

Initial Construction Management Plan

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Initial Construction Management Plan

Introduction

The Delivery Phase is when the future customer base will be developed. The community must feel like they are part of the Project. Canberra Metro will use proactive community engagement to create a fully informed and educated community. There can be no unwanted surprises for the Project's future customers.

Importantly, the Project must be constructed safely and efficiently.

Canberra Metro features the strongest construction experience in the country. John Holland and CPB (formerly Leighton Contractors) are two of Australia's biggest rail and civil contractors. They have delivered some of the most challenging transport projects across Australia.

Approach

The safety leadership and commitment of Canberra Metro's delivery team, backed by positive actions and behaviours that are visible to all, will be a major part of our approach to construction management. We will bring to the Project a working culture based on 'zero harm'. Our unwavering commitment to safety in the Delivery Phase will form the DNA of the organisation in the Operations Phase and help make Canberra the world's safest light rail system. Canberra Metro will deliver the Project in a way that ensures:

- the absolute safety of the public
- minimum impact on traffic flow, and
- a no-surprises outcome for business, utility owners and other stakeholders.

To ensure public safety we will deliver awareness campaigns focussing on pedestrians, cyclists, traffic and worksite safety and highlight changes to worksite locations and arrangements, with a particular focus on site establishment, changed traffic and pedestrian arrangements. Canberra Metro's proven capacity to manage safety risks in major construction environments is reinforced by the established systems and records of John Holland and Leighton Contractors.

The construction team has worked closely with design and operations personnel to develop a construction methodology that combines the safest, most efficient delivery methods with the best possible outcomes in operations. This will bring measurable benefits in construction safety, as well in other key performance areas such as quality, environment, sustainability, operations and maintenance. It includes:

- completing construction in late 2018 – Canberra Metro will commence operation in early 2019
- moving the track alignment from median to western verge on Flemington Road
- minimizing the visual impact of tree removal along Northbourne Avenue
- minimizing impacts such as noise, dust and vibration at the source, and
- staging works to provide access to local businesses and prevent impacts on trade.

Purpose

The purpose of the Initial Construction Management Plan (ICMP) is to describe Canberra Metro's approach to construction management and the interfaces, methodologies and activities that will ensure positive outcomes for the Project during the Delivery Phase.

Key personnel

Canberra Metro has assembled experienced and proven personnel for construction management and technical positions. The key objectives for resourcing the construction team are:

- assembling a specialist team with the expertise required to deliver the Project
- providing experienced, empowered leaders with clear accountability for delivery
- ensuring leadership responds effectively to the changing requirements of the Project
- communicating and collaboratively engaging with all parties at all levels
- recognising high performance and contributions from participants and stakeholders.

The proposed senior management team has extensive experience in light rail, brownfield construction and ACT experience and know how to mobilise for this project. Their strong leadership skills will help establish and maintain a high performing integrated delivery team and ensure a seamless transition from construction to operations. The proposed personnel for the Delivery Phase are detailed in the Initial Project Management Plan, currently under development.

Area construction teams

There will be one construction team based at each end of the alignment (north and south), plus an additional team located at the site of the stabling and maintenance facility. The location of team members and site offices is provided in the Initial Project Management Plan (currently under development). The overarching D&C organisation chart is provided in Figure 1. The rail and civil construction team structure is shown in Figure 2.

Figure 1: Overarching Design and Construction Organisation Chart

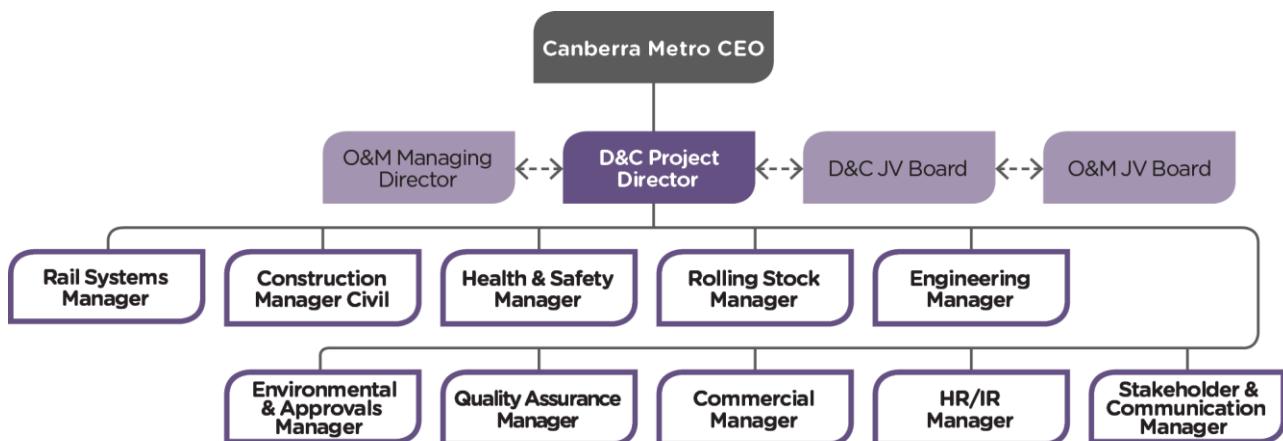
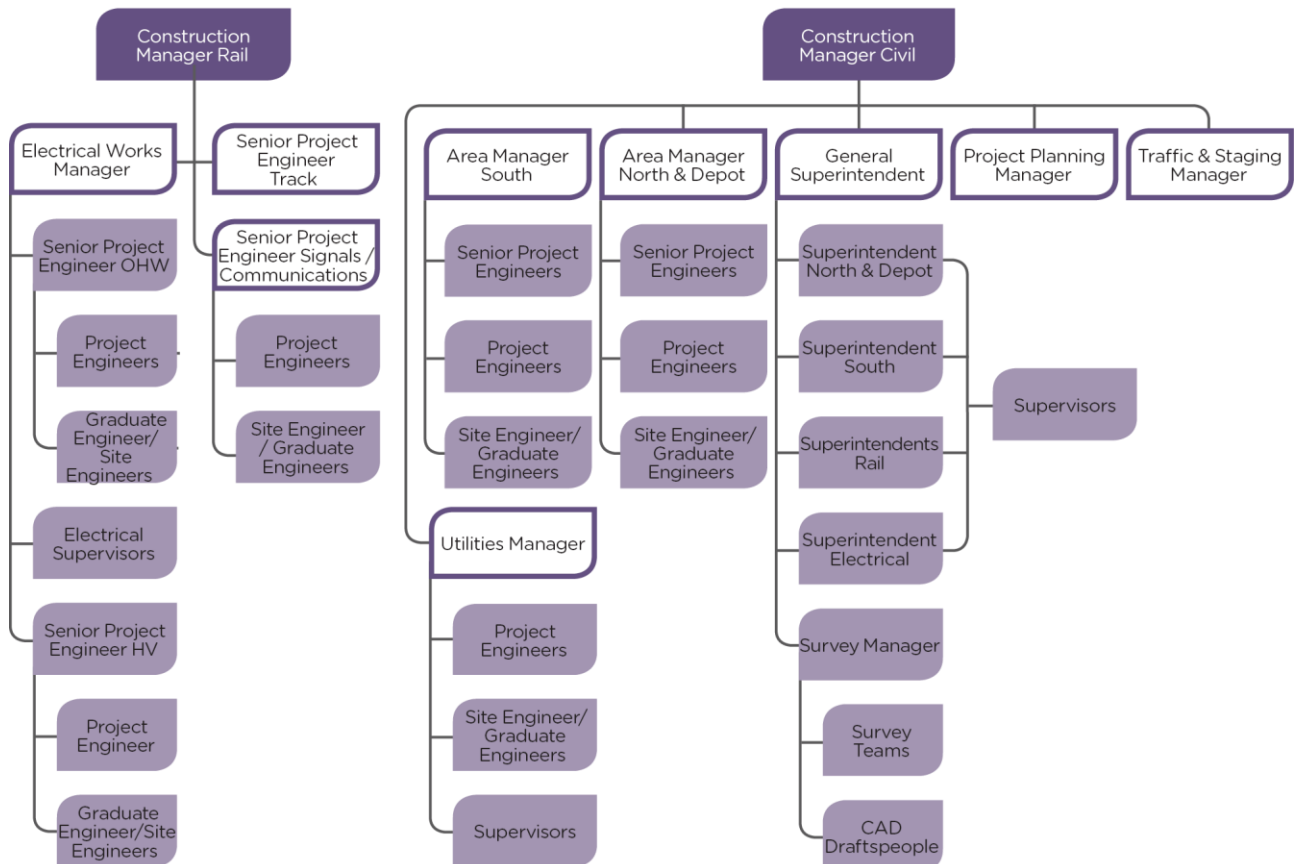


