Appendix K: Stormwater and Drainage Strategy

Byford Rail Extension
Armadale Precinct Drainage Strategy

Issued to IPLS – 29/05/2023

Table of Contents

1. Introduction

The purpose of this drainage strategy technical memo is to describe the overarching drainage design strategy that feeds into the CI-200 Package – civil design of Armadale Station Precinct. This memo has been updated to align with the latest resubmission of the Reference Design and associated layout changes dated 20th January 2023.

In addition to the Station Precinct the following areas have now been added to this document to cover the addition under via-duct structure areas.

Area 1 - North of Armadale Road to Northern Viaduct Abutment structure.

Area 2 – Between Armadale Road and Forrest Rd.

Area 4 – South of Church St to Southern Viaduct Abutment structure.

1.1 Project Locality

The site is located at the existing Armadale Station in Armadale, Western Australia.

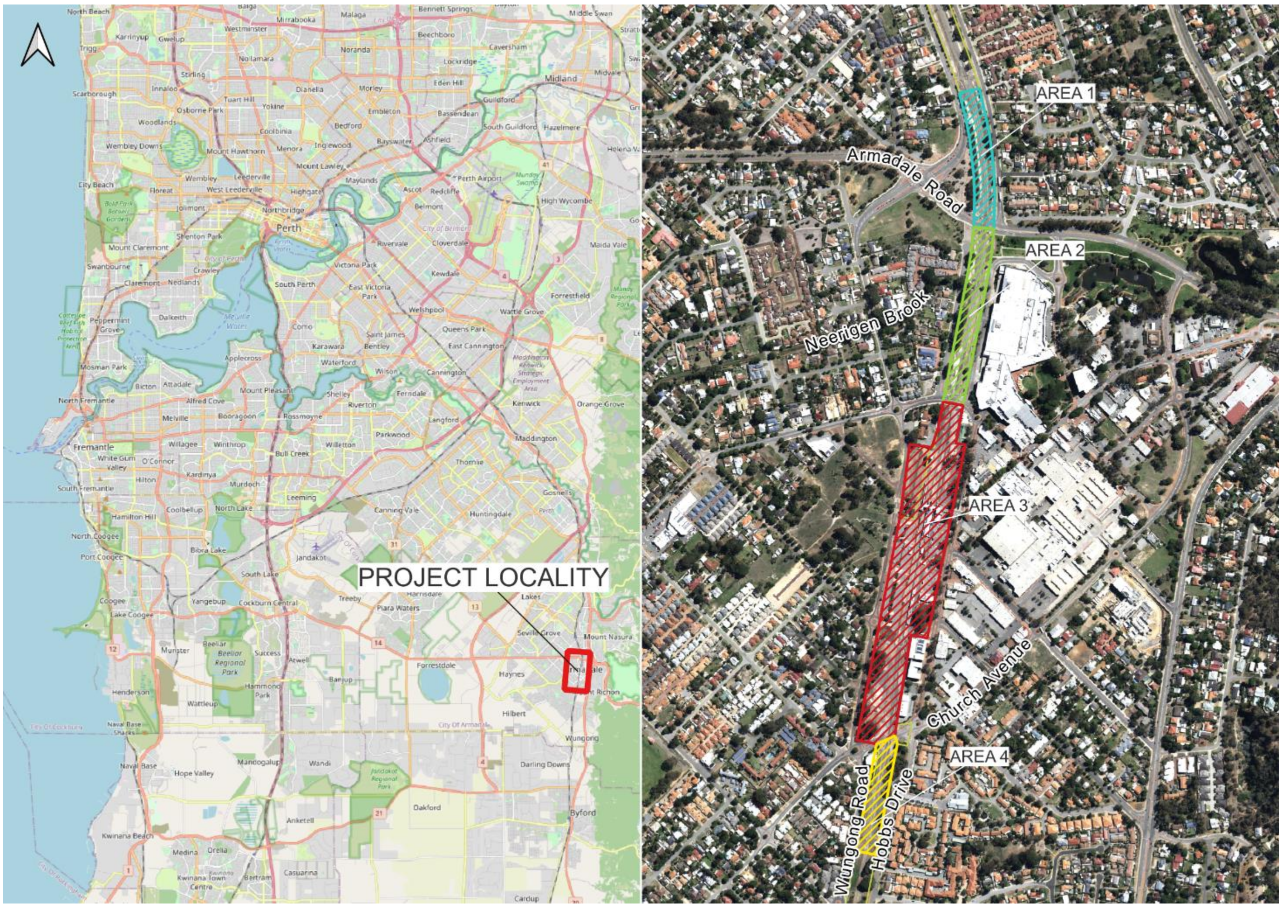


Figure 1. Project Locality

1.2 Site Layout

The Armadale Precinct consists of carparking facilities, a bus interchange, and a pedestrian concourse that site close to existing ground level. The Precinct sits underneath the Byford Rail Extension Viaduct. Figure 2 shows the layout of the proposed design.

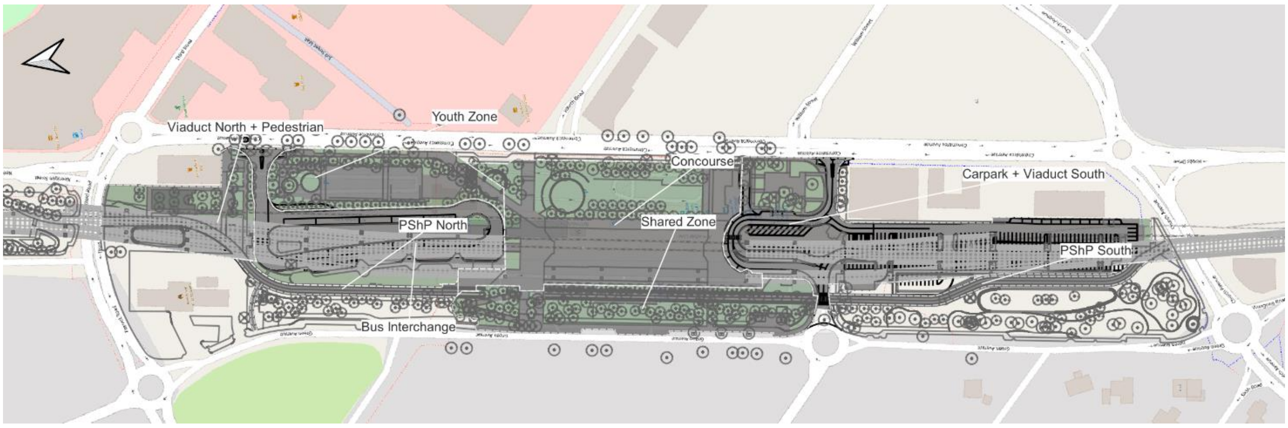


Figure 2. Site Layout

The existing Armadale Station Precinct consists of a station, carpark and bus interchange. The existing stormwater runoff is managed via the use of a traditional pit and pipe network that discharges to a basin and outlets to the City of Armadale drainage network.

Areas outside of the precinct under viaduct will predominantly be landscaped with pathways for access. The management of stormwater runoff for these areas will be achieved via swales and low-lying depression areas for storage, integrated with the overall landscaping design.

The viaduct also extends over a key waterway in Area 2. The Neerigen Brook is a Water Corporation drainage asset which currently passes under the existing rail network. No major changes are proposed to the Neerigen Brook waterway, landscaping and walkways will interface with the natural channel, concepts shown below in Figure 3.

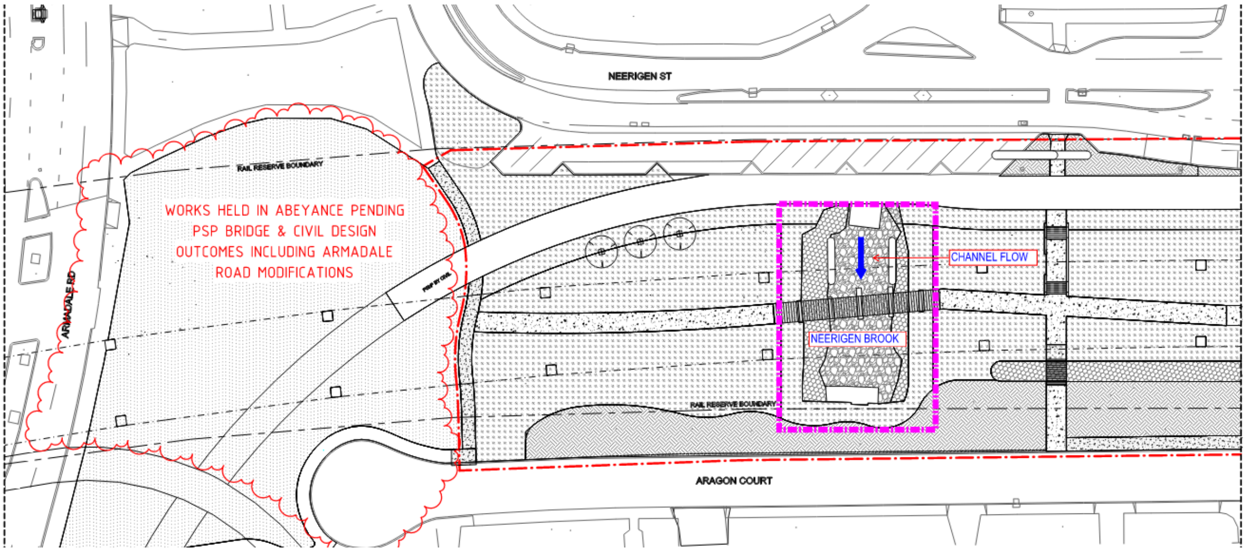


Figure 3 - Neerigen Brook Layout

1.3 Existing Catchment Plan

Predevelopment drainage catchments for the Armadale Precinct (AREA 3) are as shown below in Figure 4.

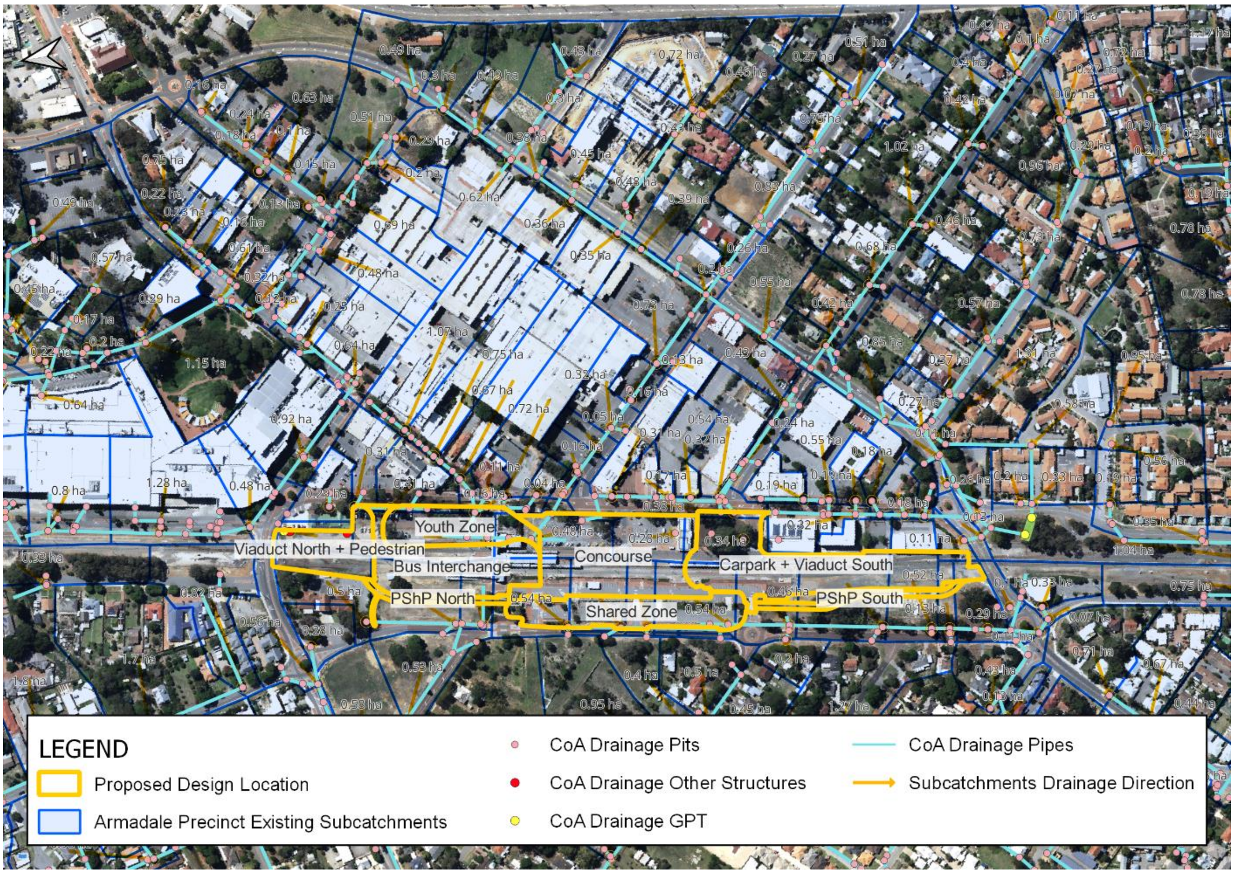


Figure 4. Catchment Plan

Catchments for areas outside of the Armadale Precinct are documented as part of the Viaduct drainage design strategy. The integration of the drainage design into the landscaping for areas under viaduct manages the runoff from the viaduct structure in addition to the localised runoff generated at ground from the landscaping and pathways.

1.4 Existing Drainage Infrastructure

The City of Armadale (COA) have a network of pit and pipe infrastructure outside of the rail corridor which typically conveys flows from east to west to follow the natural topography. The drainage network typically runs along kerb lines and/or shoulders of local roads to the west of the rail corridor. Runoff from within the rail corridor is predominantly managed by a network of open earth channels and cross track culverts, typically discharging into the COA drainage network at select locations.

Existing infrastructure at the Armadale Precinct is detailed in the civil design report for the precinct, refer to R30-MET-RPT-CI-200-00001. Further information on linewide existing drainage interfaces is also available in the detailed design reports for each relevant design package as summarised below:

- Existing drainage within the rail corridor is detailed in the R30-MET-RPT-CI-155-00002 Drainage Strategy Report for the Linewide Earthworks and Drainage.
- Existing pit and pipe infrastructure at the key road interfaces (Armadale Road, Forrest Road, Church Avenue) are documented in the road design reports, R30-MET-RPT-CI410-00001 and R30-MET-RPT-CI415-00001.

2. Design Criteria

2.1 Design Strategy

The overarching drainage strategy has the following primary objectives:

- Apply Water Sensitive Urban Design Principles
- Reduce post development runoff rates to predevelopment conditions
- Meet the SWTC requirements
- Meet the PTA Specification 8880-450-090: Design of Drainage for PTA Infrastructure

The design seeks to treat the first flush in bio-retention areas wherever possible and limit the discharge off-site to the predevelopment discharge rates as determined by hydrologic modelling. The predevelopment condition has been considered as the original unimproved site, i.e. 100% pervious.

2.2 Design Criteria Order of Precedence

The following design criteria and design guidelines have been considered during the development of the Armadale Precinct Drainage Strategy. The order in which these are listed below denotes the order of precedence as it applies to the strategy.

4.1.1 SWTC-BRE-PTAWA-PM_RPT-00007

4.1.2 8880-450-090 – Specification: Design of Drainage for PTA Infrastructure

4.1.3 A Guide to Water Sensitive Urban Design for Public Transport Infrastructure in Western Australia

4.1.4 Stormwater Management Manual of Western Australia

4.1.5 Australian Runoff Quality: A Guide to WSUD

4.1.6 Adoption Guidelines for Stormwater Biofiltration Systems produced by the CRC for Water Sensitive Cities

2.3 SWTC -BRE-PTAWA-PM-RPT-00007

Relevant extracts from the SWTC are reproduced below:

4.1.7 2.1.3-10 - The maximum storage depth of bio-retention areas in the station precinct where accessible to public shall be limited to 300mm with 1 in 4 batter slopes.

4.1.8 2.1.3-9 - The maximum emptying time for infiltration drainage system within the station precinct and outside the rail reserve shall comply with the Stormwater Management Manual for Western Australia.

Table 1 – Extract from Stormwater management manual chapter 9 Table 5

AEP	1EY	0.5EY	0.2EY	10%	5%	2%	1%
Maximum Emptying Time in days	0.5	1	1.5	2	2.5	3	3.5

4.1.9 2.1.3-8 Provision of bio-retention filter media shall comply with the Stormwater Management Manual for Western Australia

4.1.9.1 Typically, filter media consists of a sandy loam with a saturated hydraulic conductivity between 50 and 300 mm/hr

4.1.10 9.2.3-1 All rainwater run-off from roofed and platform paved areas shall be collected and be disposed of onsite via soakwells or via the local area stormwater drainage system where the NOP actions make this possible. Rainwater run-off from bus interchange shelters shall connect to the civil engineers' car park drainage system. Where soil conditions beneath platforms is not considered suitable for onsite disposal, consideration shall be given to drainage lines connecting to the civil engineers 'PERWAY' drainage system.

