# Morley-Ellenbrook Line

# MORLEY STATION – CIVIL – DESIGN REPORT

# MEL-MLCX-CI-RPT-00007

| Rev | Date | Purpose of Issue | Prepared | Reviewed | Approved |
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| A01 | 29/03/2022 | Reference Design for LOR review | Simon Tomizzi | Miguel Monteiro (JAJV SRE) | Manoj Aravind (SEM) |

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***This is to be updated with the full revision history of the document***

## Document revision history

| Rev | Date | Purpose of Issue | Sections revised | Reason for updates |
|---|---|---|---|---|
| A01 | 16/03/2022 | Reference Design for LOR review | First Issue | First issue |

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# 1. Executive Summary

This document forms part of the Reference Design for the Morley-Ellenbrook Line (MEL) in relation to the Morley Station Precinct Civil Engineering Design. The precinct design is intended for space planning purposes to allocate space for the different transport-oriented elements as per the Schedule of Accommodation noted on *SWTC Book 3: Part A- Scope of Works* and ensure there are no conflicts between the different modes of transport and pedestrians. Furthermore, it highlights constraints, risks and opportunities which will inform the IDDR phase of design.

The purpose of this document is to provide a description on the design development of the Civil Engineering elements in response to the proposed station precinct masterplan. This includes precinct geometry, stormwater drainage and earthworks including the following:

- Precinct overall layout geometry, including vehicular access and circulation areas including the Bus Interchange on Broun Avenue bridge Pick-up & Drop-off
- Access to Multi-Storey Car Park (MSCP)
- Precinct proposed levels and earthworks requirements
- Stormwater drainage strategy and storage requirements
- Primary services containment including services crossing Tonkin Highway and services accessing the Bus Interchange

The intent is that this Design Report is a live document and will be updated throughout the process of the civil engineering design for Morley Station.

**Acknowledgement of Country**

MELconnx acknowledges the Whadjuk People of the Noongar Nation as the Traditional Custodians of the land and waters on which the Morley-Ellenbrook Line Project is located. We pay our respect to their Elders, both past and present and thank them for their continuing connection to the country, culture and community.

# 2. Project overview

## 2.1 METRONET Vision and Objectives

As Perth's single largest investment in public transport, METRONET will transform the way people commute and connect. It will create jobs and business opportunities and stimulate local communities and economic development to assist communities to thrive. The METRONET vision is for a well-connected Perth with more transport, housing and employment choices.

In delivering METRONET, the WA Government has considered peoples' requirements for work, living and recreation within future urban centres with a train station at the heart.

The objectives are to:

- Support economic growth with better connected businesses and greater access to jobs
- Deliver infrastructure that promotes easy and accessible travel and lifestyle options
- Create communities that have a sense of belonging and support Perth's growth and prosperity
- Plan for Perth's future growth by making the best use of our resources and funding
- Lead a cultural shift in the way government, private sector and industry work together to achieve integrated land use and transport solutions for the future of Perth.

## 2.2 Morley-Ellenbrook Line overview

As Perth grows, so does the need for rail infrastructure and METRONET is a critical element of the State Government's infrastructure agenda. The Morley-Ellenbrook Line (MEL) Project will improve connectivity between the north east metropolitan area and the rest of the city and unlock economic development in these local community areas.


Figure 1: Morley-Ellenbrook Line © METRONET

The Public Transport Authority (PTA) is the lead agency delivering the MEL Project, with Main Roads WA (MRWA) undertaking some enabling works.

### 2.2.1 Project features

Transport infrastructure works for the Project include:

- A 21km rail line spurring from the Midland Line east of Bayswater Station, travelling north in the Tonkin Highway median, east through land north of Marshall Road and north on the western side of New Lord Street into Ellenbrook
- Stations at Morley, Noranda, Malaga, Whiteman Park and Ellenbrook with future-proofing for a station at Bennett Springs East
- Parking and bus interchanges/facilities at stations
- Significant grade separations at key road crossings
- Underpasses to allow the rail line to enter and exit the Tonkin Highway median
- Principal shared paths for walking and cycling access along the rail line
- Track and associated infrastructure to connect to the existing Midland Line
- Road and bridge reconfiguration works
- Integration across the packages of works and other nearby projects.

### 2.2.2 General scope of works

The Project's general scope of works includes the design and delivery of rail infrastructure and ancillary works to support operational passenger rail between Bayswater and Ellenbrook, including stations with inter-modal bus and rail with parking and associated road works at Bayswater, Morley, Noranda, Malaga, Whiteman Park and Ellenbrook stations.

The Project activities include all investigation, design, approvals, construction, testing and commissioning, Entry Into Service (EIS), training and operational readiness required to incorporate the new railway to Ellenbrook, and tie into the existing network including the associated road, utilities and other required works to interface with adjacent works and contracts. This will include bulk earthworks and retaining, structures, grade separations, roads and drainage.

The design and delivery of the main works package for the Project is broken into three distinct stages:

- Alliance Development Stage
- Project Alliance Reference Design Stage
- Project Alliance Delivery Stage (Detailed Design through to Project close-out).


Figure 2: Architect's Impression of Ellenbrook Station © MELconnx

### 2.2.3 Key Project Objectives, Key Compliance Objectives and Critical Success Factors

The PTA and MELconnx's single Non-Owner Participant (NOP) Laing O'Rourke Construction Australia Pty Ltd, have formed an integrated, collaborative Project Alliance to successfully deliver rail infrastructure that reflects our absolute commitment to achieving the Project Objectives and delivering positive outcomes for the State.

The following image demonstrates how we have mapped each Key Project Objective in the Project Alliance Agreement (PAA) against the Critical Success Factors to achieve best-for-project outcomes, underpinned by the Key Compliance Objectives.

| Key Project Objectives | Critical Success Factors for Successful Project Delivery (abbreviated) |
|---|---|
| **Implementation of a robust, cooperative team culture.** | • Development of a culture that results in all Participants developing behavioural values and driving principles to achieve Alliance goals and project objectives<br>• Longevity and stability of key Alliance personnel i.e. Alliance Manager, ALT and AMT. |
| **Timely delivery of Works to achieve project milestones in accordance with agreed program.** | • Development of a final proposal with a sufficiently developed design and accurate TOC<br>• Subsequent cash flow management and financial forecasting, scheduling and value-earned calculation and determination<br>• Implementation of PTA mandated systems i.e. TeamBinder, Primavera P6, TILOS and a finance system accepting the PTA's cost breakdown structure<br>• Timely completion of design, construction and commissioning through to practical completion<br>• Timely progress towards construction milestones and completion of close-out to achieve final asset acceptance compliance. |
| **Inclusion of processes that embrace/promote open tendering and promotion of work package development that encourages/ enables second and third tier tendering.**<br>**Compliance with WAIPs.** | • For professional service providers, implement a proven and mature supply-chain engagement process, including tender review, contract award and project integration. Ensure that it offers opportunity and security of payment relative to services delivered in an effort to achieve best-for-project outcomes<br>• For material suppliers and other subcontract service providers, implement a proven and mature supply-chain engagement process, including tender review, contract award and project integration that offers opportunity and security of payment relative to service delivered<br>• Proven and mature supply-chain engagement process for labour hire services, compliant with industrial and safety laws, maintained employee standards/conditions and security of employee payments<br>• Ability to develop contracts and terms and conditions in the spirit of the Alliance values and principles , appropriate and commensurate with the size, complexity and value of packages in accordance with industry best practice. |
| **Optimisation of operational and whole of life costs.** | • Sustainability considerations and outcomes for the whole of life of the works. |
| **Ensuring appropriate consultation/integration with stakeholders and community.** | • Constant and effective engagement with relevant stakeholders, particularly utilities/services, Main Roads, third party asset owners and relevant unions<br>• Effective management of PTA interfaces and PTA contractors<br>• Constant/effective engagement with the PTA in design reviews, work planning and possessions/shutdowns. |
| **Providing passengers with safe and secure services and facilities.** | • Compliance with ONSR requirements<br>• Completed rail line, stations and bus transfer infrastructure are able to deal successfully with the movement of people, including the disabled. |
| **Minimising disruption to current and anticipated rail operations.** | • Minimise impact on public transport services disruption<br>• Liaison and interaction with PTA rail operations personnel tasked with determining network closures, to confirm available network shutdowns and implement contingency plans<br>• Effective management of interfaces with others in heavily constrained areas<br>• Effective management/staging of works to reflect staged/constrained site access<br>• Effective management of existing rail infrastructure asset protection. |
| **Recognising the State's desired industrial relations objectives.** | • Develop a project-specific Industrial Relations Management Plan based on a proven and successful industrial relations approach that delivers a collaborative worksite, genuine collective agreement, making good faith in negotiations and dispute resolution, and respect for trade union rights of entry. |

| Key Compliance Objectives (abbreviated) | | | | |
|---|---|---|---|---|
| Compliance with all Statutory requirements and State Government policy requirements for construction work. | Compliance with the SWTC. | Protecting and minimising disruption to all existing facilities, infrastructure, properties or public utility services. | Meeting all obligations to impacted stakeholders and demonstrating genuine sensitivity. | Compliance with all environmental conditions and minimise adverse environmental impact. |

Figure 3: Key Project Objectives, Critical Success Factors and Key Compliance Objectives

## 2.3 Alliance vision and delivery approach

The MEL Project will be delivered under an alliance contract to support the management of project and stakeholder interfaces and to mitigate project risks. A collaborative alliance approach will see the Works carried out in a cooperative, coordinated and efficient manner in compliance with the Alliance Principles.

MELconnx understands that the successful delivery of the Project is critically linked to meeting the PTA's Key Project Objectives. These objectives have shaped our vision for the Project that is around delivering a high-quality product and creating exceptional value-for-money. We are committed to a no-blame culture and to the prompt and mutual resolution of any issues that may arise.

During the AD Stage, representatives from both the PTA and MELconnx participated in an interactive workshop to begin the process of developing a suitable Alliance Vision for the Project (refer Figure 4 below for workshop outcomes).


Figure 4: AD Stage Alliance Vision Development Outcomes (developed with the PTA)

The Alliance Foundation workshop was held on 11/11/2020 and the results of this workshop generated the basis for the Vision, Purpose, Values and Behaviours Commitment Statements represented here.


Figure 5: MELconnx Alliance Vision, Purpose and Values

## 2.4 Purpose of the Report

The Design Report identifies any interdependencies between each Design Package and how those dependencies have been accommodated within the document. The Design Report describes the relationship between each of the Package(s) engineering lifecycle and the assurance gates throughout the Project.

## 2.5 Changes Since Previous Design Submission

### 2.5.1 Alliance Development Stage to Reference Design Stage

The following design changes have occurred during the Reference Design development:

- Revised station precinct layout in response to:
  - Revised landscape architecture masterplan.
  - Revised location of Pick-up and Drop-off bays and access arrangements.
- Revised location of ancillary buildings and access arrangement.
- Development of FSLs.
- Development of Stormwater Drainage strategy.
- Development of precinct primary services (utilities) routes.
- Incorporation of Landscape Architecture masterplan requirements.

### 2.5.2 Reference Design to Interim Detailed Design

The following design changes have occurred during the Interim Detailed Design development.

Not applicable at Reference Design Stage.

### 2.5.3 Interim Detailed Design to Final Detailed Design

The following design changes have occurred during the Final Detailed Design development.

Not applicable at Reference Design Stage.

### 2.5.4 IFC Design Finalisation

The following design changes have occurred during the IFC Design finalisation.

Not applicable at Reference Design Stage.

# 3. Design Description

## 3.1 Scope of this Design Package

In accordance with the SWTC, *Book 3: Part A – Scope of Works, Section 3.2 Morley Station Surrounds*, the scope of this Design Package is outlined as follows.

### 3.1.1 General

The scope requirements within the Morley Station Precinct encompass the confirmation and detail design of the civil engineering elements as follows.

- Precinct layout and geometry.
- Stormwater drainage.
- Bulk earthworks.
- Pavement design.
- Precinct services.

The above have been undertaken for the following:

- Bus interchange on Broun Avenue bridge. Bridge designed and delivered under the Tonkin Gap Alliance.
- MSCP and associated access road.
- Station forecourt and public realm areas.
- SER compound.
- Ancillary buildings and associated access and egress.

