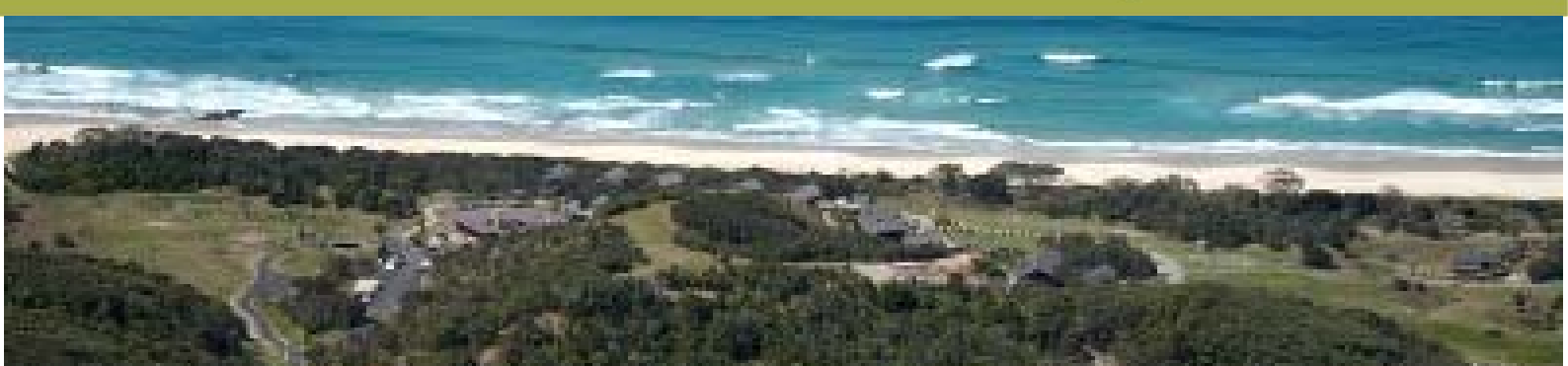
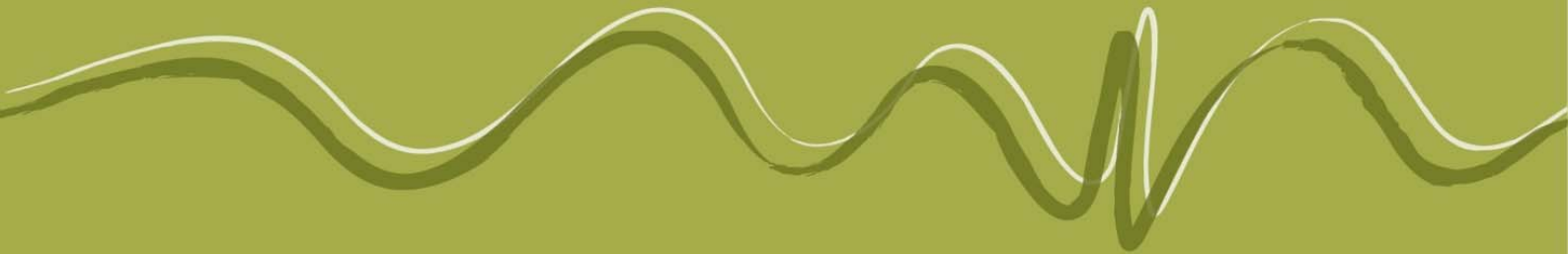


Engineering Assessment

Linnaeus Property Eco Tourism Mixed Use Proposal



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Appendix A Design Drawings



1. Introduction

1.1 Background

This Engineering Assessment Report has been prepared to accompany a development application (DA) prepared by Planners North to be lodged with Byron Shire Council (BSC) for a proposed low scale eco tourism mixed use proposal at the Linnaeus estate at the western side of 951 Broken Head Road, Lot 1 DP 1031848, Broken Head.

The proposed development includes a number of new tourist accommodation cabins, associated internal infrastructure upgrades and back-of-house facilities, supplementing existing educational facilities at the site.

1.2 Project Description

The proposed development involves retaining existing educational use of many of the existing buildings on the site and supplementing that use with new eco-tourist facilities. Existing internal infrastructure will be expanded upon to cater for the additional uses of the site.

Proposed new buildings include a total of 27 new accommodation units in a variety of forms. It is also proposed to increase the occupancy (per unit) of some of the existing education accommodation units. As a result, it is proposed to increase the total occupancy of the site from the existing approval for 112 occupants to a new total of 127 occupants.

The civil works will include:

- Upgrades and additions to internal road and path networks;
- Upgrades and additions to existing parking provisions;
- A new depot building and associated car park;
- Extension of existing water and sewerage reticulation systems;
- Earthworks to facilitate construction of the new buildings and infrastructure;
- Stormwater management works.

1.3 Structure and Scope

This report outlines the design requirements as per relevant standards and guidelines, discusses departures from the standards and describes the criteria employed in the final design.

- **Section 2** discusses the civil components of the project, including access, roads, paths, parking, earthworks and utility services.
- **Section 3** describes the management of stormwater on site, including erosion and sediment controls required during construction.
- **Section 4** provides an assessment of safety in design (SiD) including a risk assessment.

This report is to be read in conjunction with the DA submission for the proposal, in particular the Traffic Impact Assessment (TIA) and Water Supply & Wastewater Assessment, both prepared by GeoLINK to support the application.



2. Civil Works

2.1 Access

The existing access driveway connects the Linnaeus property to wider public road network via Byron Bay Road (MR545). The existing 'seagull' intersection arrangement on MR545 has been assessed as part of the TIA (GeoLINK, 2020) according to the Austroads warrants for turn treatment and safe intersection sight distance. The existing arrangement provides for traffic safety and efficiency for through traffic on MR545 considering a ten-year design horizon, traffic associated with the existing development, as well as expected development traffic generation, with ample capacity for much higher traffic volumes.

The TIA assesses access requirements for passenger cars and commercial vehicles up to and including a medium rigid vehicle. The assessment finds the existing seagull intersection on MR545 to adequately cater for the existing and generated traffic, with sufficient capacity for all projected traffic flows. The TIA also details the investigation regarding suitability of the site for commercial and emergency vehicles and finds the site to adequately cater for such vehicles for occasional deliveries and during emergency situations.

The existing access connection to MR545 also has enough width and length to meet the requirements of AS2890 for access. As a result, it is expected that the existing arrangement will continue to operate satisfactorily for traffic safety under the proposed development.

2.2 Roads

2.2.1 Layout

The internal road network consists of a number of existing sealed roads of non-uniform width. All existing and proposed roads have been designed to cater for one-way traffic while allowing passing at informal passing bays (sections of widened roadway). Passing is possible at nearly all locations due to the existing and proposed road design being at grade with flush edges.

Although the bulk of the development is within the north east portion of the site, approximately half of the parking provided for the development will be at the proposed depot building towards the south west of the property. Transport between the depot and the eco-tourism area will be via buggies (e.g. golf buggies), a fleet of which will be maintained on site for this purpose.

The existing layout includes several loops of sealed road and the proposed additional roads include two additional loops.

A proposed boardwalk (B1) will be accessible to pedestrians and some motorised vehicles, namely buggies and mobility scooters.

There is no discernible road hierarchy within the property, with all roads designed with minimal impact to the existing landscape.



2.2.2 Design Speed

As the site is wholly private property, there is no enforceable speed limit at the development. However, for the purposes of engineering analysis and design, the design speed is expected to be no more than 40 km/h.

2.2.3 Widths

Existing roads are of varying widths, generally 4.0m ranging from 3.0m minimum up to 6.0m on bends and to allow passing at intervals. As noted previously, passing is possible throughout the site given the flush edging and absence of table drains, swales, trees or other obstacles on at least one side of the road.

Given the existing and anticipate traffic expected to be low volume, this arrangement is considered satisfactory from an engineering and traffic safety perspective. The narrow roadways encourage low traffic speed within the site and the loop road offer alternatives routes in the event a section for roadway is temporarily impassable due to maintenance, for example. Further, the majority of staff and visitors will park at the proposed depot building, travelling to the central development area by golf buggies. Buggies have a lower speed and smaller dimensions compared to passenger vehicles, thus the narrow roadways are considered appropriate.

The road widths are also considered adequate for emergency vehicles such as fire trucks, given the abundance of opportunity for passing.

The B1 boardwalk is designed for use by pedestrians and buggies/mobility scooters only (i.e. no cars). Its 3.0 m width will allow for buggies to pass pedestrians. The paths providing access to each cabin will act as passing and turning bays for buggies.

2.2.4 Crossfall

Crossfall of the proposed roads is generally designed to be 3% and one way to suit stormwater management at the site. Sealed roads at 3% crossfall are considered to be the general standard to address safety, driveability and drainage.

2.2.5 Batters

Much of the site has been designed in close union with the existing topography and thus there are minimal sections of roadway requiring batters beyond 300mm. Where required, batters are generally as flat as possible for ease of maintenance (i.e. lawn mowing) and at a maximum of 1(V):4(H) at pinch points e.g. to avoid loss of vegetation, impact on services etc.

The exception is for the design of the treehouse boardwalk. Although this is not technically a road, it will be trafficked by buggies and mobility scooters. The first section of B1 will require relatively significant earthworks to climb the existing slope. To avoid extensive loss of vegetation and for ease of maintenance, retaining walls will be employed on either side of the boardwalk as required.

Beyond approximately chainage 60, the boardwalk has been designed to sit flush with the existing surface levels on the high side and be supported by posts on the low side.



2.2.6 Kerbing

The existing internal road network does not employ kerb, rather using flush edges to allow for easy drainage with an overland network and a minimal footprint.

The proposed additional roads will follow in the same way, with flush edges and no kerbs.

2.2.7 Alignment Geometry

The horizontal alignment of the proposed roads and paths has been designed in consultation with the project team, in particular the architects and environmental scientists. The road alignment and locations have been determined to best serve the proposed building locations, which in turn have been placed to minimise environmental impact and maximise amenity. The road design also required consultation with the bushfire consultant to ensure unimpeded access during a bushfire and to fit with the water supply design.

The geometry also took into consideration the optimal stormwater drainage flow paths.

Given the low design speed within the development, minimal traffic and primary design vehicle being a golf buggy, horizontal curves could be relatively tight, thus enabling minimal disturbance to identified areas of valuable vegetation.

In general, the design of the roads and paths fits closely with the existing geometry, thereby limiting earthworks and disturbance to existing vegetation and/or services. In most cases, the longitudinal grades are between 0.5% and 3% which is considered easily walkable and accessible while providing adequate drainage.

Exceptions include B1, the boardwalk accessing the treehouse cabins. The initial section of this path rises approximately 10 m from RL 20 mAHD to RL 30 mAHD. To achieve this while minimising environmental impact requires a longitudinal grade of 20% over nearly 60 m, including vertical curves at either end of the slope to ease into adjacent flat grades. Further along the boardwalk are two sections of 12.5%, each no more than 20 m in length. Elsewhere, the boardwalk is flat. Note that the boardwalk will have a slight crossfall to facilitate drainage, however the small gaps between boards will prevent puddles on the flat sections.

Where the B1 boardwalk meets a path accessing a cabin, the level of the boardwalk will match the level of the path. As such, there will be no step or slope up or down off the boardwalk when accessing the cabins.

A number of paths designated for non-vehicular access only will also require longitudinal geometry with steeper sections and steps as required. For example, the paths linking B1 to the central area will require some steps to safely navigate the height difference. The detailed design and further collaboration with the project architect will determine the location of steps, however the design aims to minimise the need for steps, thereby maximising accessibility.

2.2.8 Pavement and Surfacing

Pavement design for the proposed roads and pathways will be determined by the measured Californian Bearing Ratio (CBR) of the existing subgrade and has not yet been undertaken. However, it is anticipated that the new roads (R1, R2, R3) will comprise a 300mm pavement (150mm base and 150mm sub-base) with a two-coat bitumen seal. Alternatively, a 30mm asphalt seal may be deemed more appropriate with a longer life but higher construction cost.



2.3 Parking

2.3.1 Existing Car Parking

Existing parking is provided on site in a number of locations, including a single covered car parking space provided adjacent to each accommodation building, two spaces at the existing dwelling, three spaces near to maintenance sheds etc. and at least 49 parking spaces at the central community area. This totals a minimum of 66 parking spaces currently available on site.

The TIA has applied rates according to BSC's Development Control Plan (DCP) and communication with BSC, determining that 39 parking spaces are required to adequately provide for occupants, staff and the on-site manager. As such, there are currently a surplus of car parking provisions on site.

Existing car parking areas have been confirmed to comply with the relevant Australian Standards for dimensions and manoeuvrings commensurate to the intended use.

2.3.2 Proposed Car Parking

Applying the same rates agreed with BSC, it has been determined that the total number of parking spaces required to allow for the existing and proposed development is 99. This will accommodate the needs of residents, occupants associated with the educational facilities, occupants associated with the eco-tourism facilities, staff, the on-site manager and visitors. Further details including the calculations to determine the parking demand are provided in the TIA.

The proposed design includes an additional 45 parking spaces at the proposed new depot building. These parking spaces will primarily be staff and visitors to the site (demand totalling 48). Golf buggies will be kept on site and provided to transport employees and visitors between the depot and the main development area.

All existing and proposed car parking areas have been designed in accordance with the relevant Australian Standards (AS 2890).