Figure 2: Construction Teams – Civil and Rail



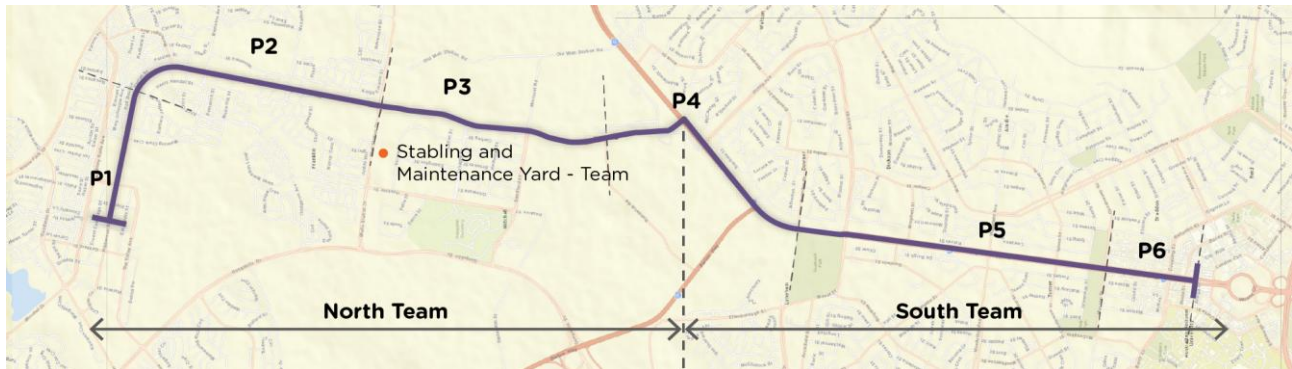
1. Indicative Construction Staging Plan

Canberra Metro's construction program runs from October 2016 to late 2018.

The construction works have been divided into six geographical precinct areas:

- Precinct One – Gungahlin Terminus to Hibberson Street
- Precinct Two – Flemington Road North
- Precinct Three – Flemington Road South
- Precinct Four – Federal Highway
- Precinct Five – Northbourne Avenue
- Precinct Six – Alinga Street (Civic) Terminus.

Figure 3: Construction Precincts 1 to 6



Construction precincts have been subdivided into smaller construction zones, representing the work areas bounded by intersections, works on intersections, and other area specific works. The detailed delivery program is in the process of being developed.

1.1 Key features of construction works

The key features of the construction works are:

- widening main roads and using existing slip lanes to reduce traffic impacts when permanent works begin
- completing works on multiple fronts to reduce program time
- completing intersections in less time than allocated by CMA (less than four weeks)
- trenching for utilities in preparation for tree removal along Northbourne Avenue
- carrying out core construction activities during off-peak hours (including material delivery times)
- using slip form paving machine for increased production efficiency and safer working.

1.1.1 Traffic management

An Initial Traffic and Transport Management Plan is being developed which describes the long-term traffic arrangements and other traffic management strategies during construction. The arrangements will be refined in consultation with TAMS. The key strategies are:

- minimise temporary traffic management (ie > 9hrs duration)
- off-peak lane occupancies
- intersection closures, and
- detours.

Canberra Metro will work cooperatively with CMA and other key stakeholders to ensure a seamless transition for road-based traffic and transport and pedestrians. The safety of the public is paramount. Workshops for each work zone will be held with the relevant authorities to confirm optimal traffic management arrangements.

1.2 Staging summary

Canberra Metro will mobilise section managers with appropriate resources to manage the utility scope investigation and delivery within their areas, ahead of commencement of permanent works construction.

This early start will enable utility works to get under way in advance of permanent design and construction work, which in turn will maximise the opportunity to commission the light rail system as early as possible. This also maintains engagement initiated by CMA, e.g. ICON and starts long lead-time procurement items. The utility scope will be the main focus for 2016, with permanent works commencing in the third quarter of 2016.