### 3.1.2 Civil Engineering Scope of Works

The civil engineering scope of works include the following:

- The bus interchange bridge structure is included in the Tonkin Gap Alliance scope, however the MEL Alliance shall design, supply and construct all earthworks, drainage, road works, kerbs, median islands, underground services, signalised intersection for the eastern bus entry, shared paths as required to connect to the precinct, soft and hard landscaping and related civil works.
- Bus interchange and on-street bus stands in Station Surrounds with active and layover bus bay capacity described in the Schedule of Accommodation (Book 3 - Part A, Station, Station Surrounds and Station Precinct Design).
- A new multi-level PTA car park located to the west of Tonkin Highway along the eastern boundary of Wotton Reserve. The car park capacity and number of bays must be provided as described in the Schedule of Accommodation (Book 3 - Part A, Station, Station Surrounds and Station Precinct Design). A vehicle access road 7m wide to the car park must be provide via Wotton Street. Modifications to the City of Bayswater existing drainage pond and football pitch must be undertaken to accommodate the new vehicle access road alignment and shared path which must also be constructed to City of Bayswater requirements and approvals.
- Pick-up and Drop-off bays / short term parking facility near the Station as described in the Schedule of Accommodation (Book 3 - Part A, Station, Station Surrounds and Station Precinct Design) including footpaths and shared path connections to Morley Station and the Embleton Avenue and Broun Avenue intersection.
- Pedestrian access for car park patrons from the car park to the station, the Bus Interchange and Station Entry building/s must be provided including a footpath adjacent to the vehicle access road to the multi-level car park.
- Provide perimeter fencing for pedestrians approximately 1.2m high to separate Wotton Reserve from the proposed access road from Wotton Street to the new multi-level car park.
- Maintenance access road to fire tank, pump room and booster and Western Power sub-station from the vehicle access road to the car park.
- Shared path over the Broun Avenue bus bridge, which shall connect to the shared path constructed by the Tonkin Gap Alliance on the east and west of the bus bridge.
- Civil Works to tie-in to the new Bus Interchange bridge and new Broun Avenue Bridge over Tonkin Highway.
- Tie in of new Bus Interchange to Broun Avenue Bridge and pathways with existing road and pathways to Broun Avenue.
- Access road to SER radio mast from Cherry Court and associated works including modification to existing MRWA Drainage basin.
- Provide new utility connections and supplies to the new Morley Station requirements and service demands including sewer and water.

## 3.2 Design Description

The basis of the design and the specific design methodology adopted is described below.

### 3.2.1 General

This section outlines the design considerations associated with the Reference design phase of the Morley Station including carpark, bus interchange and associated precinct.

The design is documented on the following: Drawings:

- 25-A-285-CI0001 Cover Sheet and Drawing Index
- 25-A-285-CI0002 Bulk Earthworks – Overall Plan
- 25-A-285-CI0020 Drainage and Finished Surface – Overall Plan
- 25-A-285-CI0060 General Arrangement – Overall Plan
- 25-A-285-CI0070 Combined Proposed Utilities - Overall Plan
- 25-A-285-CI0100 Pavement and Kerbing - Overall Plan
- 25-A-285-CI0111 Pavement and Kerbing - Detail - Sheet 1
- 25-A-285-CI0112 Pavement and Kerbing - Detail - Sheet 2
- 25-A-285-CI0130 Minor Structures - Overall Plan
- 25-A-285-CI0150 Vehicle Tracking - Overall Plan

Models:

- 25-B-285-CI0001 (Earthworks)
- 25-B-285-CI0002 (Drainage)
- 25-B-285-CI0004 (Car Parking)
- 25-B-285-CI5005 (Utilities)

### 3.2.2 Precinct Layout

The precinct design has been progressed based on AD Phase Morley Precinct Design 1, and further precinct amendments agreed during Reference Design development.

In summary the revised layout has been developed to a higher level of detail and includes:

- Revised MSCP located west of Tonkin Highway.
- Revised pick-up and drop-off north of the MSCP.
- Precinct access road from Wotton Street.
- Revised bus interchange on Broun Avenue Bridge and associated access and egress from Broun Avenue.

Refer to the table below for a summary of proposed parking facilities. A total of 400 car parking bays are achieved for the station precinct.

Table 1: Morley Station Total Car Parking Numbers

| Location | Description | No. | Notes |
|---|---|---|---|
| **Bus Interchange** | Active bus bays | 12 | |
| | Layover bus bays | 6 | |
| **Sub-total** | | **18** | |
| **Car Park** | Standard All Day Car Parking Bays | 356 | |

| | | | |
|---|---|---|---|
| | Tenant All Day Parking Bays | 1 | |
| | Electric All Day Car Bays | 2 | |
| | Short Term Bays | 21 | Within main car park |
| | Short Term Bay | 1 | Accessible |
| | Accessible Car Bays | 7 | |
| | Taxi Bays | 1 | |
| | Service Bays (co located loading bay) | 2 | |
| | Staff Parking Bays | 4 | |
| **Pick-Up & Drop-Off** | - | 5 | Short Term Bays (within Pick-Up &Drop-Off) |
| | **Sub-total** | **400** | |

Bicycle storage facilities have been proposed to the northeast of the MSCP.

#### *3.2.2.1 Pick-up and Drop-off*

The pick-up and drop-off layout has been designed to be compliant with Australian Standards 2890.1 Off-street Car Parking and 2890.6 Off-street parking for people with disabilities, and include:

- Parking Bay Dimensions: 3.0m x 8.0m (min.) parallel parking
- Circulation access road width: 3.5m (one-way)
- Turning facilities

#### *3.2.2.2 Precinct Access Roads*

The carpark access road has been designed to interface with the proposed Wotton Street intersection design (refer to JAJV Highways drawings).

#### *3.2.2.3 Vehicle Tracking*

Vehicle tracking movements have been assessed for the following Austroads 2013 design vehicles:

- 5.2m B99 passenger vehicle for access road and KnR area
- 12.2m pumper fire truck (emergency vehicle access to the station concourse area and fire pumps and tanks compound)
- 12.5m rigid bus and 19m articulated bus (for bus interchange movements)
- 8.8m refuse vehicle to fix the geometry of the rejection lane adjacent to the MSCP.

#### *3.2.2.1 Traffic Calming*

Traffic calming measures have been proposed along the precinct access road in the form of a wombat crossing and a road hump.

An overview of the location of proposed traffic calming measures can be seen on drawings 25-A-285-CI0060.

### 3.2.3 Earthworks

The design surface has been modelled using 12D software design package, with the resulting bulk earthworks cut/fill volumes shown on drawings 25-A-285-CI0002.

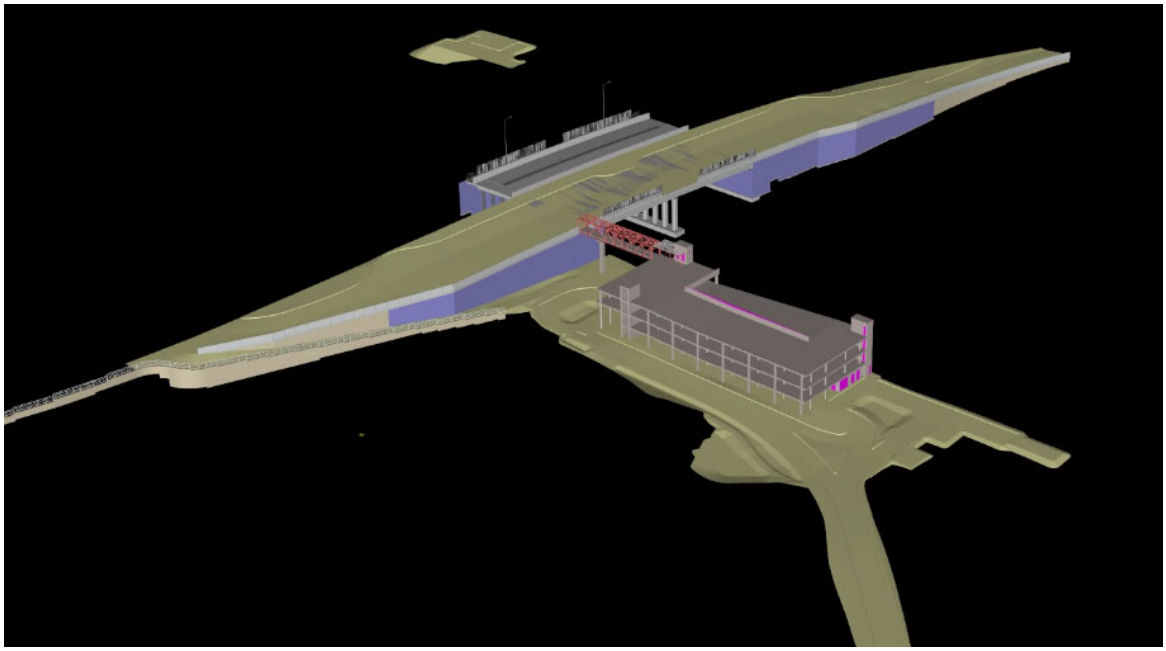

Figure 6: Perspective view indicating proposed Morley Station Precinct design

The site has been modelled to minimise cut and fill volumes. For the bus interchange, we will optimise earthworks once an interim Earth Works surface is available from TGA. Currently the cut and fill volumes have been calculated based on existing levels.

Each site within the precinct has been assessed independently to manage precinct constraints and to provide surface grading for stormwater drainage collection purposes. In general, falls have been limited to a minimum grade of 1:200 and a maximum grade of 1:20. The earthworks design strategy for each site is highlighted further in the report sections below.

In regard to Broun Avenue bridge and associated TGA design, we have re-assessed the Morley Bus Interchange based on our latest 2D layout, which resulted in minor modifications to the TGA Bus Interchange Design to allow for bus turning movements.

Our design ties-in to the TGA Broun Ave design and matches their proposed bridge deck levels and extent.

The following grades are achieved:

| | PTA Acceptable Threshold Grades | JAJV Design (16/12/2021) Grades |
|---|---|---|
| Bus Driveways | 7% | 7% |
| Bus Stands | 2.5% | 2% |
| Bus Turnaround | 4% | 4% |

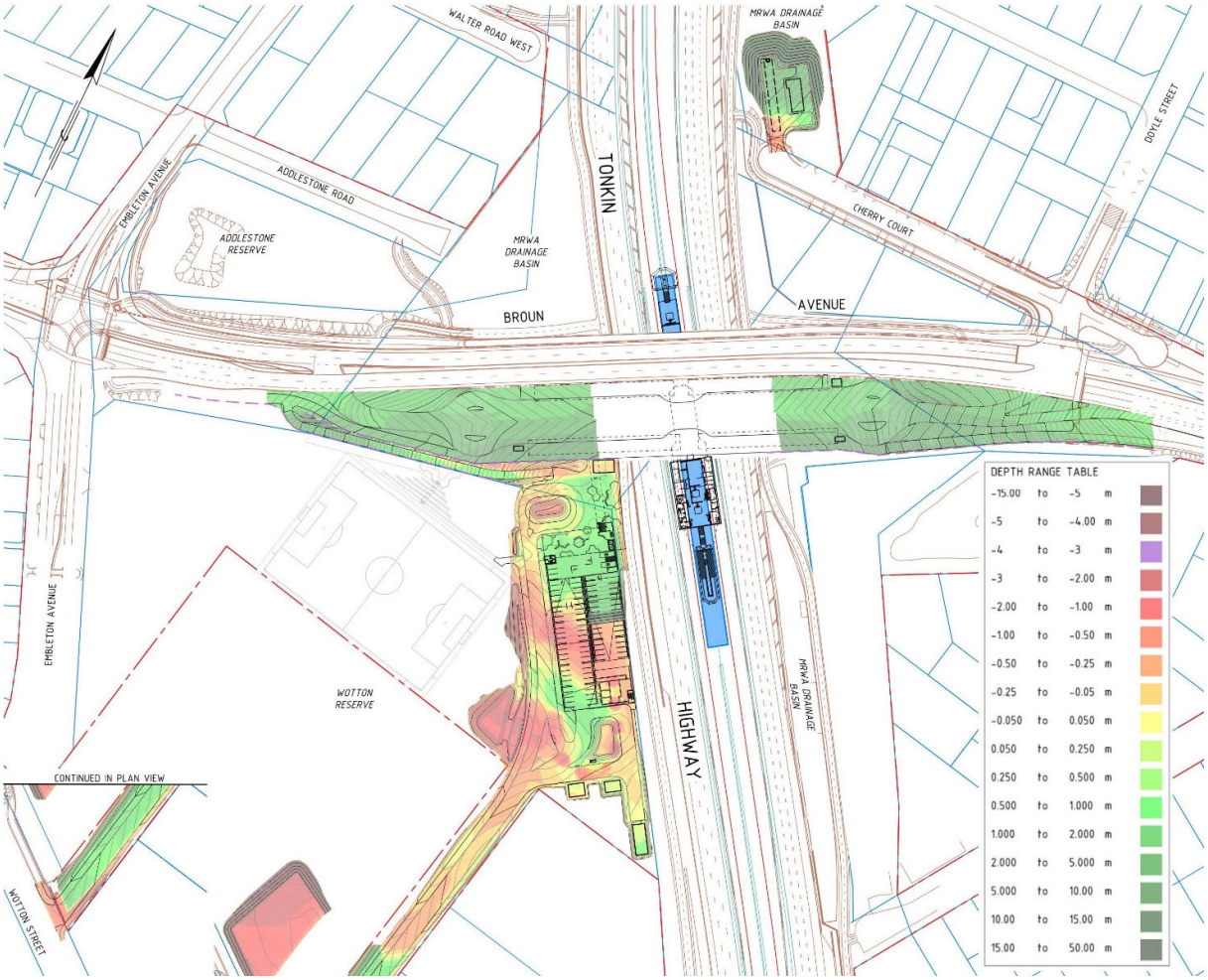


Figure 7: Morley station precinct earthworks depth range (cut/fill requirements)

Bulk earthworks volumes have been calculated based on the bulk earthworks design surface (design surface minus 300mm depth to allow for pavement build-up and landscaping) and the existing surface model (minus 100mm for topsoil stripping).