2.4 8880-450-090 - Specification: Design of Drainage for PTA Infrastructure

Relevant extracts from the Specification are reproduced below:

4.1.11 Table 7 Drainage Annual Exceedance Probabilities for Outside the Rail Reserve

Table 2 – Extract from 880-450-090 (Table 7: Drainage Annual Exceedance Probabilities for Outside the Rail Reserve)

Item	Situation	AEP %
1	Major system check: TWL to property and railway building floor levels with 300mm freeboard	1
2	Stormwater drainage contained in principal shared path (PSP) corridor: PSP crossfall shall be away from the rail reserve. For larger storms and major storm overland flow paths, and where discharge into PTA rail reserve is unavoidable, this shall be communicated with and accepted by the PTA prior to construction.	20
3	Water Corporation main / branch drains.	
4	Kerb overtopping.	20
5	Drainage basins and sumps	10
6	Swales and open drains.	20
7	Gutter flow spread limits.	20
8	Piped system with 150 mm of freeboard from HGL to FSL.	20
9	Groundwater level (dry subgrade).	2
10	Drainage system overflows that might cause erosion or scour.	10
11	Drainage basin backwater onto pavement.	5
12	Swales and open drains backwater onto pavement.	10

4.1.12 2.3.5.13 - No part of the carparks shall be flooded, or inundated, during any storm event smaller than the 10% AEP storm event. The depth of stormwater during the 1% AEP event shall not be more than 200 millimetres in any part of the carpark, at any time, and there shall not be any ponding of stormwater for longer than six hours in any part of the carpark during a 1% AEP storm event

4.1.13 2.3.5.5 - Stormwater runoff from constructed impervious surfaces generated by the first 15 mm of rainfall from a frequently occurring event shall be retained and/or detained, and treated (if required) at the source as much as practical to meet WSUD requirements

4.1.14 2.3.17.5 - Infiltration / detention basins shall be designed to include a stormwater biofilter (where treatment of runoff is required) unless otherwise approved by the PTA. Biofilters shall be designed and installed in accordance with the Adoption Guidelines for Stormwater Biofiltration Systems produced by the CRC for Water Sensitive Cities. Where treatment of runoff is not required, basins/flood storage areas shall be designed with vegetative retention/detention systems noting that the root systems of vegetation help to minimise potential soil clogging and maintain infiltration of runoff.

4.1.15 2.3.15.1 - Any discharge into existing drains shall be compensated to reduce peak flows to pre-development flows or limits acceptable to the controlling authorities

4.1.16 2.3.15.2 a. - Infiltration into natural surface: If the soil permeability is adequate and no adverse environmental or community effects will result from standing water up to 96 hours, the run-off shall be managed in open drains and swales to infiltrate. Drain blocks at regular intervals and based on hydraulic calculations can be used to maximise infiltration. Excess run-off shall be treated by passing through a vegetated detention basin or approved treatment system. In the sites with potential high-risk pollution (e.g. fuel filling or storage areas, station open carparks, open train and other vehicle depot), first flush runoff should have appropriate treatment before infiltrating to groundwater or discharging to downstream environment when infiltration is not feasible.

3. Hydrologic Input Data

The Hydrologic input data used in the drainage strategy is described in this section.

3.1 Rainfall

Rainfall data is extracted from the Bureau of Meteorology and is provided as Intensity-Frequency-Durations (IFD).

3.1.1 Intensity Frequency Duration

Rainfall IFDs were extracted from the Bureau of Meteorology Website for the site location. The IFDs have been republished below.

Table 3 - IFD Extraction Data and Location

IFD Design Rainfall Depth (mm)				
Issued:	29-Jun-22			
Location Label:				
Requested coordinate:	Latitude	-32.155	Longitude	116.013
Nearest grid cell:	Latitude	32.1625 (S)	Longitude	116.0125 (E)

Table 4 - IFD Data

Duration in min	63.20%	50%	20%	10%	5%	2%	1%
1	1.82	2.01	2.64	3.09	3.55	4.19	4.71
2	3.21	3.51	4.51	5.23	5.98	7.01	7.86
3	4.3	4.71	6.07	7.07	8.09	9.52	10.7
4	5.19	5.7	7.39	8.62	9.89	11.7	13.1
5	5.93	6.54	8.52	9.96	11.4	13.5	15.2
10	8.57	9.48	12.5	14.6	16.8	19.9	22.4
15	10.3	11.4	15.1	17.7	20.3	24	26.9
20	11.7	12.9	17	19.9	22.9	27	30.3
25	12.8	14.1	18.5	21.7	25	29.5	33.1
30	13.7	15.2	19.9	23.3	26.7	31.5	35.4
45	16.1	17.7	23	26.9	30.9	36.6	41.1
60	18	19.7	25.5	29.8	34.3	40.6	45.7
90	21	22.9	29.5	34.4	39.6	47.1	53.3
120	23.4	25.5	32.7	38.2	44	52.5	59.7
180	27.2	29.6	37.9	44.3	51.2	61.5	70.4
270	31.7	34.4	44.1	51.6	59.9	72.3	83.1
360	35.3	38.3	49.1	57.5	66.8	81	93.4
540	40.9	44.4	57	66.9	77.8	94.6	109

3.1.2 Pre-burst

Median Pre-burst Rainfall depths were applied to rainfall data to account for ARR Data Hub storm losses.

The conversion from storm Initial losses to burst initial losses is shown in Equation 1.

$$\text{Burst initial loss} = \text{Storm initial losses} - \text{Pre} - \text{burst rainfall (for Burst initialloss} \geq 0)$$

Equation 1

The median pre-burst rainfall data is published in Table 5.

Table 5 - Median Pre-burst rainfall depths

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	6.4	6.3	6.3	6.3	5.6	5.1
90 (1.5)	7.3	7.5	7.6	7.7	7.9	8
120 (2.0)	3.4	4.7	5.6	6.5	6.5	6.5
180 (3.0)	3.2	3.8	4.3	4.7	5.1	5.4
360 (6.0)	1.9	2.1	2.2	2.3	3.1	3.7
720 (12.0)	0.6	0.7	0.7	0.7	1.9	2.8
1080 (18.0)	0.2	0.2	0.2	0.2	1	1.5
1440 (24.0)	0	0	0	0	0.4	0.7
2160 (36.0)	0	0	0	0	0	0
2880 (48.0)	0	0	0	0	0	0
4320 (72.0)	0	0	0	0	0	0

3.2 Losses

Initial and continuing losses have been extracted from the ARR Data Hub for use in hydrologic modelling. The values are shown in Table 6.

Table 6 - Storm Losses

ID	Value
Storm Initial Losses (mm) - Pervious	26
Storm Continuing Losses (mm/h) - Pervious	6
Storm Initial Losses (mm) - Impervious	1
Storm Continuing Losses (mm/h) - Impervious	0
Antecedent Moisture Condition (AMC)	3 – Rather Wet
Soil Type/Classification	C – Slow Infiltration rates

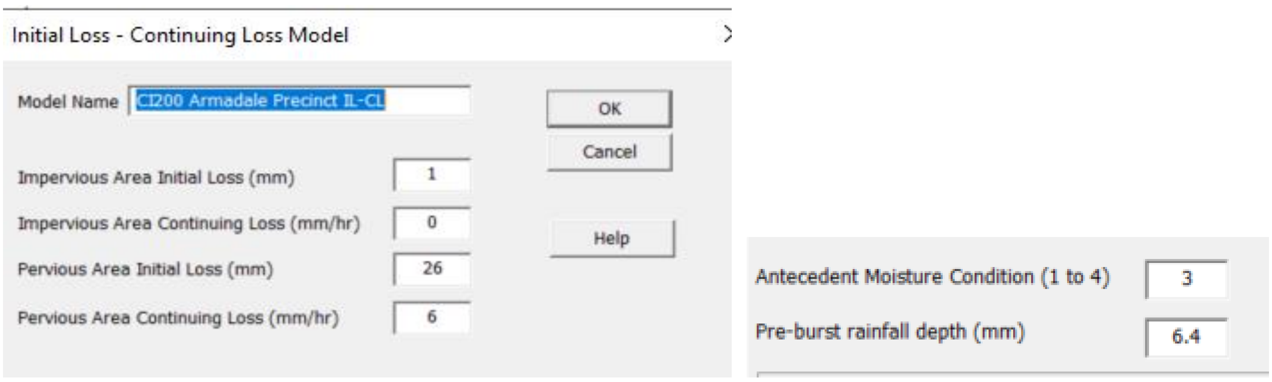


Figure 5: Depression Storage and Soil Classification

4. Storm Water Design Strategy

4.1 Area 1 – North of Armadale Road

Stormwater runoff from the existing rail corridor is currently managed by an open drain on the eastern side of the corridor. Flow is conveyed across the corridor via an existing transverse culvert (CUL-A104) at approximate chainage 28,270 which then runs north along the western boundary of the corridor before discharging into the piped CoA drainage network at approximate chainage 27,700.

Culvert A104 also receives overflow from an existing LGA drainage basin to the east of the rail corridor, located at the corner of Frys Lane and Streich Avenue.

Design development for this area is still noted as on hold as the design for the PShP and Armadale Road will influence the final design of drainage and landscaping for this section.

Notwithstanding, the overall approach for the management of stormwater runoff through the 'on-grade' section is to replicate the existing drainage regime by providing open drains (swales) under the viaduct to receive discharge from the viaduct above.

The swales will convey runoff towards shallow drainage basins positioned within the corridor under viaduct. Basins will be landscaped with the design being driven predominately by the design of the open space, incorporating storage requirements and drainage overflows as required to maintain a balance of pre and post development flows.

Swales will run south to north along the column lines either centrally or on both sides of the viaduct, depending on the final PShP alignment. Treatment of the 'first flush' storm events will be achieved either within the drainage channel via drain blocks or within the drainage basin areas.

4.2 Area 2 – Between Armadale Road and Forrest Road

Armadale Road to Neerigen Brook

Runoff from the existing rail formation sheets from the formation to existing open drains or localised depressions before flowing through existing culverts crossing under Armadale Road, conveying flow north towards Area 1.

The rail corridor slopes from east to west with a raised existing track formation acting as a 'bund' to overland flows from the east. The external upstream catchment also slopes from east to west, the bund serves as a flow control mechanism in minor and major storm events, this is discussed further below in Section 4.2.4.

External catchment flow is predominately channelled across the corridor via the Neerigen Brook, which is a critical Water Corporation drainage asset, managing external catchment flows and receiving overflows from the rail corridor. The Brook passes under rail, which is supported via existing bridge structure, elsewhere the rail formation is elevated via raised embankment earthworks. The bridge structure is proposed to be retained, and final landscaping design will maintain existing rail formation levels to replicate the existing hydrologic regime.

The bunded formation currently attenuates flows from larger storm events where the Neerigen Brook overtops and is restrained by the bund. It is therefore imperative that the bund be retained to replicate the existing drainage regime and mitigate risk of downstream flooding issues, as a removal of the bund would result in a loss of storage within the corridor and increase downstream flows.

Minor storm events will be managed in drainage swales under viaduct, receiving flows from downpipes at each column location via 'splash pad', which is a rock-lined pad around the downpipe discharge and into the channel. This is explained in further detail in Section 4.2.1.

The key constraint to design for this area is the undulating nature of the corridor. As the PShP design is yet to be confirmed, the final alignment of the drainage swales cannot be confirmed at this time. Though due to the undulating nature of the corridor, separate swales for the east and west side of the corridor will likely be required for the section of corridor North of Neerigen Brook to Armadale Road.

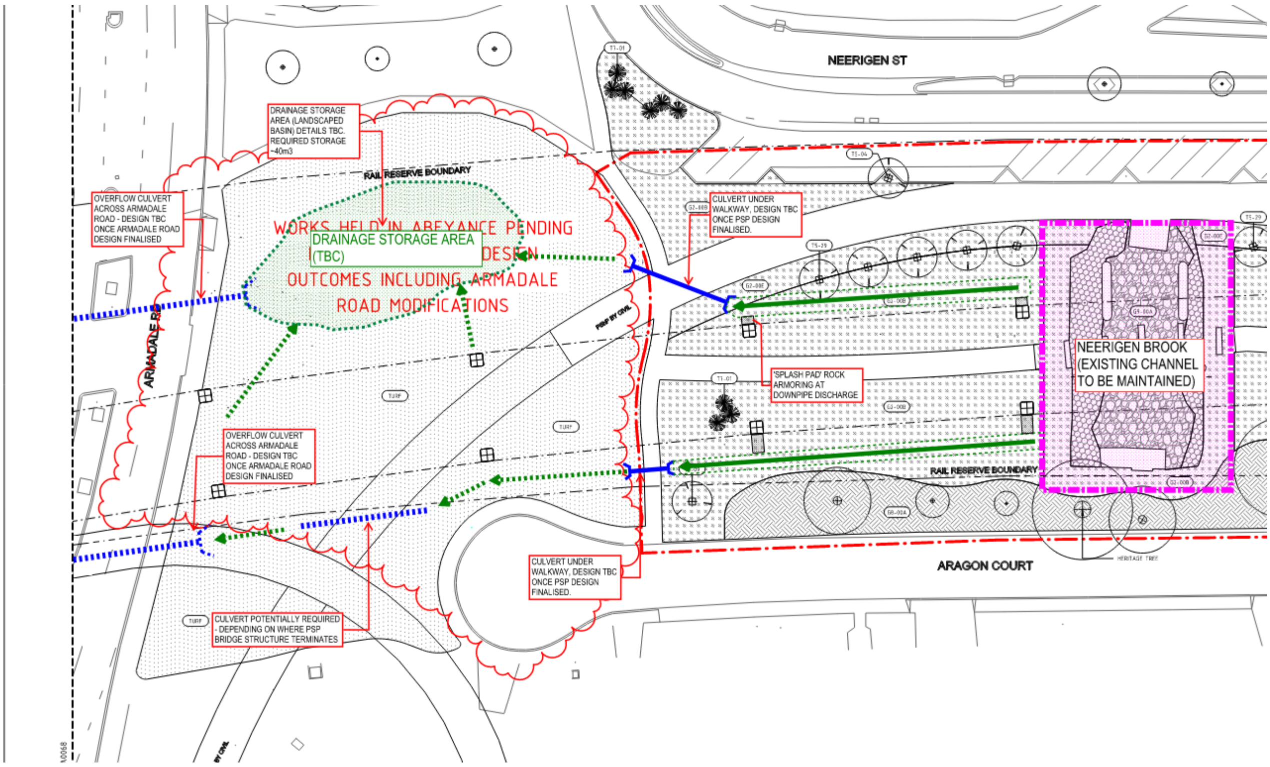


Figure 6 - Drainage Scheme between Armadale Road and Neerigen Brook

Neerigen Brook to Forrest Road

The section of corridor from Neerigen Brook to Forrest Road has similar hydrological constraints to the area from Armadale Road to the Brook. The elevated formation acting as a bund eventually grades out to verge level towards the level crossing through Forrest Road

Similar to the previous section, the earthworks and drainage requirements through this section shall be integrated into the landscaping design, incorporating critical bund levels into the overall landscaping scheme and utilising swales and basin for stormwater management.

The drainage strategy for this section manages both minor and major storm events, replicating the existing drainage regime. Open drains (swales) are provided either side of the viaduct columns to collect stormwater runoff and convey flow towards basins for treatment and storage. An overflow connection is proposed to the existing CoA drainage network along Aragon Court. Drain blocks are also proposed within the channels upstream of the depression to provide linear storage of runoff.

Due to the undulating terrain across the corridor, swale drains will be required on both sides of the corridor. The swale running along the east side of the corridor will be positioned between the PShP and the line of columns supporting the viaduct. Due to space and terrain constraints, this drain will only be a V drain at shallow depth. A high flow catch pit is placed at the end of the swale drain to capture and convey runoff across to the west for treatment in the drainage basins.

The swale drain on the western side of the corridor will sit within an existing localised depression which serves as flood control mechanism in the pre-development environment. This regime will be replicated in design, with the landscaping providing a wide based vegetated swale for conveyance and treatment of minor and major storm events.

Rock armoured drain blocks have been shown within the channel to control the rate of discharge into the basin and regulate discharge flow rates from the corridor. These flow control devices are governed by the flood modelling which is ongoing and may change during further design development, these have been shown indicatively along with the overall design scheme in Figure 7 below.