Mobilisation to site and the setup of construction compounds is anticipated to begin in early July, together with the installation of conduit runs for utility diversions on Flemington Road and Northbourne Avenue. Main construction begins in October 2016. A mobilisation plan will be provided in the Initial Project Management Plan.

Utility services conflicts along Northbourne Avenue have been avoided by splitting the current utilities into two trenches, one on either side of the wide median. This allows the utilities to be far enough away from the Design Kinetic Envelope (DKE) to ensure they are not impeded by operation of the light rail during maintenance/emergency or new installation works. The details of these utilities works will be provided in the Initial Utility Service Treatment Plan.

The community team will undertake consultation and notification within the local area prior to any changes to public parking and traffic conditions, in accordance with a Communications Plan (currently being developed), including:

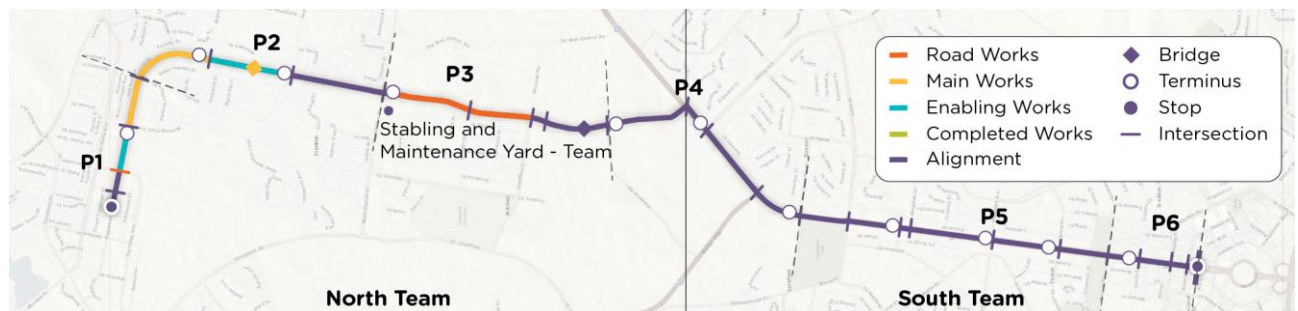
- consultation with businesses and public
- letterbox drops
- site signage, and
- updates to the construction website.

The following descriptions of construction timing are indicative only and may be subject to change.

1.2.1 October 2016 to December 2016

The first construction activities are anticipated to occur along Flemington Road in Precinct 3 (Figure 4) with traffic barriers erected and demolition works taking place. Construction vehicle parking for these works will be provided at the north site compound in Gungahlin. No construction parking will be allowed on public streets.

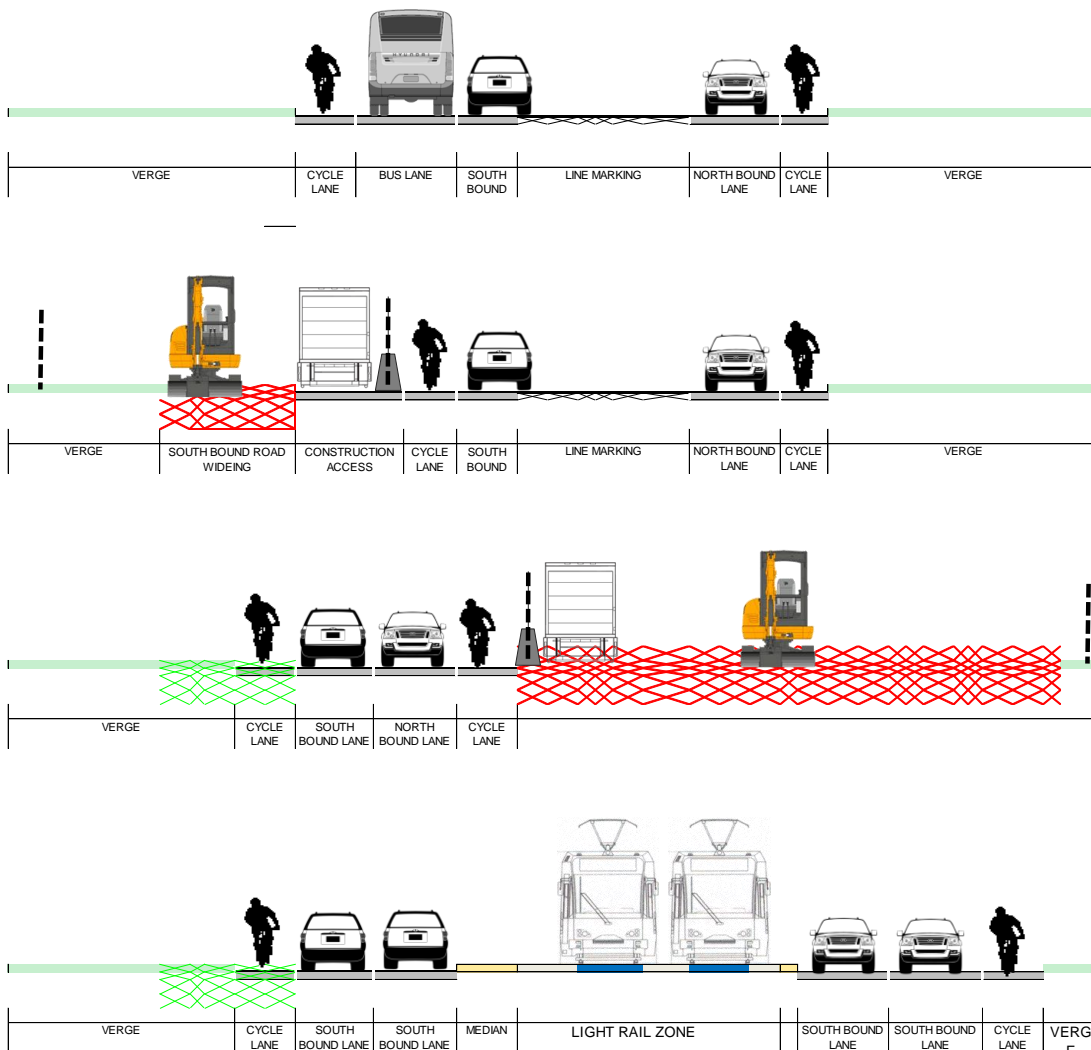
Figure 4: October 2016



Roads will be widened and slip lanes used before permanent works start to minimise impacts on the local area during median works and to retain where possible the existing road conditions (Figure 5).