2.3.3 Parking for People with Disabilities

According to BSC's DCP, at least one accessible parking space must be provided for 10% of units, rounded up to the nearest whole number. With 21 existing units and 27 proposed, a total of five accessible parking spaces will be required. With three accessible parking spaces already available, an additional two will be required (and are proposed) as part of the development.

2.4 Earthworks

Minimal earthworks are proposed in order to maintain the existing topography of the site, minimise environmental disturbance, avoid impacting existing services and allow for retention of the existing stormwater drainage flow paths.

However, minor earthworks will be required to facilitate construction of the proposed buildings and infrastructure. With regards to the proposed civil works, the majority of the proposal requires very little cut and/or fill. Where required, the design aims to match cut to fill allowing for a bulking factor, thus minimising the need to cart away spoil or import fill. It is noted that most of the roads and paths will generate a small quantity of cut material as it is intended to generally maintain existing surface levels.



It is anticipated that this material can be stockpiled on site for use during the construction of buildings, as required.

The most substantial earthworks associated with the proposal will be during construction of the first 60 m of the B1 boardwalk. As previously discussed, the boardwalk will be required to provide pedestrian and vehicular (golf buggy, motorised scooter etc.) access to the treehouse cabins, being approximately 10 m higher than the central road and car parking area. To minimise the footprint of disturbance, this section will include retaining walls on either side as required to span the height.

Minimal earthworks will be required for the remainder of this boardwalk, as it has been designed to sit generally flush with the existing surface on the high side and supported by posts on the low side.

Final earthworks volumes will be determined with better precision at the detailed design stage. However, it is expected that the civil works will result in no more than 100 m³ of spoil.

2.5 Retaining Walls

The retaining walls required to facilitate construction of the boardwalk accessing the treehouse cabins will be detailed at the detailed design phase of the development in conjunction with the project architect, structural engineer and geotechnical engineer. It is anticipated that the walls will be blockwork in construction with a decorative face where visible.

The retaining walls will be up to 2.0 m in height.

2.6 Bridges

The proposed road layout requires a short (15 m) bridge to span the existing stormwater flow gully at the north eastern corner of the site.

The bridge will be design by a suitably qualified engineer with geotechnical input at the detailed design phase of the development.


2.7 Utility Services

The design has been carried out within the constraints to minimise impact on existing utility services. For example, the design will require no power/light poles to be relocated. However, revised design surface levels may require the lids of some services to be raised and made flush with the finished surface.

Proposed utility services are discussed in the following subsections.

2.7.1 Water Supply

The existing water supply system at Linnaeus comprises a raw water dam, water treatment plant and a reticulation network to service interior plumbing, outdoor taps and fire hydrants. Details of the existing facilities and current operation are provided in the *Water Supply & Wastewater Assessment* report (GeoLINK, 2020), together with an assessment of the water supply demands of the proposed development.



The existing water supply recirculation system will be augmented to provide supply to all new buildings. It is likely that a boosted system will be required to take water up to the treehouse cabins, which will be sized and specified at the detailed design stage.

Several new hydrants will also be required to comply with bushfire and structural fire fighting requirements to ensure the existing and proposed structures can be adequately protected in case of fire. Each group of cabins will have access to a fire fighting water supply (hydrant) with suitable access by fire fighting vehicles in accordance with *Planning for Bush Fire Protection* (NSW RFS, 2019). All faces of new and existing structures will be reachable by fire hoses connected to the nearest hydrant.

The depot building, being some distance away from the remainder of the development will be supplied by a 50 kL tank. The tank will be fitted with a Storz fitting located at the northern end of the building, within 4 m of the adjacent reversing bay to comply with bushfire requirements.

Refer to the *Water Supply & Wastewater Assessment* report and design drawings for details of the proposed water supply system.

2.7.2 Sewerage

Similar to the water supply network, wastewater is captured and treated on site via a gravity sewage network draining to a pump station with a rising main to the wastewater treatment plant. Details of the existing facilities and current operation are provided in the *Water Supply & Wastewater Assessment* report (GeoLINK, 2020), together with an assessment of the wastewater generation expected from the proposed development. The report explains that the existing system is to be upgraded under a separate application. The assessment has found that if upgrade as proposed, there will be sufficient capacity in the system to accommodate and treat the additional wastewater flows.

The existing reticulation system will be augmented to collect wastewater from all proposed buildings. The preliminary design has been undertaken in accordance with the Water Association of Australia specifications. Further details including longitudinal sections of each proposed line will be provided at the detailed design phase.

Once again, since the depot building is a substantial distance from the remainder of the development, it is intended that wastewater generated by the facilities at the depot will be captured and treated via a standalone system. There is ample suitable land available to accommodate the associated land application (disposal) area, which will be detailed at the next stage of the development.

Refer to the *Water Supply & Wastewater Assessment* report and design drawings for details of the proposed sewerage system.

2.7.3 Electricity and Communications

Existing electricity and communications infrastructure will be assessed at the detailed design stage of the development to determine if there is sufficient capacity within the existing mains to service the additional demand.

All proposed electricity and communications infrastructure, aside from transformers, pillar boxes and distribution hubs will be installed underground.



3. Stormwater Management

3.1 Existing Stormwater Network

The current stormwater system within the development area comprises open swale drains of varying dimensions, a small pit and pipe network providing drainage of the existing main car parking area adjacent to the centre CB.01 building, and a culvert linking one open drain to another.

3.2 Proposed Stormwater Management

The existing and proposed stormwater networks are shown in the design plans, attached. As is currently the case, the majority of the stormwater flows for both the minor and major storm events are to stay aboveground. The philosophy embraced for the stormwater management at the site is to match the existing conditions as best as possible. This has been made possible by the proposed design including roads and paths matching the existing topography, cabins designed 'on stilts' allowing for flow underneath the buildings, and an overall minimal use of hardstand areas.

Rainwater harvesting will be used wherever possible, collecting roof water rather than allowing it to generate runoff. In larger or longer storm events, overflow from rainwater tanks will be directed to basic constructed gravel pits, encouraging as much flow as possible to infiltrate.

The existing network of open swale drains will be expanded to fit the proposed works and design to ensure stormwater flow has a minimal impact on the amenity, usability and integrity of the infrastructure. For example, a small table drain is proposed on the high side of the loop road R1, preventing the majority of stormwater from crossing the road surface. Some small culverts will be required, as per the design plans to direct the flows around the proposed development and into the main overflow gully central to the site.

The central gully along with the other open swale drains will be vegetated to provide water quality treatment during the flow of stormwater through the site. Given the nature of the development, in particular the use of electric buggies rather than petrol vehicles will likely result in a relatively low volume of pollutants entering the stormwater treatment train from the road network.

The stormwater discharge location remains the same, at the north eastern corner of the property.

3.2.1 Hydrology and Hydraulic Assessment

Given the minimal impact on the existing hydrology of the site expected as a result of the proposal, a hydraulic assessment has not been carried out.



4. Safety in Design

4.1 SiD Introduction

Consideration of work health and safety (WHS) issues in the design stage of a construction project has been identified as essential for improved WHS outcomes. As outlined by Safe Work Australia (2014):

“A designer must provide a written report to the person conducting a business or undertaking who commissioned the design that specifies the hazards relating to the design of the structure that, so far as the designer is reasonably aware:

- *create a risk to persons who are to carry out the construction work, and*
- *are associated only with the particular design and not with other designs of the same type of structure.”*

The purpose of this Safety in Design (SiD) section is to highlight safety issues that would not be expected to occur in the design of a standard civil works project. It is also noted that this SiD contains recommendations only and its existence does not alter or remove any responsibility associated with site safety from the constructor and their workforce undertaking the construction and or maintenance works.

The following references have been used:

- Australian Federal Government, (2011). Work Health and Safety Act 2011.
- Australian Federal Government, (2011). Work Health and Safety Regulations 2011.
- Safe Work Australia, (2014). Safe design of structures code of practice, July 2014.

4.2 Design Elements

The project description is provided in **Section 1.2**. Design plans are provided in **Appendix A**.

4.3 Specific Features Unique to the Design

A risk assessment register has been developed for elements unique to the design which have been identified as having unusual or atypical features that present potential safety hazard and risk during the construction phase. These elements include:

1. Proximity to operational roadway.
2. Restricted access due to environmental constraints.
3. Proximity to underground or overhead services.
4. Staging and coordination with other works (e.g. building works).

4.4 Risk Assessment

Refer to **Table 4.1** for the assessed risk rating, proposed control measures, and residual risk rating for the unique design elements identified above. The tool used to assess the risks of the design features are presented in **Table 4.2**.

Table 4.1 Design Risk Assessment

Task Relating to Hazard	Hazard Causes	Persons Affected	Possible Hazard Consequence	Risk Rating	Control Measures and Actions	Persons Responsible	Residual Risk Rating
Vehicles and persons (workers/ visitors) working near active road	<ul style="list-style-type: none"> Proximity of works to adjacent road 	Workers Site visitors	<ul style="list-style-type: none"> Collision involving construction vehicle and another vehicle or pedestrian Persons being struck by vehicle 	19	<ul style="list-style-type: none"> Site specific TCP to be implemented for works on roads, especially in public road reserve, including provision for cyclists and pedestrians. All Workcover and WHS guidelines to be implemented on site. Clear communication with other contractors to ensure works are coordinated. Adhere to road rules. 	Contractor	11
Lifting and positioning of construction components by heavy machinery (cranes etc.)	<ul style="list-style-type: none"> Restricted access due to environmental constraints Incorrect handling; crane or sling failures 	Workers Site visitors	<ul style="list-style-type: none"> Possible causes result in heavy components being dropped or vehicle overturn 	19	<ul style="list-style-type: none"> Works to be planned to allow for adequate traffic management to be implemented, including any temporary road closures required for installation of heavy components. All WorkCover and WHS Task guidelines to be implemented onsite. Site specific TCP to be implemented. 	Contractor	6
			<p><i>Note that it is the Principal Contractor's responsibility to ensure that site materials are delivered, transported, stored and positioned in a safe manner and in accordance with the product specification, the site-specific safety plan and general safety regulations, and to ensure that the workers are suitably qualified, trained and insured for the tasks being undertaken.</i></p>				

Task Relating to Hazard	Hazard Causes	Persons Affected	Possible Hazard Consequence	Risk Rating	Control Measures and Actions	Persons Responsible	Residual Risk Rating
Traversing batter slopes by mobile plant	<ul style="list-style-type: none"> ▪ Restricted access due to environmental constraints ▪ Steep grades ▪ Plant operators not appropriately licenced/ trained 	Plant operators	<ul style="list-style-type: none"> ▪ Construction vehicles rolling when carrying out works on batters 	15	<ul style="list-style-type: none"> ▪ The Principal Contractor shall ensure all work on slopes is carried out in a safe manner, utilising specialised equipment as required. ▪ The Principal Contractor shall ensure that plant operators and workers are suitably qualified, trained and insured for the tasks being undertaken. 	Contractor	6
Working near underground services (other than electrical)	<ul style="list-style-type: none"> ▪ Excavation for underground services 	Plant operators and workers	<ul style="list-style-type: none"> ▪ Hitting underground services during excavation resulting in possible serious harm/ death to workers 	20	<ul style="list-style-type: none"> ▪ Principal Contractor to verify and, if required, conduct further searches to accurately locate underground and above ground services prior to construction. ▪ Principal Contractor to Undertake a <i>Dial Before You Dig</i> search prior to commencement of works. ▪ Use a cable locator to identify exact location of underground services, if required. 	Contractor	1
Working near underground electrical services	<ul style="list-style-type: none"> ▪ Excavation for underground services 	Plant operators and workers	<ul style="list-style-type: none"> ▪ Contact with live electrical wires during excavation resulting in possible serious harm/ death to workers 	20	<ul style="list-style-type: none"> ▪ Principal Contractor to accurately locate underground electrical services prior to construction. ▪ Undertake a <i>Dial Before You Dig</i> search and use a cable locator if necessary. ▪ Electricity to be disconnected by licenced tradesperson. 	Contractor	6
Working near overhead electrical services	<ul style="list-style-type: none"> ▪ Plant or vehicles making contact with o/h powerlines 	Plant operators and workers	<ul style="list-style-type: none"> ▪ Contact with live electrical wires resulting in possible serious harm/ death to workers 	14	<ul style="list-style-type: none"> ▪ Existing o/h power lines to be marked with on-ground markers and flagging 	Contractor	6

Table 4.2 Risk Tool
Hierarchy of Controls

Highest Level of Control			Lowest Level of Control	
Elimination	Substitution	Engineering	Administration	Personal Protective Equipment

Step 1 – Determine Consequence (Impact) (C)

Consequence (Impact) Table		
Impact band	Health & Safety	
Substantial (5)	Fatal Incident (Class 1)	
Major (4)	Permanent Injury (Class 1)	Damage, which permanently alters a person's future (e.g. quadriplegia, paraplegia, amputation of a limb).
Moderate (3)	Lost Time Injury (Class 2)	Damage, which temporarily alters a person's future.
Minor (2)	Medical Treatment (Class 2)	Damage, which temporarily inconveniences a person
Negligible (1)	First Aid Treatment (Class 3)	Actual injury which requires no treatment or simple first aid

Step 2 – Determine Probability (Likelihood) of Event Occurring (P)

Probability (Likelihood) Table			
Probability band	Description		
Almost Certain (5)	The threat can be expected to occur 75% - 99%	Common / Frequent Occurrence	More than 1 event per month
Likely (4)	The threat will quite commonly occur 50% - 75%	Is known to occur or "It has happened regularly"	More than 1 event per year
Possible (3)	The threat may occur occasionally 25% - 50%	Could occur or "heard of it happening"	1 event per 1 to 10 years
Unlikely (2)	The threat could infrequently occur 10% - 25%	Not likely to occur very often	1 event per 10 to 100 years
Rare (1)	Threat may occur in exceptional circumstances 0% - 10%	Conceivable but only in exceptional circumstances	Less than 1 event per 100 years

Step 3 – Assess Risk Level (R) Determine the risk rating by combining Consequence with Probability

Risk Assessment Matrix		Consequence (Impact) Table				
		Negligible (1)	Minor (2)	Moderate (3)	Major (4)	Substantial (5)
Probability (Likelihood)	Almost Certain (5)	Low (5)	Moderate (10)	Very High (18)	Extreme (23)	Extreme (25)
	Likely (4)	Low (4)	Moderate (9)	Very High (17)	Very High (20)	Extreme (24)
	Possible (3)	Low (3)	Moderate (8)	High (13)	Very High (19)	Very High (22)
	Unlikely (2)	Low (2)	Low (7)	High (12)	High (15)	Very High (21)
	Rare (1)	Low (1)	Low (6)	Moderate (11)	High (14)	High (16)



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Topographic information presented on the drawings is suitable only for the purpose of the document as stated above. No reliance should be placed upon topographic information contained in this report for any purpose other than that stated above.



