii*	*Senna artemisioides ssp oligophylla*
Eucalyptus camaldulensis	*Atriplex semilunaris*	*Senna notabilis*
Eucalyptus flavescens	*Canavalia rosea*	*Spinifex longifolius*
Eucalyptus leucophloia	*Crotalaria cunninghamii*	*Swainsona formosa*
Eucalyptus vitrix	*Enchylaena tomentosa*	*Triodia epactia*
Melaleuca argentea	*Eremophila fraserii*	*Triodia pungens*
Melaleuca leucadendra	*Eremophila maculata ssp brevifolia*	*Triodia wiseana*
	Ipomoea muelleri	

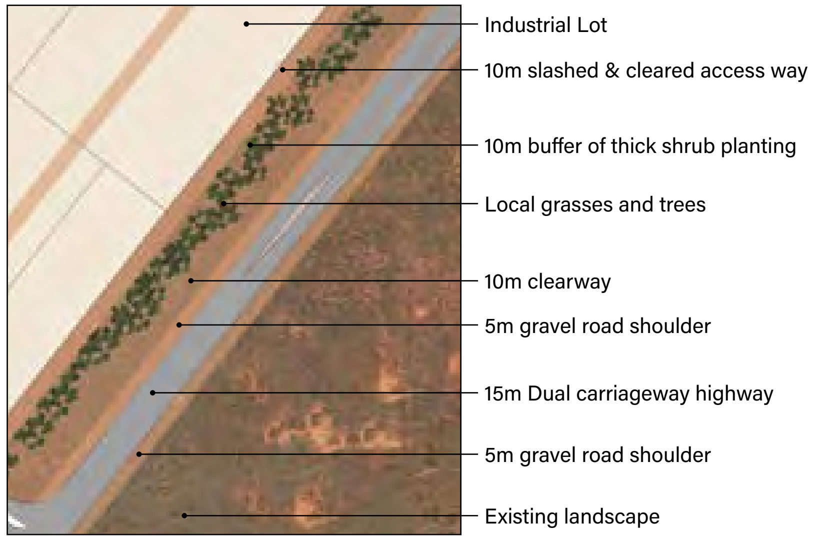


*Indicative images of planting selections



MAJOR ENTRY PLAN 1:5000 @A3



POWELL ROAD BUFFER STREET SCAPE PLAN 1:5000 @A3

WEDGEFIELD INDUSTRIAL ESTATE_STREETSCAPE

DevelopmentWA

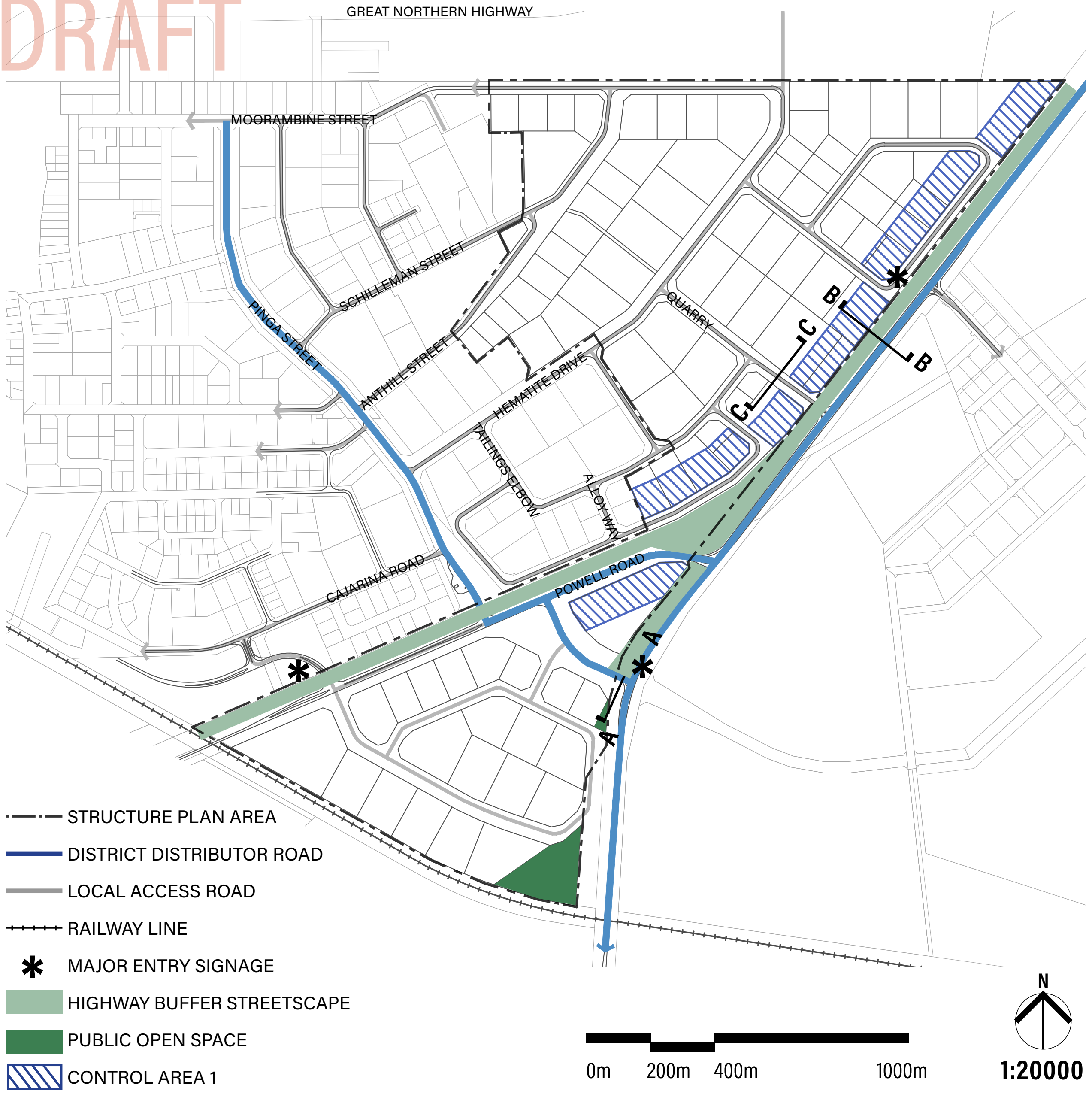