Bulk Earthworks volumes are as below:

- Cut: 7,306 $m^3$
- Fill: 33,369 $m^3$

The existing surface model is based on model no. MEL-MLCX-SV-MDL-00001.

#### *3.2.3.1 Multi Storey Car Park*

The multi-storey carpark is constrained by the proposed Broun Avenue bridge abutment and retaining structures, existing mature trees, the existing Wotton Reserve recreational fields and facilities and the PSP adjacent to Tonkin Highway.

The ground floor has been modelled to respond to the proposed architectural ground floor profile.

Carpark, pick-up and drop-off facilities, are designed to be at grade facilities.

The bulk earthworks surface and volumes for the carpark ground floor level have been calculated based on a modified bulk earthworks design surface and the increased scope of bulk earthworks excavations required to suit structural foundations.

#### *3.2.3.2 SER Compound*

The SER compound drainage has been designed with a one way fall from east to west.

#### *3.2.3.3 Pick-up and Drop-Off*

The road design surface falls towards the internal kerb line for stormwater drainage collection purposes with a typical crossfall of max. 3%. Allowance for footpath and landscaping works have been included. A central soft landscaped area segregates traffic flows in opposite directions.

### 3.2.4 Pavements

In coordination with landscape architecture, eight (8no.) pavement types have been specified for the station, as follows:

- Pavement Type 1: Asphalt Pavement (Light-Duty)
- Pavement Type 2: Asphalt Pavement (Heavy Duty)
- Pavement Type 3A: Block Paving, not subject to vehicular loading
- Pavement Type 3B: Block Paving, subject to vehicular loading
- Pavement Type 4: Bus interchange – on bridge
- Pavement Type 5: Block Paving – on bridge
- Pavement Type 6: PShP/ Shared path
- Pavement Type 8A: Pedestrian areas (concrete), not subject to vehicular loading

Pavements subject to vehicular traffic have been designed to MRWA Engineering Road Note 9. Pavement design thicknesses have been rationalised based on a 40-year design life and following design traffic assumptions described in the pavements design report document 20220118 MEL-MLCX-CI-RPT-00013.

The pavement extents and details and are documented on drawings 25-A-287-CI0088, 25-A-287-CI0089 and 25-A-287-CI0097 respectively.

In line with MELconnx Geotechnical Investigation Interpretive Report – Linewide (MEL-MLCX-GE-RPT-00010), a design CBR value of 12% has been adopted.

### 3.2.5 Drainage

#### *3.2.5.1 Existing Drainage*

The Morley MSCP and Drop Off/Pick Up Precinct development is within a multi-use open space that contains clubroom facilities, sports fields, skate park and car parks. At the southern end of the reserve is a basin which will be impacted by the access road into the  precinct.  There is limited drainage infrastructure within the northern portion of the project boundary.

#### *3.2.5.2 General design strategy*

An increase in the impermeability through roads and the MSCP will increase the stormwater runoff. The general design strategies for the precinct are as follows:

- Capture and treat the 1EY 1hour runoff.
- Minor Storm: 10% AEP. The drainage system shall be capable of carrying and controlling flow from the minor storm event. The flood level to be kept below the pavement level.
- Major Storm: 1% AEP. Safe, well-defined overland flow paths will be incorporated in the surface design. Above ground storage will be kept away from critical infrastructure (i.e., buildings, major roads) with a minimum of 300mm freeboard. All drainage infrastructure will be approved by the relevant local council. A maximum flood depth of 200mm to be maintained.
- Major Storm: 1% AEP. Station building and platform runoff to be captured and dissipated on site.

Furthermore, where management of superficial groundwater is required as part of the project work, groundwater to be managed consistent with the DWER's publication "Water resource considerations when controlling groundwater levels in urban development, DoW, April 2013", and the requirements specified in the SWTC Book 3: Part A: Scope of Works.

#### *3.2.5.3 General design input*

The key drainage design inputs for the  precincts are noted as:

- Design Intensity-Frequency-Duration (IFD) Rainfall – BOM 2016 IFD (climate change factor is applied)

- 2% AEP Ground Water Levels
- Geotechnical investigation and report
- Climate change factor applied to the IFD
- An Infiltration rate for the site has been adopted as 5 m/day for the minor and major analysis (as per MELconnx Geotechnical Interpretive Report MEL-MLCX-GE-RPT-00010 Rev1)
- Infiltration rate for the design of soakwells has been reduced to 3 m/day to account for the clogging factor.

#### *3.2.5.4 Drainage Design*

The stormwater strategy for the site is documented on drawings 25-B-286-CI0012 and 25-B-286-CI0013 and is separated into five components as follows:

- Bus Interchange
- Pick up and drop off
- Car Park
- Access Road

The station building and platform are discussed in the hydraulics design report.

Modelling was completed in DRAINS software using the ILSAX method to determine pipe sizes. The swales and underground storage features were modelled as “basins with infiltration” in DRAINS. The pipe network layout was developed using 12D to allow integration with other design packages.

Figure 6 below shows the design contours and proposed stormwater drainage networks which indicate the proposed stormwater drainage management strategy.

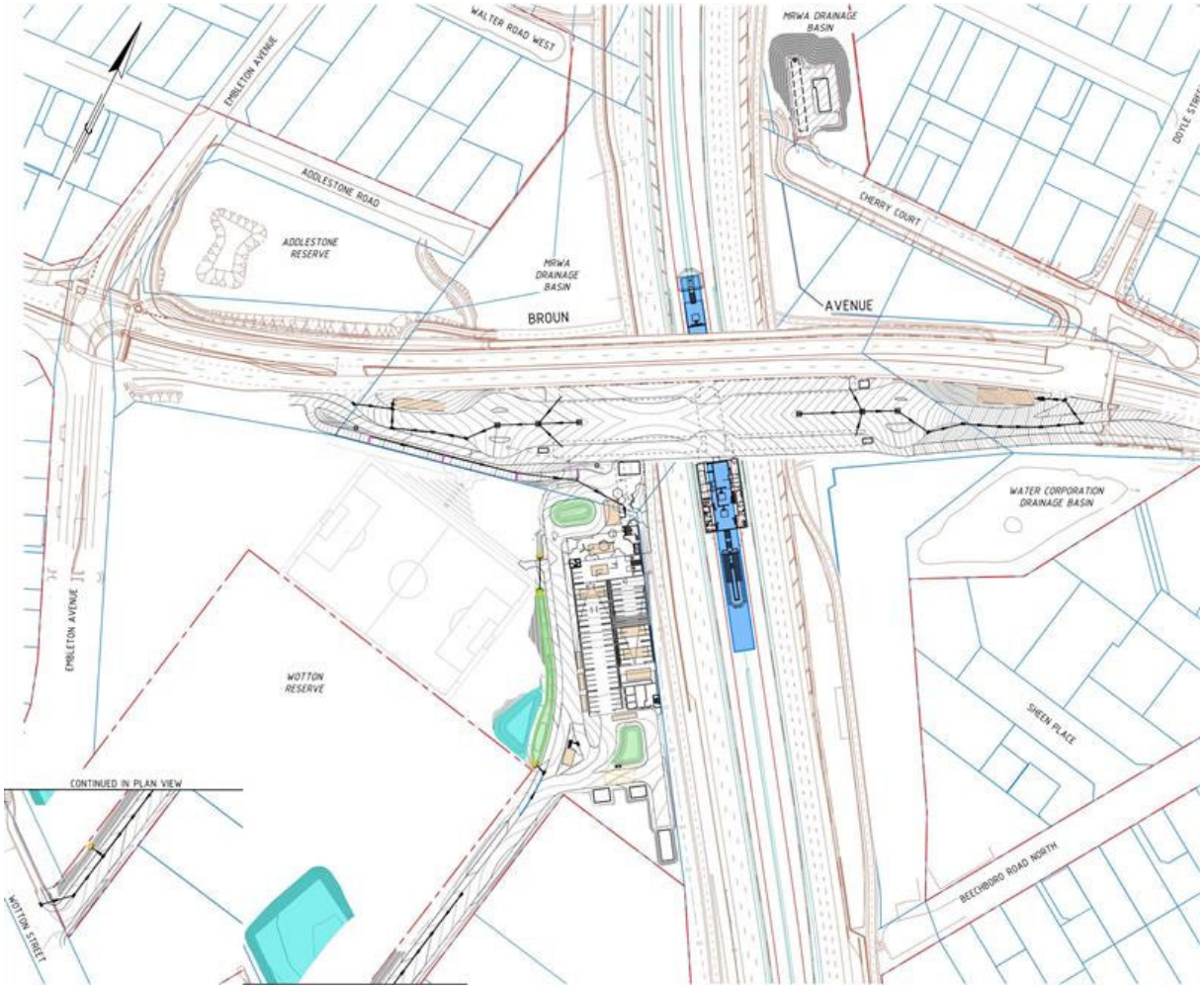


Figure 6 Morley Station main precinct stormwater drainage and proposed contour

### *3.2.5.5 Bus Interchange*

The Bus interchange consists of an eastern and western drainage systems which capture and convey runoff from the canopy roof, road and surrounding hardstand areas via a pit and pipe system into underground storages. The underground storages will detain the 5% AEP flood event with overflows from larger events entering the adjoining road drainage infrastructure.

A GPT prior to the underground storage inlet will provide treatment for the 1EY 1 hour event prior to discharges into the LGA drainage network.

The bus interchange is elevated over Tonkin Highway with ramps to provide access onto and off Broun Avenue. The bridge over Tonkin Highway divides the bus interchange into the eastern and western areas. The bus interchange and turn around areas generally grade to the centre median, switching to one-way crossfall on the access ramps.

Runoff from the realigned PSP from Broun Avenue to the Tonkin Highway PSP will be conveyed via a pit and pipe system to an underground storage within the hardstand area to the north of the multilevel car park. The underground storage will detain the 1% AEP flood event with overflows from larger events flowing towards the central island of the pick-up and drop-off area. The landscaped batter between the bus interchange and PSP will be directed along a table drain into soakwells catering for the 10% AEP event.

### *3.2.5.6 SER*

The SER is located at the northern end of the car park, with the compound graded to the west. Kerbing along the perimeter of the trafficable compound area will convey 10% AEP runoff to soakwells. Runoff from the 1% AEP

flood event will be conveyed within a swale to the northern end of the site to a depression. The flood depth within the SER compound does not exceed the maximum allowance of 200 mm.

#### *3.2.5.7 Pick-up and Drop-off*

The pick-up/drop off loop is located at the northern end of the multistorey car park. The loop is graded towards the central island into a landscaped median bioretention swale.

The island swale will include a layer of bioretention media for the treatment of the 1EY runoff. Modelling shows that the central island will cater for the 10% AEP event, with major rainfall events overflowing towards a swale along the western side of the access road. Ponding depth over the pavement not exceeding the maximum allowance of 200 mm.