Appendix A

Design Drawings

Linnaeus Property Eco Tourism Mixed Use Proposal



Source: Broken Head Coastal Foundation

Civil engineering drawing register

C000	Cover and Drawing Register
C001	Overall Site Layout Plan
C002	Precinct B - Depot and Car Park
C003	Precinct A - Overall Plan
C004	Precinct A - Sheet 1 of 3
C005	Precinct A - Sheet 2 of 3
C006	Precinct A - Sheet 3 of 3
C010	Boardwalk B1 Longitudinal Section
C011	Boardwalk B1 Cross Sections
C012	Roads R1 and R2 Longitudinal Sections
C013	Road R1 Cross Sections
C014	Road R2 Cross Sections
C020	Water and Sewerage Layout Plan
C030	Stormwater Management Plan
C040	ERSED Control Typical Details and Notes

Rev/	Description	Amendments				
		Date	Des.	App.	CHK.	
C	Additional hydrants	28/01/2021	MVE	MVE	MVE	
B	Additional refuge building and paths	15/09/2020	MVE	MVE	MVE	
A	Location of existing services revised	31/07/2020	MVE	MVE	MVE	

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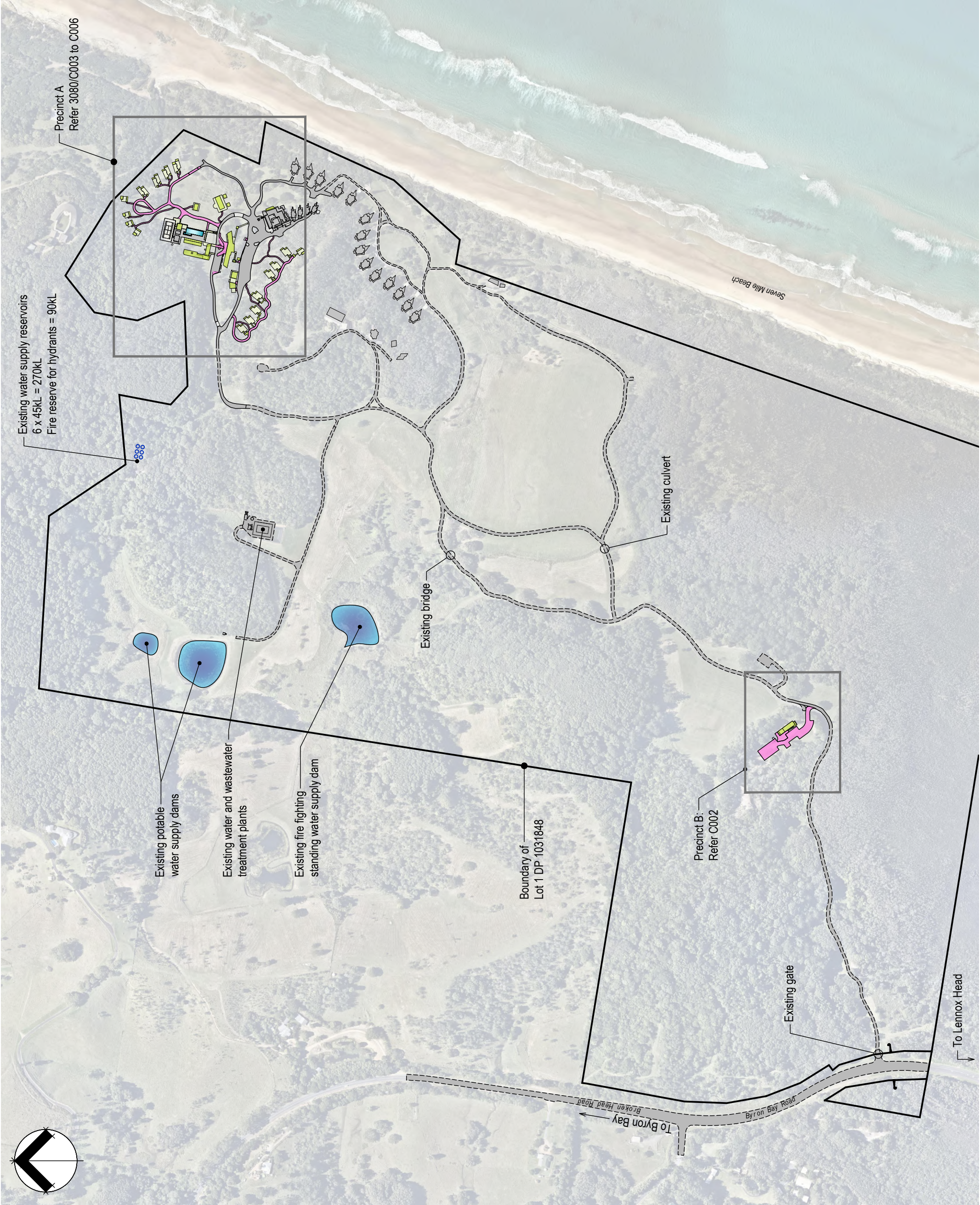
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Project Title
Linnaeus - Ecotourism Development

Client			
Linnaeus Property Pty Ltd			
Designed	MVE	Drawn	MVE
		Checked	
Approved	MVE	Date	29/05/2020
XREFs		JLC	
Scale			
metres			

Drawing Title
Cover Sheet and
Drawing Register
3080-1068
Drawing Number
3080/C000
Revision
C



LEGEND

Existing building

Existing asphalt road

Proposed building

Proposed road / path

Rev./Description	Date	Des.	App.	Chk.	Amendments	
C Additional hydrants	28/01/2021	MVE	MVE	MVE		
B Additional refuge building and paths	15/09/2020	MVE	MVE	MVE		
A Location of existing services revised	31/07/2020	MVE	MVE	MVE		

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Project Title
Linnaeus - Ecotourism Development

Client Linnaeus Property Pty Ltd				
Designed	MVE	Drawn	MVE	Checked JLC
		Approved	MVE	
XREFs		Date	29/05/2020	
Scale				
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Drawing Title
Overall Layout Plan

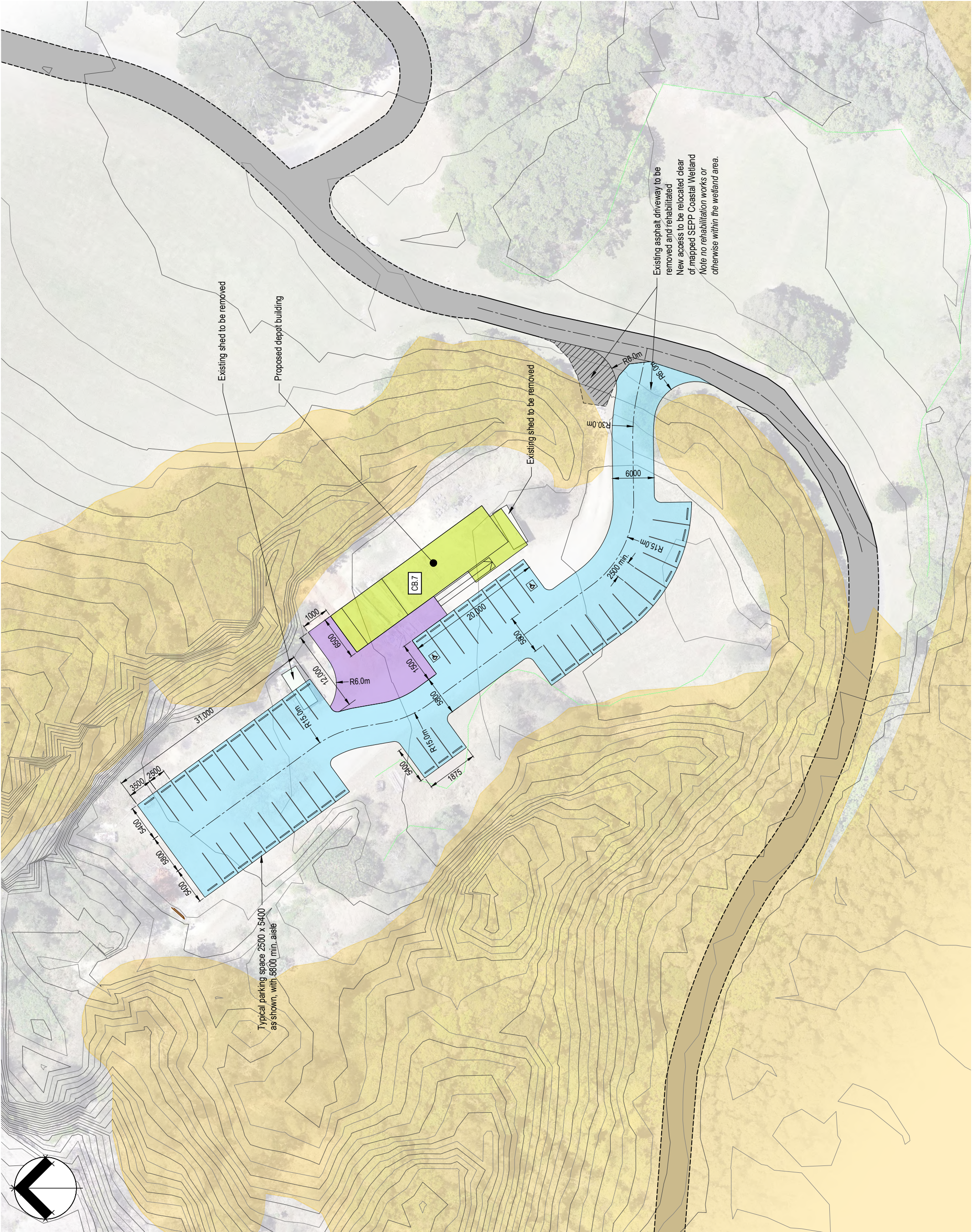
3080-1068

Drawing Number

3080/C001

Revision

C



- LEGEND
- Existing asphalt road
 - Existing asphalt to be removed
 - Mapped SEPP Coastal Wetland
 - Surveyed edge of vegetation
 - Proposed building
 - Proposed asphalt road car park
 - Proposed concrete hardstand
 - Existing site contours shown at 0.5m intervals

- NOTES
- All dimensions in millimetres uno.
 - Buildings as per architectural design plans
 - Approximate edge of existing sealed road outside extent of surveyed area shown dashed.
 - All car parking, including line markings and dimensions to be in accordance with AS 2890.1.
 - Accessible parking bays to be provided where shown and in accordance with AS 2890.6.
 - Wheelstops to be provided as per AS 2890.1.
 - Proposed 50KL static water supply to provide water supply and fire fighting service to the depot building. Tank to include Storz fitting as required by *Planning for Bush Fire Protection 2019*, located at northern end of building within 4.0m of reversing bay.