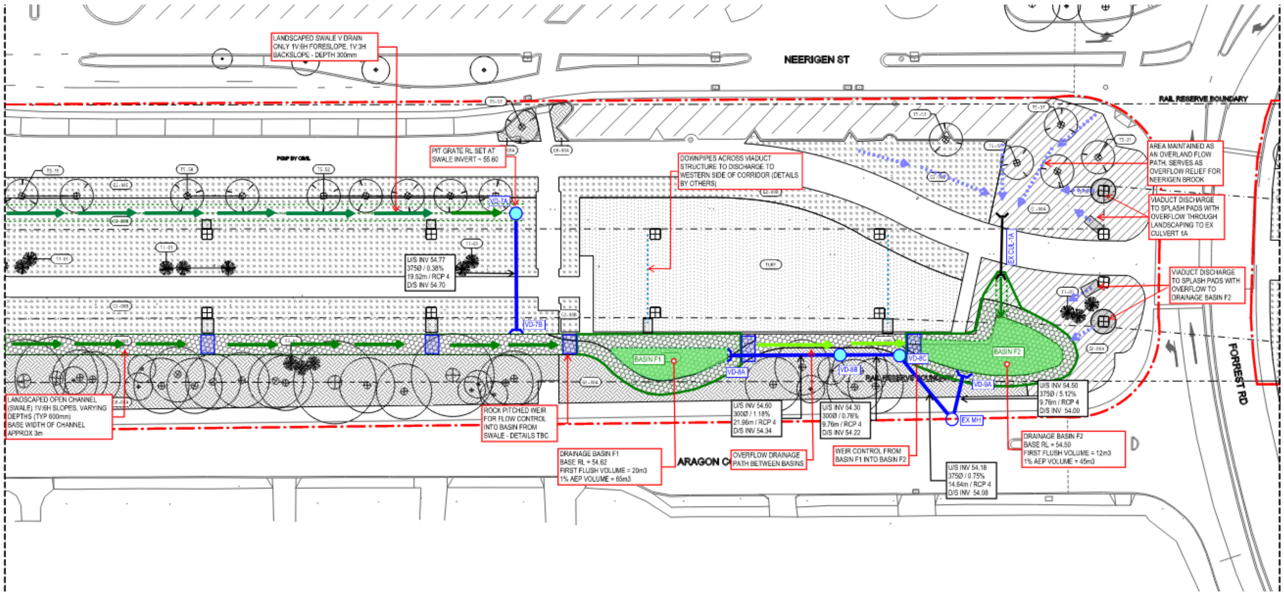


Figure 7 - Drainage Scheme between Neerigen Brook and Forrest Road

Two new drainage basins will be provided towards the intersection of Forrest Road and Aragon Court. Basins F1 and F2 are placed on the lower side of the corridor in the southwest corner of the section. Basin F1 will overflow into Basin F2 in major events, overtopping of F2 will occur in events exceeding the 1% AEP storm event, with runoff flowing along the adjacent roadways. The drainage basins will be integrated into the landscaping providing treatment and attenuation for controlled discharge to the LGA drainage network to a pre-development flow rate level.

The existing cross track culvert just north of Forrest Road will be retained as it serves as a relief overflow for major storm events when the Neerigen Brook overtops. This culvert has been integrated into the overall drainage design and landscaping scheme to function in both minor and major events.

4.2.1 Viaduct Drainage to Landscaped Areas

Runoff from the viaduct is conveyed from structure via downpipe connection that runs external to the column structure.

The sizing of downpipes and details for the outlet structures on the viaduct will be captured as part of the viaduct structural design package and the viaduct drainage strategy memorandum. These packages are currently in design development and further details will be available in subsequent phases of the project.

The ‘on-ground’ drainage strategy manages runoff once discharged from downpipe to ground level. The drainage strategy promotes the use of open channel drainage (swales) over pit and piped networks, as such no piped connections to pits are proposed through landscaped areas under viaduct, specifically through Areas 1,2 and 4.

Conveyance is managed via open channel drainage, or through direct discharge from downpipe into the shallow landscaped drainage basins.

Rock protection will be provided at downpipe discharge points to mitigate risk of scour and erosion at the column base and as discharge enters the drainage channels. Details of the rock armouring will be captured as part of the final landscaping design however landscape examples are provided in Figure 8 and 9 demonstrates the proposed discharge arrangement at concept level for different scenarios.

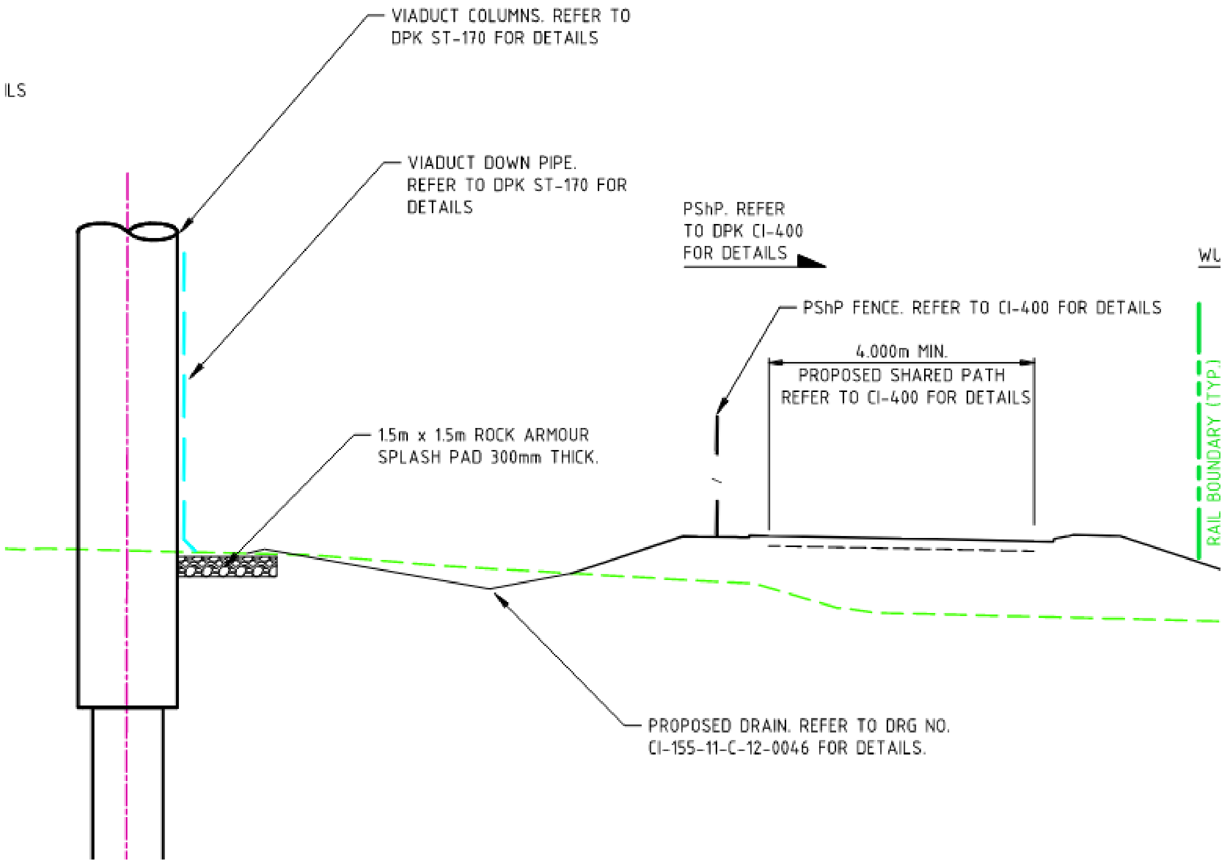


Figure 8 - Discharge from Viaduct to splash and shallow swale

The figure below provides a less engineered alternative splash pad layout to blend in with the surrounding landscape design. Showing column downpipe runoff discharging onto a splash pad made up natural creek like stone which is then connected to treatment swale.

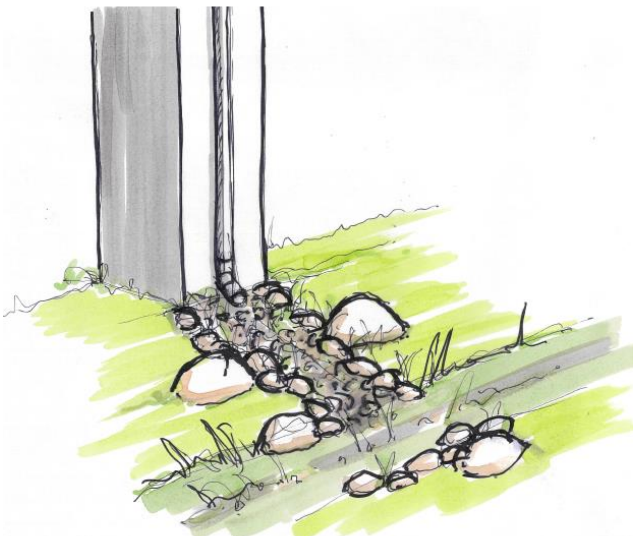


Figure 9– Possible Splash Pad and Swale design Integration.

4.2.2 WSUD and Landscape Design Integration

Water Sensitive Urban Design (WSUD) is key to providing effective ways to minimise impacts of the rail development on waterways within the site. The site will provide treatment of storm water and overland water flow pollutants onsite for treatment via vegetated swales and planting. The design and implementation of WSUD systems will be jointly coordinated with Civil, Hydrology and Landscape.

These will be reflected in the design drawings noting size and volume of treatment areas, choice of filtration media and selection of specific plant species for the job. The aim is to provide drainage entities that are more focused on a 'natural' aspect rather than hard engineered and should blend into the landscape. The use of local materials (stone and boulders) and vegetation will assist providing this creek like outcome for stormwater flows from viaduct downpipes and connect with the Hills character the Armadale Station is apt to reflect. This will also manage flows directing stormwater where it needs to go and mitigate any erosion.

Figure 10 below shows Precedence imagery showing creek like entities to manage stormwater flow from viaduct downpipes to treatment swales and basins.

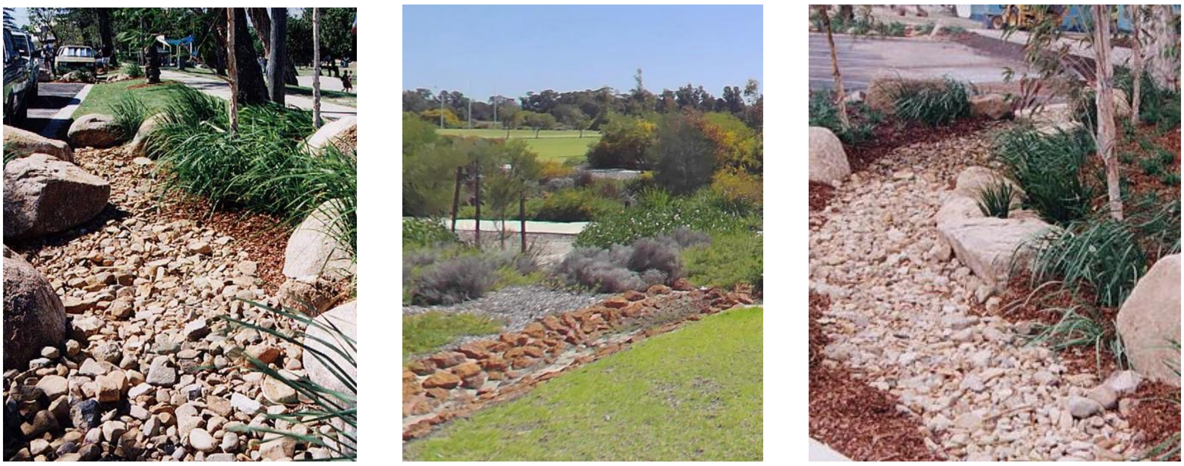


Figure 10 Precedence imagery showing creek like entities

4.2.3 Runoff Assessment

Calculations for viaduct runoff are included separately as part of the Viaduct Drainage Strategy. The viaduct structure is considered as an impervious surface, discharging runoff down to ground level at every column support.

Runoff generated at ground level is calculated based on the landscaping coverage as shown in the LA-230 package. Coverage is mostly pervious though design is subject to change through further development in subsequent phases which require slight adjustment to storage requirements in each drainage basin. The PShP drainage is not considered as it is managed separately, either discharging into the Brook or sheeting directly to Neerigen Street.

The catchment areas and flows for the 1% AEP Storm event have been calculated in the Viaduct Drainage Strategy however have been shown in Table 5 below for information.

Table 7 - Area 2 Runoff Data

Start Pier	End Pier	Catchment Area (m2)	1% AEP Flow (L/s)
11 (Armadale Road)	12	264	12
12	13	264	12

Start Pier	End Pier	Catchment Area (m2)	1% AEP Flow (L/s)
13	14	264	12
14	15	264	12
15	16	264	12
16	17	264	12
17	18 (Forrest Road)	230	11

4.2.4 Storage Requirements

Runoff from both the viaduct and area below is mitigated to control post-development flow rates to a predevelopment level. Storage volumes for this section are solely based on attenuation requirements for localised runoff only, runoff for the PShP is not considered as it is managed separately (considered as MRWA drainage).

To replicate the hydrologic regime for the Neerigen Brook area, 50m^3 storage volume is required on the western side of the corridor, this storage volume has been incorporated into the designs for Basins F1 and F2 in addition to the storage volumes required for attenuation of post-development flow.

Volumes may change during the development of design of the Earthworks and Drainage package. Table 6 below identifies the current storage requirements based on the IDD design for the CI-155 design package. The first flush volume (treatment volume) requirement is based on capturing and treating the first 15mm of impervious runoff for the catchment area.

<u>Drainage Basin Summary</u>

Table 8 - Basin Storage Summary for Area 2

Basin ID	Base RL (Indicative – TBC)	First Flush Volume (m^3)	1% AEP Storage Volume (m^3)
F1	54.62	20	65
F2	54.50	12	45

4.2.5 Neerigen Brook

It should be noted that Neerigen Street floods during the 1% AEP event due to the Minnawarra Park Ponds breaching. The existing railway embankment acts as a flood protection bund to the immediate downstream properties with the Neerigen Street reserve providing temporary attenuation. Refer Figure below.

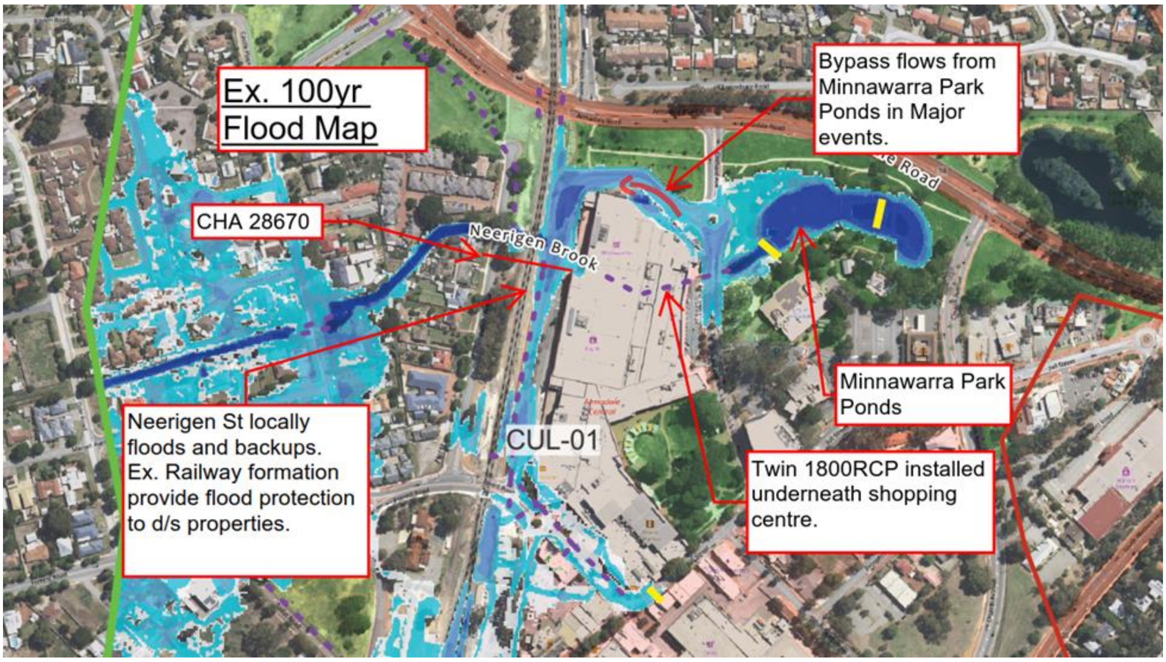


Figure 11 Existing 1% AEP Flood Map

Flood levels in this area are highly sensitive to changes to the existing cross-sectional profile which the Alliance has had to monitor during the design phase and ensure flood Afflux compliance during the design development of the proposed treatment for this area. The figure below shows the buildup of flood levels within Neerigen Street with the existing railway bund providing important downstream flood protection.

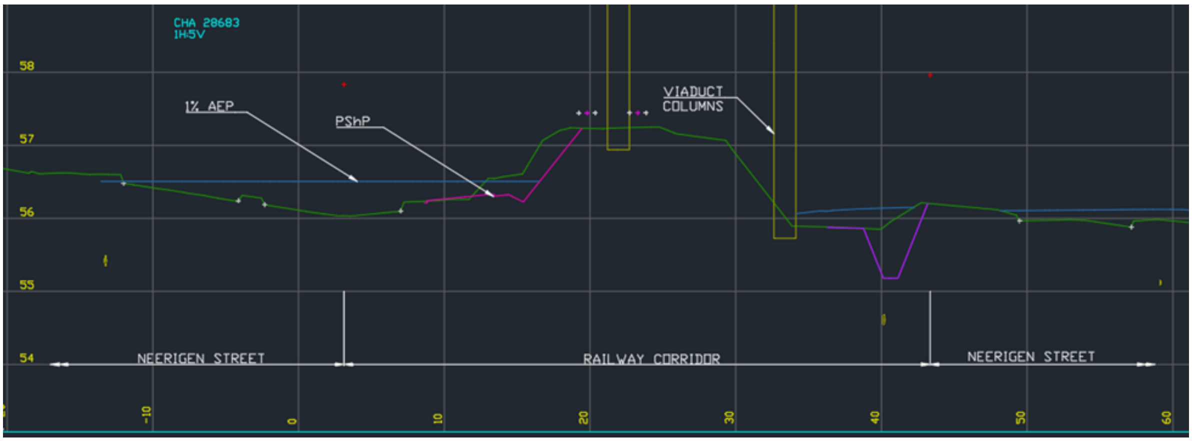


Figure 12 - Chainage 28,683

For further flood and hydrological information refer to R30-MET-RPT-CI-160-00001 Linewide -Flood & Hydrology Report.