#### *3.2.5.8 Multistorey Carpark*

The multistorey car park drainage is discussed in detail in the hydraulics report. Underground storage units are proposed to detain up to the 1% AEP flood event. Major rainfall events will pond over the pavement not exceeding the maximum allowance of 200 mm.

The current car park layout does not provide suitable area for bioretention areas to treat runoff. In-line proprietary SQIDs are proposed prior to underground infiltration storages to treat car park runoff.

The shared path link from Broun Avenue to the existing Tonkin Highway PSP will be drained by a combination of channel drains and a pit and pipe system discharging to an underground storage system located on the east side of the KnR area. The underground storage unit will detain the 5% AEP flood event with overflows from larger events entering the adjoining central soft landscaped area.

#### *3.2.5.9 Access Road*

The precinct access road has a one-way crossfall towards the adjoining reserve area (western side). A pit and pipe system on the low side will collect and convey runoff to the existing basin at the entrance to the site. For the northern section of the access road, runoff will flow via kerb openings into a road side swale which will convey run-off to a new basin.

Portion of the roadside swale will contain a layer of bioretention media for the treatment of the 1EY runoff prior to discharge into the new basin. In the 1% AEP flood event ponding over the pavement will not exceed the maximum allowance of 200 mm.

### 3.2.6 Utilities

#### *3.2.6.1 Existing Utility Impacts*

Existing services within the vicinity of the Morley Station and associated precinct are documented on drawing 25-A-285-CI0070.

Several services are likely to be impacted by the proposed works. These include:

> ATCO Gas high pressure main follows the existing eastern Tonkin Highway reserve in a north-south direction, is within proximity to the proposed power supply and comms route from the Station to the SER room. Further discussions with ATCO Gas are required regarding excavation being carried out in the proximity of their asset.

Temporary utility supplies, utility protection measures considering construction activities and utility relocations and modifications are not included as part of this scope of works.

#### *3.2.6.2 Proposed Utilities*

#### *3.2.6.3 Overall Strategy*

The general strategy for the Morley Precinct is to provide dedicated services corridors with connections to:

- It is envisaged that water, sewer and power supply to Morley station precinct will be supplied from Embleton Avenue and Wotton Streets. These are as follows:
    - Electrical: Western Power – 22kV underground cable (Wotton Street).
    - Water and Fire: Water Corporation 150mm water main (Wotton Street).

- Sewer: Water Corporation 150mm PVC gravity sewer located at the intersection of Broadway and Embleton Avenue (IL. 21.37).

There is no existing Water Corporation sewer network at the boundary of the station. The sewer rising main shall continue in the road reserve and discharge into the water corporation network as shown on sketch MEL-MLCX-UT-SKT-81019.

The width of the services corridors has been kept as narrow as possible to minimise impact on the adjacent landscaping and proposed underground stormwater storage units.

It is to note that services connection to the station building will be under Tokin Highway as highlighted in drawing 25-A-285-CI0070.

Fire connection to the bus interchange facilities have been coordinated with the TGA design and associated services sleeves though the proposed Broun Avenue Bridge as highlighted on drawing TGA-02-BR-0453-DRG-0194 Rev1.

#### *3.2.6.4 HV Electricity*

The HV power connection to the station will be taken from the Western Power 22kV distribution line within the south side of Wotton Street.

A Western Power substation is proposed south of the MSCP.

- 4no. 150mm Ø ducts are proposed.

#### *3.2.6.5 LV Electricity*

A precinct wide primary network has been developed from the station isolation transformer adjacent to the Western Power Substation.

Typical connectivity has been provided as follows:

- 12no. LV ducts (8no 100mm Ø and 4no 150mm Ø) between Station Isolation Transformer and the station intake point located along southern façade of the platform services building
- 8no 100mm Ø LV ducts to the MSCP intake point located along the southern façade of the structure
  - 2no 100mm Ø LV ducts running along the Pick-Up and Drop-off access road.
- 1no. 100mm Ø LV duct has been provided along the bus interchange feeding the eastern and western approaches.

#### *3.2.6.6 Precinct Telecommunications*

The telecommunications connection will be taken from the existing Telstra cable on the south side of Wotton Street.

#### *3.2.6.7 Potable Water*

Water and fire pipe to connect to existing150mm Ø water corporation water main on the north side of Wotton St. For connection details, please refer to drawing MEL-MLCX-UT-SKT-81019.

A water meter is proposed to be located at the entrance to the station precinct boundary.

#### *3.2.6.8 Fire Water*

Fire pipe to connect to existing150mm Ø water corporation water main on the north side of Wotton St. For connection details, please refer to drawing MEL-MLCX-UT-SKT-81019.

Similarly, to potable water a meter will be required at the entrance to the station precinct.

#### *3.2.6.9 Sewer*

There is no existing Water Corporation sewer network at the boundary of the station. The sewer rising main shall continue in the road reserve and discharge into the water corporation network as shown on sketch MEL-MLCX-UT-SKT-81019.

In light of the existing sewer connection, a private pump station is proposed to be located to the south of the proposed MSCP to enable discharge from the precinct area to the future Water Corporation 150mm diameter pipe.

## 3.3 Relationship with other Design Packages

The relationship and/or reliance of this design package on other MEL design packages is outlined in the Design Interface Matrix included in Appendix X of this report.

## 3.4 External Interfaces

The relationship and/or reliance of this design package on external interfaces and details of integration strategies are outlined in the Table below.

| Item | External Party | Interface Elements | Integration Strategy |
|---|---|---|---|
| **1** | Main Roads WA | Storm Water Drainage | MELconnx engaging with MRWA through Project Advisory Group (PAG) |
| **2** | Water Corporation | Water Supply | Liaison with Water Corporation. |
| **3** | Water Corporation | Sewer Connection | Liaison with Water Corporation. |
| **4** | Western Power | Power Supply | Liaison with Western Power. |
| **5** | Western Power | Interface with existing 22kV distribution cables | Liaison with Western Power. |
| **6** | Western Power | Proposed Western Power Substation | Liaison with Western Power. |
| **7** | NBN/ Telstra | Fibre connection | Liaison with Telstra/ NBN. |
| **8** | DFES | Access and Egress | Ensure that access and egress for fire and emergency vehicles in agreed. |
| **9** | Tonkin Gap Project (TGA) | Broun Avenue Bridge Earthworks and Pavements | Liaison with TGA. |

# 4. Design Inputs

## 4.1 Project Design Requirements

The following design inputs have been used in preparation of this report.

### 4.1.1 SWTC Requirements

The following sections of the SWTC are applicable to the Permanent Way Design and have been considered:

- MEL-PTAWA-PM-RPT-00001.0.IFU_Ver1 - Book 1: Part A - General Scope of the Alliance Works.
- MEL-PTAWA-PM-RPT-00002.0.IFU_Ver1 - Book 1: Part B - Limit of Works.
- MEL-PTAWA-PM-RPT-00004.0.IFU_Ver1 - Book 3: Part A - Scope of Works.
- MEL-PTAWA-PM-RPT-00006_Ver2 - Book 4: Technical Criteria.
- MEL-PTAWA-PM-RPT-00007_Ver1 - Book 5: Appendices to the SWTC.

## 4.2 Design software used for this package

The following design software has been used in preparation of the design.

- AutoCAD
- 12D
- DRAINS

## 4.3 Applicable Codes and Standards

The applicable standards, codes and guidelines are in accordance with SWTC Appendix 3. Standards and codes listed in the Table below are those in addition or amended revisions applied to the design.

| Reference | Description/Title | Compliance (Specific Provisions, Criteria and Classifications) |
|---|---|---|
| **Australian and Other Standards and Guidelines** | | |
| - | Main Roads WA Supplements to Austroads Guide to Road Design | |
| **AS3798 -2007** | Guidelines on earthworks for commercial and residential developments | |
| **AS2890.1** | Part 1: Off-Street car parking | |
| **AS2890.6** | Part 6: Off-street parking for people with disabilities | |
| - | Utility Providers Code of Practice for Western Australia | |
| - | Water Corporation Design Standard No. DS 50 Wastewater Gravity Sewers | |
| - | Water Corporation Design Standard No. DS 51 Wastewater Pump Stations and Pressure Mains | |
| - | Water Corporation Design Standard No. DS 60 Distribution pipelines other than reticulation | |
| - | Water Corporation Design Standard No. DS 63 Water reticulation pipelines | |
| - | Western Power Underground Cable Installation Manual and other design guidelines | |
| - | ATCO Gas Additional Information for Working around Gas Infrastructure | |
| - | APA Group Information for Planners and Developers | |

| | | |
|---|---|---|
| - | Department of Lands – Land Use Guidelines, Dampier to Bunbury Natural Gas Pipeline Corridor. | |
| - | DWER's guidelines 'Decision Process for Stormwater Management in<br>WA November 2017' & 'Stormwater Management Manual for WA" | |
| - | Local council engineering standards for drainage (City of Swan, City of Bayswater) – including:<br>• City of Swan Handbook of Storm Water Drainage Design.<br>• City of Swan Development Design Specification – Storm Water Drainage Design. | |
| - | MRWA Supplement to Austroads Guide to Road Design Part 5, Part 5A and Part 5B | |
| - | Water Corporation Design Standard No. DS66 Urban Main Drainage Standard | |
| - | Department of Water and Environmental Regulation - Stormwater Management Manual for Western Australia | |
| - | Department of Water and Environmental Regulation – Decision Process for Stormwater Management | |
| - | Australian Rainfall and Runoff: A Guide to Flood Estimation. Commonwealth of Australia (2016) | |
| - | Australian runoff quality - a guide to water sensitive urban design (2006)' published by Engineers Australia | |

## 4.4 Reference Information

The project specific reference information and reports that have been used as inputs into the development of the detailed design are included in the table below.

| Document Reference | Description/Title |
|---|---|
| **25-B-00-CI001** | Rail Model |
| **25-B-285-LA0001** | Landscape Masterplan |
| **25-B-285-AR0001** | Architectural Model |

| | |
|---|---|
| **TGA-02-CI-0150-MOD-0001, TGA-02-CI-0160-MOD-0001, TGA-02-CI-0180-MOD-0001** | TGA Design models for Broun Avenue |
| **MEL-MLCX-GE-RPT-00010** | Geo reports |
| **TIN_Grndwater_Full_Align_AEP002** | Groundwater Models |
| **MEL-MLCX-SV-MDL-00001** | Topographical Survey |
| **MEL-MLCX-CI-RPT-00001** | Flooding Modelling Report |
| **TGA-02-GE-0250-MEM-0001** | TGA Infiltration Basin Parameters for PCSump (V6.1) – Associated Works - 100% Stage Geotechnical Design Report |
| **TGA-02-CI-0180-REP-0001** | TGA IFC Design Report |

## 4.5 Design Criteria

The design criteria utilised in the development of this design package are outlined below.

### 4.5.1 Earthworks

Earthworks modelling was undertaken to provide cut and fill volumes for all design surfaces, including:

- Station forecourts
- Station carparks
- Station Pick-up Drop-off areas
- Precinct minor roads

The following key criteria shown in Table 7 and PTA Standard Drawing 00-C-04-0085 Cut and Fill Surface Railway, behave been used when developing batter slopes for the earthworks model for these various aspects of the design listed above.

| | Precincts | Minor Roads |
|---|---|---|
| **Max batter slope - cut** | 1:4 | 1:3 |
| **Max batter slope - fill** | 1:4 | 1:4 |

All imported material and excavated material for re-use will need to comply with Main Roads WA Specification 302 – Earthworks, and PTA Specification 8880-450-067 - Specification: Roads, Busways and Paths.

### 4.5.2 Utilities

All works associated with the MEL project will aim to avoid impacting existing utilities where possible and reasonable.

Where impacts to existing utilities are unavoidable, these will be identified. Diversions/realignments will be developed by MELConnx in accordance with the above standards in conjunction with the associated authorities, PTA and METRONET.