Rev/Description	Date	Des. App. Ckng.	Amendments		
C Additional hydrants	28/01/2021	MVE	MVE	MVE	
B Additional refuge building and paths	15/09/2020	MVE	MVE	MVE	
A Location of existing services revised	31/07/2020	MVE	MVE	MVE	

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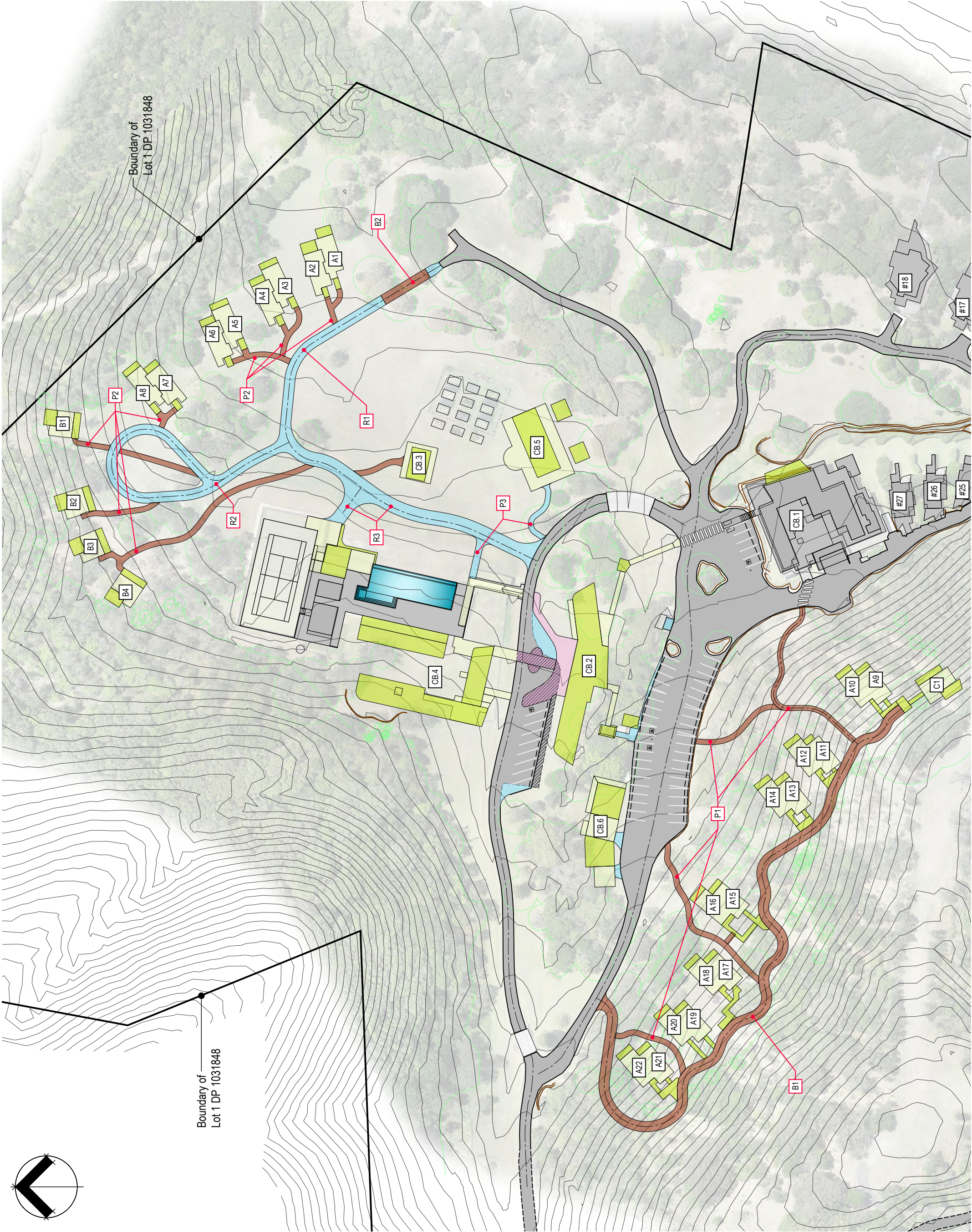
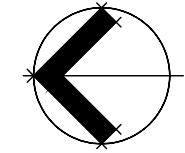
Email: info@geolink.net.au

Project Title
Linnaeus - Ecotourism Development

.....	Designed		
	Approved		
	XREFs		
	Scale		

Drawing Title
Precinct B
Depot and Car Park

3080-1068
Drawing Number
3080/C002
Revision
C



- LEGEND
- Existing building
 - Existing asphalt road
 - Existing asphalt road to be removed
 - Surveyed tree / edge of vegetation
 - Proposed building / walkway
 - Proposed asphalt road
 - Proposed paved/concrete area
 - Proposed path / raised boardwalk
 - Existing site contours shown at 1.0m intervals

NOTES

- All roads designated **RX** (e.g. R1, R2, R3). Roads to be trafficable by motor vehicles, such as passenger and service vehicles, as well as pedestrians, buggies and mobility scooters. **R1** and **R2** to be 3.0m wide min. with sealed surface. **R3** road and driveway to be 4.0m wide.
- All paths designated **PX** (e.g. P1, P2, P3). Paths to be 1.5-2.0m in width and used by pedestrians only.
- Boardwalk **B1** to be 3.0m wide and trafficable by pedestrians and buggies / mobility scooters.
- Bridge **B2** to be 3.0m wide min. and trafficable by motor vehicles, such as passenger and service vehicles, as well as pedestrians, buggies and mobility scooters.

Rev./Description	Amendments			
	Date	Des.	App.	Chk.
C Additional hydrants	28/01/2021	MVE	MVE	MVE
B Additional refuge building and paths	15/09/2020	MVE	MVE	MVE
A Location of existing services revised	31/07/2020	MVE	MVE	MVE

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Project Title
Linnaeus - Ecotourism Development

Client Linnaeus Property Pty Ltd			
Designed	MVE	Drawn	MVE
Approved	MVE	Date	29/05/2020
XREFs		JLC	
Scale			

metres 0 5 10 15 20 25

Drawing Title
**Precinct A
Overall Plan**

Drawing Number
3080/C003

Revision
C



LEGEND

Existing building

Existing asphalt road

- NOTES
1.

All dimensions in millimetres uno.
2.

Buildings as per architectural design plans.
3.

Refer to C005 for car park details
4.

Refer to C010 for boardwalk B1 longitudinal section and C011 for cross sections.
5.

Extent of works subject to detailed design.
6.

Ch 0 to Ch 60 of boardwalk B1 to be construction with retaining walls as required in cut, and on posts where design levels are above the natural surface. The remainder of the boardwalk will be constructed as a raised boardwalk with posts and handrails on the low side. Refer cross sections.
7.

Retaining walls to be vertical blockwork with decorative face, or as per architect and structural engineering details.
7.

Paths P1 to be 1.5m wide min. bitumen and/or concrete with steps, landings and handrails as required to satisfy relevant guidelines e.g. Austroads Guide to Road Design Part 6A.
8.

Boardwalk B1 designed for use by pedestrians and buggies/mobility scooters. No access by passenger/service vehicles. Turning to be undertaken using level paths to cabins.

Rev.	Description	Date	Des.	App.	Chk.
C	Additional hydrants	28/01/2021	MVE	MVE	MVE
B	Additional refuge building and paths	15/09/2020	MVE	MVE	MVE
A	Location of existing services revised	31/07/2020	MVE	MVE	MVE

Amendments

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Project Title

Linnaeus - Ecotourism Development

Client

Linnaeus Property Pty Ltd

Designed

MVE

Drawn

MVE

Checked

JLC

Approved

MVE

Date

29/05/2020

XREFs

Scale

metres

0

2

4

6

8

10



- LEGEND
- Existing building
 - Existing asphalt road
 - Existing asphalt to be removed
 - Surveyed tree / edge of vegetation
 - Proposed building / walkway
 - Proposed sealed road / path
 - Proposed paved area
 - Proposed path / raised boardwalk
 - Existing site contours shown at 0.5m intervals

NOTES

- All dimensions in millimetres uno.
- Buildings as per architectural design plans
- All car parking, including line markings and dimensions to be in accordance with AS 2890.1.
- Accessible parking bays to be provided where shown and in accordance with AS 2890.6.
- Wheelstops to be provided as per AS 2890.1.
- Pedestrian crossings to be provided as shown in general accordance with AS 1745.10.
- Paths P1 to be 1.5m wide min. bitumen and/or concrete with steps, landings and handrails as required to satisfy relevant guidelines e.g. Austroads Guide to Road Design Part 6A.
- Path P3 to be 1.5m wide min. concrete with grades < 3%.
- Boardwalk B1 designed for use by pedestrians and buggies/mobility scooters. No access by passenger/service vehicles. Turning to be undertaken using level paths to cabins.

Rev.	Description	Date	Des.	App.	Chk.
C	Additional hydrants	28/01/2021	MVE	MVE	MVE
B	Additional refuge building and paths	15/09/2020	MVE	MVE	MVE
A	Location of existing services revised	31/07/2020	MVE	MVE	MVE
Rev.	Description	Date	Des.	App.	Chk.

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Project Title
Linnaeus - Ecotourism Development

Client	Linnaeus Property Pty Ltd				
	Designed	MVE	Drawn	MVE	Checked
	Approved	MVE	Date	29/05/2020	JLC
	XRERs				
	Scale				

metres

0246810

metres 0 2 4 6 8 10

Drawing Title
Precinct A
Sheet 2 of 3
3080-1068
Drawing Number
3080/C005
Revision
C

- LEGEND**
- Existing building
 - Existing asphalt road
 - Surveyed tree / edge of vegetation
 - Proposed building
 - Proposed sealed road
 - Proposed raised boardwalk
 - Approx. limit of R1, R2 and R3 works
 - Existing site contours shown at 0.5m intervals

NOTES

- All dimensions in millimetres uno.
- Buildings as per architectural design plans.
- Extent of works subject to detailed design.
- Roads R1 and R2 to be 3.0m min. sealed width. Refer to C012 for road R2 and R3 longitudinal section including vertical and horizontal geometry, and C013-014 for cross sections.
- Driveway R3 to be 4.0m wide and sealed to provide buggy and utility access.
- Bridge B2 to be detailed at next design stage in conjunction with structural and geotechnical engineering assessment and architect's plans.
- Paths P2 to be 1.5m wide min. timber boardwalk. Grades to avoid steps where possible, however some steps to access cabins B1 to B4 may be needed.
- Path P3 to be 1.5m wide min. concrete with grades < 3%.

Rev./Description	Date	Des.	App.	Chk.	Amendments	
C Additional hydrants	28/01/2021	MVE	MVE	MVE		
B Additional refuge building and paths	15/09/2020	MVE	MVE	MVE		
A Location of existing services revised	31/07/2020	MVE	MVE	MVE		

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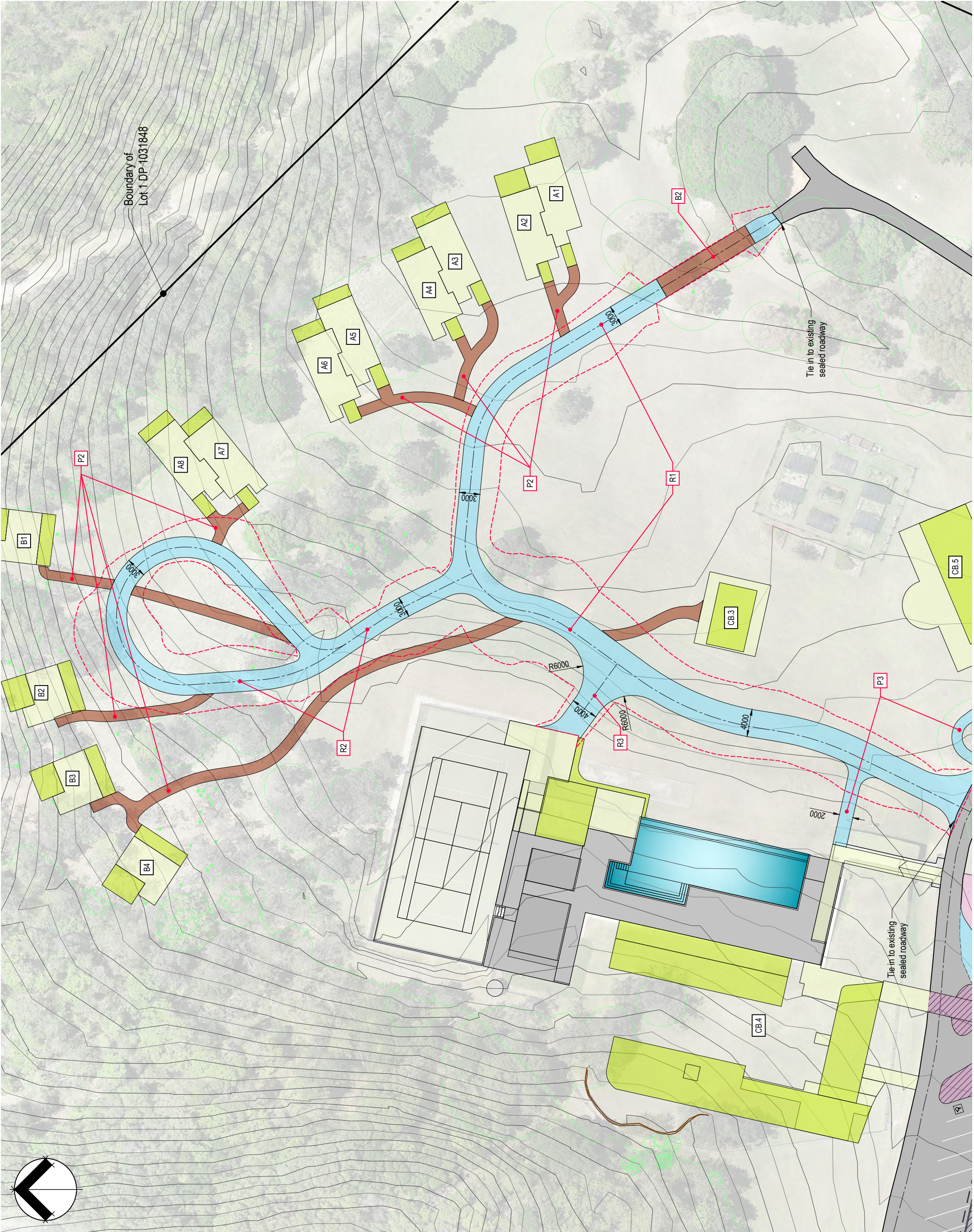
Linnaeus - Ecotourism Development