4.3 Area 3 – Armadale Precinct

A high-level assessment was undertaken on the pre and post development scenarios for each developed area in the Armadale Precinct. These areas are as follows:

4.1.17 Viaduct North

4.1.18 Pedestrian Zone

4.1.19 PShP North

4.1.20 Bus Interchange

4.1.21 Youth Zone

4.1.22 Concourse

4.1.23 Shared Zone

4.1.24 Carpark

4.1.25 Viaduct South

4.1.26 PShp South

4.3.1 Fraction Impervious

The fraction impervious has been calculated as Total Impervious Area (TIA) via GIS. Impervious areas were assessed using aerial imagery in the existing case and proposed design drawings in the developed case.

Figures 11 to 14 below show the extent of impervious area for each location.

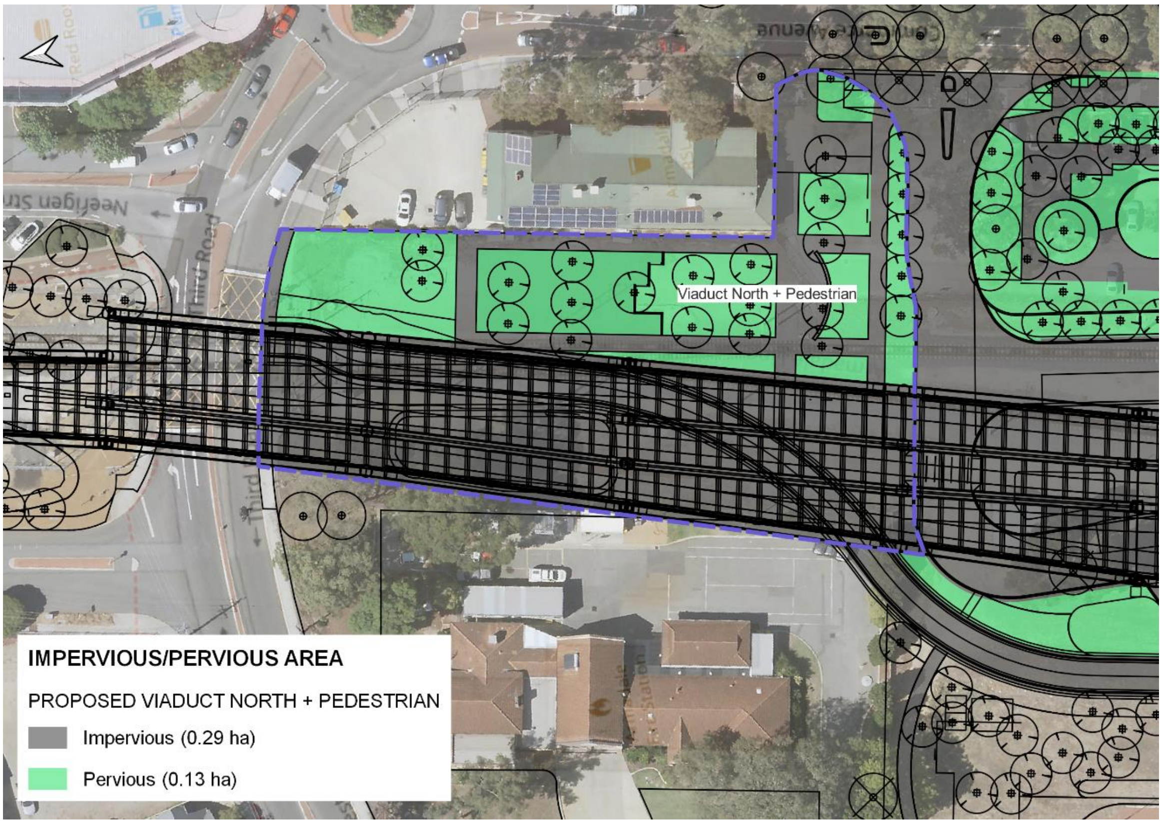


Figure 13. Viaduct North and Pedestrian Zone

Figure 13 above shows the Viaduct North and Pedestrian Zone. The Pedestrian Zone contains pervious areas, shown in green, used to treat and detain the impervious area runoff.

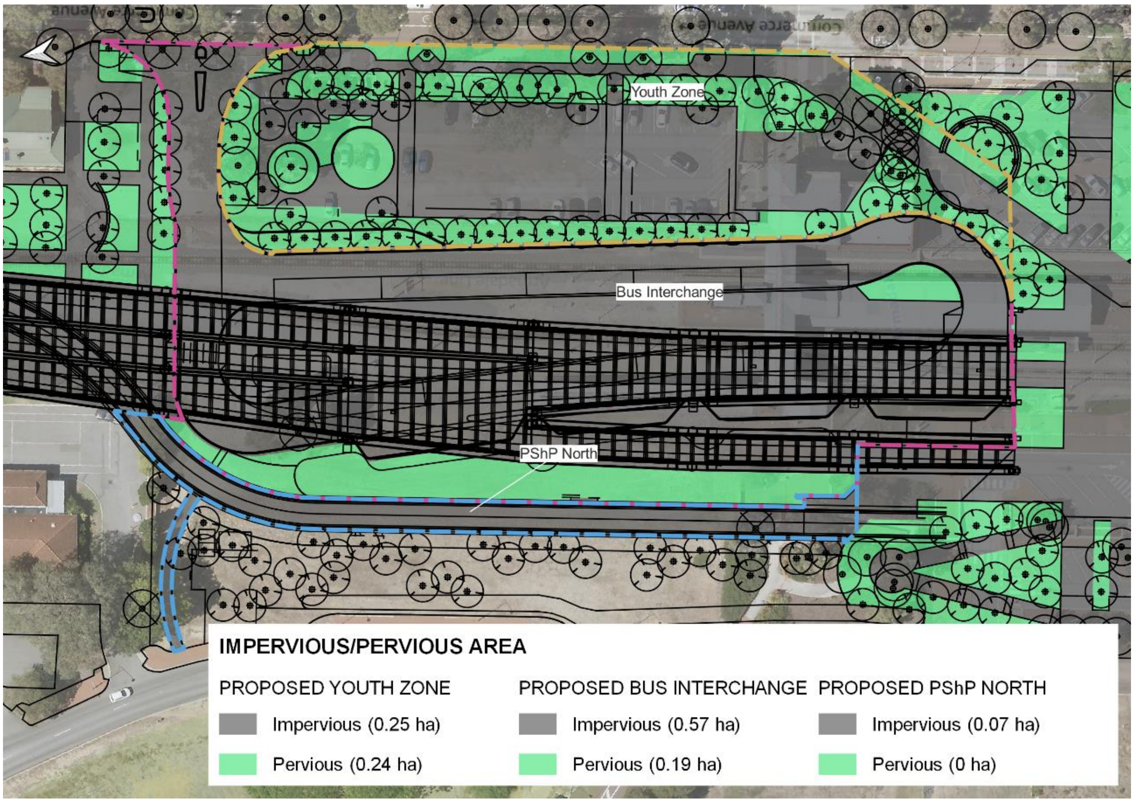


Figure 14. Youth Zone, Bus Interchange and PShP North

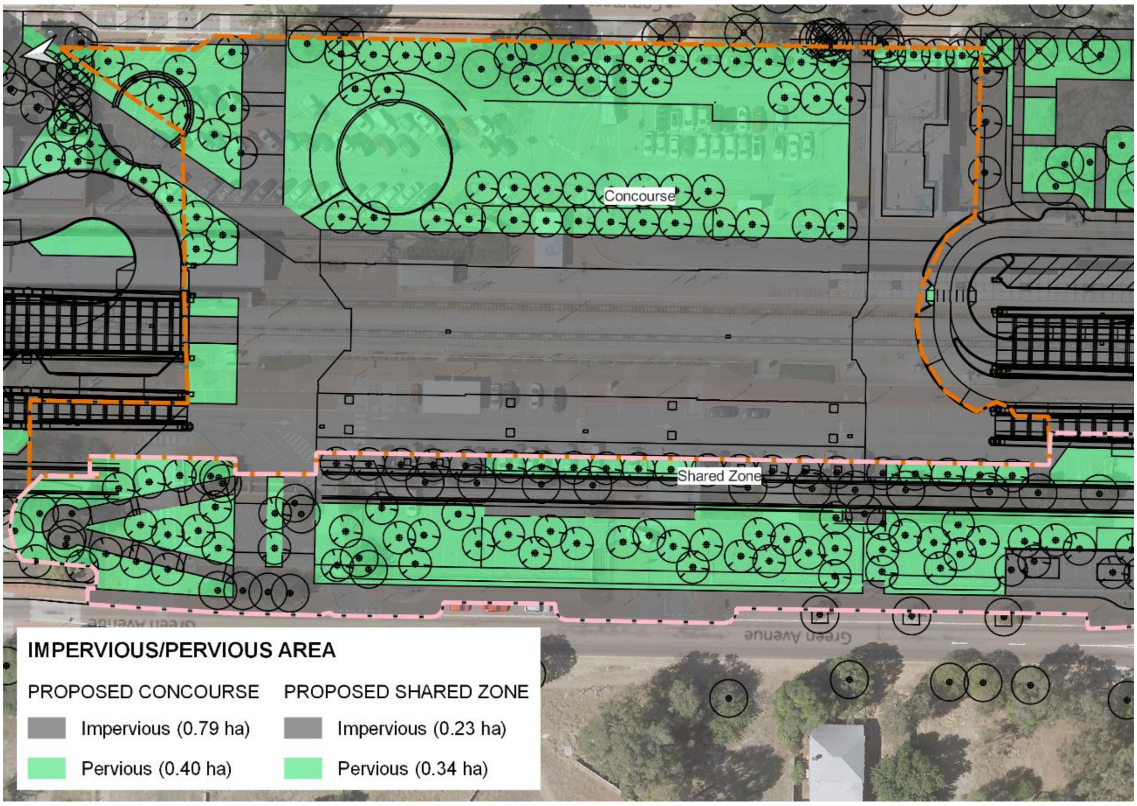


Figure 15. Concourse and Shared Zone

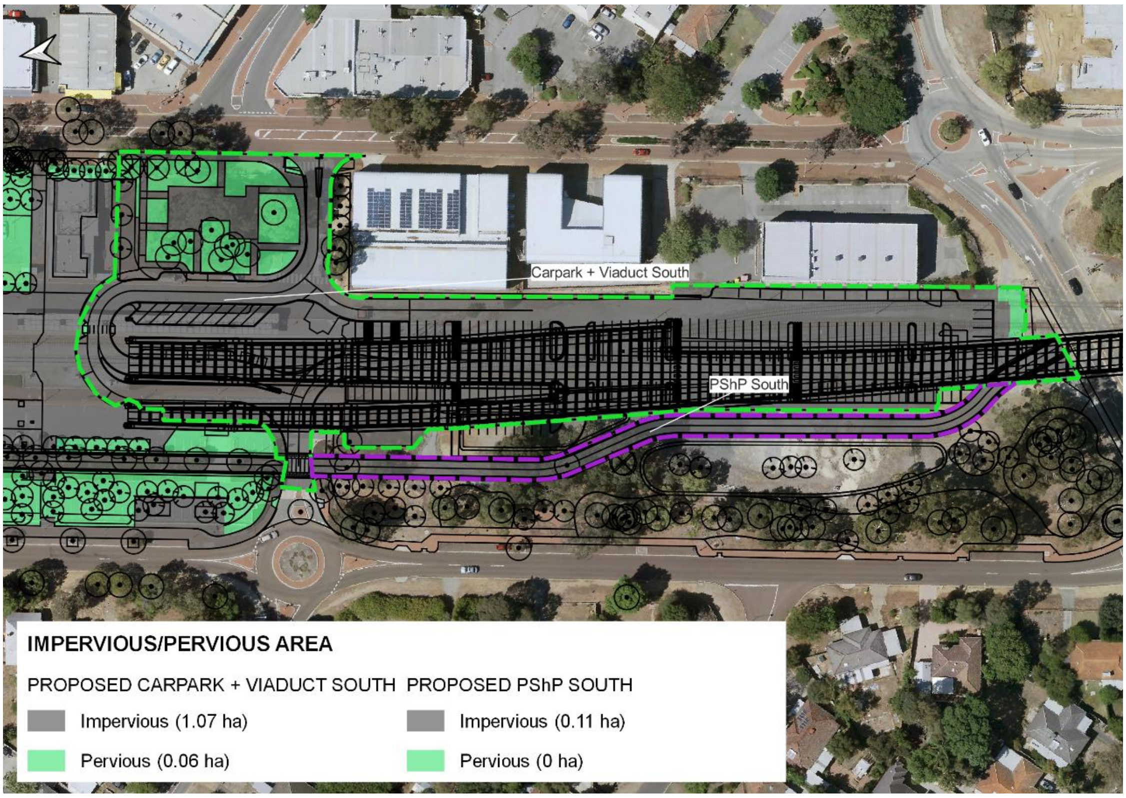


Figure 16. Carpark, PShP South and Viaduct South

The southeast carpark is highly impervious. The car park grades to the south via a grated trench system and discharges to a bio-retention area and ultimately discharges to the existing City of Armadale drainage network on Green Street.

Runoff from the Viaduct structure is managed via downpipes and brought to ground level. Here it is conveyed via a traditional pit and pipe system.

For the purposes of initial design and drainage storage volume assessment, a conservative approach has been undertaken, whereby pre-development catchments have been assessed as completely pervious. This will ensure sufficient on-site storage is achieved in order to limit post development run-off to predevelopment peak flows. During detailed design development within the station precinct, this catchment assessment will be refined to more accurately reflect pre-development conditions.

Table 9 Fraction Impervious Assessment

AREA	PRE -DEVELOPMENT			POST-DEVELOPMENT		
CATCHMENT	*IMPERVIOUS AREA (ha)*	*PERVIOUS AREA (ha)*	*%IMP*	*IMPERVIOUS AREA (ha)*	*PERVIOUS AREA (ha)*	*%IMP*
VIADUCT NORTH + PEDESTRIAN	0.00	0.42	0%	0.29	0.13	69%
YOUTH ZONE	0.00	0.49	0%	0.25	0.24	51%
BUS INTERCHANGE	0.00	0.76	0%	0.57	0.19	75%
PShP NORTH	0.00	0.07	0%	0.07	0.00	100%
CARPARK + VIADUCT SOUTH	0.00	1.13	0%	1.07	0.06	95%
PShP SOUTH	0.00	0.11	0%	0.11	0.00	100%
CONCOURSE	0.00	1.19	0%	0.79	0.40	66%
SHARED ZONE	0.00	0.57	0%	0.23	0.34	40%

4.3.2 Required Storage Volumes

The storage volumes required refer to any volume of water detained on site. This can be achieved via above ground storage e.g., detention basins/swales, infiltration, or underground storage. Based on PTA drainage requirements, storage areas are designed predominantly as bio-retention basins, in order to achieve water quality objectives. These will be designed as far as possible to have a maximum water storage depth of 300mm, with a controlled high-level outlet, and underlying bio-retention media, allowing for percolation of low flow events. Larger flows would move towards tiered bio-retention basins and ultimately into existing stormwater drainage outlet pipe connections as per the existing condition piped outlets for major flows. The storage volume requirements for on-site detention basins as shown below is based on post-development catchment runoff into bio-retention/detention basins for major events up to the 1%AEP, whilst allowing for pre-development peak flow values for this equivalent event.

The required volumes can also be combined to be managed in a larger detention system if this is necessary.