Construction crews will erect safety barriers to clearly demarcate the construction site from the road and pedestrian traffic. Clearing and grubbing activities are carried out to prepare the widened areas for the road works. The works are followed by the relocation of utilities and earthworks and drainage works.

Figure 5: Well Station Drive to Lysaght Street Flemington road widening – cross section example



Mobilisation to the depot site is also anticipated in October 2016. The first activities include enabling works, remediation of contaminated material, bulk earthworks and completion of the main compound.

The installation of the access bridge across existing culvert at the stabling and maintenance yard entrance in December will increase the ease of construction of the maintenance shed. The bulk earthworks at the access area will also take place. Piling at the maintenance area and shotcrete operations in the stabling area will commence. The movement of material offsite will be minimised.

The existing road conditions and speeds along Flemington Road between Well Station Drive and Morisset Road will remain unchanged. Bus bays on both sides of Flemington Road will be retained for use during construction. The works occurring between Well Station Drive and Morisset Road are shown in Figure 6.

Figure 6: Precinct 3 – Well Station Drive to Federal Hwy – October 2016



Additional work fronts are anticipated to start on Flemington Road in November in Precincts 2 and 3 (Figure 7). Nullarbor intersection is completed in late November. Works on the Gungaharra Creek rail underbridge also commence. Environmental protection measures will be put in place to ensure the creek is protected from contaminants. All necessary edge protection safety measures will be implemented.

All construction activities cease in late December and begin again on 4 January. Compounds will be made secure and road conditions returned to normal during this period.

Figure 7: November 2016



1.2.2 January 2017 to March 2017

A combination of civil, road and track works are expected to be underway in Precincts 1, 2 and 3 in January 2017 (Figure 8). The track works include the excavation for trackform and installation of overhead wiring footings, cable service routes and base foundations for low voltage substations.

The first trenching works along Northbourne Avenue in Precinct 5 also begins in January so that TransACT can perform its utilities services relocations in 2017.

Figure 8: January 2017



The depot site civil works will commence in January 2017 upon the completion of bulk earthworks. These works include foundations and base slabs for structures, footings for signals and over-head posts and track form.

Road widening works will be completed in Precincts 2 and 3 by March 2017.

Flemington Road between Kate Crace Street and Manning Clark Road intersections will be closed to northbound traffic during off-peak hours, and traffic diverted (Figures 9 & 10). This maximises the safety of road users and the rail/road interface by closing off the construction site. No two adjacent intersections will be closed concurrently to minimise the impacts on traffic.

Figure 9 Kate Crace Street to Manning Clark Road – traffic diversion – March 2017

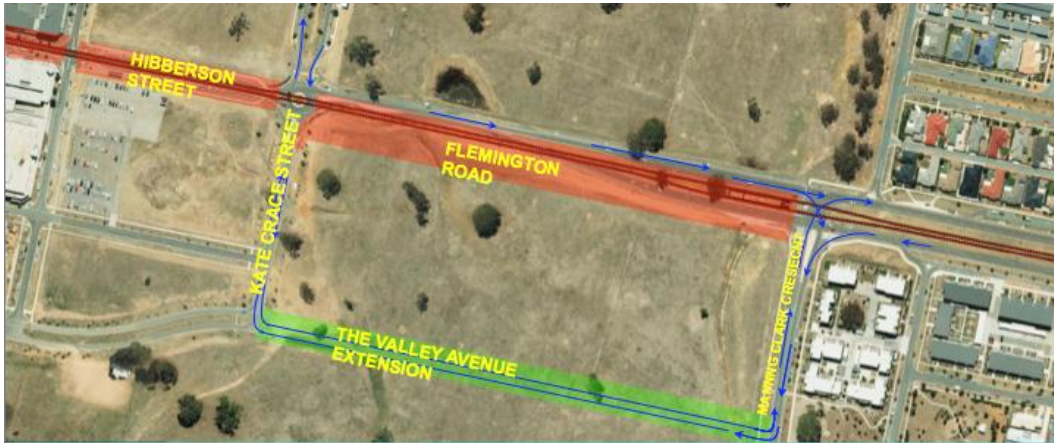
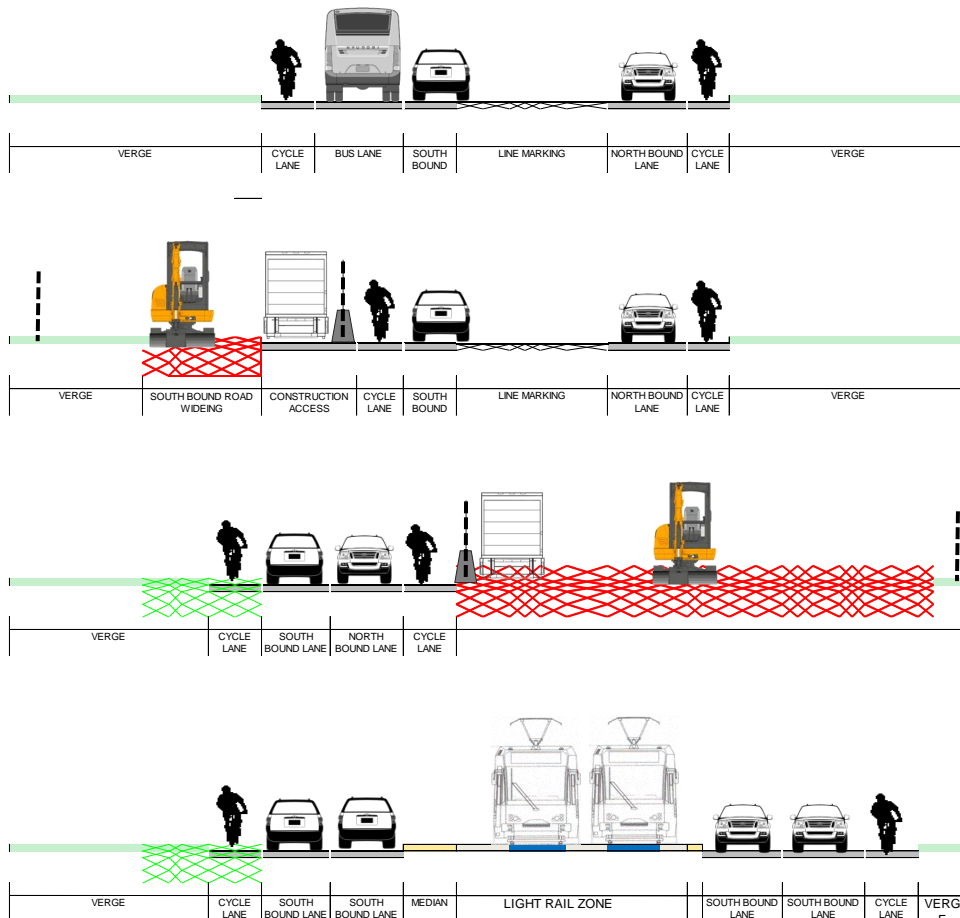