Clearances to existing utilities will be maintained (as applicable) as summarised below.

| | Precincts / Road | Rail Reserve (not | Rail Reserve (under |
|---|---|---|---|

| | Reserves (Code of Practice) | under tracks) AS4799 | tracks) (PTA: 8110-400-030) |
|---|---|---|---|
| **Power** | 750mm | 600mm | 2500mm |
| **Telecommunications** | 450mm/ 600mm | 600mm/ 900mm | 2500mm |
| **MCR (Power)** | 1000mm | 1000mm | 2500mm |
| **MCR (Telecoms)** | 1000mm | 1000mm | 2500mm |
| **Water** | 600mm | 600mm | 2500mm |
| **Sewer** | 600mm | 600mm | 2500mm |
| **Trunk Services/ Major Pipelines** | 750mm | 1200mm | 2500mm |

Cover to proposed services crossing the transit corridor will be assessed and discussed in detail with PTA on a case-by-case basis. Any non-conformances will be discussed and agreed with PTA, prior to progressing to Detailed Design.

### 4.5.3 Drainage Design Criteria

The drainage philosophy for the Morley Precinct can be summarised as follows:

- Capture all runoff from the site for water quality treatment.
- Discharge runoff at a rate equivalent to the existing condition to ensure no increased flood risk to the downstream environment.
- Protect the environment and infrastructure.

Specific criteria and requirements are in the SWTC. Some criteria from ADA are highlighted below:

- Treatment of 1EY 1 hour runoff within bioretention areas in the carpark.
- 10% AEP flood level to be kept below the pavement level.
- Depth of the 1% AEP flood on the pavement does not exceed 200mm on the pavement surface.

As a minimum, the design for the station precinct has considered the following:

- An assessment of surface water hydrology and groundwater hydrology.
- Modifications to existing LGA drainage systems has been undertaken to the design standard for the relevant authority.
- Drainage must be designed and constructed in accordance with the PTA relevant specifications, and project specific requirements.
- The invert level for swales and basins must be minimum of 300mm above the maximum groundwater (1%, 2%% AEP) level (MGL). MGL to be determined by groundwater monitoring and historical data.
- Limited use of pit and pipe drainage solutions may be used in locations where there is insufficient room for swale drains.
- Drainage features wherever possible will be integrated into the built form and proposed landscaping design.
- Maintenance vehicular access to basins to be incorporated into overall design.
- WSUD principles will be incorporated into the storm water strategy.
- LGA Water Management requirements will be included in Design requirements.

## 4.6 Design Life

The design life requirements related to this design package are outlined in the Table below.

| Item | Asset Element of the Works | Design Life (Years) |
|---|---|---|

| | | |
|---|---|---|
| **1** | All civil and structural elements of tunnels, underground stations, dive structures and other associated underground structures, inclusive of other load bearing elements, internal support structures, foundations, retaining structures, track slab structures, transition slab structures, drainage structures and waterproofing elements. | 120 |
| **2** | All civil and structural elements of on or above-ground structures and buildings, inclusive of any other load bearing elements, internal support structures, steel trusses, purlins and associated roof structural elements, foundations, retaining structures, drainage structures and waterproofing elements. | 120 |
| **3** | All civil and structural elements of rail bridges or bridge overpasses, including pedestrian bridges associated with the stations or spanning the railway inclusive any other load bearing elements, foundations, retaining structures, transition slab structures, drainage structures and waterproofing elements. | 120 |
| **4** | Storm water surface drainage structures, tanks and inaccessible pipe systems including all pits | 50 |
| **5** | Water treatment systems excluding structural elements. | 7 |
| **6** | Noise barriers, noise attenuation devices and acoustic panels and support systems excluding structural elements. | 30 |
| **7** | Artwork, signage and way finding excluding foundations and supporting structures. | 20 |
| **8** | External pedestrian paving (including substrate and paving finish). | 25 |
| **9** | External furniture and fittings, fences and security/fire gates or doors excluding structural elements. | 20 |
| **10** | Internal non-structural elements - fit out, fixtures and finishes | 20 |
| **11** | Protective galvanised coatings to steelwork (excluding structural elements) | 25 |
| **12** | Associated support, gantries and other equipment associated with ticketing systems not otherwise supplied by PTA | 30 |
| **13** | Road sign support structures and other roadside furniture | 25 |
| **14** | Flexible (asphalt) road pavements, car park surfaces, external paving, footpaths, shared paths and hard landscaping features | 25 |
| **15** | External pedestrian paving (including substrate and paving finish) | 25 |
| **16** | Existing drainage structures underneath new pavement | 50 years residual |
| **17** | Street lighting and light fittings excluding structural elements | 20 |
| **18** | Road surfacing of dense graded asphalt | 25 |

| | | |
|---|---|---|
| **19** | Road surfacing of open graded asphalt | 20 |
| **20** | Road and pedestrian bridges (including foundations) and all road drainage structures | 120 |
| **21** | All other Assets not described above must be agreed with the PTA's Representative to meet with Design Life in the above category | |

## 4.7 Durability Requirements

Details of durability issues and risks, and measure to comply with the durability requirements are outlined in Appendix U of this report.

## 4.8 Specialist Technical Inputs

The following specialist technical design documents have provided inputs to this design package:

- Geotechnical Interpretive Reports
- Groundwater Models
- Flooding Models.
- Topographical Survey

## 4.9 Constructability Requirements

Details of constructability issues and measures, including traffic management during construction of the Works and the Temporary Works, where this influences design.

- Works will be carried out in the vicinity of live services.
- Works in the vicinity of an operational PSP (along Tonkin Highway).
- Working in the vicinity of an operational football club.
- Dewatering activities are likely to be required considering the high ground water table.
- Sewer and water main extensions from the junction of Wotton Street.

## 4.10 Environmental & Sustainability Design Criteria

The following key environmental and sustainability initiatives have been developed as part of this design package.

- Optimisation of earthworks requirements minimising the requirement for imported fill.
- Utilisation of Crushed Recycled Concrete (CRC) subbase in accordance with MRWA Specification Series 500, Clause 501.92
- Integration of Water Sensitive Urban Design (WSUD) initiatives in close collaboration with Landscape Architecture to form the basis of the proposed Stormwater Strategy for the Station precinct. WSUD initiatives have been considered and implemented in the design. The main storm-water discharge principles rely on infiltration which will reduce the peak discharge to the main storm-water line (as applicable). Furthermore, planted swales have been incorporated where possible which will aid the removal of first flush pollutants. During IDDR JAJV will work closely with the Landscape Architect for the choice of the planted species to best suit the WSUD strategy.

For further details refer to Sustainability Management Plan (MELAD-MLCX-EN-PLN-00002).

### 4.10.1 Risk and Opportunities Assessment

In the development of the design the following opportunities have been identified:

- Water Sensitive Urban Design (WSUD);
- Use of Crushed Recycled Concrete (CRC) for pavement sub-base material

## 4.11 Future Proofing

In the development of the design the climate change factor of RCP 4.5 has been considered. This has been adopted as a reasonable allowance based on the process that was outlined by PTA. The proposed factor will be revised after the risk analysis for the entire project is complete. A Project wide climate Change Risk Assessment

workshop will be undertaken in June 2021 and any high risks identified will be mitigated through design, wherever possible.

## 4.12 Value Engineering

A Value Engineering Optimisation workshop has been completed. The outcomes of this workshop are summarised as follows:

- Significant reduction of earthworks fill requirements.
- Reduction in the requirements for precinct retaining structures.

## 4.13 Third Party Operational Stakeholders

The following key Third Party Operational Stakeholders requirements have been developed as part of this design package.

Not applicable to this design package.

For further information on third party requirements, refer to the RATM extract for this design package contained in Appendix O.

## 4.14 Design Input from Stakeholders and Community Involvement Process

The design inputs from Stakeholders and local Community are detailed in the following sub-sections:

### 4.14.1 Stakeholder Requirements Register

To be confirmed at the next Design state.

### 4.14.2 Community Involvement Process Input

## 4.15 Design Assumptions, Dependencies, and Constraints (ADC's)

Details of design assumptions, dependencies, and constraints are outlined in the following sub-section.

### 4.15.1 Design Assumptions

Design assumptions related to this design package are detailed in the Table below.

| ID | Description | Status | Evidence of Validation |
|---|---|---|---|
| | *No design assumptions have been made at this stage of design.* | | |
| | | | |

### 4.15.2 Design Dependencies

Design dependencies related to this design package are detailed in the Table below.

| ID | Description | Status | Evidence of Validation |
|---|---|---|---|
| **1** | Station Architecture Model | Closed | Precinct design has considered proposed architectural model. Model Ref. 25-B-286-LA0001 |
| **2** | Landscape Architecture Masterplan | Closed | Precinct design has responded to |

| | | | |
|---|---|---|---|
| | | | the landscape masterplan. Drawing Ref. 25-B-286-AR0001 |
| **3** | Broun Ave Modifications Highways Model | Closed | Precinct design has considered proposed Broun Ave modification highways model. Model Re.25-B-00-CI3005 |
| **4** | Rail Transit Corridor Model | Closed | Precinct design has considered proposed transit corridor model. Model Ref. 25-B-00-CI002 |

### 4.15.3 Design Constraints

Design constraints related to this design package are detailed in the Table below.

| ID | Description | Status | Evidence of Validation |
|---|---|---|---|
| **1** | High ground water table | Closed | Drainage design has considered revised ground water model. Model Ref. TIN_Grndwater_Full_Align_AEP002 |
| **2** | Existing Main Roads WA Tonkin Highway stormwater basin adjacent to Cherry Court. Interface with SER compound. | Open | Further liaison with MRWA required during Detailed Design phase. |

## 4.16 Requests for Information (RFI)

Requests for information submitted in relation to this design package are outlined in the Table below. Copies of the RFIs are provided in Appendix W of this report.

| RFI REFERENCE | Description/Title | Status |
|---|---|---|
| **MELD-MLCX-RFI-00239** | RFI - Morley Station Precinct Infiltration Rate (JAJV RFI-00181/RFIC128) | Closed |
| **MELD-MLCX-RFI-00168** | RFI - Amended Scope for Independent Verification | Change to SWTC Agreed with PTA |
| **MELD-MLCX-RFI-00137** | RFI - Settlement Requirements for Shallow Foundations | Closed |
| **MELD-MLCX-RFI-00127** | RFI - Blast Loading Tech Memo | Closed |

| | | |
|---|---|---|
| **MELD-MLCX-RFI-00125** | RFI - Retaining Walls Specification PTA drawing (RFIC026) | Closed |
| **MELD-MLCX-RFI-00113** | RFI - Noise Walls Vertical Supports (RFIC014) | Change to SWTC Agreed with PTA |
| **MELD-MLCX-RFI-00076** | RFI - Confirmation of Parking Requirements – Station Precincts (Civil/BCA) | Closed |
| **MELD-MLCX-RFI-00025** | RFI - Aerial Imagery Updates | Closed |
| **MELD-MLCX-RFI-00024** | RFI - PTA RFI - Xref naming exemption from PTA Standard 8110-300-001 | Closed |
| **MELD-MLCX-RFI-00019** | RFI - Review Requirements - Amended Scope for Independent Verification | Change to SWTC Agreed with PTA |

# 5. Design Outputs

## 5.1 Deliverables List

A matrix of all document/ deliverable types required at each design stage associated with this design package are provided in the Table below.

| Deliverable | Reference Design | Interim Detailed Design | Final Detailed Design | IFC |
|---|---|---|---|---|
| **Design Report** | X | X | X | X |
| **Drawings** | X | X | X | X |
| **Specifications** | | X | X | X |
| **Specialist Reports** | | X | X | X |
| **Construction Methodologies** | | X | X | X |
| **Third party approvals** | | | X | X |

## 5.2 Drawings and Models

The drawing and model list for this design package is provided in the TIDP in Appendix A of this report.

## 5.3 Specifications

The specification list for this design package is provided in the TIDP in Appendix A of this report.

## 5.4 Standard Reference Drawings

The standard drawings which form part of this design package have been summarised in the Table below.

Not applicable to this design stage.

| Drawing Number | Description/Title | Revision |
|---|---|---|
| **n/a** | | |
| | | |

## 5.5 System Coordination Drawings and Models

The system coordination drawings and models which form part of this design package have been summarised in the Table below (General arrangements and typical cross-sections).

| Drawing Number | Description/Title |
|---|---|
| **E007** | Architecture drawings |
| **E008** | Landscape Architecture drawings |
| **E018** | Line Wide Track drawings |
| **E020** | MCR drawings |
| **E025** | Civil - Flooding & Hydrology Model |
| **E026** | Track, Earthworks, Drainage, Civils drawings |
| **E089** | Structures - Foundations, Platform, Concourse & Roofs and Canopies & Pedestrian Bridges and Walkways |
| **E090** | Electrical - Lighting & LV & Communications & Security |
| **E092** | Hydraulics and Wet Fire |
| | |
| | |

## 5.6 Type Approvals

Not Applicable.