Table 10 Required Storage Volumes

STORAGE REQUIREMENTS			
Area	*Post-Development Detention Storage Volume (m^3)*	*First Flush Volume (m^3)*	*Remaining Storage Requirement (m^3)*
VIADUCT NORTH + PEDESTRIAN ZONE	56	44	13
YOUTH ZONE	30	36	-
BUS INTERCHANGE	105	86	19
PShP NORTH	17	11	6
CARPARK + VIADUCT SOUTH	200	161	39
PShP SOUTH	28	17	11
CONCOURSE	120	119	1
SHARED ZONE	30	35	-

4.3.3 Pre and Post Development Hydraulic Outputs

Pre-development, post-development unmitigated and post-development mitigates critical design flow result output are published in Figures 15 to 20

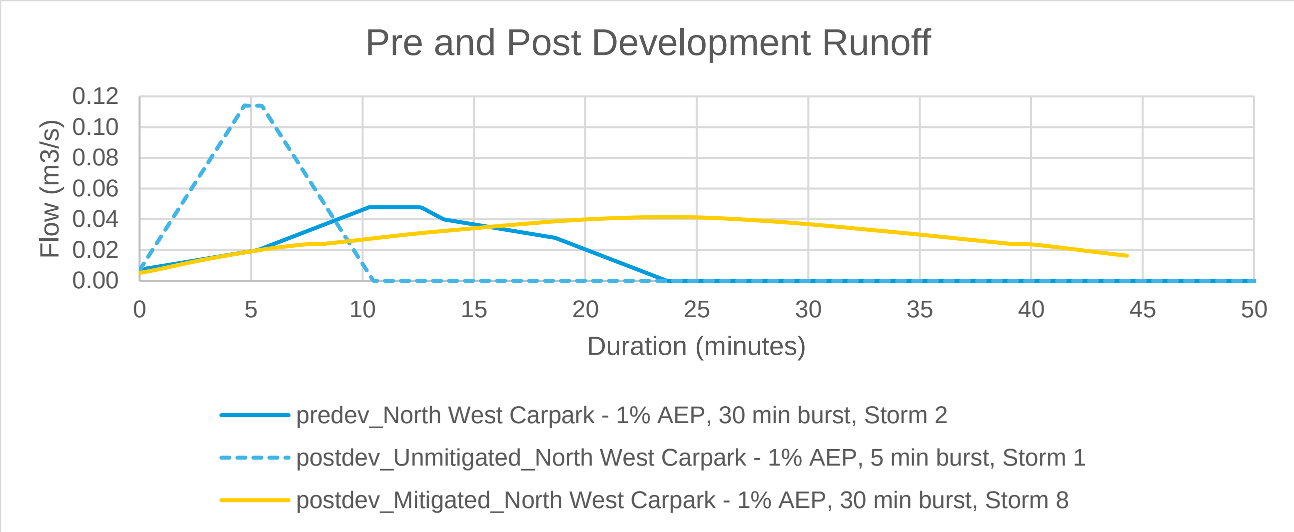


Figure 17 – Pre and Post-Development Critical Duration Runoff 1% AEP VIADUCT NORTH + PEDESTRIAN ZONE

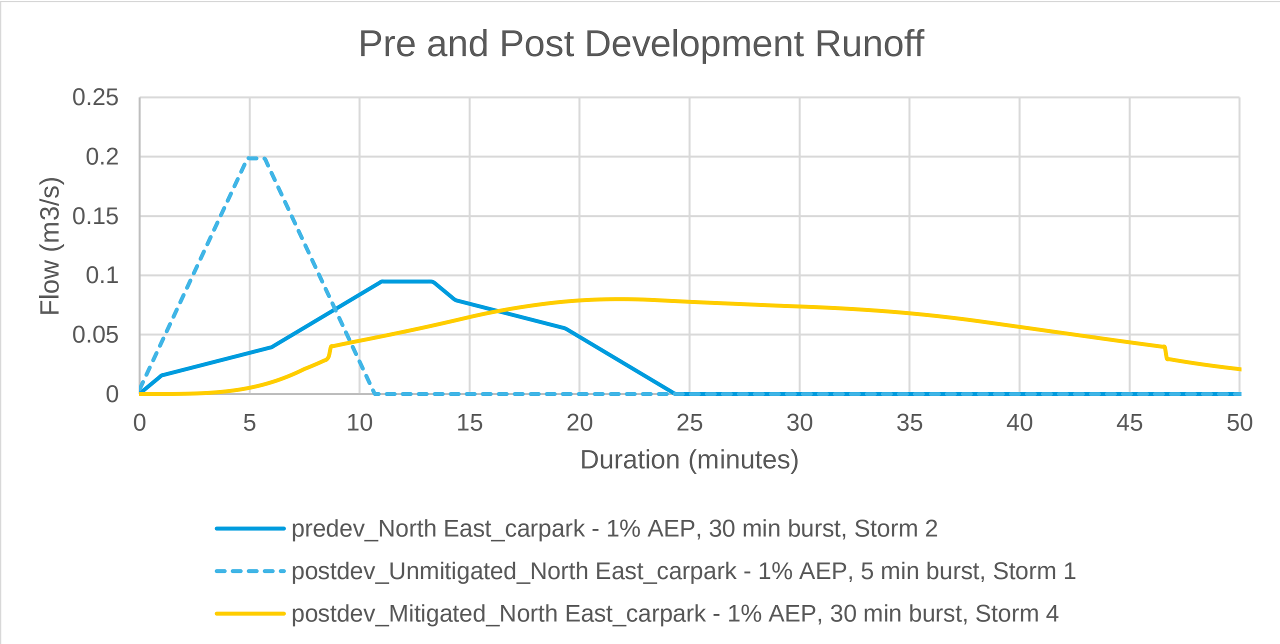


Figure 18 – Pre and Post Development Critical Duration Runoff 1% AEP SOUTHEAST CARPARK + VIADUCT SOUT

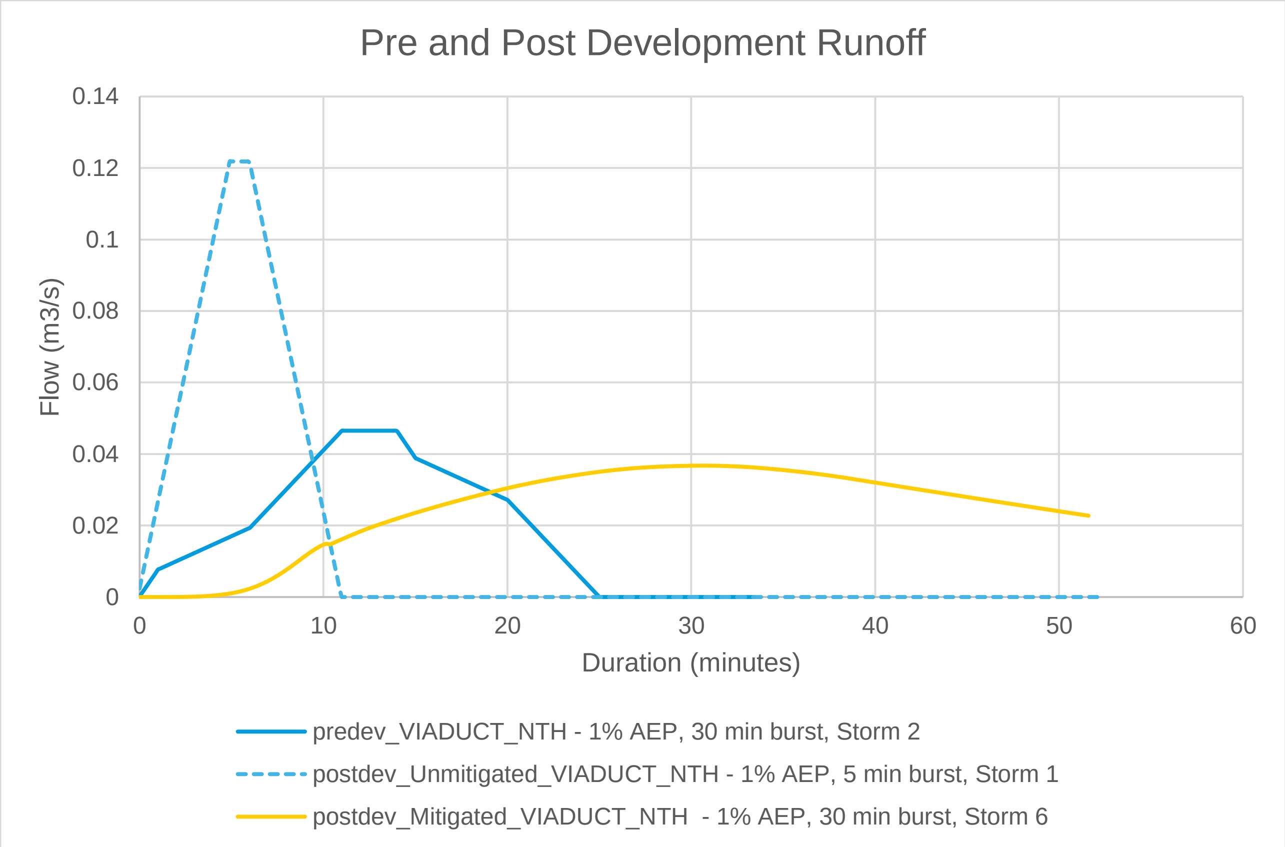


Figure 19 – Pre and Post Development Critical Duration Runoff 1% AEP BUS INTERCHANGE

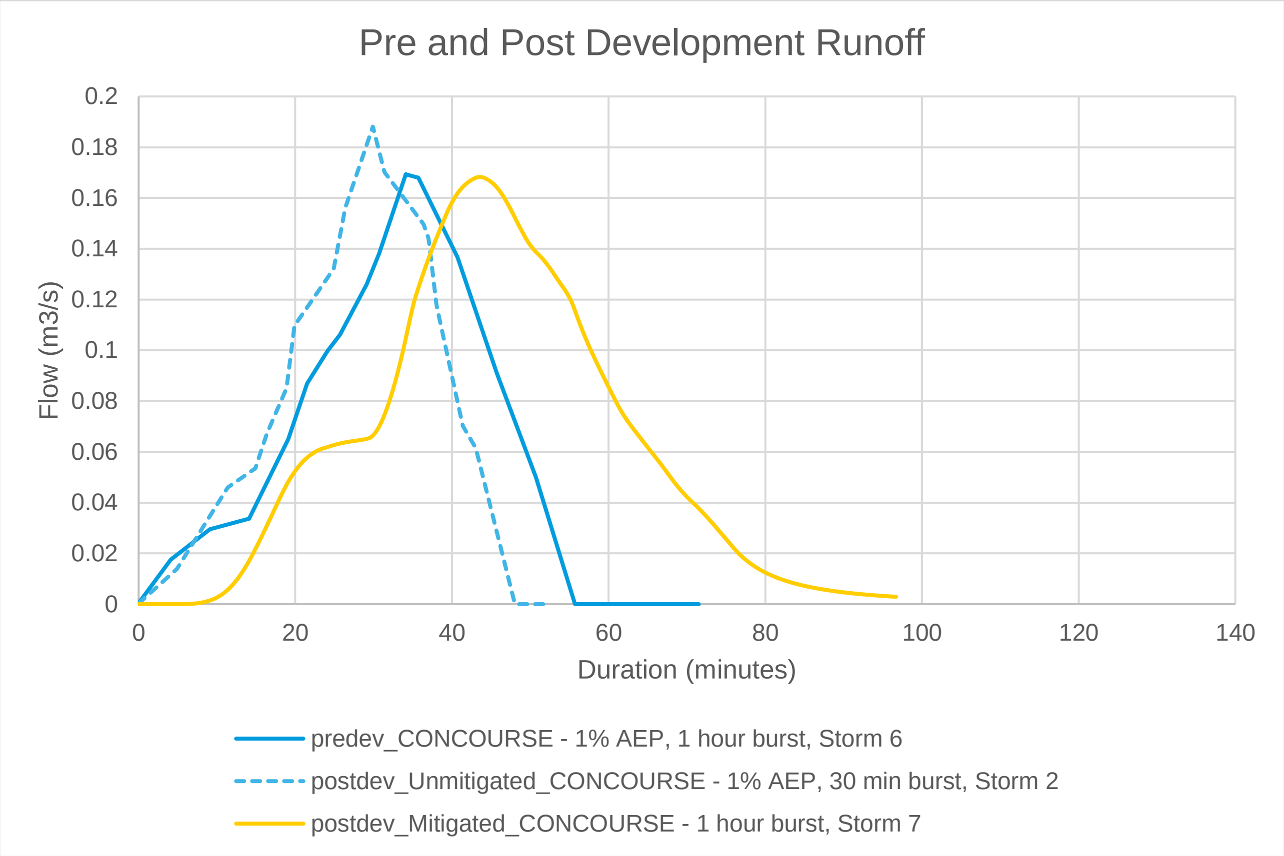


Figure 20 – Pre and Post Development Critical Duration Runoff 1% AEP PHSP NORTH

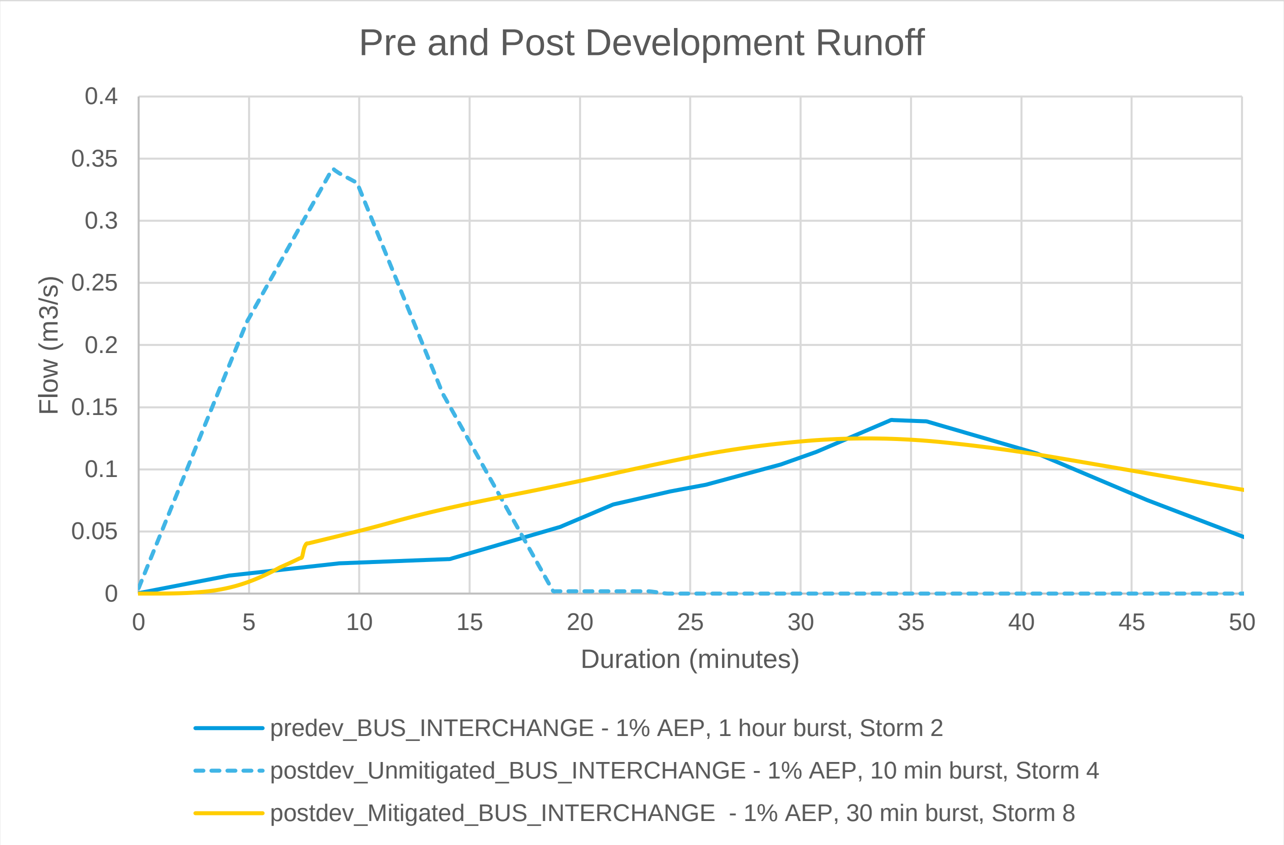


Figure 21 – Pre and Post Development Critical Duration Runoff 1% AEP PHSP SOUTH

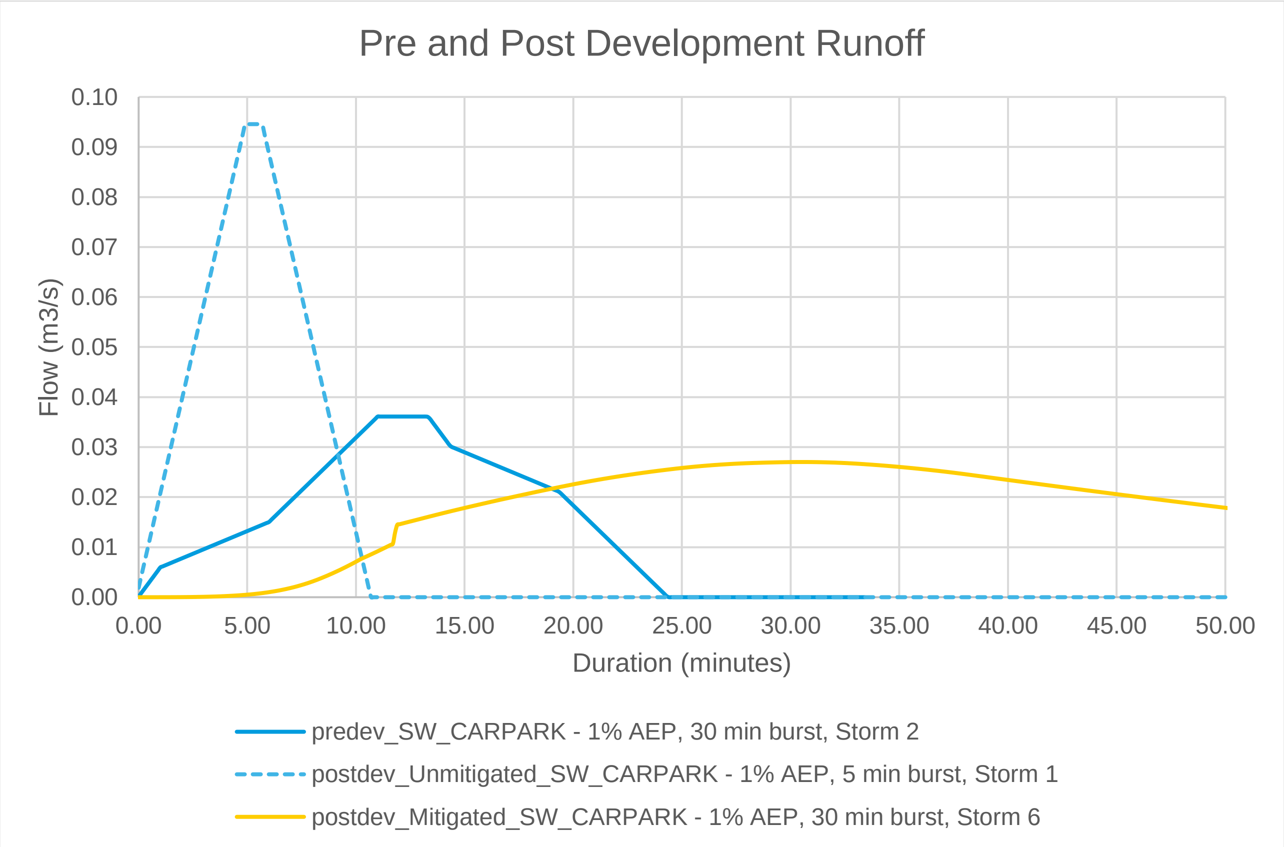


Figure 22 – Pre and Post Development Critical Duration Runoff 1% AEP SHARED ZONE

4.3.4 Treatment Volumes

The first 15mm of stormwater runoff from impervious areas will be treated in bioretention areas. Table 9 shows the volumes required to treat the first flush.