UDLA

Client: DevelopmentWA

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Draft report	V1	SSh	ATo	electronic	3 March 2020
Final report	V2	SSh	Rep	electronic	5 October 2023

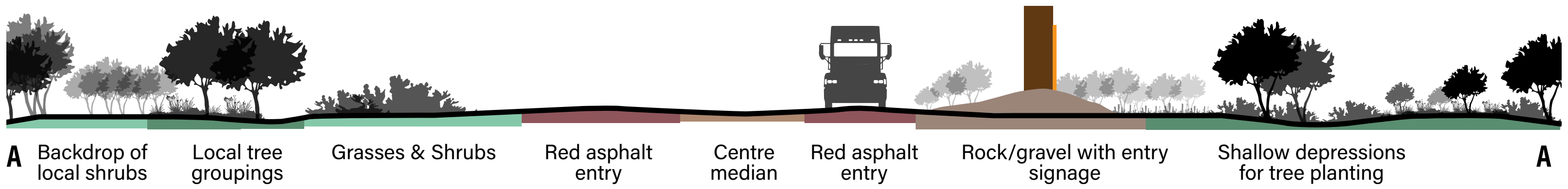
Urbaqua
land & water solutions
Suite 4/225 Carr Place, Leederville 6007
p: 08 9328 4663 | f: 08 6316 1431
e: info@urbaqua.org.au
www.urbaqua.org.au

APPENDIX G – LANDSCAPE MANGEMENT PLAN



- ·–·– STRUCTURE PLAN AREA
- ━ DISTRICT DISTRIBUTOR ROAD
- ━ LOCAL ACCESS ROAD
- +++++ RAILWAY LINE
- ✱ MAJOR ENTRY SIGNAGE
- 🟩 HIGHWAY BUFFER STREETSCAPE
- 🟩 PUBLIC OPEN SPACE
- ▨ CONTROL AREA 1

* All Landscape Buffers alongside road edges are managed by local authorities as appropriate.