Figure 10 Kate Crace to Manning Clark road widening – January to March 2017



Intersections in Precinct 2 are also completed in March. Excavation for track foundation begins in Precinct 3 between Well Station Drive and Morisset Road. Traffic will be running on widened sections to minimise disruption of traffic while rail works are carried out in the median areas.

Figure 11: Precinct 3 – Well Station Drive to Federal Hwy – March 2017



1.2.3 April 2017 to June 2017

A large portion of works in Precinct 2 is anticipated to be completed in April 2017. Civil works start in the Gungahlin precinct. Pedestrian safety and access to shops in this area has been maximised by using temporary fencing and clear segregation of work sites.

At the depot site, structural and mechanical works commence in May. Building services, electrical and rail systems works, all occurring concurrently, follow these works.

Figure 12: May 2017



The relocation of TransACT(iiNet) services is completed in Precincts 3 and 4 and the main works around the EPIC compound between Sandford Street / Morisset Road and Federal Highway commences in April. Construction activities around the Sandford Street/Morisset Road area will be staged to maintain traffic flow through Flemington Road – subject to speed restrictions for safety reasons.

All construction noise and vibration will be managed using respite periods and by rotating activities to minimise the duration of impacts on the local residents and businesses. The works include:

- construction of new rail bridge – a safer option than modifying the existing structure
- widening of slip road at Federal Highway onto Flemington Road, and
- clearing works preparing for the western verge track works.

Moving the track alignment at EPIC – Flemington Road, Federal Highway to Depot entrance

The design team has moved the track alignment away from the median to the western verge – for a distance of approximately 1.3km. This brings the following benefits in construction and operations:

- reduces road widening works
- modification or demolition of existing southbound road bridge no longer required
- avoids services and utilities clashes, reducing the number of potential relocations
- provides safer working for construction crews (no longer required to work in the median)
- reduces the impact on road lane closures
- improves access to the construction site without disrupting traffic
- reduces program duration and cost
- improves capacity and public safety at EPIC Stop.

The first road widening works outside the corridor in the south section Precinct 5 start in June 2017. The opening of works along the alignment on multiple fronts has reduced the program time. Works are staged to minimise impacts on existing road conditions.

Figure 13: June 2017



1.2.4 July 2017 to September 2017

Main works in Precincts 1, 2 and 3, including eight of ten intersections near completion in July 2017.

The majority of works along Northbourne Avenue, including track works will start by August. Two work fronts are open and progress south to north. Works between Gungahlin and Stabling Yard in Precincts 1, 2 and 3 are completed in September. Works in the depot continue including track slab and turnouts installation, as well as roofing and cladding works in the building.

Figure 14: Precinct 3 – September 2017

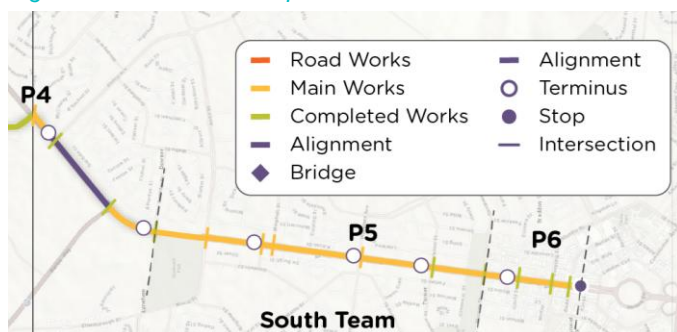


Figure 15: Precinct 3 – Well Station Drive to Federal Hwy – September 2017



Intersection staging – Federal Highway / Flemington Road

The Federal Highway / Flemington Road intersection in Precinct 4 will be closed for one weekend mid-2017. Works will be staged in the week leading up to the closure to minimise the amount of works on the weekend.

1.2.5 October 2017 to January 2018

Slip form paving works in the whole southern section in Precincts 4 to 6 continue in October and November. All intersections along the entire alignment will be completed by October. Access roads, fencing and landscaping works will take place in the Depot, together with fit-out works in the maintenance building. Landscaping commences in October 2017, followed by rail systems commissioning activities.

Figure 16: January 2018



2. Construction Compound Layout Plans

A map showing the locations of offices and compounds will be provided in the Initial Project Management Plan.

The locations of compounds are in Table 1.

Table 1: Location of construction compounds

Office / Compound	Location
North Compound – Gungahlin	Off Kate Crace Street, Gungahlin
Depot	Cnr Sandford Street and Flemington Road
EPIC	Off Flemington Road, Lyneham
Project Office	330 Northbourne Avenue, Dickson (Visitor Centre)
South Compound – London Circuit	Corner London Circuit and Northbourne Avenue

The north delivery team will be located at the North Compound in Gungahlin. The site sheds at the Gungahlin compound are located away from residential areas to minimise noise impacts from construction crews. Entry only will be permitted from Flemington Road.

The south delivery team will be located at the South Compound in London Circuit. The site sheds at the compound have been located away from government buildings to minimise noise impacts. Two gates will be made available at the site, which can be used to control construction vehicle movements and minimise general traffic congestion if it occurs during peak times

The north and south teams will use an office at EPIC when they are working on the central precincts of the project. The location of the construction compound inside the car park of EPIC increases the safety of construction personnel, as they no longer need to cross the alignment to reach the works.

A separate compound and team will be set up at the Stabling and Maintenance Facility. The site sheds at the compound have been located as far from the National Archives building to minimise noise impacts. An additional satellite office close to EPIC will be used primarily for storage of construction materials. All satellite offices and compounds will contain:

- office space (including hot desks for visitors)
- workforce amenities
- first aid (including defibrillator).