Table 11 Storm Losses

Water Treatment Volumes		
Area	First Flush Volume (m^3)	First Flush Area (ha)
VIADUCT NORTH + PEDESTRIAN ZONE	44	0.29
YOUTH ZONE	36	0.25
BUS INTERCHANGE	86	0.57
PShP NORTH	11	0.07
CARPARK + VIADUCT SOUTH	161	1.07
PShP SOUTH	17	0.11
CONCOURSE	119	0.79
SHARED ZONE	35	0.23

4.4 Area 4 – Church Avenue to Southern Viaduct Abutment

This area captures the space under viaduct south of Church Avenue to the Southern Viaduct Abutment (where the viaduct structure terminates and retained embankment starts). Stormwater runoff from the PShP is managed separately to maintain separation between MRWA and PTA stormwater runoff.

Runoff from the viaduct will discharge to ground via downpipe structures at each column location, refer Figure 8 in Section 4.2.1 for discharge schematic. Once at ground level, stormwater runoff will be managed either by a network of open channel drains (landscaped swales) or overflow directly into a low-lying drainage basin.

Catchment areas for this section are relatively small, catering for the viaduct structure runoff over Church Avenue down to the retained abutment transition, as well as the overland flow from the area below structure (within the rail corridor).

The final design details for this section are still under development, as civil and drainage design elements need to be integrated into the final landscape design. The current concept design includes open channels meandering around column supports to direct runoff towards new shallow landscaped drainage basins, or direct discharge from downpipes into the drainage basins.

There are two low lying drainage basins proposed within this section, Drainage Basin C1 and Drainage Basin C2. Refer Figure 21 below. Both basins will have overflow pits to control discharge into the PTA network downstream. Larger events will overtop the basin and flow onto Wungong Road per the predevelopment scenario.

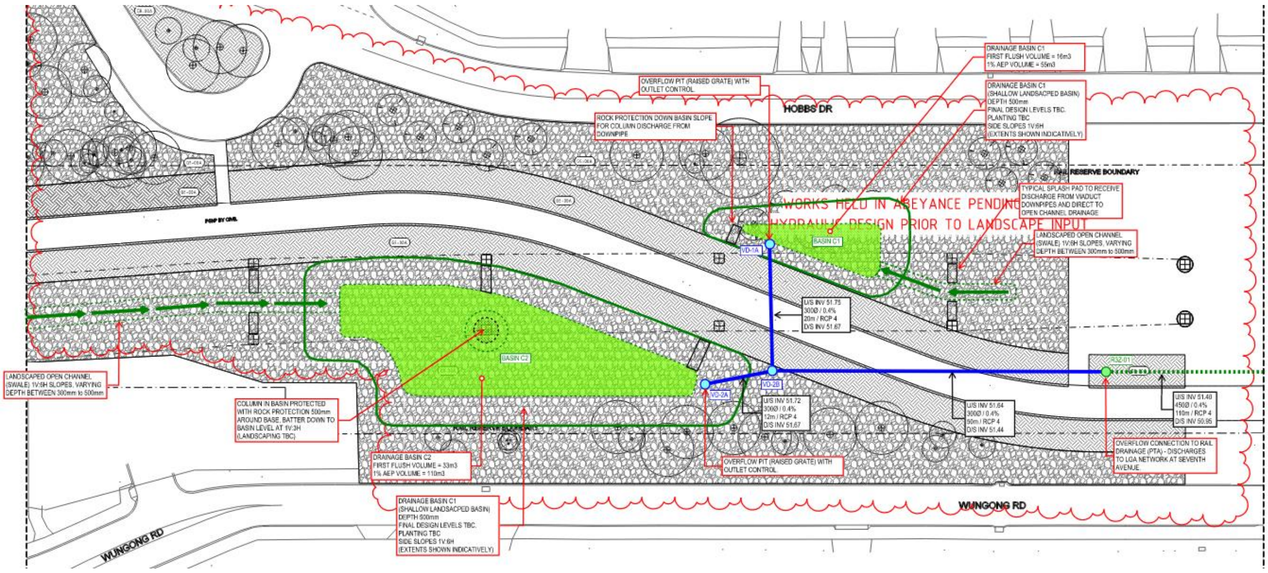


Figure 23 - Drainage Scheme for Area 4

The SWTC requires runoff from the PSP to be managed separate to rail corridor runoff. Therefore, the PSP runoff is managed via kerb, conveying runoff to new grated pits with soak well bases.

4.4.1 Runoff Assessment

Calculations for viaduct runoff are included separately as part of the Viaduct Drainage Strategy. The viaduct structure is considered as an impervious surface, discharging runoff down to ground level at every column support.

Runoff generated at ground level is calculated based on the landscaping coverage as shown in the LA-230 package. Coverage is mostly pervious though design is subject to change through further development in subsequent phases which require slight adjustment to storage requirements in each drainage basin.

The catchment areas and flows for the 1% AEP Storm event have been calculated in the Viaduct Drainage Strategy however have been shown in Table 10 below for information.

Table 12 - Runoff Assessment for Area 4

Start Pier	End Pier	Catchment Area (m2)	1% AEP Flow (L/s)
39 (Church St North)	40	210	11
40 (Church St South)	41	210	10
41	42	210	10
42	43	210	10
44	45	210	10
45	Abutment-02	210	10

4.4.2 Storage Volume Required

Runoff from both the viaduct and area below is mitigated to control post-development flow rates to a predevelopment level. Storage volumes for this section are solely based on attenuation requirements for localised runoff only, runoff for the PShP is not considered as it is managed separately (considered as MRWA drainage).

Volumes may change during the development of design of the Earthworks and Drainage package. Table 11 below identifies the current storage requirements based on the IDD design for the CI-155 design package. The first flush volume (treatment volume) requirement is based on capturing and treating the first 15mm of impervious runoff for the catchment area.

Table 13 - Storage Requirements for Area 4

Start Chainage	End Chainage	Drains to Basin	Discharge	First Flush Volume (m3)	1% AEP Storage Volume (m3)
29,550	29,670	C1	Overflow to PTA Drainage Network (Via VD-1A)	16	55
29,670	29,770	C2	Overflow to PTA Drainage Network (Via VD-2A)	33	110
			Totals	**49**	**165**

5. Conclusion

The overall stormwater strategy applies water sensitive urban design principles and safely conveys water via surface drainage to above ground storage systems. The design maintains pre-development runoff rates by utilising stormwater bio-retention basins.

Enclosed Drawings/Sketches:

- Area 2
  - Drainage Markup – Area 2 Sheet 1A
  - Drainage Markup – Area 2 Sheet 1B
- Area 4
  - Drainage Markup – Area 4 Sheet 1A
  - Drainage Markup – Area 4 Sheet 1B
- Area 3 – Main Precinct Area
  - R30-MET-DWG-CI-200-04000
  - R30-MET-DWG-CI-200-04001
  - R30-MET-DWG-CI-200-04002
  - R30-MET-DWG-CI-200-04003
  - R30-MET-DWG-CI-200-04004

INTERIM DETAIL DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01	16.05.23	ISSUE FOR IDD-IDC	DF	YD	MH	AE
B	10.02.23	ISSUED FOR RD	DF	YD	MH	AE
A	05.08.22	ISSUED FOR RD	DF	YD	MH	AE
A.01	01.07.22	ISSUE FOR RD-IDC	DF	YD	MH	AE

ORIG SIZE A1

0 2500 5000 7500 10000 12500 25000mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-UDL-DWG-LA-230-00402 | Rev: C.01

REFERENCES

R30-MET-MDL-SV-000-00001
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-CAD-CI-200-00003
XR01GN_SURVEY_PCG2020
R30-WWH-MDL-AR-225-00001
R30-MET-MDL-ST-235-00001
R30-DEA-MDL-ST-170-01000

SCALE 1 : 250 (@ A1)

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED	D.F
DRAWN	Y.D
CHECKED	M.H
APPROVED	A.E
DATE	16/05/23

Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE STATION PRECINCT
LANDSCAPE
PLANTING PLAN 03

PTA Drawing No: 11-A-107-LA0069 | Rev: C.01

CAD DRAWING PATHNAME Autodesk Docs://BRE BYFORD RAIL EXTENSION/R30-UDL-MDL-LA-230-00001.rvt

DRAINAGE MARKUP - AREA 2 SHEET 1B

INTERIM DETAIL DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01	16.05.23	ISSUE FOR IDD-IDC	DF	YD	MH	AE
B	10.02.23	ISSUED FOR RD	DF	YD	MH	AE
A	05.08.22	ISSUED FOR RD	DF	YD	MH	AE
A.01	01.07.22	ISSUE FOR RD-IDC	DF	YD	MH	AE

ORIG SIZE A1 — 0 2500 5000 7500 10000 12500 25000mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-UDL-DWG-LA-230-00403 | Rev: C.01

REFERENCES
- R30-MET-MDL-SV-000-00001
- R30-MET-XRF-CI-200-00001
- R30-MET-XRF-CI-200-00002
- R30-MET-CAD-CI-200-00003
- XR01GN_SURVEY_PCG2020
- R30-WWH-MDL-AR-225-00001
- R30-MET-MDL-ST-235-00001
- R30-DEA-MDL-ST-170-01000

SCALE 1 : 250 (@ A1)

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED	D.F
DRAWN	Y.D
CHECKED	M.H
APPROVED	A.E
DATE	16/05/23

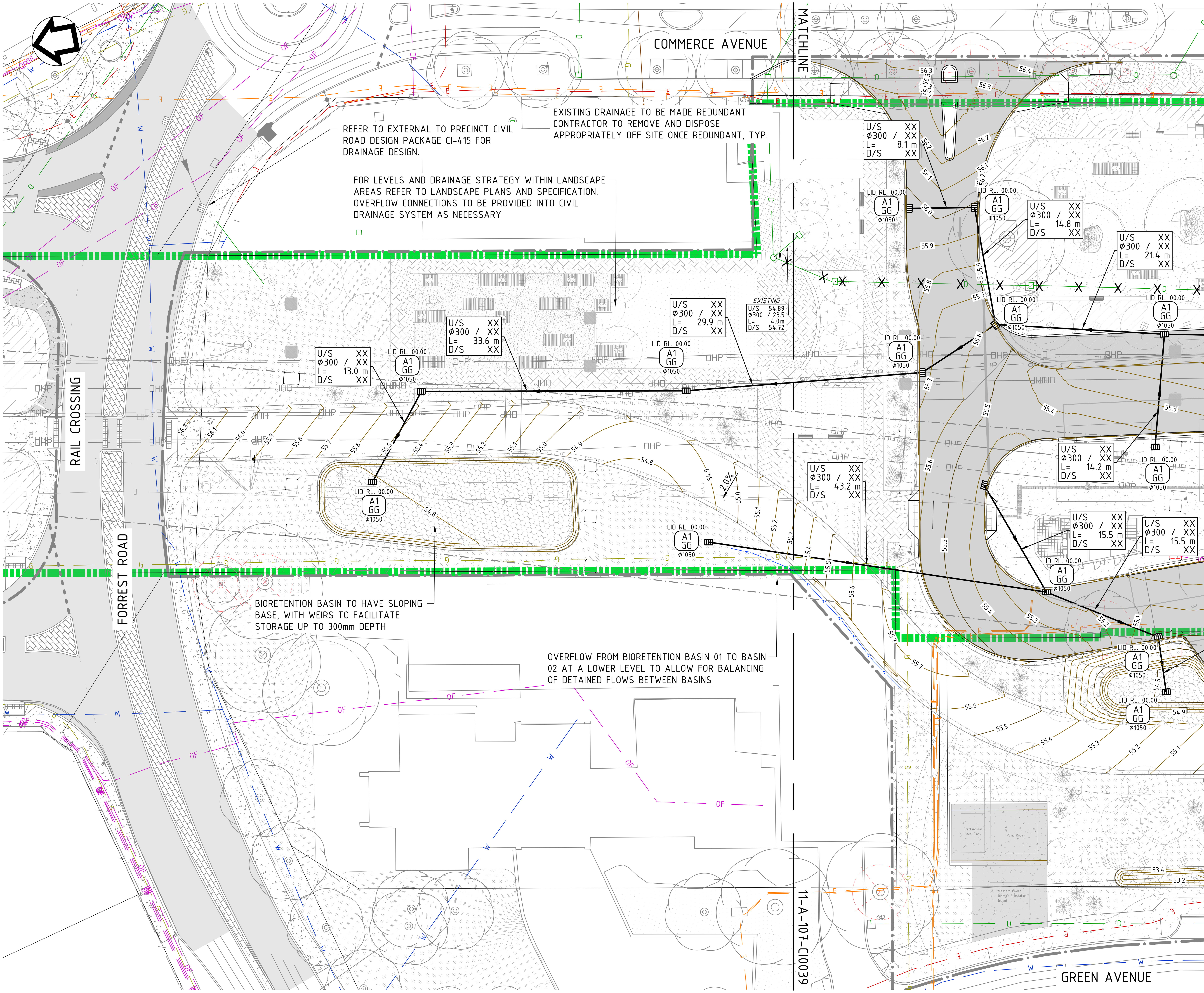
Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE STATION PRECINCT
LANDSCAPE
PLANTING PLAN 04

PTA Drawing No: 11-A-107-LA0070 Rev: C.01

CAD DRAWING PATHNAME Autodesk Docs://BRE BYFORD RAIL EXTENSION/R30-UDL-MDL-LA-230-00001.rvt



NOTES

1. FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
2. FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
3. FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
4. LOCAL PRECINCT DRAINAGE HAS BEEN COMPLETED IN ACCORDANCE WITH THE WIDER PRECINCT DRAINAGE STRATEGY, AS INCLUDED IN APPENDIX E OF THE ARMADALE PRECINCT CIVIL DESIGN REPORT. REFER TO DESIGN REPORT AND APPENDIX E FOR FURTHER DETAILS ON PRECINCT WIDE STORMWATER DRAINAGE STRATEGY.
5. FLOWS GREATER THAN 100-YR ARI STORM EVENT ARE INTENDED TO BE CONVEYED TO COA DRAINAGE NETWORK VIA AN OUTLET PIT AND PIPE CONNECTION OR VIA OVERLAND FLOW.
6. LOCATION AND SIZES OF ALL BIORETENTIVE BASINS NEED TO BE FUTHER COORDINATED WITH LANDSCAPE IN SUBSEQUENT DESIGN PHASE.
7. VIADUCT DRAINAGE TO BE CONVEYED VIA DOWNPIPES PRECAST INTO PIERS. VIADUCT DRAINAGE OUTLET POINTS SUBJECT TO CONFIRMATION AND COORDINATION WITH CIVIL, VIADUCT AND LANDSCAPE DESIGN
8. LANDSCAPE/VEGETATIVE STRIPS TO BE DRAINED VIA SUBSOIL. SUBSOIL PLANS TO BE FURTHER DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH CIVIL, LANDSCAPE AND HYDRAULICS.
9. CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS
10. EXISTING RAIL SYSTEM SERVICES TO BE MADE REDUNDANT FOLLOWING INSTALLATION OF THE TEMPORARY MCR AND SHUT DOWN OF RAIL. FOR TREATMENT OF REDUNDANT SERVICES, REFER TO RESPECTIVE DISCIPLINE DESIGN DRAWINGS.
11. EXISTING AND PROPOSED DRAINAGE SUBJECT TO FURTHER INVESTIGATION AND FINALISATION OF DRAINAGE DESIGN IN DETAILED DESIGN.
12. FOR OVERALL TREATMENT OF UTILITY SERVICES, REFER TO UTILITIES PACKAGE UT-040.
13. PROPOSED DRAINAGE INFRASTRUCTURE MAY CLASH WITH EXISTING SERVICES THAT MAY BE MADE REDUNDANT. PRIOR TO INSTALLATION OF DRAINAGE, ENSURE SERVICES ARE ACCURATELY LOCATED AND IDENTIFIED. REDUNDANT SERVICES TO BE REMOVED AS PER PTA REQUIREMENTS.