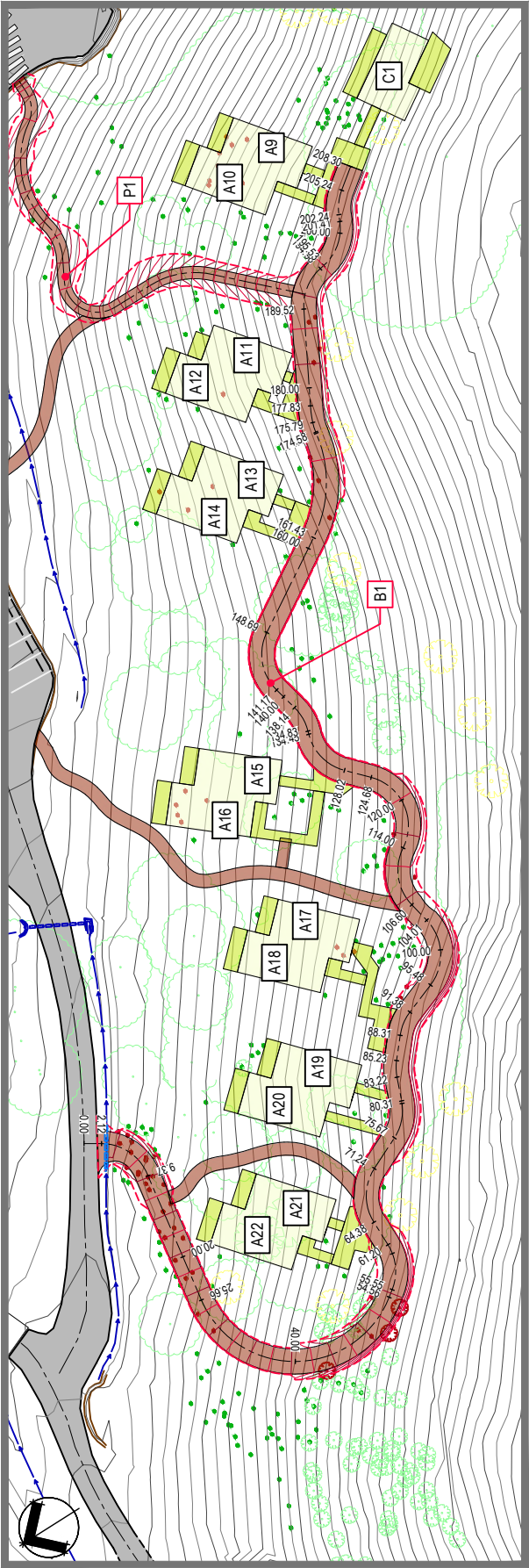
Linnaeus Property Pty Ltd			
Client			
Designed	MVE	Drawn	MVE
Approved	MVE	Date	29/05/2020
XREFs		JLC	
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Drawing Title
Precinct A
Sheet 3 of 3

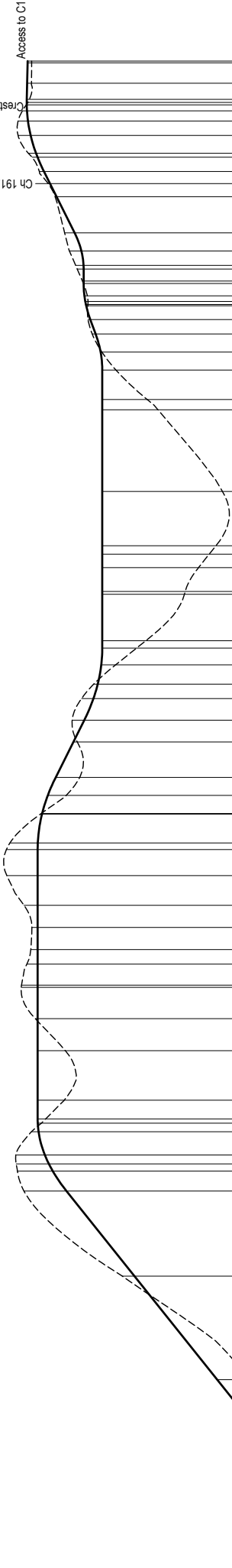
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3080-1068

Revision
C





Ch 191.326 Intersection with Path P1
Crest Ch 202.575 RL 30.829



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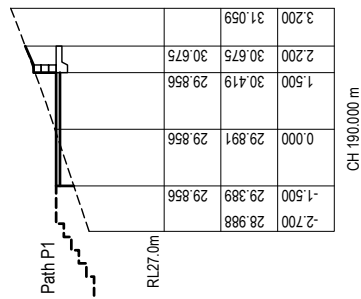
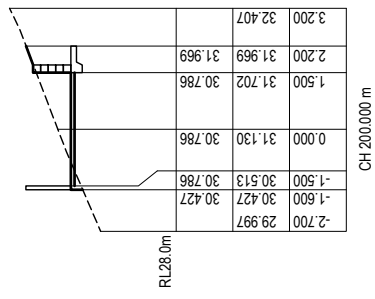
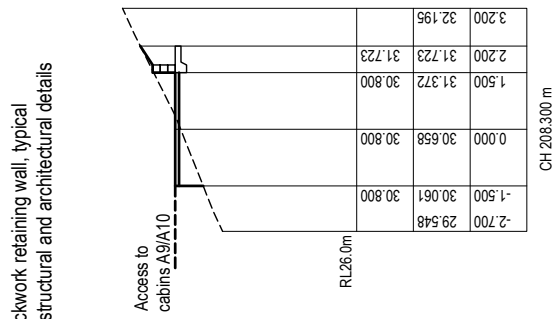
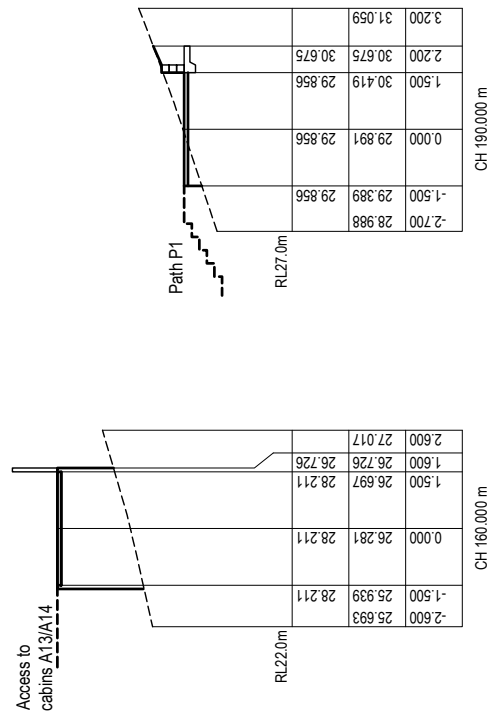
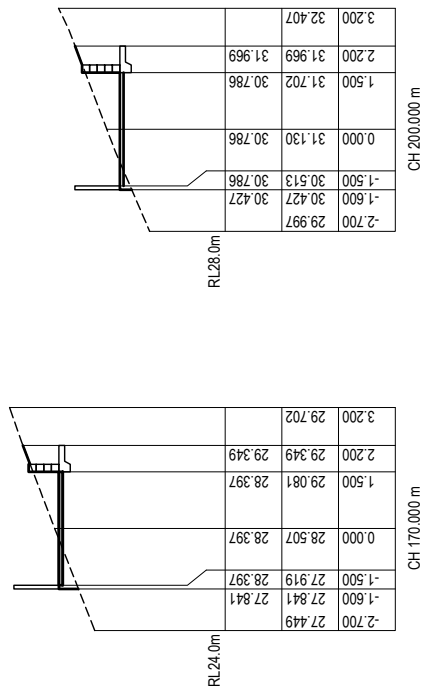
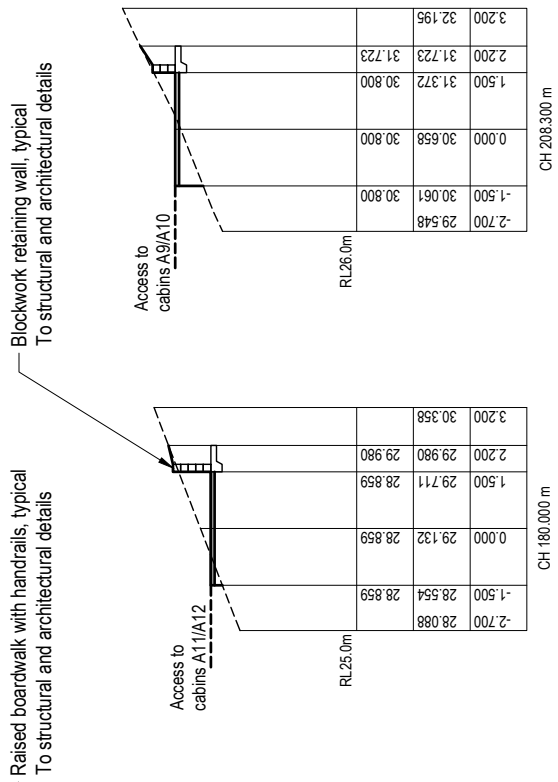
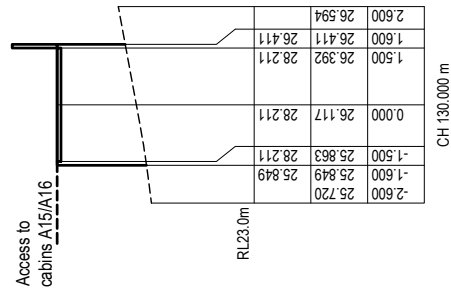
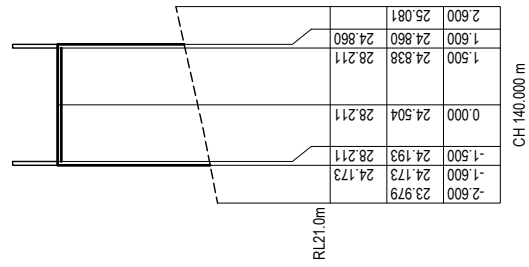
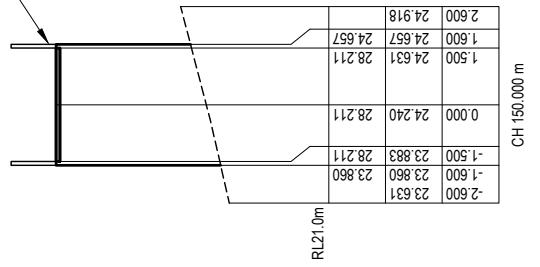
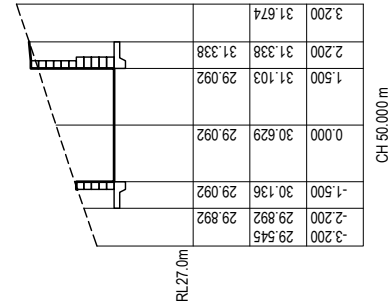
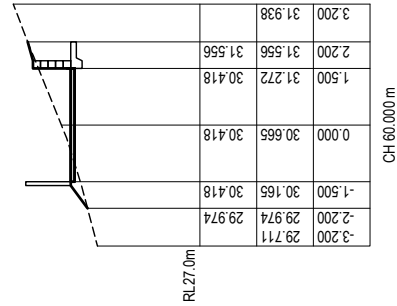
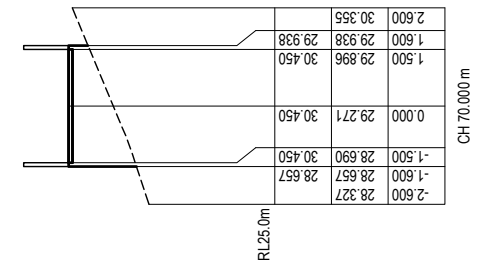
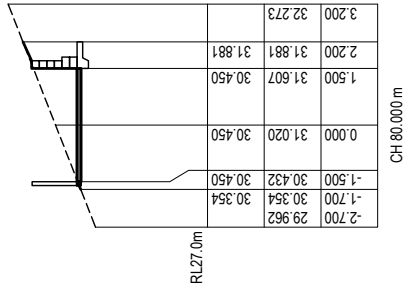
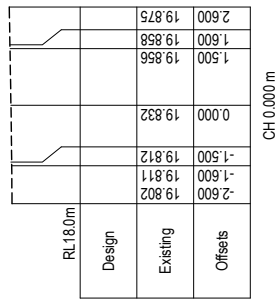
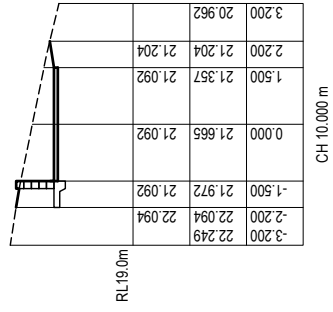
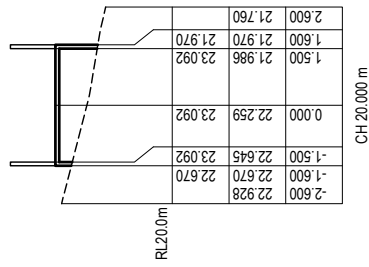
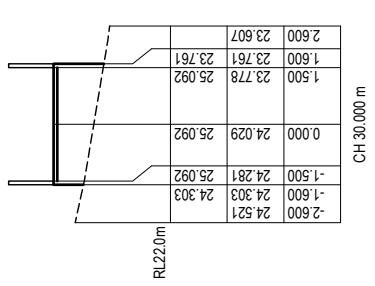
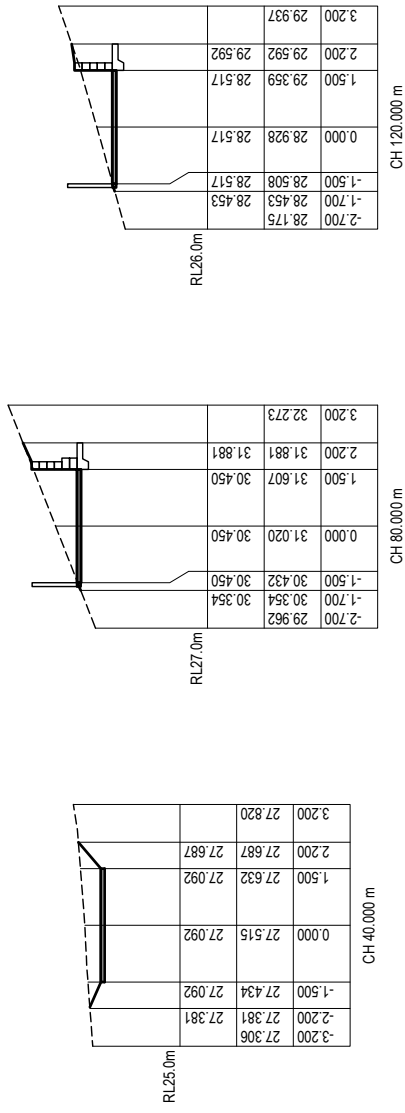
Revisions		Amendments	
Rev.	Description	Date	Des. App. Ck.
C	Additional hydrants	28/01/2021	MVE MVE
B	Additional refuge building and paths	15/09/2020	MVE MVE
A	Location of existing services revised	31/07/2020	MVE MVE