There will be restricted parking at all construction compounds to minimise impact on the surrounding road network. Employees will be encouraged to use public transport and site vehicles will be kept to a minimum.

3. Spoil and Waste

3.1 Approach

Canberra Metro’s spoil management strategy will be consistent with Infrastructure Sustainability rating benchmarks and based on:

- maximising material reuse, including topsoil and minimising waste sent to landfill
- avoiding contamination of land or water from contaminated spoil and waste
- managing associated impacts on residents and other sensitive receivers
- minimising adverse traffic and transport related issues.

An Indicative Waste Management Plan (being developed) will set out the management framework to eliminate, manage, mitigate or minimise the potential impacts from spoil and contaminated soil. The plan will be based on the Development Control Code for Best Practice Waste Management in the ACT. It will:

- identify the measures to reduce spoil quantities, maximise beneficial reuse and minimise disposal
- describe methodologies for excavation, handling, storage, haulage and disposal of spoil
- define the procedures to manage all types of spoil generated as a result of the works, and
- identify indicative quantities of spoil that will be reused on site, beneficially reused off site or require disposal to a licensed facility.

3.2 Waste reduction strategy

The following environmental management measures will be used to manage resource consumption:

- investigating opportunities to reuse or recycle other construction and demolition waste
- applying the waste hierarchy (avoid, minimise, reuse/recycle, dispose) during construction
- preparing and maintaining a waste management system on site (including recycling)
- promoting minimal resource use as a design target
- treating any wastewater collected prior to discharge, in accordance with current standards
- chipping leaf material and small branches of native vegetation for use as mulch in revegetation or landscaping works
- disposing all other green waste from vegetation removal to a green waste recycling facility
- maintaining work sites in a tidy state, and appropriately disposing of all general litter (including food scraps, plastics, glass bottle)
- providing reuse and recycling training and infrastructure at construction sites
- setting construction reuse and recycling targets and monitoring waste generated to manage and classify waste for disposal in accordance with the relevant ACT EPA Guidelines
- using a licensed contractor to remove contaminated waste, under current ACT EPA Guidelines
- where appropriate, sourcing of materials would be undertaken using locally available resources and materials.

3.3 Licensing and approvals

The disposal of spoil off site and acceptance of fill on site in the ACT is regulated under the *Environment Protection Act 1997*. The Indicative Waste Management Plan will be developed in full to satisfy the requirements of the Act, as well as associated planning approvals, other environmental documents and contract requirements.

3.4 Roles and responsibilities

The following key roles will be responsible for overseeing and implementing the processes and procedures to identify, handle and manage spoil and waste materials:

- **Construction Managers (Rail Systems and Civil):** Manages the delivery of the construction process, in relation to spoil and waste management across all sites, and in conjunction with the Approvals and Environment Manager
- **Environment & Approvals Manager:** Oversees the implementation off the Waste Management Plan and Spoil Management Plan and all associated initiatives, processes and procedures
- **Environment Coordinators:** Monitor spoil and waste management against procedures and investigate and report any pollution incidents relating to spoil or waste management.

All construction personnel will receive training appropriate to their role in spoil and waste management on the project. Ongoing toolbox talks covering the requirements for management of spoil will be used to raise awareness to the wider project team. Records will be regularly audited and reviewed.

3.5 Reducing spoil during the Delivery Phase

Areas and activities will be assessed prior to construction to identify potential additional reuse opportunities. Each area and activity will be assessed as part of the detailed planning process prior to commencement of construction. This process will refine existing spoil quantities and identify new opportunities to minimise spoil for disposal off site and maximise beneficial reuse both on and off site.

3.6 Storing construction spoil and waste

Construction spoil and waste will be stockpiled at:

- Gungahlin (north compound)
- EPIC
- Stabling and Maintenance Yard.

It is not suitable to stockpile spoil or waste at the London Circuit (south) compound because it is in the city and will be formed from hardstand areas only. Spoil and waste will be removed from site to nominated locations, able to receive the relevant material.

Measures for the storage, stockpiling and disposal of materials will include the following:

- Stockpiles would be located on relatively level ground and away from areas of ecological or heritage value or from drainage lines and waterways.
- Stockpiling of materials within the median along Northbourne Avenue would be limited where possible to minimise visual impacts.
- Prior to removal of material for off-site disposal, these materials would be assessed for suitability for beneficial reuse. Where material is intended for beneficial reuse, a beneficial reuse assessment (BRA) would be undertaken in accordance with the ACT EPA 2014, Information Sheet 4 – Requirements for the reuse and disposal of contaminated soil in the ACT.
- Any hazardous materials required for the operation and maintenance of the Project would be stored in accordance with relevant ACT EPA guidelines.

All stockpiles of spoil and waste material will be managed in accordance with the requirements of the *'Blue Book', Volume 1, Managing Urban Stormwater: Soils and Construction (Landcom 2004)*, to prevent erosion and minimise the potential for pollution. Water-based organic polymers will be used for short-term control of risks associated with erosion and pollution. Water-based polymers or vegetative stabilisation will typically be used to manage spoil that is to be stockpiled for an extended period.

3.7 Removal of spoil and waste from site

The key principle for spoil haulage by road is to select the most appropriate route that will minimise impact and facilitate efficient access to arterial roads. Haulage routes associated with the movement of spoil will be described in the Initial Traffic and Transport Management Plan.

All waste generated and surplus spoil from the construction of the Project will be transported to the West Belconnen Resource Management Centre, or another appropriate facility. Initial consultation with ACT NoWaste has been undertaken by CMA to confirm the suitability of this facility for the disposal of waste. At this point in time, this facility has the capacity to process, recycle or dispose of all waste generated by the Project.

4. Services Connection

Services connections for electricity, water and sewerage will be required at the following compounds:

- Gungahlin
- Depot
- EPIC
- London Circuit.

Canberra Metro will contact the following providers to arrange the connections:

- ActewAGL (electricity)
- ICON Water (water and sewer).

The requirements for each services connection will be determined following initial consultation with the relevant providers.

5. Construction Methodology and Scheduling

Canberra Metro features the strongest construction experience of the tendering consortia. John Holland and Leighton Contractors are two of Australia's biggest rail and civil contractors. They have delivered some of the most challenging rail construction projects in Australia. We will use this experience to deploy the latest methodologies, plant and techniques during construction.