MAJOR ENTRY ELEVATION 1:400 @A3

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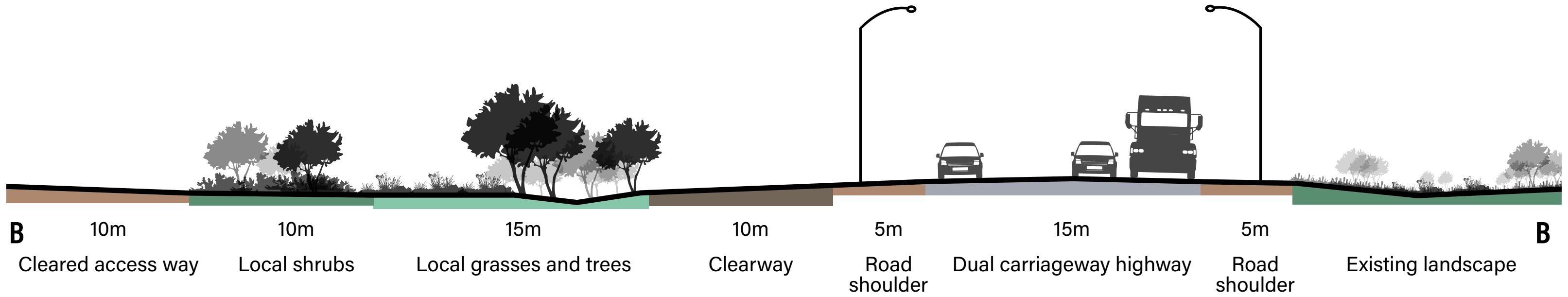

HIGHWAY BUFFER STREET SCAPE SECTION ELEVATION 1:400 @A3

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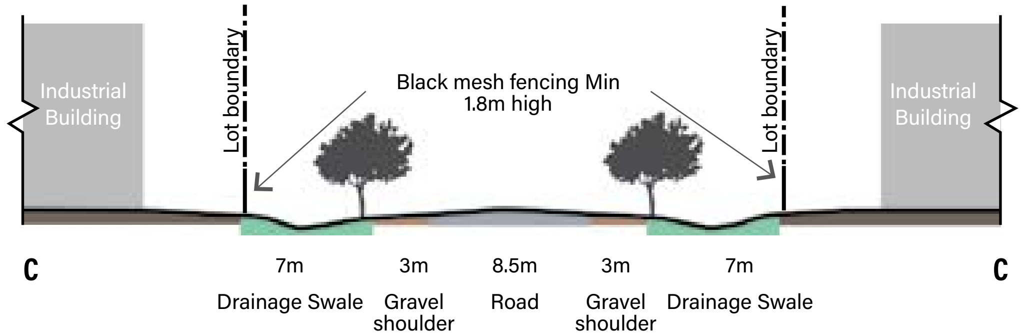

INTERNAL ROAD STREET SCAPE SECTION ELEVATION 1:400 @A3

A clean, low maintenance outcome with a simple swale system within the road reserve. Tree species may be used to identify different zones within the industrial area.

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- *Brachychiton diversifolius*
- *Corymbia deserticola*
- *Corymbia opaca*
- *Eucalyptus camaldulensis*
- *Eucalyptus flavescens*
- *Eucalyptus leucophloia*
- *Eucalyptus vitrix*
- *Melaleuca argentea*
- *Melaleuca leucadendra*