Project Title		Client	
Linnaeus - Ecotourism Development		Linnaeus Property Pty Ltd	
Designed	MVE	Drawn	MVE
Approved	MVE	Date	29/05/2020
XREFs		Checked	
		JLC	
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		Vertical	
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Vertical			

Boardwalk B1
Longitudinal Section

3080-1068
Drawing Number
Revision

3080/C010 C



Rev	Description	Date	Des.	App.	Chk.	Amendments
C	Additional hydrants	28/01/2021	MVE	MVE	MVE	
B	Additional refuge building and paths	15/09/2020	MVE	MVE	MVE	
A	Location of existing services revised	31/07/2020	MVE	MVE	MVE	

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Project Title

Client		Linnaeus Property Pty Ltd				
Designed	MWE	Drawn	MWE	Checked		
Approved	MWE	Date	29/05/2020	JLC		
XREF's						
Scale						
metres						
0 1 2 3 4 5						

Drawing Title

Boardwalk B1

Cross Sections

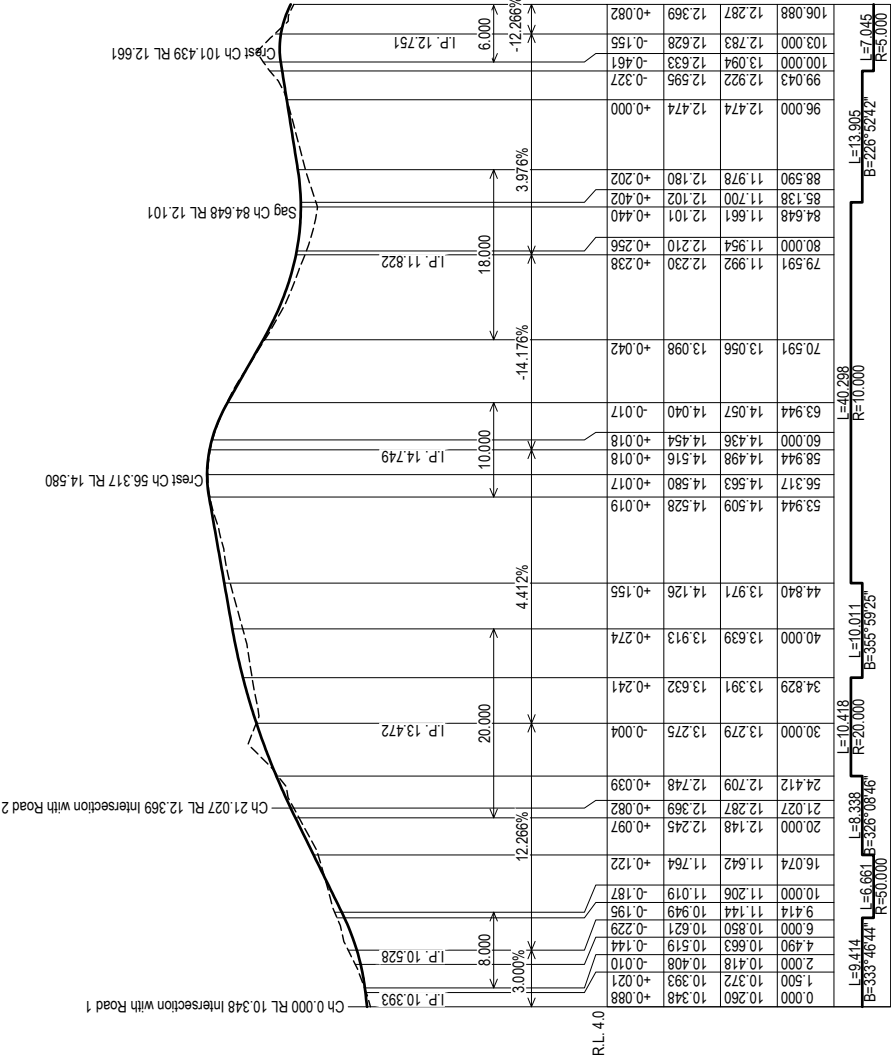
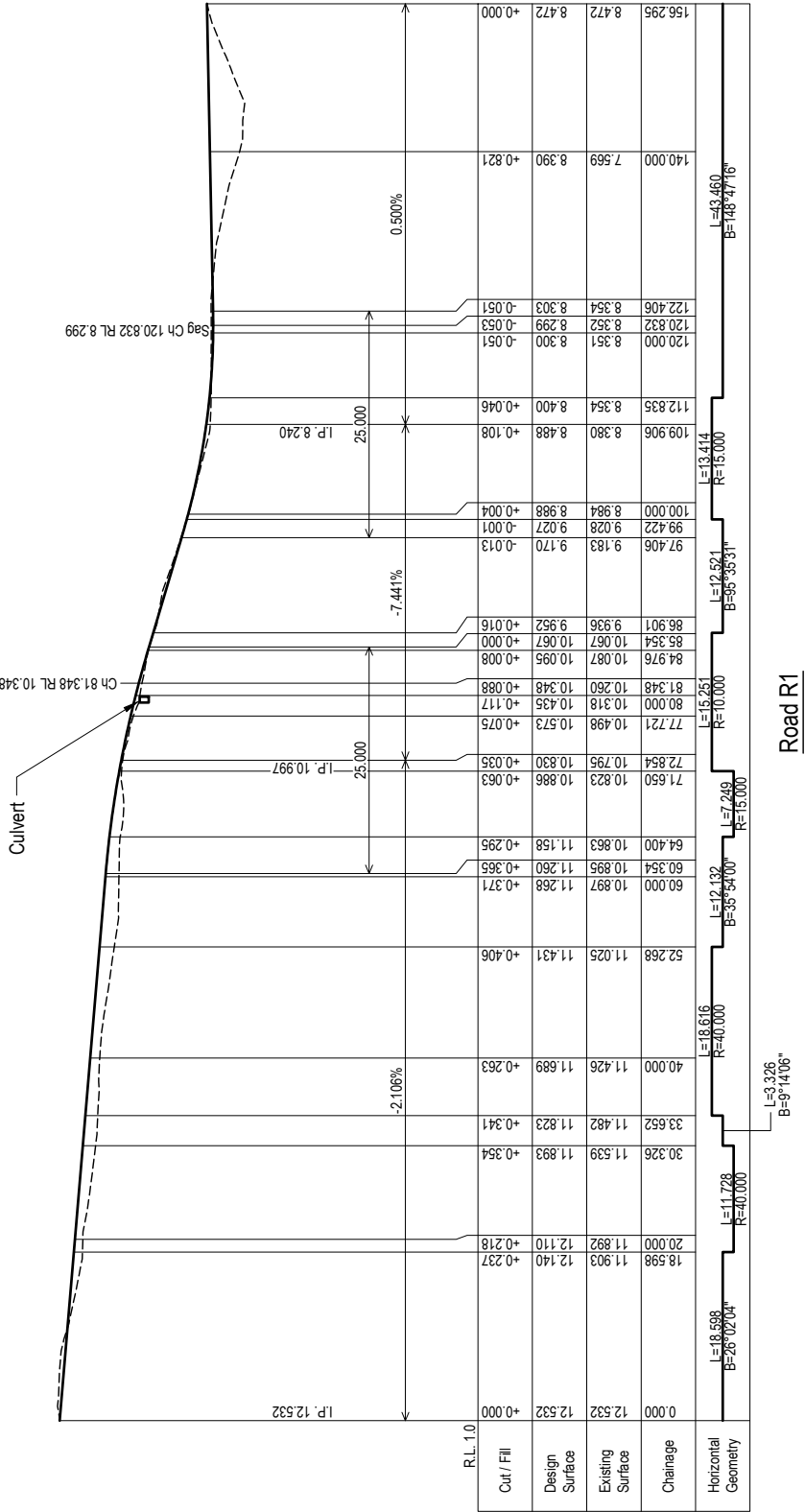
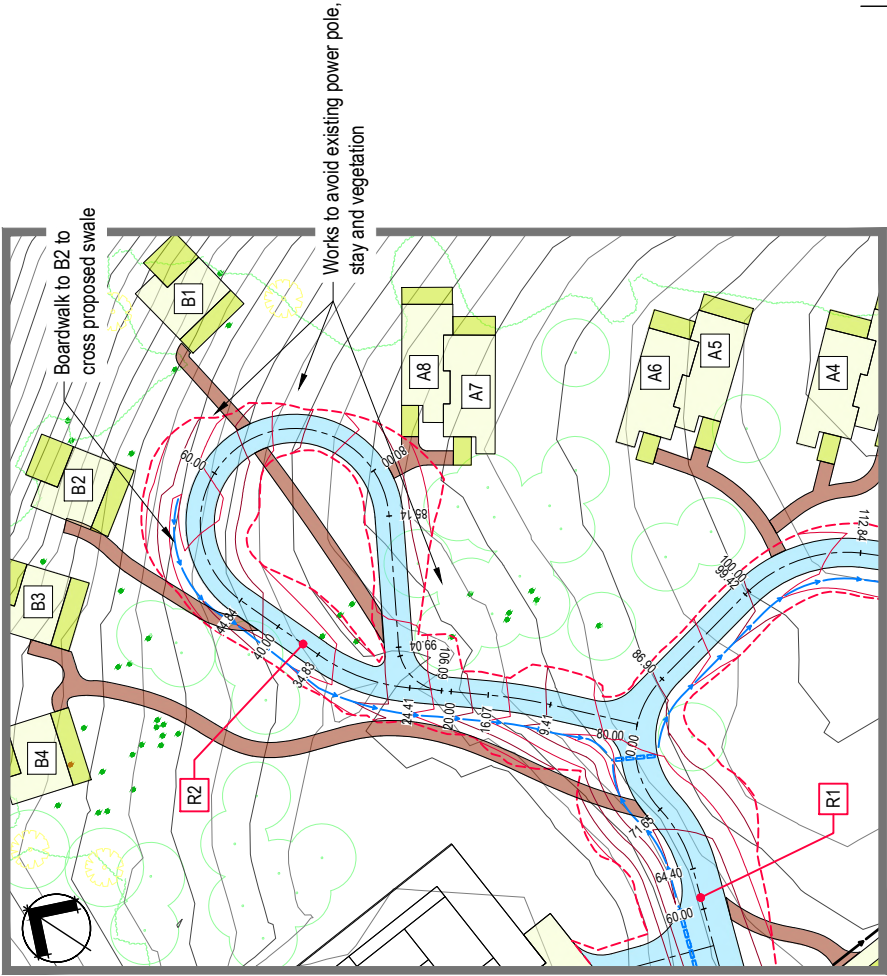
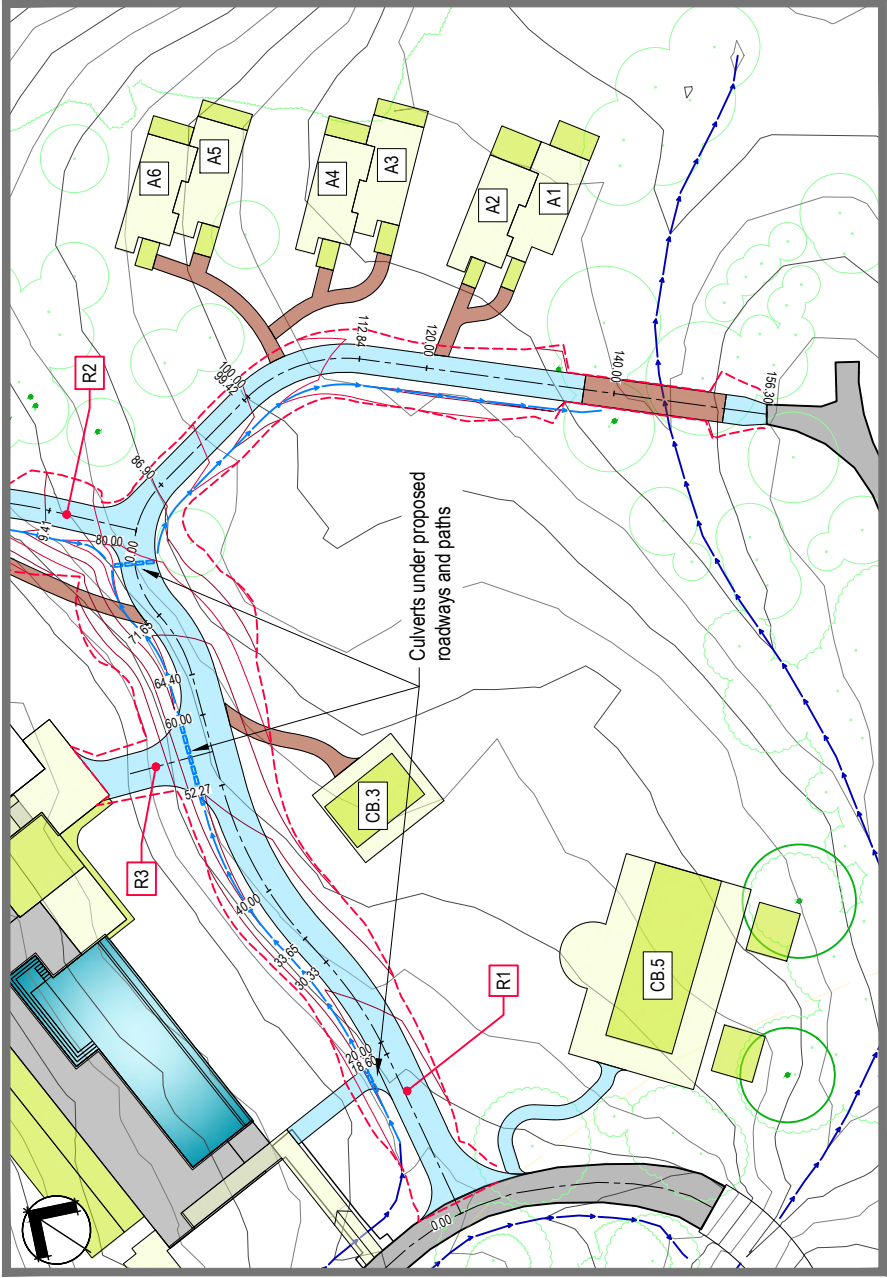
3080-1088