## 5.7 Calculations

Calculations are provided in Appendix E of this report. Calculations are not required as part of this design stage.

## 5.8 Schedules

Schedules for this design package are provided in Appendix F of this report. Schedules are not required as part of this design stage.

# 6. Competence for Design

The competence assessments for relevant design personnel have been undertaken and is evidenced in the PTA SRE Appointment form contained in Appendix J of this report.

# 7. Design Reviews and Certification

## 7.1 Interdisciplinary Design Coordination (IDC) Review

An Interdisciplinary Design Coordination (IDC) review has been carried out as outlined in the Table below

| Reference | Design Stage | Description/Scope | Evidence |
|---|---|---|---|
| IDC-001 | **Reference Design** | Morley IDC | Refer to Appendix H & I |
| IDC-002 | **Interim Detailed Design** | N/A | N/A |
| IDC-003 | **Final Detailed Design** | N/A | N/A |

## 7.2 IDC Certificate

Design checking has been carried out. An IDC Certificate is provided in Appendix I of this report.

## 7.3 Design Checking and Verification

Design verification has been carried out. Evidence of design checking and verification is provided in Appendix J of this report.

## 7.4 Independent Verification

Independent Verification has been carried out. Evidence of independent verification is provided in Appendix K of this report.

## 7.5 BCA

Not applicable to this design package.

## 7.6 DDA

Not applicable to this design package.

## 7.7 PTA Design Submission Reviews.

Review comments raised in the previous design stage have been responded to and closed out. The comments register is attached in Appendix N of this report.

# 8. Design Compliance

The demonstration of compliance with the requirements of the Project Definition Documents, including any non-conformances of concessions is summarised on the following sections.

## 8.1 Standards & Guidelines

The standards and guidelines relevant to this design package are outlined in Section 4.3. The design has been carried out, checked and verified by competent personnel as outlined in Section 6.

## 8.2 SWTC

Refer to the RATM extract in Appendix O of this report.

## 8.3 Planning & Environmental Approvals

Refer to the RATM extract in Appendix O of this report.

## 8.4 Third Party Requirements

Refer to the RATM extract in Appendix O of this report.

## 8.5 Engineering Change

The following categories of Engineering Change that have been considered for the design development are as follows:

- Engineering Change – A novel design solution that is subject to review and approval from PTA through Management of Engineering Process, refer to PTA Procedure 8110-100-014
- Design Departures – A design non-compliance to relevant codes and standards. Will be subject to review and approval from PTA through Management of Engineering Process, refer to PTA Procedure 8110-100-014.
- SWTC Departures – To be discussed and agreed with PTA in the first instance, technical justification required for departure and confirmation of impacts/benefits to the overall Project. Departure to be formalised through the RFI process once agreed in principle.

Engineering changes are summarised in the table below

| ID | Category | Description | Status |
|---|---|---|---|
| **1** | Deviation | Broun Avenue Bus Road Geometry (Vertical Alignment). Please refer to MEL-MLCX-GCOR-00839. | Open |
| | | | |

# 9. External Interface Work Packages

A copy of the Project Interface Management Plan will be provided at the next Design stage.

## 9.1 Project Interface Control Plan

A copy of the Project Interface Control Plan has been provided in Appendix X.

# 10. Effects of the Works

The predicted effects of the Works (EOW) in relation to this design package are outlined in the Table below.

| ID | Description | Status |
|---|---|---|
| **1** | Interface with existing services that may require diversion or protection. | Open |

# 11. Safety Assurance

## 11.1 Safety in Design and Hazard Analysis

### 11.1.1 Overview

Safety in Design is a standard process defined as the integration of hazard identification and risk assessment methods early in the design process to eliminate or minimise the risks of injury throughout the life of the product being designed. It encompasses all design including facilities, hardware, systems, equipment, products, tooling, materials, energy controls, layout and configuration.

By this definition, the designer takes a leading role in the integration of concepts of safety into the design of a product. In brief, this is achieved through progressive development of the Project Hazard Log (PHL). The PHL included in Appendix Y has been filtered to communicate package relevant hazards and controls. Key Safety in Design considerations include the following (listed in order of precedence):

- Eliminating hazards at the source;

- If hazards cannot be eliminated, then a control will be established to reduce the level of risk associated with the hazard in order of a hierarchy of possibilities and controls:
- Substitution of a less hazardous alternative;
- Engineering controls;
- Administrative controls;
- Other control mechanisms; and
- Communicate known controlled and residual risks to affected parties.

Safety in Design workshops have incorporated combined hazard analysis processes with sub-system hazards (SSHA), operating and support hazards (OSHA) and interface hazards (IHA) being considered by workshop participants and relevant hazards captured within the SiD Report and PHL.

Engineering controls identified through SiD / Hazard Analysis processes have been derived into safety requirements and added to the Safety Requirement Specification within DOORS as detailed in Section 11.2.

### 11.1.2 Safety in Design Activities

Safety in Design has been addressed through the engagement of appropriate SREs in a workshop discussion to examine and discuss the design details with a view to determining the safety risk and appropriate treatments in the minimisation of any identified safety risks. The SiD activity builds on the work conducted to manage the hazard log which forms and input to the SiD workshop.

At this issue of the design report a SiD workshop was conducted (MELconnx - Reference Design Safety-in-Design Workshop No. 13) on the 19th January 2022 which covered hazard identification for:

- Package 7 – Morley Station and Precinct

A record of which was captured in MEL - Safety in Design Workshop No.13 Report (MEL-MLCX-RS-RPT-00053) and the actions close-out has been captured as part of the SiD process. Any impacts on the hazard log have been managed by raising a hazard transfer form and specific hazards have been added to the hazard log.

A record of the SiD Workshop Report detailed above have been included in Appendix Z.

### 11.1.3 Safety Interfaces

Internal interfaces between design packages have been defined in the $N^2$ Design Interface Matrix which has been reviewed and confirmed with relevant design and construction SREs.

Interfaces are either identified as Physical Interfaces (PI) or Safety Interfaces (SI). Physical interfaces between packages have been assessed and coordinated through the MELconnx IDC process to ensure clashes and spatial geometry have been resolved. Resolution of these interfaces is evidenced through the IDC Certificate documented in Appendix I.

Safety Interfaces have been considered through Safety in Design risk assessments with relevant hazards and controls captured and managed in the Project Hazard Log.

The following Submission Packages have been identified as having interfaces with Package 7 – Morley Station & Precinct - Civils:

- Package 1 – Linewide
- Package 6 – Southern Dive to Northern Dive
- Package 7 – Morley Station & Precinct

These interfaces are discussed in detail in sections below.

#### *11.1.3.1 Safety Interfaces – Package 1 – Linewide*

| MELconnx Design Interface Matrix | | Package 7 - Morley Station & Precinct | Morley Precinct - Civil - Earthworks | Morley Precinct - Civil - Drainage | Morley Precinct - Civil - Highways & Roads | Morley Precinct - Civil - Car Parking and Bus Interchange, Fencing and Gates, Retaining |
|---|---|---|---|---|---|---|
| | | | E063 | E064 | E065 | E066 |
| | **Package 1 - Linewide** | I | | | | |
| E018 | Linewide - Permanent Way and Stabling & Track – Transit Space & Structure /Ballast Interface | | PI | PI | PI | SI |
| E019 | Linewide - Electrical LV | | PI | PI | PI | PI |
| E020 | Linewide Northern Dive to Whiteman Park MCR | | | | | |
| E021 | Linewide Whiteman Park to Ellenbrook MCR | | | | | |
| E022 | Linewide Bayswater Station to Southern Dive MCR | | | | | |
| E023 | Linewide Southern Dive to Northern Dive MCR | | PI | PI | PI | PI |
| E026 | Linewide Northern Dive to Whiteman Park Track & Civil | | | | | |
| E027 | Linewide Whiteman Park to Ellenbrook Track & Civil | | | | | |
| E028 | Linewide Bayswater Station to Southern Dive Track & Civil | | | | | |
| E029 | Linewide Southern Dive to Northern Dive Track & Civil | | PI | PI | PI | SI |
| E030 | Linewide Northern Dive to Whiteman Park OLE | | | | | |
| E031 | Linewide Whiteman Park to Ellenbrook OLE | | | | | |
| E032 | Linewide Bayswater Station to Southern Dive OLE | | | | | |
| E033 | Linewide Southern Dive to Northern Dive OLE | | PI | PI | PI | SI |
| E118 | Linewide - Communications | | PI | PI | PI | PI |
| E124 | Linewide - Signalling | | PI | PI | PI | PI |
| E131 | Linewide - Operational Technologies (IMS and RATs) | | PI | PI | PI | PI |

Figure 7: Interfaces - Package 1 – Linewide

At this stage the interfaces above have only been identified. These will be further assessed and reported on in the IDD submission of this design package.

### 11.1.3.2 *Safety Interfaces – Package 6 – Southern Dive to Northern Dive*

| MELconnx Design Interface Matrix | | Package 7 - Morley Station & Precinct | Morley Precinct - Civil - Earthworks | Morley Precinct - Civil - Drainage | Morley Precinct - Civil - Highways & Roads | Morley Precinct - Civil - Car Parking and Bus Interchange, Fencing and Gates, Retaining |
|---|---|---|---|---|---|---|
| | | | E063 | E064 | E065 | E066 |
| | **Package 6 - Southern Dive to Northern Dive** | I | | | | |
| E059 | Southern Dive to Northern Dive - Civil - Earthworks, Drainage & Highways & Roads | | PI | PI | PI | |
| E060 | Southern Dive to Northern Dive - Civil - Lighting & LV | | | | | |
| E061 | Southern Dive to Northern Dive - Civil - Fencing and Gates, Retaining Walls & Minor Structures, Noise Walls | | | | | |
| E062 | Southern Dive to Northern Dive - Tunnel - Fitout | | | | | |
| E079 | Southern Dive to Northern Dive - Pedestrian Underpass (Benara Road) | | | | | |

Figure 8: Interfaces - Package 6 - Southern Dive to Northern Dive

At this stage the interfaces above have only been identified. These will be further assessed and reported on in the IDD submission of this design package.

### 11.1.3.3 *Safety Interfaces – Package 7 – Morley Station & Precinct*

| MELconnx Design Interface Matrix | | Package 7 - Morley Station & Precinct | Morley Precinct - Civil - Earthworks | Morley Precinct - Civil - Drainage | Morley Precinct - Civil - Highways & Roads | Morley Precinct - Civil - Car Parking and Bus Interchange, Fencing and Gates, Retaining |
|---|---|---|---|---|---|---|
| | | | E063 | E064 | E065 | E066 |
| | **Package 7 - Morley Station & Precinct** | I | | | | |
| E001 | Morley Pecinct-Urban Design - Architecture | | PI | PI | PI | PI |
| E002 | Morley Precinct - Urban Design - Landscape | | PI | PI | SI | SI |
| E003 | Morley Precinct - Urban Design - BCA | | | | | |
| E063 | Morley Precinct - Civil - Earthworks | | | PI | PI | PI |
| E064 | Morley Precinct - Civil - Drainage | | PI | | PI | PI |
| E065 | Morley Precinct - Civil - Highways & Roads | | PI | PI | | PI |
| E066 | Morley Precinct - Civil - Car Parking and Bus Interchange, Fencing and Gates, Retaining Walls & Minor Structures, Noise Walls & Lighting | | PI | PI | PI | |
| E067 | Morley Precinct - Structures - Foundations, Platform, Concourse & Roofs and Canopies | | PI | PI | PI | PI |
| E068 | Morley Precinct - Structures - Pedestrian Bridges, Walkways and Car Park | | PI | PI | PI | PI |
| E069 | Morley Precinct - Electrical - Communications & Lighting & LV | | PI | PI | SI | SI |
| E070 | Morley Precinct - Electrical - Fire Detection & Security | | | | | |
| E071 | Morley Precinct - Hydraulics and Wet Fire | | | | PI | PI |
| E072 | Morley Precinct - Mechanical and BMSC | | | | | |
| E073 | Morley Precinct - Vertical Transport | | | | | |
| E074 | Morley Precinct - Fire & Life Safety | | | PI | PI | SI |
| E119 | Morley Precinct - Communications | | | PI | PI | PI |
| E132 | Morley Precinct - Operational Technologies (IMS and RATs) | | | PI | PI | PI |

Figure 9: Interfaces - Package 7 - Morley Station & Precinct

At this stage the interfaces above have only been identified. These will be further assessed and reported on in the IDD submission of this design package.