LEGEND

- PROPOSED DRAINAGE PIPE
- PROPOSED V-DRAIN
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE TO BE DEMOLISHED

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

DIAL BEFORE YOU DIG
www.1100.com.au
The Essential First Step.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01.01	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE A1 — 0 10 20 30 40 50 100mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-MET-DWG-CI-200-04000 Rev: C.01.01

REFERENCES
XR01GN_CADASTRAL_BDY_PCG2020
XR01GN_SURVEY_PCG2020
XR01UT_UTILITIES_PCG2020
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-XRF-CI-200-00003
XR01GN_RAIL_RESERVE_BDY_PCG2020
_LOGO_METCONNX
R30-UDL-XRF-LA-230-00001
R30-WWH-XRF-AR-225-00001
R30-DEA-XRF-ST-170-01001
~~XR01GN_ENVIRONMENTAL_SITES_PCG2020~~
R30-MET-XRF-CI-415-00001

SCALE 1:250

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

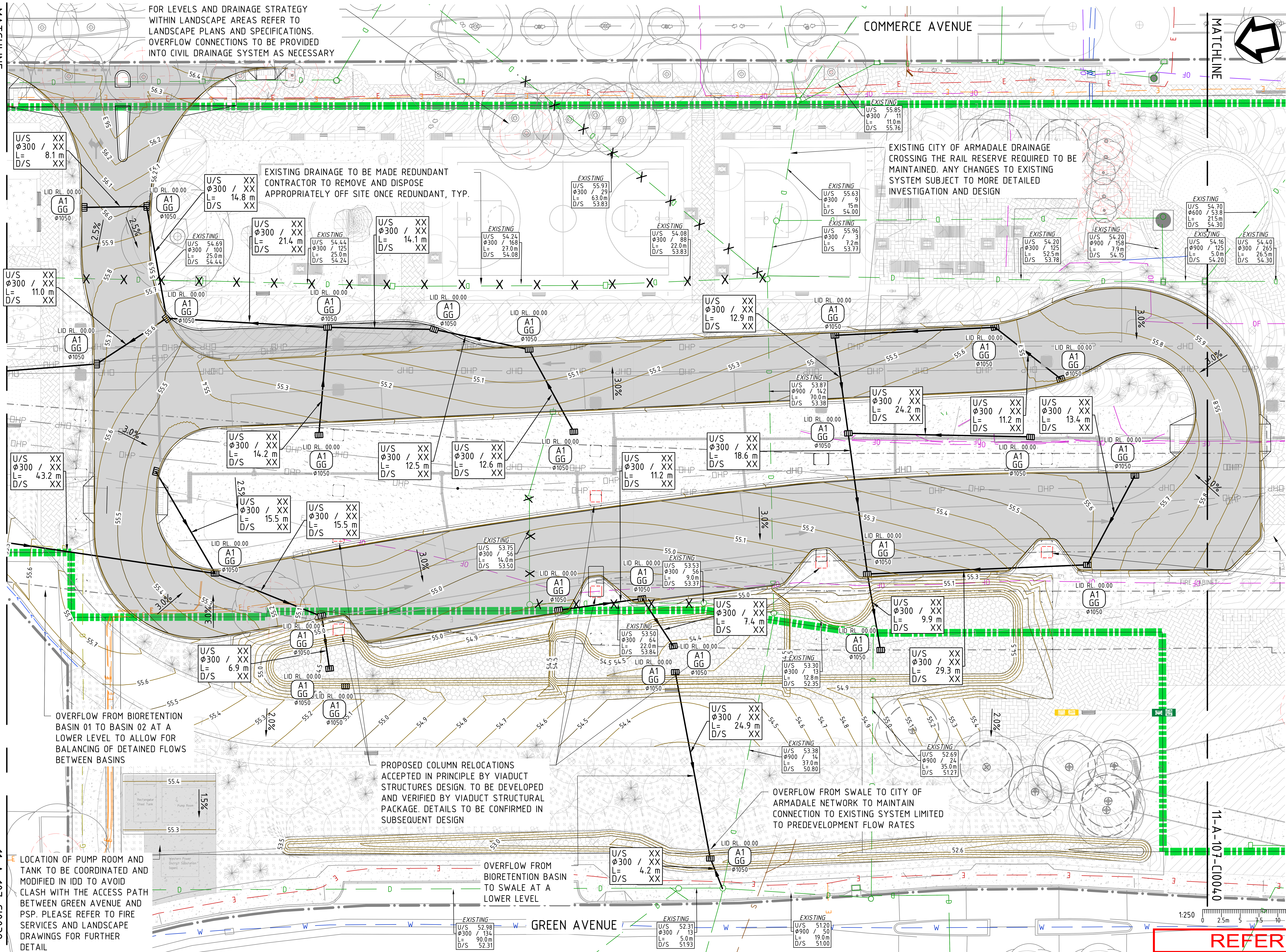
Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 1 OF 5

PTA Drawing No: 11-A-107-CI0038 Rev: B

CAD DRAWING PATHNAME L:\03 - AutoCAD\New Standards - Nov 2019\PTA Drawing Sheets - General\PTA_A1_Sheet.dwg



NOTES

1. FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
2. FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
3. FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
4. LOCAL PRECINCT DRAINAGE HAS BEEN COMPLETED IN ACCORDANCE WITH THE WIDER PRECINCT DRAINAGE STRATEGY, AS INCLUDED IN APPENDIX E OF THE ARMADALE PRECINCT CIVIL DESIGN REPORT. REFER TO DESIGN REPORT AND APPENDIX E FOR FURTHER DETAILS ON PRECINCT WIDE STORMWATER DRAINAGE STRATEGY.
5. FLOWS GREATER THAN 100-YR ARI STORM EVENT ARE INTENDED TO BE CONVEYED TO COA DRAINAGE NETWORK VIA AN OUTLET PIT AND PIPE CONNECTION OR VIA OVERLAND FLOW.
6. LOCATION AND SIZES OF ALL BIORETENTIVE BASINS NEED TO BE FUTHER COORDINATED WITH LANDSCAPE IN SUBSEQUENT DESIGN PHASE.
7. VIADUCT DRAINAGE TO BE CONVEYED VIA DOWNPIPES PRECAST INTO PIERS. VIADUCT DRAINAGE OUTLET POINTS SUBJECT TO CONFIRMATION AND COORDINATION WITH CIVIL, VIADUCT AND LANDSCAPE DESIGN
8. LANDSCAPE/VEGETATIVE STRIPS TO BE DRAINED VIA SUBSOIL. SUBSOIL PLANS TO BE FURTHER DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH CIVIL, LANDSCAPE AND HYDRAULICS.
9. CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS
10. EXISTING RAIL SYSTEM SERVICES TO BE MADE REDUNDANT FOLLOWING INSTALLATION OF THE TEMPORARY MCR AND SHUT DOWN OF RAIL. FOR TREATMENT OF REDUNDANT SERVICES, REFER TO RESPECTIVE DISCIPLINE DESIGN DRAWINGS.
11. EXISTING AND PROPOSED DRAINAGE SUBJECT TO FURTHER INVESTIGATION AND FINALISATION OF DRAINAGE DESIGN IN DETAILED DESIGN.
12. FOR OVERALL TREATMENT OF UTILITY SERVICES, REFER TO UTILITIES PACKAGE UT-040.
13. PROPOSED DRAINAGE INFRASTRUCTURE MAY CLASH WITH EXISTING SERVICES THAT MAY BE MADE REDUNDANT. PRIOR TO INSTALLATION OF DRAINAGE, ENSURE SERVICES ARE ACCURATELY LOCATED AND IDENTIFIED. REDUNDANT SERVICES TO BE REMOVED AS PER PTA REQUIREMENTS.

LEGEND

- PROPOSED DRAINAGE PIPE
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE TO BE DEMOLISHED

DIAL BEFORE YOU DIG www.1100.com.au The Essential First Step.

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01.01	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE A1 — 0 10 20 30 40 50 100mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-MET-DWG-CI-200-04001 Rev: C.01.01

REFERENCES
XR01GN_CADASTRAL_BDY_PCG2020
XR01GN_SURVEY_PCG2020
XR01UT_UTILITIES_PCG2020
BRE_C3D_SERVICES_ALL POINTS
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-XRF-CI-200-00003
_LOGO_METCONNX
XR01GN_RAIL_RESERVE_BDY_PCG2020
R30-UDL-XRF-LA-230-00001
R30-DEA-XRF-ST-170-01001
XR01GN_ENVIRONMENTAL_SITES_PCG2020

SCALE 1:250

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

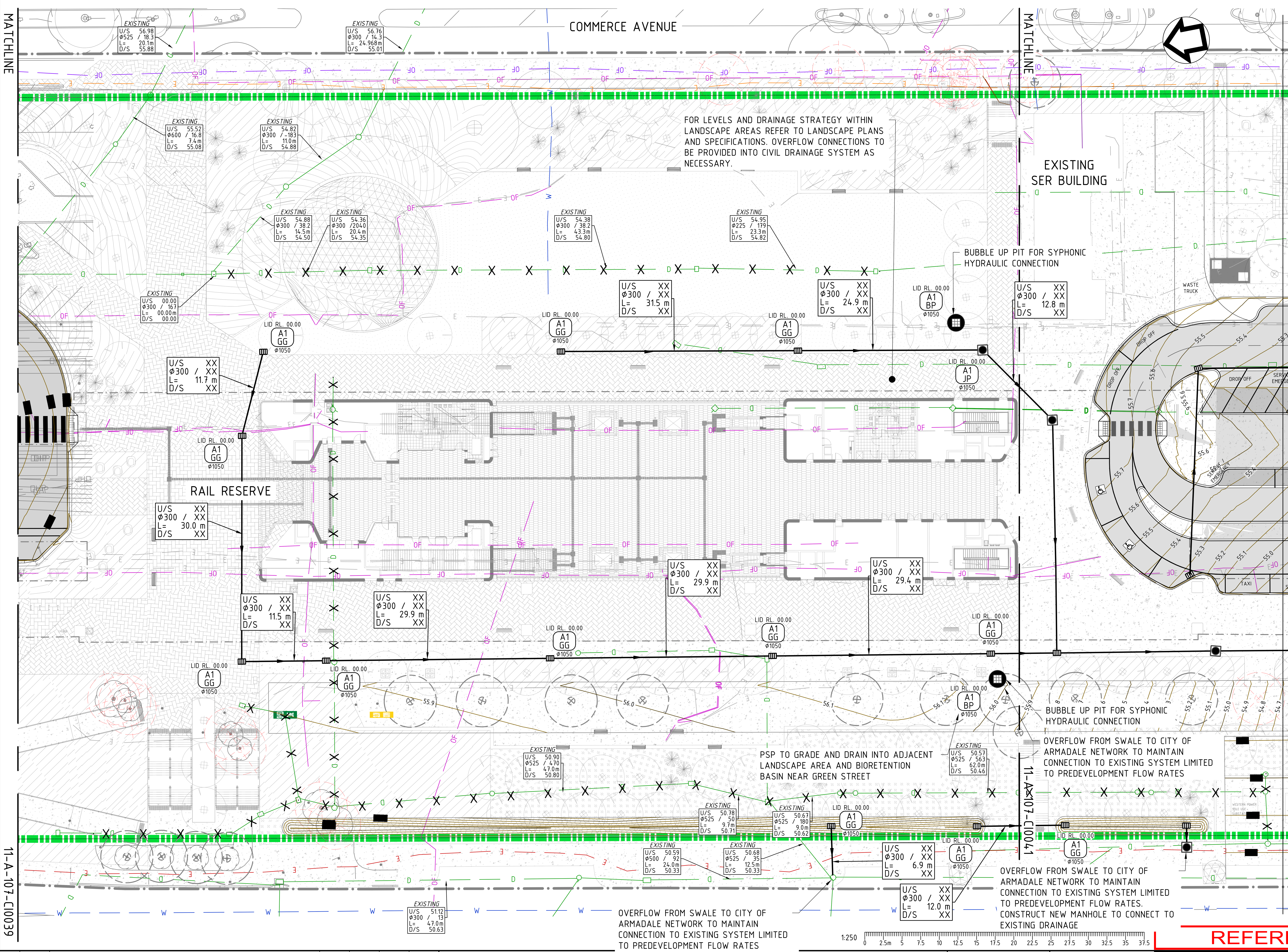
Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 2 OF 5

PTA Drawing No: 11-A-107-CI0039 Rev: B

CAD DRAWING PATHNAME L:\03 - AutoCAD\New Standards - Nov 2019\PTA Drawing Sheets - General\PTA_A1_Sheet.dwg



NOTES

1. FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
2. FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
3. FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
4. LOCAL PRECINCT DRAINAGE HAS BEEN COMPLETED IN ACCORDANCE WITH THE WIDER PRECINCT DRAINAGE STRATEGY, AS INCLUDED IN APPENDIX E OF THE ARMADALE PRECINCT CIVIL DESIGN REPORT. REFER TO DESIGN REPORT AND APPENDIX E FOR FURTHER DETAILS ON PRECINCT WIDE STORMWATER DRAINAGE STRATEGY.
5. FLOWS GREATER THAN 100-YR ARI STORM EVENT ARE INTENDED TO BE CONVEYED TO COA DRAINAGE NETWORK VIA AN OUTLET PIT AND PIPE CONNECTION OR VIA OVERLAND FLOW.
6. LOCATION AND SIZES OF ALL BIORETENTIVE BASINS NEED TO BE FUTHER COORDINATED WITH LANDSCAPE IN SUBSEQUENT DESIGN PHASE.
7. VIADUCT DRAINAGE TO BE CONVEYED VIA DOWNPIPES PRECAST INTO PIERS. VIADUCT DRAINAGE OUTLET POINTS SUBJECT TO CONFIRMATION AND COORDINATION WITH CIVIL, VIADUCT AND LANDSCAPE DESIGN
8. LANDSCAPE/VEGETATIVE STRIPS TO BE DRAINED VIA SUBSOIL. SUBSOIL PLANS TO BE FURTHER DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH CIVIL, LANDSCAPE AND HYDRAULICS.
9. CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS
10. EXISTING RAIL SYSTEM SERVICES TO BE MADE REDUNDANT FOLLOWING INSTALLATION OF THE TEMPORARY MCR AND SHUT DOWN OF RAIL. FOR TREATMENT OF REDUNDANT SERVICES, REFER TO RESPECTIVE DISCIPLINE DESIGN DRAWINGS.
11. EXISTING AND PROPOSED DRAINAGE SUBJECT TO FURTHER INVESTIGATION AND FINALISATION OF DRAINAGE DESIGN IN DETAILED DESIGN.
12. FOR OVERALL TREATMENT OF UTILITY SERVICES, REFER TO UTILITIES PACKAGE UT-040.
13. PROPOSED DRAINAGE INFRASTRUCTURE MAY CLASH WITH EXISTING SERVICES THAT MAY BE MADE REDUNDANT. PRIOR TO INSTALLATION OF DRAINAGE, ENSURE SERVICES ARE ACCURATELY LOCATED AND IDENTIFIED. REDUNDANT SERVICES TO BE REMOVED AS PER PTA REQUIREMENTS.

LEGEND

- PROPOSED DRAINAGE PIPE
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE TO BE DEMOLISHED

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

DIAL BEFORE YOU DIG www.1100.com.au The Essential First Step.