Drawing Number

3080/C011

Revision

C



Amendments			
Rev.	Description	Date	Des.
C	Additional hydrants	28/01/2021	MVE
B	Additional refuge building and paths	15/09/2020	MVE
A	Location of existing services revised	31/07/2020	MVE
Rev.	Description	Date	Des.

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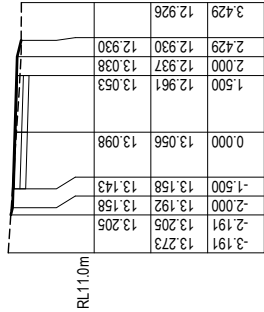
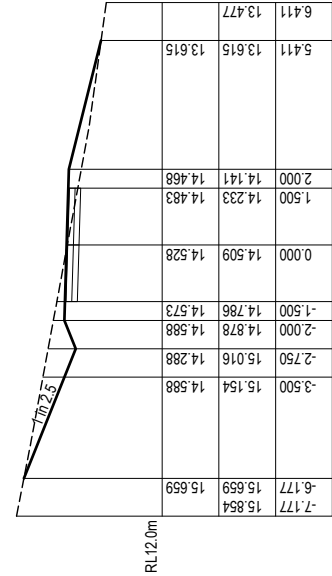
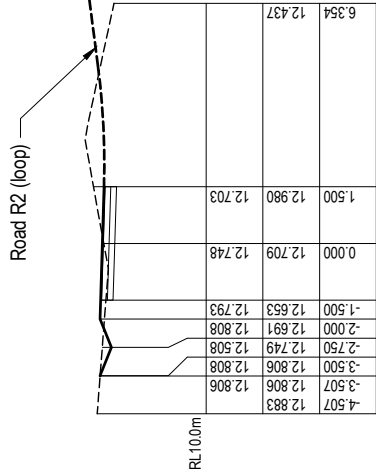
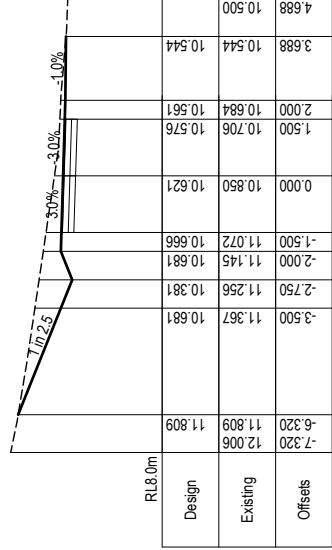
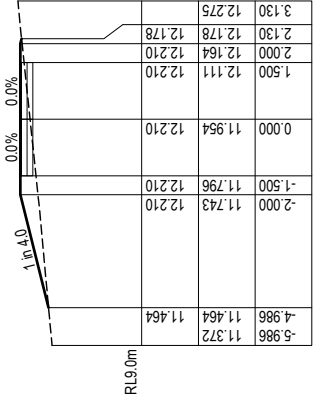
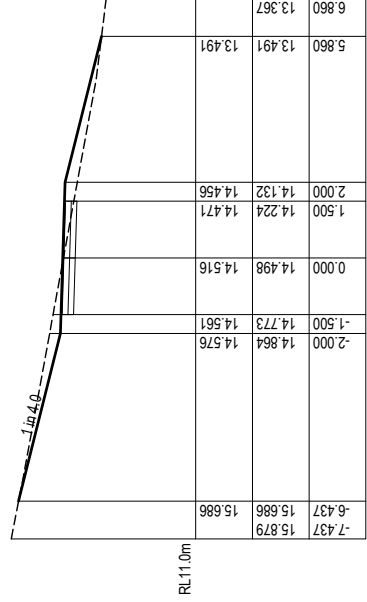
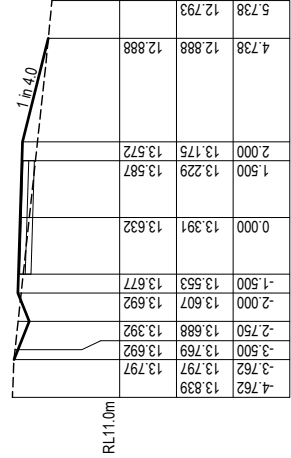
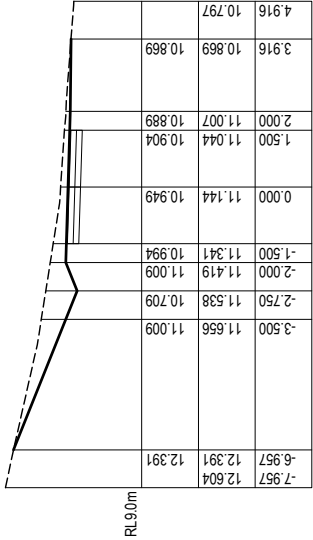
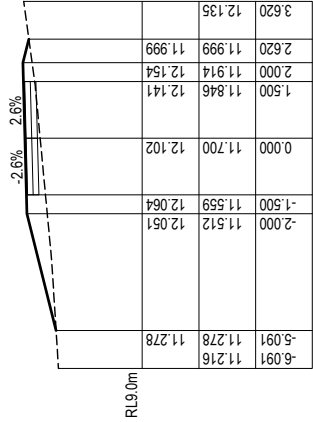
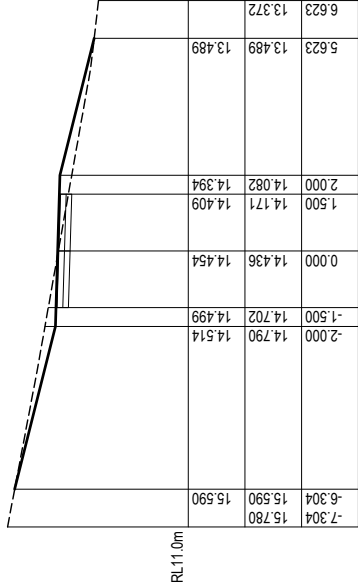
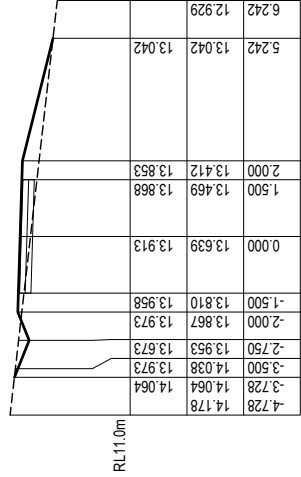
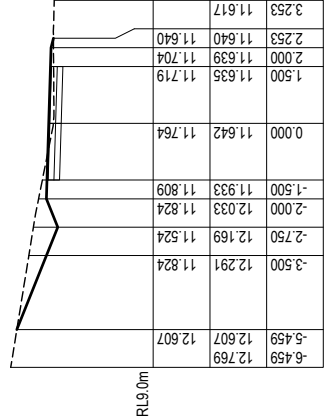
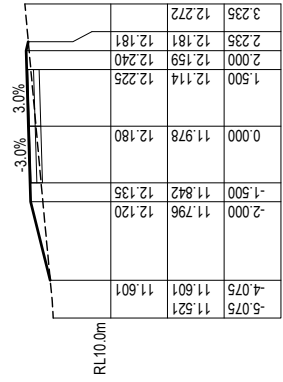
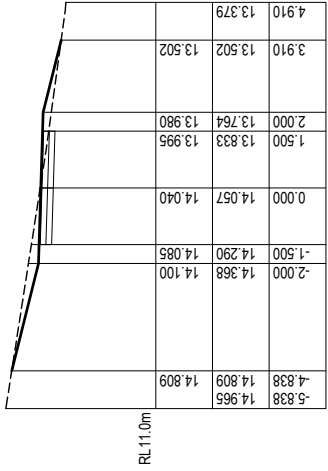
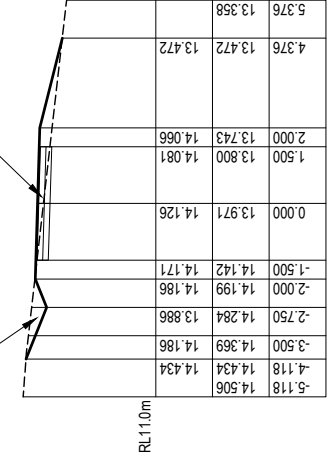
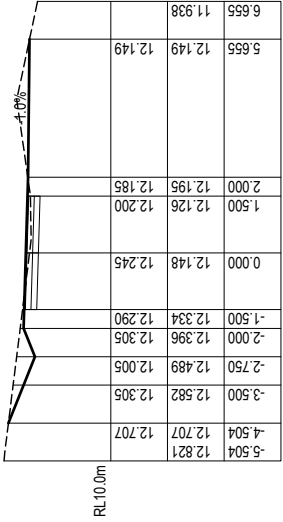
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Linnaeus - Ecotourism Development

Project Title			
Client	Linnaeus Property Pty Ltd	Drawn	MVE
Designed	MVE	Date	29/05/2020
Approved	MVE	Checked	JLC
XREFs			
Scale			
Horizontal	metres	0	4
Vertical	metres	0	4

Vegetated swale drain, typical

Sealed 3.0m wide roadway with 0.5 shoulders, typical



Rev	Description	Date	Des.	App.	Chk.
C	Additional hydrants	28/01/2021	MVE	MVE	MVE
B	Additional refuge building and paths	15/09/2020	MVE	MVE	MVE
A	Location of existing services revised	31/07/2020	MVE	MVE	MVE

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quality solutions sustainable future

Project Title
Linnaeus - Ecotourism Development

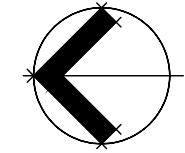
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Designed	MVE	Drawn	MVE	Checked
Approved	MVE	Date	29/05/2020	JLC
XREFs				
Scale				
metres 0 1 2 3 4 5				

Drawing Title
Road 2

Cross Sections

3080-1068
Drawing Number
Revision

3080/C014
C



IMPORTANT: Underground services including 11kV power line not shown for clarity. Dial Before You Dig!

Boundary of Lot 1 DP 1031848

Boundary of Lot 1 DP 1031848

LEGEND

- Existing building
- Existing asphalt road
- Proposed building / walkway
- Proposed paved / sealed road
- Proposed raised boardwalk
- Existing open swale
- Existing open swale to be filled
- Proposed open swale
- Existing stormwater pit / pipe
- Proposed stormwater pit / pipe
- Existing site contours shown at 1.0m intervals

NOTES

- No change proposed to existing open swale drains or pits / pipes uno.
- Cross section of proposed swale drains and diameter of reinforced concrete pipe culverts to be confirmed at detailed design stage.
- Roof water from all buildings to be collected by rainwater tanks. Overflow to be directed to gravel pits to encourage infiltration.