## 11.2 Hazard Management

A Project Hazard Log (PHL) has been maintained for the project which covers the full scope of the project. The baseline set of hazards has been developed which is reflective of the current PTA suite of technical standards, as extracted from the SWTC. A PHA exercise has been conducted to build this baseline set of hazards which has included review of the PTA PHA and Tender Design SiD findings.

The hazard log has been progressively updated to incorporate outcomes from hazard analysis workshops, including those detailed in Section 11.1.2. An extract of the hazard log identifying hazards relevant to this design package is included in Appendix Y.

The hazard log has been progressively updated to capture and derive safety requirements that have been incorporated into the MELconnx requirements management system (DOORS).

Safety requirements which have been addressed by this design have been reported in the RATM (see Appendix O) and PHL in accordance with the Safety Derived Requirement Management Process in Figure 10.

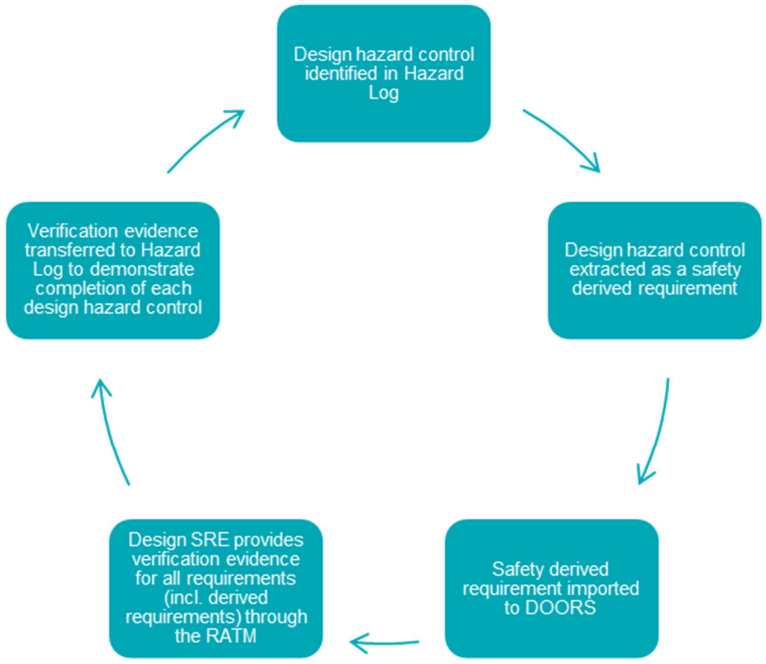


Figure 10: Safety Derived Requirement Management Process.

## 11.3 Management of Safety Requirements

Controls identified in the workshops are raw controls that are transferred to relevant design package owners. During hazard identification workshops controls are identified as either to Implement or to Consider. Controls identified as implement are embodied in the design at the current design stage whereas controls to consider may be implemented into the design at some point in the future pending further consideration.

Subsequent to the workshops, as part of the design process, hazard controls have been assessed as either Open, Implemented or Rejected:

- **Open** signifies that implementation is not yet confirmed.
- **Rejected** signifies that the control is not implemented; reasons for rejection recorded at Safety Control Verification Reference column in the PHL.
- **Implemented** signifies that implementation in the current stage design has been confirmed with evidence recorded at Safety Control Verification Reference column in the RATM.

Controls which are Implemented shall be further developed into Derived Safety Requirements which are traced in the RATM in DOORS. These safety requirements shall follow the wording convention of other requirements in the RATM and in addition shall be specific, measurable, relevant and realistic.

The System Requirement Specification has been developed based on the system performance, functions and process defined in the SWTC chapters, and has been structured in accordance with the PTA SRS specification:

- Part A – Functional Requirements
- Part B – General Requirements
- Part C – Discipline Specific Requirements
- Part D – Validation Requirements
- Derived Safety Requirements.

The MELconnx Project requirements taken from the SWTC therefore form the Project requirements baseline. Project requirements which include derived requirements from specialty disciplines are progressively managed in accordance with the requirements management process which is described in the Requirements Management Plan. The section below presents an overview of the RATM and the status of the safety requirements (listed in the RATM) associated with each of the design packages covered under the scope of this design report. A full list of requirements listed in the RATMs is summarised in Section 12.2.1.

### 11.3.1 Requirements Allocation Traceability Matrix

Table 2: Table of Requirements Compliance.

| Design Package | Compliant | Partial-Compliant | Non-Compliant | To be confirmed Post Design Phase | TOTAL | Assurance passed |
|---|---|---|---|---|---|---|
| **E063** | 0 | 0 | 0 | 2 | **2** | **0** |
| **E064** | 0 | 0 | 0 | 2 | **2** | **0** |
| **E065** | 0 | 0 | 0 | 2 | **2** | **0** |
| **E066** | 0 | 0 | 0 | 2 | **2** | **0** |
| **Total** | **0** | **0** | **0** | **8** | **8** | **0** |

Requirement compliance status is divided in to the following categories:

- **Compliant**: the design is compliant with the requirement,
- **Partial-Compliant**: the design is only compliant in part with the requirement,
- **Non-Compliant**: the design is not compliant with the requirement,
- **To be confirmed at later Design Phase**: the designs compliance status is yet to be determined at this design stage
- **To be confirmed Post Design Phase**: the compliance status of these requirements will be determined during construction/commissioning.
- **Assurance Passed**: a review of the verification evidence provided by the designer has taken place and it is deemed satisfactory for the associated requirement

## 11.4 Risk Profile

### 11.4.1 Hazard Summary

This section provides a summary of the hazards relating to the scope of this design report. A hazard will be marked as “Managed” once all controls and safety requirements have been agreed and the related safety requirements have been verified. A hazard will be marked as “Resolved” when all controls and safety requirements have been agreed but have not been verified.

Where a hazard is required to be transferred to an external stakeholder, the status of “Transferred” will only be achieved once the formal acceptance has been agreed between the two parties. The Hazard Status is in alignment with the PTA Project Hazard Transfer Procedure (8810-000-008). A summary of the hazard status is detailed in Table 3 below. All hazards identified in the PHL will be reviewed and agreed with the relevant PTA PE’s in accordance with the PTA Hazard Transfer Process, prior to entry into service.

Table 3: Morley Station and Precinct – Civils - Hazard Status Summary.

| Hazard Status | Number of Hazards | Comments |
|---|---|---|
| Open | 10 | These hazards will be managed as the design progresses. |
| Cancelled | 3 | These hazards were cancelled and derived into location specific hazards. |
| Closed | 0 | N/A |
| Managed | 0 | N/A |
| Resolved | 0 | N/A |
| Transferred | 0 | N/A |
| **Total** | 13 | |

There is very minimal risk of proceeding with Open hazards as all outstanding controls are required to be verified within these packages. These will all be verified prior to reaching IFC.

The residual risk profile and risk status for the hazards related to the scope of this design report are detailed in Table 4 below.

Table 4: Morley Station and Precinct – Civils - Residual Risk Profile.

| Residual Risk Ranking Vs Hazard Status | | | | | |
|---|---|---|---|---|---|
| Hazard Status | Very High | High | Medium | Low | Total |
| Open | 1 | 3 | 4 | 2 | **10** |
| Closed | 0 | 0 | 0 | 0 | **0** |
| Managed | 0 | 0 | 0 | 0 | **0** |
| Resolved | 0 | 0 | 0 | 0 | **0** |
| Transferred | 0 | 0 | 0 | 0 | **0** |
| **Total** | **1** | **3** | **4** | **2** | **10** |

**NOTE** – The number of hazards listed in the Residual Risk Profile (Table 4) differs to that in the Hazard Status Summary (Table 3) as cancelled hazards have not been considered within the Residual Risk Profile.

**NOTE** – In the following sub-sections the Cancelled Hazards have been removed from the residual risk profile for each design package and the Control Summary.

### 11.4.2 Control Summary

The control status for Morley Station and Precinct - Civils is detailed in Table 5. A control will receive a status of "Implemented" once there is verification evidence from the related safety requirement.

Table 5: Control Status Summary.

| | Proposed | Implemented | Explore Further | Rejected | Total |
|---|---|---|---|---|---|
| TOTAL | 31 | 0 | 2 | 0 | 33 |

As mentioned in Section 11.4.1, all proposed and explore further controls are required to be verified within this package. These will all be verified prior to reaching IFC.

The status of PTA owned controls is shown below.

Table 6: PTA Control Status Summary.

| | Proposed | Implemented | Explore Further | Rejected | Total |
|---|---|---|---|---|---|
| TOTAL | 4 | 12 | 0 | 0 | 16 |

### 11.4.3 Summary of Key Hazard

At RD Hazard analysis activities are still ongoing. This section will be populated at IDD.

## 11.5 Transfer of Residual Risks and Safety Related Operational Conditions

Once all controls associated with a hazard have been implemented with verification evidence or rejected with suitable SFARIP justification, the hazard status will be changed to "Managed" in the PHL. Residual hazards will then be transferred to relevant Hazard Owners for acceptance. PTA owned controls will be transferred in accordance with PTA Project Hazard Transfer Procedure (8810-000-008).

As part of this process both Hazards and Safety Related Operational Conditions identified in the PHL will be transferred to PTA.

## 11.6 Safety Assurance Report

Safety Assurance activities detailed in this design report will be integrated into the MELconnx Safety Assurance Report (MEL-MLCX-RS-RPT-00030).

## 11.7 Outstanding Issues

The following outstanding issues are required for the scope of this design report to achieve IFC status.

- Conduct IDD Safety in Design Workshop
- Documentation of outstanding verification evidence for outstanding controls

The following outstanding issues are not required for the scope of this design report to achieve IFC status. These actions will be completed as part of progressive safety assurance activities.

- Hazard Transfer

## 11.8 Safety Assurance Statement

The design covered under the scope of this report is safe to construct following closure of outstanding items listed in Section 11.7. Progressive Safety Assurance for the scope of this design report has been evidenced through:

- Design compliance with relevant codes and standards and EM4P Procedure has been evidenced (Section 8)
- Design has been undertaken by competent personnel (Refer Section 6)
- Safety in Design risk assessments and hazard analysis has been undertaken in consultation with relevant SME's (Refer Section 11.1)
- Hazards identified by SME's through workshops relating to the overall system, sub-systems, interfaces and operations and maintenance activities have been captured and progressively managed in the Project Hazard Log. (Refer Section 11.2)
- All known ways to eliminate, or where not practicable, prevent or mitigate have been identified by SMEs through workshop activities. (Refer Section 11.1)
- The implementation of identified risk controls associated with this design package has been undertaken in accordance with SFARIP principles. Relevant justification for the rejection of controls has been documented within the Project Hazard Log (Appendix Y).
- Risk controls that have been identified for implementation have been derived into Safety Requirements and traced through the RATM in DOORS. (Refer Section 11.3)
- Design Safety Requirements have been appropriately evidenced and verified through design documentation. (Refer Section 11.3)
- Individual safety risks have been managed in accordance with SFAIRP principles. (Refer Section 11.8)
- Safety assurance evidence contained in this design report will support the progressive safety argument provided in the Safety Assurance Report (SAR) which will consolidate the safety case and provide a cumulative safety argument for the overall system. (Refer Section 11.6)