SHRUBS/GRASSES/GROUND-COVER

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- *Acacia coriacea*
- *Acacia wickhamii*
- *Atriplex semilunaris*
- *Canavalia rosea*
- *Crotalaria cunninghamii*
- *Enchylaena tomentosa*
- *Eremophila fraserii*
- *Eremophila maculata ssp brevifolia*
- *Ipomoea muelleri*
- *Plectrachne schinzii*
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- *Ptilotus exaltatus*
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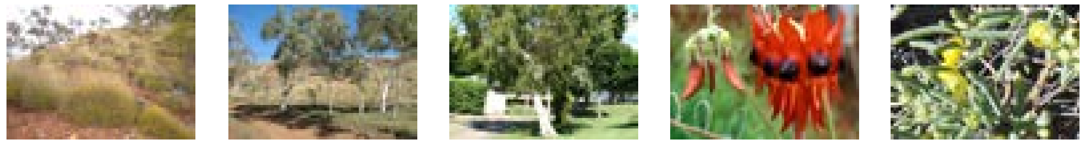
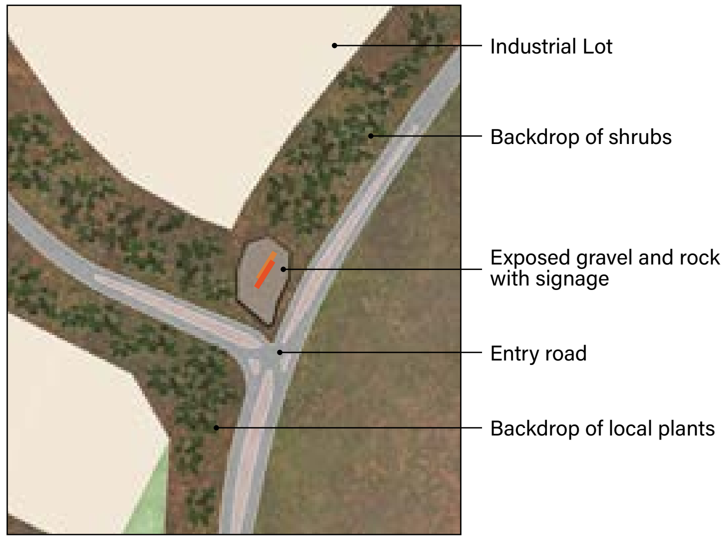
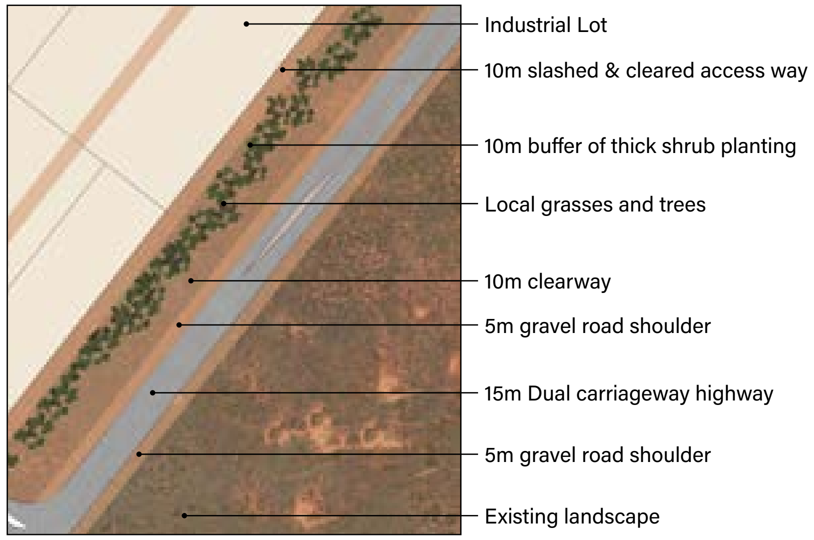
- *Spinifex longifolius*
- *Swainsona formosa*
- *Triodia epactia*
- *Triodia pungens*
- *Triodia wiseana*



*Indicative images of planting selections



MAJOR ENTRY PLAN 1:5000 @A3



POWELL ROAD BUFFER STREET SCAPE PLAN 1:5000 @A3

WEDGEFIELD INDUSTRIAL ESTATE_STREETSCAPE

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