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01.01	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE A1 — 0 10 20 30 40 50 100mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-MET-DWG-CI-200-04002 Rev: C.01.01

REFERENCES
XR01GN_CADASTRAL_BDY_PCG2020
XR01GN_SURVEY_PCG2020
XR01UT_UTILITIES_PCG2020
R30-DEA-XRF-ST-170-01001
R30-UDL-XRF-LA-230-00001
_LOGO_METCONNX
R30-MET-XRF-CI-200-00003
XR01GN_RAIL_RESERVE_BDY_PCG2020
R30-WWH-XRF-AR-225-00001
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
XR01GN_ENVIRONMENTAL_SITES_PCG2020

SCALE 1:250

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

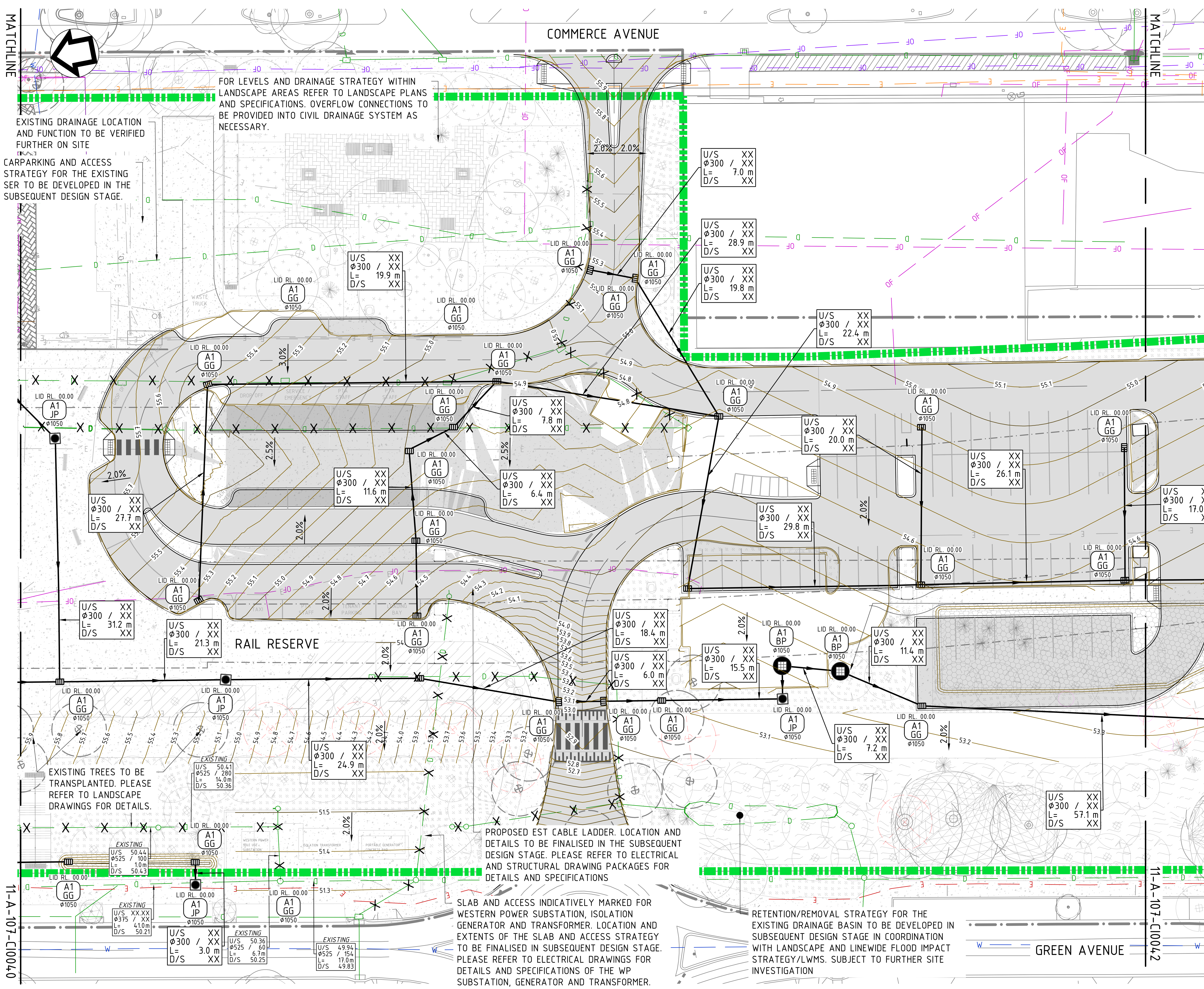
Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 3 OF 5

PTA Drawing No: 11-A-107-CI0040 Rev: B

CAD DRAWING PATHNAME L:\03 - AutoCAD\New Standards - Nov 2019\PTA Drawing Sheets - General\PTA_A1_Sheet.dwg



NOTES

1. FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
2. FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
3. FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
4. LOCAL PRECINCT DRAINAGE HAS BEEN COMPLETED IN ACCORDANCE WITH THE WIDER PRECINCT DRAINAGE STRATEGY, AS INCLUDED IN APPENDIX E OF THE ARMADALE PRECINCT CIVIL DESIGN REPORT. REFER TO DESIGN REPORT AND APPENDIX E FOR FURTHER DETAILS ON PRECINCT WIDE STORMWATER DRAINAGE STRATEGY.
5. FLOWS GREATER THAN 100-YR ARI STORM EVENT ARE INTENDED TO BE CONVEYED TO COA DRAINAGE NETWORK VIA AN OUTLET PIT AND PIPE CONNECTION OR VIA OVERLAND FLOW.
6. LOCATION AND SIZES OF ALL BIORETENTIVE BASINS NEED TO BE FUTHER COORDINATED WITH LANDSCAPE IN SUBSEQUENT DESIGN PHASE.
7. VIADUCT DRAINAGE TO BE CONVEYED VIA DOWNPIPES PRECAST INTO PIERS. VIADUCT DRAINAGE OUTLET POINTS SUBJECT TO CONFIRMATION AND COORDINATION WITH CIVIL, VIADUCT AND LANDSCAPE DESIGN
8. LANDSCAPE/VEGETATIVE STRIPS TO BE DRAINED VIA SUBSOIL. SUBSOIL PLANS TO BE FURTHER DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH CIVIL, LANDSCAPE AND HYDRAULICS.
9. CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS
10. EXISTING RAIL SYSTEM SERVICES TO BE MADE REDUNDANT FOLLOWING INSTALLATION OF THE TEMPORARY MCR AND SHUT DOWN OF RAIL. FOR TREATMENT OF REDUNDANT SERVICES, REFER TO RESPECTIVE DISCIPLINE DESIGN DRAWINGS.
11. EXISTING AND PROPOSED DRAINAGE SUBJECT TO FURTHER INVESTIGATION AND FINALISATION OF DRAINAGE DESIGN IN DETAILED DESIGN.
12. FOR OVERALL TREATMENT OF UTILITY SERVICES, REFER TO UTILITIES PACKAGE UT-040.
13. PROPOSED DRAINAGE INFRASTRUCTURE MAY CLASH WITH EXISTING SERVICES THAT MAY BE MADE REDUNDANT. PRIOR TO INSTALLATION OF DRAINAGE, ENSURE SERVICES ARE ACCURATELY LOCATED AND IDENTIFIED. REDUNDANT SERVICES TO BE REMOVED AS PER PTA REQUIREMENTS.

LEGEND

- PROPOSED DRAINAGE PIPE
- EXISTING DRAINAGE PIPE
- EXISTING DRAINAGE PIPE TO BE DEMOLISHED

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

DIAL BEFORE YOU DIG
www.1100.com.au
The Essential First Step.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01.01	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE A1 — 0 10 20 30 40 50 100mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-MET-DWG-CI-200-04003 Rev: C.01.01

REFERENCES
XR01GN_CADASTRAL_BDY_PCG2020
XR01GN_SURVEY_PCG2020
XR01UT_UTILITIES_PCG2020
XR01GN_RAIL_RESERVE_BDY_PCG2020
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-XRF-CI-200-00003
_LOGO_METCONNX
R30-UDL-XRF-LA-230-00001
R30-DEA-XRF-ST-170-01001
XR01GN_ENVIRONMENTAL_SITES_PCG2020

SCALE 1:250
DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

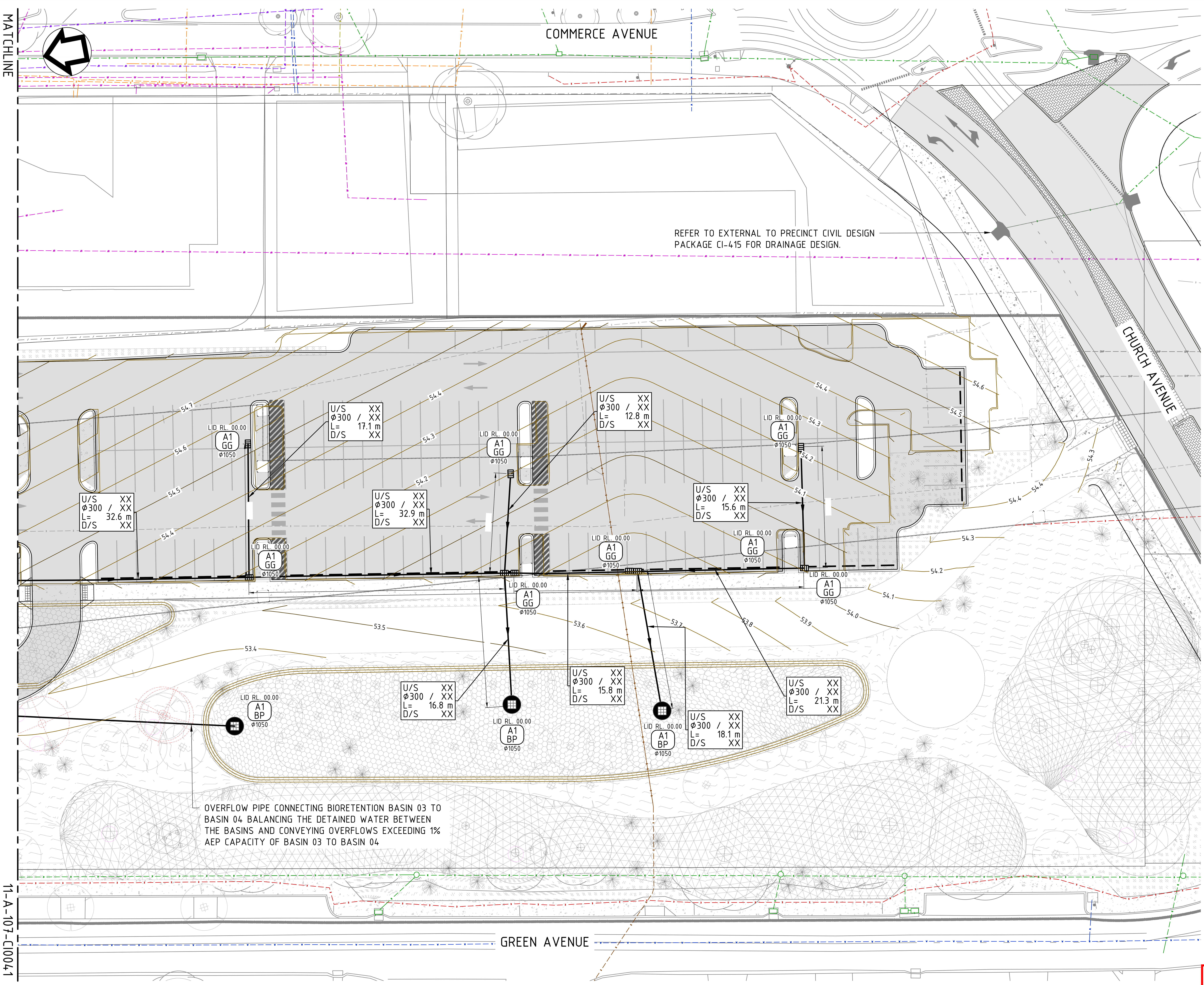
DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION
ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 4 OF 5

PTA Drawing No: 11-A-107-CI0041 Rev: B

CAD DRAWING PATHNAME L:\03 - AutoCAD\New Standards - Nov 2019\PTA Drawing Sheets - General\PTA_A1_Sheet.dwg



NOTES

1. FOR DRAINAGE OF HARDSCAPE AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO LANDSCAPE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
2. FOR DRAINAGE OF BUILDINGS AND ROOF AREAS AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO HYDRAULIC PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES
3. FOR DRAINAGE OF VIADUCT STRUCTURES AND CONNECTION INTO CIVIL DRAINAGE SYSTEM, REFER TO VIADUCT STRUCTURE PLANS FOR FURTHER DETAILS. FURTHER COORDINATION REQUIRED IN SUCCESSIVE DESIGN PHASES.
4. LOCAL PRECINCT DRAINAGE HAS BEEN COMPLETED IN ACCORDANCE WITH THE WIDER PRECINCT DRAINAGE STRATEGY, AS INCLUDED IN APPENDIX E OF THE ARMADALE PRECINCT CIVIL DESIGN REPORT. REFER TO DESIGN REPORT AND APPENDIX E FOR FURTHER DETAILS ON PRECINCT WIDE STORMWATER DRAINAGE STRATEGY.
5. FLOWS GREATER THAN 100-YR ARI STORM EVENT ARE INTENDED TO BE CONVEYED TO COA DRAINAGE NETWORK VIA AN OUTLET PIT AND PIPE CONNECTION OR VIA OVERLAND FLOW.
6. LOCATION AND SIZES OF ALL BIORETENTIVE BASINS NEED TO BE FUTHER COORDINATED WITH LANDSCAPE IN SUBSEQUENT DESIGN PHASE.
7. VIADUCT DRAINAGE TO BE CONVEYED VIA DOWNPIPES PRECAST INTO PIERS. VIADUCT DRAINAGE OUTLET POINTS SUBJECT TO CONFIRMATION AND COORDINATION WITH CIVIL, VIADUCT AND LANDSCAPE DESIGN
8. LANDSCAPE/VEGETATIVE STRIPS TO BE DRAINED VIA SUBSOIL. SUBSOIL PLANS TO BE FURTHER DEVELOPED IN SUBSEQUENT DESIGN STAGE IN COORDINATION WITH CIVIL, LANDSCAPE AND HYDRAULICS.
9. CONCOURSE PAVEMENT TO SHEET FLOW INTO VEGETATED LANDSCAPE STRIPS. STRATEGY TO BE FURTHER DEVELOPED IN THE SUBSEQUENT DESIGN STAGE IN COORDINATION WITH LANDSCAPE AND HYDRAULICS

LEGEND

PROPOSED DRAINAGE PIPE

EXISTING DRAINAGE PIPE

CAUTION: HIGH PRESSURE GAS IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE PIPELINE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

DIAL BEFORE YOU DIG www.1100.com.au
The Essential First Step.

CAUTION: FIBRE OPTIC CABLE IN VICINITY.
CONTRACTOR TO LOCATE AND DETERMINE DEPTH PRIOR TO COMMENCEMENT OF WORKS. ALL WORK UNDERTAKEN WITHIN PROXIMITY OF THE CABLE SHALL BE IN ACCORDANCE WITH THE RELEVANT AUTHORITY REQUIREMENTS.

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

REFERENCE DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
C.01.01	17/05/23	ISSUED FOR IDD - IDC	R.T.	M.B.	R.T.	A.E.
B	08/02/23	RE-ISSUED FOR RD	R.T.	M.B.	F.O.	A.E.
A	05/08/22	ISSUED FOR RD - PTA REVIEW	R.T.	M.B.	Y.K.	A.E.

ORIG SIZE A1 — 0 10 20 30 40 50 100mm AT ORIGINAL PLOT SIZE

MetCONNX

Contractor No: R30-MET-DWG-CI-200-04004 Rev: C.01.01

REFERENCES
XR01GN_CADASTRAL_BDY_PCG2020
XR01GN_SURVEY_PCG2020
XR01UT_UTILITIES_PCG2020
R30-UDL-XRF-LA-230-00001
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-XRF-CI-200-00003
_LOGO_METCONNX
R30-DEA-XRF-ST-170-01001
XR01GN_ENVIRONMENTAL_SITES_PCG2020
R30-MET-XRF-CI-415-10001

SCALE 1:250

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED R. THOMPSON
DRAWN M. BLIGH-SHEPPARD
CHECKED R. THOMPSON
APPROVED A. EYRES
DATE 17/05/23

Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE PRECINCT
CIVIL WORKS
PIT AND PIPE LAYOUT - SHEET 5 OF 5

PTA Drawing No: 11-A-107-CI0042 Rev: B

CAD DRAWING PATHNAME L:\03 - AutoCAD\New Standards - Nov 2019\PTA Drawing Sheets - General\PTA_A1_Sheet.dwg

INTERIM DETAIL DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
A.01	16.05.23	ISSUE FOR IDD-IDC	DF	YD	MH	AE

ORIG SIZE A1

0 2500 5000 7500 10000 12500 25000mm
AT ORIGINAL PLOT SIZE

Contractor No: R30-UDL-DWG-LA-230-00407 Rev: A.01

REFERENCES
R30-MET-MDL-SV-000-00001
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-CAD-CI-200-00003
XR01GN_SURVEY_PCG2020
R30-WWH-MDL-AR-225-00001
R30-MET-MDL-ST-235-00001
R30-DEA-MDL-ST-170-01000

SCALE 1 : 250 (@ A1)

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED D.F
DRAWN Y.D
CHECKED M.H
APPROVED A.E
DATE 16/05/23

Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION

ARMADALE STATION PRECINCT
LANDSCAPE
PLANTING PLAN 08

PTA Drawing No: 11-A-107-LA0074 Rev: A.01

CAD DRAWING PATHNAME Autodesk Docs://BRE BYFORD RAIL EXTENSION/R30-UDL-MDL-LA-230-00001.rvt

DRAINAGE MARKUP - AREA 4 SHEET 1B

INTERIM DETAIL DESIGN

REV	DATE	AMENDMENT	DSN	DRN	CHK	APP
A.01	16.05.23	ISSUE FOR IDD-IDC	DF	YD	MH	AE
C.01	16.05.23	ISSUE FOR IDD-IDC	DF	YD	MH	AE

ORIG SIZE A1 — 0 2500 5000 7500 10000 12500 25000mm AT ORIGINAL PLOT SIZE

This document must not be copied without PTA's written permission, and the contents thereof must not be imparted to a third party nor be used for any unauthorised purpose.

Contractor No:R30-UDL-DWG-LA-230-00408 | Rev: A.01

MetCONNX

REFERENCES
R30-MET-MDL-SV-000-00001
R30-MET-XRF-CI-200-00001
R30-MET-XRF-CI-200-00002
R30-MET-CAD-CI-200-00003
XR01GN_SURVEY_PCG2020
R30-WWH-MDL-AR-225-00001
R30-MET-MDL-ST-235-00001
R30-DEA-MDL-ST-170-01000

SCALE 1 : 250 (@ A1)

DATUM
HORIZONTAL: PCG2020
VERTICAL: AHD71

DESIGNED D.F
DRAWN Y.D
CHECKED M.H
APPROVED A.E
DATE 16/05/23

Government of Western Australia Public Transport Authority

BYFORD RAIL EXTENSION
ARMADALE STATION PRECINCT
LANDSCAPE
PLANTING PLAN 09

PTA Drawing No: 11-A-107-LA0075 | Rev: A.01

CAD DRAWING PATHNAME Autodesk Docs://BRE BYFORD RAIL EXTENSION/R30-UDL-MDL-LA-230-00001.rvt