# 12. Systems Engineering

## 12.1 Sub-system Allocation

The sub-system (s) related to this design package are:

| SBS ID | Title | Related to Package | Level | Design Packages | E063, JA JV - Morley Precinct - Civil Earthworks | E064, JA JV - Morley Precinct - Civil Drainage | E065, JA JV - Morley Precinct - Civil Highways & Roads | E066, JA JV - Morley Precinct - Civil Car Parking and Bus Interchange, Fencing and Gates, Retaining Walls Minor Structures, Noise Walls & |
|---|---|---|---|---|---|---|---|---|
| 2 | Track & Structures | Yes | 0 | | x | x | x | x |
| 2.1 | Structures | Yes | 1 | | x | x | x | x |
| 2.1.1 | Fencing & Barriers | Yes | 2 | | | | | x |
| 2.1.2 | External Structure | Yes | 2 | | | | | x |
| 2.1.3 | Back of house | Yes | 2 | | | | | x |
| 2.1.4 | Building (non-operational) | Yes | 2 | | | | | x |
| 2.1.5 | Bike Parking Machine | Yes | 2 | | | | | x |
| 2.1.6 | Trackside Equipment Building | No | 2 | | | | | |
| 2.1.7 | Station Equipment Room | Yes | 2 | | | | | |
| 2.1.8 | Rail Depot | Yes | 2 | | | | | |
| 2.1.9 | Railway Station | Yes | 2 | | | | | |
| 2.1.10 | Urban Design & Landscaping | Yes | 2 | | | | | |
| 2.1.11 | Parking | Yes | 2 | | | | | x |
| 2.1.12 | Fencing & barriers | Yes | 2 | | | | | x |
| 2.1.13 | Formation | Yes | 2 | | | | | |
| 2.1.14 | Rail Reserve | Yes | 2 | | | | | |
| 2.1.15 | Bridge | Yes | 2 | | | | x | |
| 2.1.16 | Culvert | Yes | 2 | | | x | | |
| 2.1.17 | Footbridge | Yes | 2 | | | | | |
| 2.1.18 | Pedestrian Bridge | Yes | 2 | | | | | |
| 2.1.19 | Platform Edge | Yes | 2 | | | | | |
| 2.1.20 | Pedestrian Underpass | Yes | 2 | | | | | |
| 2.1.21 | Rail Bridge | Yes | 2 | | | | | |
| 2.1.22 | Road Bridge | Yes | 2 | | | | x | |
| 2.1.23 | Tunnel | Yes | 2 | | | | | |
| 2.1.24 | Access Stairs and Handrails | Yes | 2 | | | | | |
| 2.1.25 | Drainage | Yes | 2 | | | x | | |
| 4 | Miscellaneous Passenger Convenience Services | Yes | 0 | | | | | x |
| 4.1 | Vertical Transport | Yes | 1 | | | | | |
| 4.2 | Hydraulic Systems | Yes | 1 | | | | | |
| 4.3 | Lighting | Yes | 1 | | | | | x |
| 4.3.1 | Event Lighting | Yes | 2 | | | | | x |
| 4.3.2 | Emergeny Lighting Contoller | Yes | 2 | | | | | x |
| 4.3.3 | Emergeny Light | Yes | 2 | | | | | x |
| 4.3.4 | General Light | Yes | 2 | | | | | x |
| 4.3.5 | General Lighting Controller | Yes | 2 | | | | | x |
| 4.3.6 | Light Switching | Yes | 2 | | | | | x |
| 4.3.7 | Photoelectric Cel | Yes | 2 | | | | | x |

## 12.2 Requirements Management

Requirements management occurs throughout the life cycle of the project and is described in the Systems Requirements Management Plan (RMP). The Requirements Allocation and Traceability Matrix (RATM) has been established and is used to track the requirements from the identification and allocation stages through to verification for contract requirements and derived requirements, such as safety and Human Factors requirements from hazard analysis.

In Reference Design phase, these requirements were allocated to package(s) for demonstrating compliance at agreed points in the project lifecycle. For the Interim and Final Detailed Design phases, the progressive compliance of requirements allocated to this package is shown at Appendix O.

The System Requirement Specification has been developed based on the system performance, functions and process defined in the SWTC chapters, and has been structured in accordance with the PTA SRS specification:

- Part A – Functional Requirements
- Part B – General Requirements
- Part C – Discipline Specific Requirements

- Part D – Validation Requirements
- Derived Requirements

The MELconnx Project requirements taken from the SWTC therefore form the Project requirements baseline. Project requirements which include derived requirements from specialty disciplines are progressively managed in accordance with the requirements management process which is described in the Requirements Management Plan. The section below presents an overview of the RATM and the status of the technical requirements (listed in the RATM) associated with the design package.

### 12.2.1 Requirements Allocation Traceability Matrix

Table 7: Table of Requirements Compliance.

| SRS– System Requirements | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Design Package** | **Compliant** | **Partial-Compliant** | **Non-Compliant** | **To be confirmed at Later Design Phase** | **To be confirmed Post Design Phase** | **TOTAL** | **Assurance Passed** |
| **E063** | 0 | 0 | 0 | 17 | 0 | **17** | 0 |
| **E064** | 0 | 0 | 0 | 18 | 0 | **18** | 0 |
| **E065** | 0 | 0 | 0 | 17 | 0 | **17** | 0 |
| **E066** | 0 | 0 | 0 | 41 | 0 | **41** | 0 |
| **Total** | **0** | **0** | **0** | **90** | **0** | **93** | **0** |

The above table includes safety requirements identified in the SWTC, which have been reported separately in Section 11.3.1.

Requirement compliance status is divided in to four categories:

- **Compliant:** the design is compliant with the requirement,
- **Partial-Compliant:** the design is only compliant in part with the requirement,
- **Non-Compliant:** the design is not compliant with the requirement,
- **To be confirmed at later Design Phase:** the designs compliance status is yet to be determined at this design stage
- **Assurance Passed:** a review of the verification evidence provided by the designer has taken place and it is deemed satisfactory for the associated requirement.

A copy of the RATM is contained in Appendix O.

## 12.3 Outstanding Issues

There are no outstanding issues.

# 13. Sustainability in Design

Development and documentation of sustainability initiatives have been determined for this design package and are included in detailed in Section 4.10.

# 14. Testing & Commissioning Requirements

Inspection and Test Plans (ITP) summarise the requirements of the Specifications and Design Drawings by detailing the criteria for workmanship, verification activities including Witness and Hold Points, and related authorities/responsibilities for each stage of the construction/installation process.

Refer to summary below for specific ITP requirements including Hold Points and Witness Points which will be required to be undertaken as part of the construction phase support activities.

### 14.1 ITP's

ITP's relevant to this Design Package will be included at detail design.

### 14.2 Hold Points

To be provided when specifications are provided in future design stages.

### 14.3 Witness Points

Witness points relevant to this Design Package will be included at detail design.

## 15. Human Factors

Human Factors Integration for the Malaga Station and Precinct component of the Morley Ellenbrook Line (MEL) has been developed in accordance with the management plan to identify, consider and evaluate the HF issues through combination of:

- Design development meetings
- Interdisciplinary checks (IDC)
- RAM workshops
- PHL workshops
- MEL project Safety in Design Workshop No.13
- Design drawing review
- Scenario development and 'virtual walk through' activity

The HF segments of workshops focused on how users are likely to interact with the Morley Station and surrounding precinct. Particular focus has been given to the Human Factors Issues Register (HFIR) which is the primary tool for recording and managing the integration of HF in the design. The table below shows the number of Human Factors Issues applicable to the civils packages (E063, E064, E065, and E066), and their closure status at the time of this report issue. The specific HF issues are included in the Human Factors Issues Register in Appendix AA of this report.

Table 8: Human Factors Issues Register Summary.

| Risk Level | Number of HF Issues | Open | Closed |
|---|---|---|---|
| Low Risk <8 | 2 | 2 | 0 |
| Med Risk 8-9 | 1 | 1 | 0 |
| High Risk 10-15 | 2 | 2 | 0 |
| Very High Risk >15 | 1 | 1 | 0 |
| **Total** | **6** | 6 | 0 |

HF Issues will be closed progressively as design develops.

Details for the HF activities across the whole project can be found in the MELconnx Safety Assurance Report (MEL-MLCX-RS-RPT-00030)

## 16. Reliability, Availability and Maintainability (RAM)

### 16.1 System Analysis Results

Reliability, Availability, and Maintainability (RAM) for the Reference Design stage of the Morley Station and Precinct components of the Morley Ellenbrook Line (MEL) has been developed in accordance with the Reliability, Availability, Maintainability Management Plan (MELAD-MLCX-EA-PLN-00001).

A RAM Report (MEL-MLCX-EA-RPT-00027) for the entire station and precinct was developed through a series of workshops with the designers and PTA, alongside design report and engineering drawing reviews. The output of the report is an assessment of the service criticality of each system and the resultant analysis to be conducted for Interim and Final Detailed design.

No quantitative analysis will be conducted for the scope applicable to this design report as the scope is:

- Principally comprised of static structures;
- Not directly service affecting; or
- Not subject to intrinsic random failure mechanisms.

The scope will contribute to the overall project RAM goals by being designed and constructed in accordance with the SWTC and appropriate standards.

Based on the above, and the absence of any specific Quantitative targets applicable to this scope, only qualitative analysis has been conducted.

### 16.2 Outstanding Issues

There are no outstanding items relevant to RAM.

### 16.3 RAM Issues Log

There are no RAM Issues in the RAM Issues Log relating to this design package.

### 16.4 Overall Assessment

The scope of this design report is qualitatively assessed as supporting the overall RAM objectives through adherence to the design process.

## 17. Construction Methodology

The following construction methodology and staging has been assumed in the development of this design package.

### 17.1 Construction Methods

The following construction methodology and staging has been assumed in the development of this design package.

### 17.2 Operational Staging

The works associated with this design package will be delivered in one Operational Stage as it is a brownfield site with limited interfaces with the operational network along Benara Road.

### 17.3 Works in Track Occupancies

To be confirmed at the next Design stage.

## 18. Asset Maintenance Strategy

The following asset management strategy is required for this design package:

### 18.1 RTO Assets

To be confirmed at the next Design stage.

### 18.2 Other Assets

To be confirmed at the next Design stage.

## 19. Asset Operations Strategy

The following operational strategy has been assumed in this design package:

### 19.1 Normal Modes of Operations

To be confirmed at the next Design stage.

### 19.2 Degraded Modes of Operations

To be confirmed at the next Design stage.

## 20. Decommissioning Strategy

A decommissioning review, including a decommissioning methodology and staging review has been undertaken to identify any restrictions on the assets capability to be modified, and or decommissioned on final completion of the Works (following transfer to the final asset owner).

### 20.1 Capability to Modify

To be confirmed at the next Design stage.

### 20.2 Decommissioning Strategy

To be confirmed at the next Design stage.

## 21. Project Actions

A list of outstanding issues and assumptions that may affect the design are outlined in the Table below.

| ID | Outstanding Issues | Potential Effect | Status |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

# Appendix A: Drawing and Model List

# Appendix B: Specifications

| Doc No. | Doc Title | Discipline | Revision |
|---|---|---|---|
| MEL-MLCX-QA-SPC-00201 | Specification 201 – Quality Systems | Civil | A |
| MEL-MLCX-CI-SPC-00301 | Specification 301 – Vegetation Clearing and Demolition | Civil | A |
| MEL-MLCX-CI-SPC-00302 | Specification 302 - Earthworks | Civil | B |
| MEL-MLCX-CI-SPC-00303 | Specification 303 -Materials and Water Sources | Civil | A |
| MEL-MLCX-CI-SPC-00304 | Specification 304 – Landscaping and Revegetation | Civil | A01 |
| MEL-MLCX-CI-SPC-00402 | Specification 402 – Surface Drains and Levees | Civil | A |
| MEL-MLCX-CI-SPC-00404 | Specification 404 - Culverts | Civil | A |
| MEL-MLCX-CI-SPC-00405 | Specification 405 – Drainage Structures | Civil | A |
| MEL-MLCX-CI-SPC-00406 | Specification 406 – Rock Protection | Civil | A |
| MEL-MLCX-CI-SPC-00407 | Specification 407 – Kerbing | Civil | A01 |
| MEL-MLCX-CI-SPC-00410 | Specification 410 – Low Strength Infill | Civil | A |
| MEL-MLCX-CI-SPC-00501 | Specification 501 - Pavements | Civil | A |
| MEL-MLCX-CI-SPC-00503 | Specification 503 -Bituminous Surfacing | Civil | A |
| MEL-MLCX-CI-SPC-00504 | Specification 504 – Asphalt Wearing Course | Civil | A |
| MEL-MLCX-CI-SPC-00505 | Specification 505 – Segmental Paving | Civil | A01 |
| MEL-MLCX-CI-SPC-00508 | Specification 508 – Cold Planing | Civil | A |
| MEL-MLCX-CI-SPC-00510 | Specification 510 – Asphalt Intermediate Course | Civil | A01 |
| MEL-MLCX-CI-SPC-00511 | Specification 511 – Materials for Bituminous Treatments | Civil | A |
| MEL-MLCX-CI-SPC-00601 | Specification 601 – Signs | Civil | A01 |
| MEL-MLCX-CI-SPC-00604 | Specification 604 – Pavement Marking | Civil | A01 |
| MEL-MLCX-CI-SPC-00606 | Specification 606 – Tactile Ground Surface Indicators | Civil | A01 |