Rev./Description	Date	Des.	App.	Chk.	Amendments
C Additional hydrants	28/01/2021	MVE	MVE	MVE	
B Additional refuge building and paths	15/09/2020	MVE	MVE	MVE	
A Location of existing services revised	31/07/2020	MVE	MVE	MVE	

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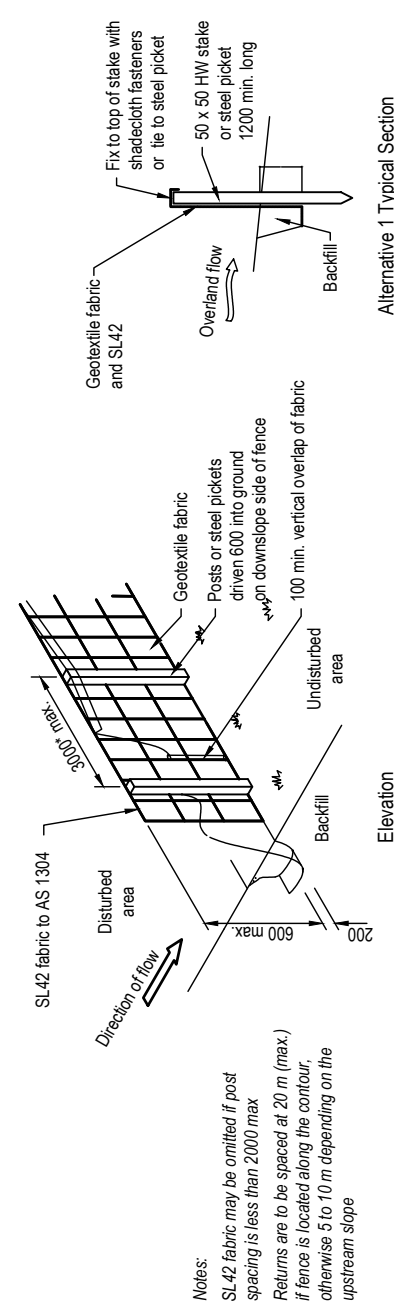
Client	Linnaeus Property Pty Ltd				
Designed	MVE	Drawn	MVE	Checked	JLC
Approved	MVE	Date	29/05/2020		
XREF's					
Scale					

metres 0 5 10 15 20 25

Drawing Title
Stormwater Management Plan

3080-1068
Drawing Number
Revision

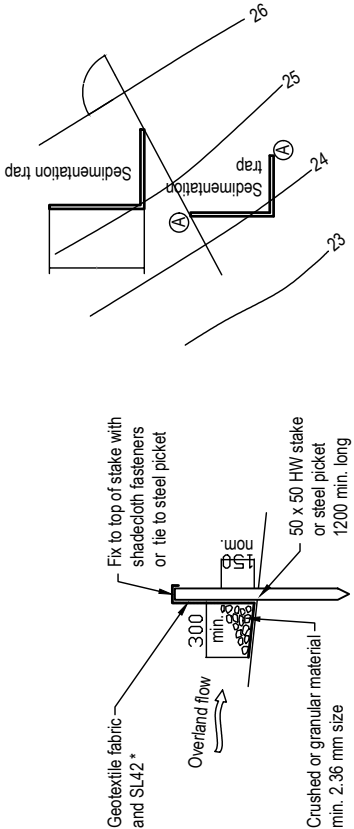
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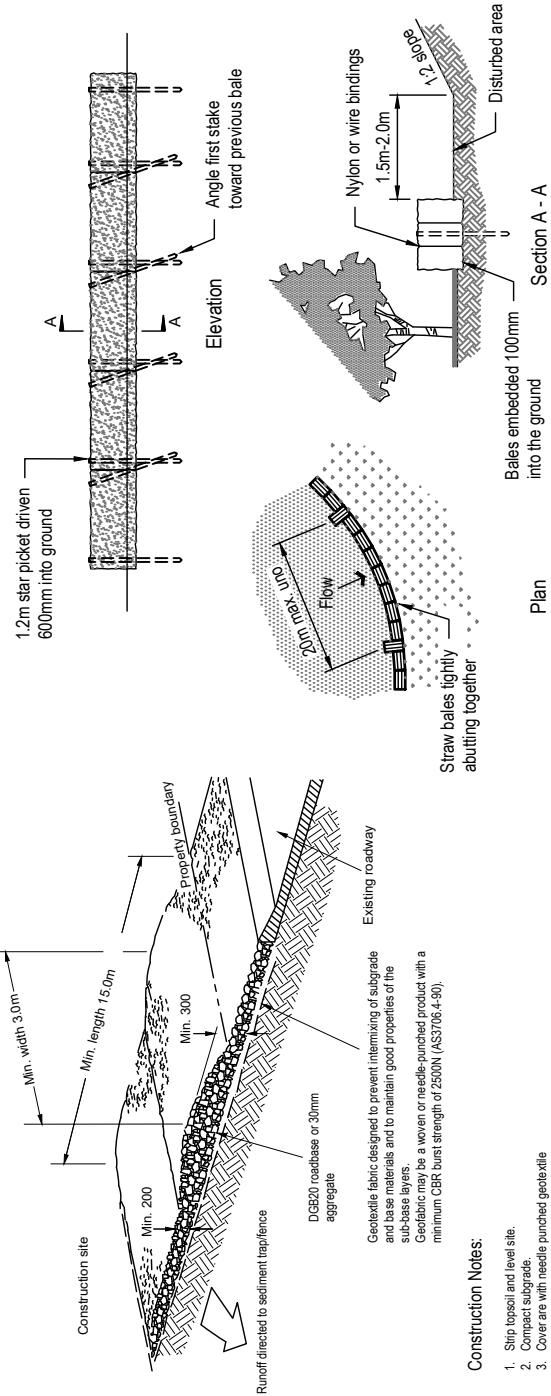
Elevation

Alternative 1 Typical Section

Sediment Fence



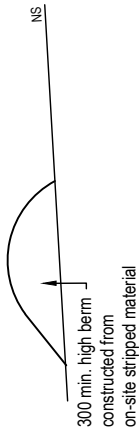
Alternative 2 Typical Section



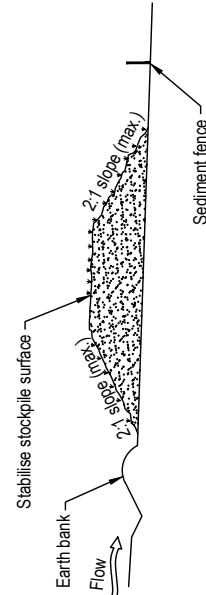
Construction Notes:

1. Strip topsoil and level site.
2. Compact and level subgrade.
3. Construct with needle punched geotextile.
4. Construct 200mm thick pad over geotextile using road base or 30mm aggregate. Minimum length - 15 metres or to building alignment. Minimum width 3 metres.
5. Construct hump immediately within boundary to divert water to a sediment fence or other sediment trap.

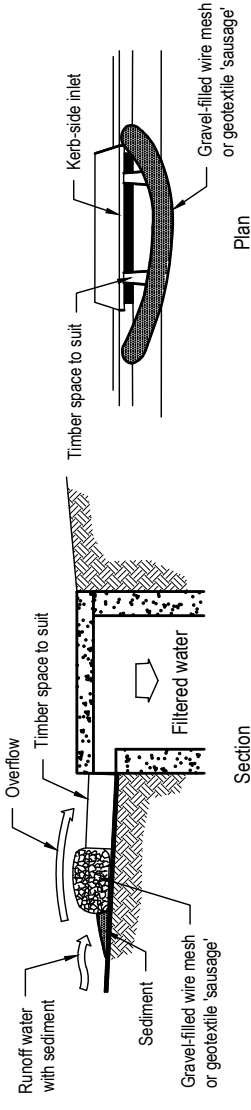
Stabilised Site Access



Straw Bale Filter



Clean/Dirty Water Diversion Bank



Typical Stockpile Elevation

1. Shall not be located in areas of concentrated flow.
2. Ate to be installed along the contour with a max. catchment area 0.6 ha per 100 m length of fence.
3. Woven fabrics are to be used.
4. Where fences need to be located across the contour the layout shall conform to 'typical layout across grade'.
5. Fences are required 2 m min. from toe of cut or fill batters, where not practical, one fence can be at the toe with a second fence 1 m min. away. Fence should not be located parallel with toe if concentration of flow will occur behind the fence.
6. Wherever possible, construct the sediment fence from a continuous roll. To join fabric, either: a) attached each end to individualisation stakes, hold the stakes together, rotate the stakes 180°, then drive the two stakes into the ground or b) overlap the fabric to the next support post.
7. Both ends of the fence should be turned up the slope a minimum of 1.5 m to minimise the risk of flow bypassing around the ends of the fence.
8. Returns are to be spaced at 20 m (max.) If fence is located along the contour, otherwise 5 to 10 m depending on the upstream slope.
9. At least 300 mm of fabric must be buried in either a 200 mm deep trench or under a continuous 100 mm high layer of sand or aggregate (not soil).
10. Sediment fences are to be braced for long-term stability. Spill-through weirs are to be incorporated at intervals of 20 - 30 m with rock rubble scour protection on the down stream side to control overflow.
11. Barrier and sediment fencing are to be located no more than 5 m (2 m desirable) from construction activities, to ensure disturbed land is minimised.
12. Captured sediment is to be removed and spread on site in locations where further erosion and or sedimentation is unlikely to occur.

General Erosion and Sediment Notes

1. All erosion and sediment controls are to be in accordance with the Soils and Construction Volume 1 - Managing Urban Stormwater 4th Ed. (the Blue Book).
2. These notes and accompanying plans are to be read in conjunction with any relevant engineering plans, and any other written instructions issued in relation to development on site.
3. All sub contractors are to be informed of their responsibilities in relation to erosion and sedimentation.
4. Accidentally disturbed areas would be stabilised and/or re-vegetated or secured with geofabric as soon as practical after the damage has occurred.
5. Work are to cease if any pollution problems are suspected or detected.
6. A spill containment kit, including equipment to address both terrestrial and aquatic spills, would be available at all times. Staff would be trained in the effective deployment of the spill containment kit.
7. Safety issues must be considered at all times; incorporate traffic control devices to the satisfaction of the superintendent. Wind erosion on the site shall be managed by limiting traffic on disturbed areas, utilising water trucks, covering stockpiles with anchored geofabric, and providing dust covers on trucks and dumpers. If wind speed exceeds 10m/s, increase watering or cease dust generating activities until dust controls are operating effectively. Other measures may be employed as outlined in the Landcom manual.
9. Works are to be carried out wherever possible during the cooler months, when rainfall events occur less frequently. The weather is to be monitored during the proposed period of works. Works would be scheduled outside of forecasted significant rain events and postponed during unforeseen rain events.
10. Pavement formations and any excavation works are to be scheduled outside of average high rainfall periods.
11. Works would cease and all sediment control measures checked and repaired or re-installed (if required) if heavy rainfall was forecast.
13. Sediment control features would be checked as soon as practical (within 24 hours) after significant rainfall events.

Water Quality

To ensure the receiving sensitive environment is not adversely affected by the proposed works, the following measure shall be put in place:

1. No cleaning of tools or equipment would occur within any drainage line or creek.
2. All equipment would be maintained in good working order and operated according to manufacturer's specifications;
3. An incident management and emergency response procedure would be prepared detailing procedures to be followed in the event of a spill or release of waste.
4. Vehicles, machinery and equipment would be maintained in accordance with manufacturer's specifications in order to meet the requirements of the Protection of the Environment Operations Act 1997 and associated regulations.
5. Vehicles and equipment would be switched off when not operating.
6. No materials are to be placed within areas of potentially high velocity flow.

Stockpiles

1. Place stockpiles a min. of 2 m (preferably 5 m) from existing vegetation, concentrated water flow and roads etc.
2. Construct on the contour as low, flat, elongated mounds, less than 2 m high (if possible)
3. Earth banks shall be constructed on the upslope side, and sediment fences installed within 2 m downslope.

Sediment Fences

1. Shall not be located in areas of concentrated flow.
2. Ate to be installed along the contour with a max. catchment area 0.6 ha per 100 m length of fence.
3. Woven fabrics are to be used.
4. Where fences need to be located across the contour the layout shall conform to 'typical layout across grade'.
5. Fences are required 2 m min. from toe of cut or fill batters, where not practical, one fence can be at the toe with a second fence 1 m min. away. Fence should not be located parallel with toe if concentration of flow will occur behind the fence.
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11. Barrier and sediment fencing are to be located no more than 5 m (2 m desirable) from construction activities, to ensure disturbed land is minimised.
12. Captured sediment is to be removed and spread on site in locations where further erosion and or sedimentation is unlikely to occur.

Mesh and Gravel Inlet Filter

3080-1068

Drawing Number

Revision

3080/C040

C

Rev.	Description	Date	Des.	App.	Chk.	Amendments
C	Additional hydrants	28/01/2021	MVE	MVE	MVE	
B	Additional refuge building and paths	15/09/2020	MVE	MVE	MVE	
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Client

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Approved	MVE	Date	29/05/2020				
XREFs							
Scale							
	metres	0	5	10	15	20	25

Drawing Title
**Erosion and Sediment Control
Typical Details and Notes**

3080-1068

Drawing Number

3080/C040

C