Canberra Metro will meet all project objectives by:

- providing a safe system of work
- implementing effective environmental controls to reduce noise

- coordinating with CMA and other stakeholders on a daily basis
- maximising the prefabrication of mechanical, electrical and piping installations
- using precast and modularisation systems where practicable and cost effective
- using 3D modelling to ensure successful coordination of building and structural elements.

5.1 Safety in design

Safety in design workshops will be held prior to construction commencement. The workshops will identify risks to health and safety arising from the design. A report will be formulated that contains the findings of the workshop and the respective control measures. It will be issued to the Territory for review and comment.

A project risk assessment will also be undertaken before any works commence on site. The risk assessment will identify all risks and proposed mitigation measures. An Initial Design Management Plan being developed will describe Canberra Metro's approach to safety in design and will ensure safety risks are eliminated or reduced in design for both temporary and permanent works and processes and methodologies to prioritise safety.

The construction delivery team has provided constructability input into the safety in design review process and this will continue during detail design development. Outputs and residual risk from safety in design reviews is transferred to the construction teams using design reports. This information is incorporated into the detailed planning of the works via Safe Working Method Statements and Inspection and Test Plans.

5.1.1 Work health and safety management

The risks identified for each work area during the design phase will be re-assessed during construction planning and updated. The risks assessments will be recorded and assigned to owners and managed through the planning phase. Construction staff will review the risks, including the risk assessment and safe work systems, as part of a pre-start briefing.

No activity can commence until an Activity Method Statement (AMS) has been developed, reviewed by engineers and Safety, Quality, Environment (SQE) representatives, and approved by the relevant Area Project Manager. AMS's are operational documents that specify the construction methodology and the resources (plant, equipment, people skills and materials) required to safely undertake the work covered by the AMS. The methodology is determined and the resources are selected on the basis of the risks identified for that scope of works and the controls agreed for implementation. Additional risks identified using these tools will be retained in the AMS unless they're considered to have commercial, safety or environmental impact broadly across the work area or Project.

Where it is not possible to separate construction deliveries and works from the public, Canberra Metro will implement traffic control to manage the interface areas. In developing construction traffic management plans (CTMPs), Canberra Metro will ensure that:

- safe pedestrian movements, including alternative routes, where required are maintained
- footpath widths accommodate pedestrian traffic with appropriate lighting and barriers where required
- additional traffic controllers or security are deployed where required to ensure the safety of pedestrians
- protocols with Emergency Services (Police, Fire and Rescue, Ambulance) and building occupants regarding emergency response and evacuation are agreed before work starts
- clear wayfinding signage is installed so the public and emergency services can navigate around the construction site
- existing cycle paths within the construction corridor are maintained and, where this is not possible, alternative routes are provided

5.2 Environmental and sustainability management

Construction will be completed in accordance with EPL and IS rating requirements. Initiatives include:

- reducing the requirement for water wherever practicable
- using non-potable water in place of potable water wherever practicable
- capturing and processing groundwater and storm water for treatment and non-potable use
- reducing fuel consumption by minimising double handling
- minimising material to be exported or imported

- reusing material on site e.g. excavated material for haul roads
- minimising environmental impacts by using appropriate techniques and equipment for the task
- implementing respite periods for long-duration high noise/vibration activities
- using barriers and carrying out noise and vibration monitoring at appropriate locations

5.3 Traffic management

The measures that will be used for effective traffic management and planning include:

- directional signage and line marking to guide drivers and pedestrians through or around worksites
- variable message signs to advise drivers of potential delays, traffic detours, speed restrictions or alternative routes
- notification of proposed traffic changes via newspaper, radio, internet and community briefing sessions
- active on-site management by traffic controllers, physical barriers or temporary traffic signals to facilitate access and egress around and through work sites
- maintenance of the implemented traffic management scheme
- ensuring access to existing business premises and residents for pedestrians.

Modular designs and prefabrication

Prefabrication and standardisation are important drivers of efficiency on this Project. Modular designs have been created for the stops and termini. This creates the most cost effective and least disruptive solution during construction with low on-site construction times. They also offer cost saving advantages based on economies of scale.

Large system components such as stop and termini canopy frames, equipment cabinets and substation enclosures will be built away from site. This will help ensure the Project is completed on time and on budget, as works across the corridor can be undertaken concurrently. Construction in a factory setting is also safer and delivers a higher quality of finished product than on-site construction of major elements.

A high proportion of components will also be brought to site in a prefabricated condition, ready for immediate installation, which will improve construction times. This includes steel frames with bolted rather than welded connections. The use of precast concrete for panels external walls and cladding at the stabling yard buildings will also improve the speed of construction because the building can be made weather proof in a shorter time, with interior finishing and services trades able to complete their work sooner.

Prototypes

Prototypes will be constructed and tested where required, with proposed materials for some built elements of the project. This will be done ahead of programmed activities to allow design solutions to be fine-tuned and issues to be resolved without affecting progress.

Site mobilisation

A mobilisation plan will be provided in the Initial Project Management Plan. The key activities will include:

- starting first mobilisation activities in Canberra and Sydney offices
- appointing senior leaders from D&C and O&M to key roles in the delivery team
- engaging designers and begin work on developing the concept designs
- establishing main project office at the former Canberra Information Centre
- establishing satellite offices at the main compounds during the enabling works
- starting the application process for Rail Safety Accreditation for design and construction of the works
- finalising Construction Environmental Management Plan and associated sub-plans
- obtaining Environment Protection Licence (EPL) from the Environment Protection Authority.

Site establishment

The site compounds will be set up with total consideration of the communities they surround. Traffic issues will be minimised and noise levels controlled. Site fences will be established at each construction compound. The fencing will prevent intruders from entering the site. Shade cloth may be installed to minimise dust transfer to adjacent areas from each site.

Vegetation removal will take place and site sheds will be erected to include meal rooms, change rooms, toilets and showers. Services and utilities will be installed for lighting and amenities, as required.

Security measures at each compound will include normal daily site lock-up and opening protocols. All physical protection measures for erosion and sediment control will be installed immediately on possession of each site. Traffic management activities will be carried in accordance with the Initial Traffic and Transport Management Plan.

Engineers will manage deliveries to each compound. They will book all deliveries 24 hours in advance. Traffic controllers will control vehicle and delivery access by checking bookings on the delivery schedule.

Water will be sprayed to prevent airborne dust particles migrating into the surrounding environment. Stockpiles and haulage trucks will be covered with tarpaulins to prevent dust particles getting in to the air.

Inspection and testing

The Inspection and Testing Strategy is crucial to ensure constructed items are in accordance with the design documentation. During the design phase Canberra Metro shall prepare a document that sets out the Project's Inspection and Test Plan (ITP) requirements. During construction, Canberra Metro personnel will undertake self-certification of civil, geotechnical and structural works, with the design team providing a site surveillance team to act as verifiers to ensure the ITPs are complied with.

5.4 Construction Works

Temporary civil works

The safety risks associated with temporary works have been reduced through both early planning and consideration of the best temporary works options. The required works include:

- shoring of trenches
- propping, and
- major crane lifts for bridge girders.

Permanent civil works

The permanent works involve the following activities:

- bulk earthworks
- utilities relocation
- cable service routes
- track slab and drainage

Bulk earthworks

Earthmoving equipment including scrapers, dump trucks, compactors, dozers and excavators will be used to cut and fill the bulk earthworks. Excess material will be reused on site, if needed, and elsewhere on the Project, with stockpiles minimised.

Utilities

All utilities excavation works will undergo rigorous assessment using excavation procedures, to control and mitigate safety risks. As required, excavations will be fenced off, covered and sign-posted at the completion of works. No excavations will be left without being backfilled or plated prior to the close of shift or the site on weekends. Penetrations will be protected with fixed penetration covers, fenced off and sign-posted to indicate potential hazards.

Permanent works will commence once enabling works in the area are complete – with construction works between zones linked and based on optimising work fronts and minimising construction periods.

Construction activities will be assessed on the basis of the available access and level of impact on traffic, noise, safety and people. All works associated with utilities and services will be adequately protected to ensure public safety and exclusion at all times.

The relocation and installation of utilities below ground will be undertaken mostly using open-cut trenching methods. In some instances, directional drilling or non-destructive digging techniques may be an option. This

will be limited, however, due to the quantity and uncertainty of other utilities in the area. Trench shoring methods may be used during trenching to prevent collapse and undermining of adjacent utilities or roads.

Road works – slip forming method

Canberra Metro has proposed slip forming methods for road works. Slip forming paving machines, such as a Gomaco Commander III, or similar, will be used to construct the kerbs. This is common practice for this type of work, minimising the amount of material needed. The profile will be completed in one pass of the paver.

Track drainage (embedded)

For the track drainage we plan to use an Aco system (or equivalent) with a transverse duct collecting water from flangeway grooves via slots cut into the rail keep and concrete. A carrier drain then removes water to the nearest roadside drain. The box is fitted with a top grill, which allows for additional drainage between the rails and provides easy access for maintenance.

Trackform and general rail construction

The rail construction methodology has been developed to minimise disruption. A “bottom up” approach will increase production rates and retain a quality to the finished corridor.

The chosen trackform types for the Project are based on proven track configurations in use on urban rail systems. Canberra Metro proposes two main types of trackform:

- Embedded track
- Open slab (non-shared corridor).

Embedded track

Embedded sections of trackform will be constructed using predominately the “bottom up” construction method. Slip forming will be carried out to create a channel for the rail. The rail is placed next to the channel in 18m lengths and welded in to 108m strings dependable on section length.

The channel is surveyed and shims are positioned into the channel to achieve vertical alignment. The rail is placed onto the shims and rechecked for vertical alignment. The rail is also checked for horizontal alignment. Horizontal alignment is achieved by inserting wedge shims positioned against the channel wall and the rail foot.

Tolerance will be accounted for within the alignment of the channel rather than being dependent on the quality of the construction tolerances achieved by the slip form paver. This ensures that exact gauge, rail inclination, and horizontal and vertical alignment are maintained.

Open slab

This method involves embedding sleepers into a concrete slab. The main advantage is in the pre-casting sleepers, which saves time because the alignment supports can be included in the design.

The sleeper and rail are first positioned onto a level formation. The track is then set to line and level by use of adjustable levelling screw incorporated into the sleeper placed, at approximately 750mm intervals (closer on tight curves). The final position is surveyed within design tolerances and adjusted if required.

Open track between Well Station Drive and Sandford Street

- The available work zone does not allow for the slip form paver, without going outside existing kerb lines
- Embedded track requires additional carrier drainage pipes to be laid. Due to the restricted space in the median, laying the pipes would be difficult considering the other services required in the CSR
- Open track allows surface water to flow through the rails and discharge over land to road drainage pits
- The O&M maintenance vehicle will run on the open track slab and not foul the OHW structures or road vehicles.

Rail and concrete interface

The top surface of the concrete shoulders adjacent to the rail will be at or slightly above the railhead level at on-street track sections to reduce the skidding hazard the rail presents to road vehicles.

The surface of the concrete immediately adjacent to the rail will be kept at railhead level for a width of 40mm outside the encapsulation. This controls the risk of wheel running on concrete in the worn-rail situation. It

allows for approximately 3mm of railhead wear before the wheel is likely to run on the concrete surface. When the wear on the railhead is about to run on the concrete, the 35mm strip will be ‘scabbled’ or ‘flailed’ as part of a routine maintenance process to provide an allowance for further rail wear.

Stray current management

Stray current will be minimised by ensuring the rails have low resistivity. The track will be subjected to a strict regime of testing to determine the fall of potential and earth resistance. These tests will be carried during installation to a schedule determined in the Test and Inspection Plan for rail insulation. Embedded track is insulated with the encapsulation system.

The track bed will have a Stray Current Collection System (SCCS). The SCCS is a form of welded reinforcement with drain-off cables to a stray current collection cable. This provides electrical continuity. It is looped into the substations for monitoring purposes. Connections to the SCCS are made at regular chainages into a trackside watertight recess. Tests are carried to ensure the integrity of the SCCS. The tests are recorded and form part of the as-built information.

Turnout construction

All turnouts will be installed on concrete bearers or sacrificial jigs. The minimum turnout design for main line turnouts will be 1:3.5 50m radius. The minimum turnout design for the turnout in the depot will be 1:2.28m 25m radius. All turnouts will be pre-assembled and match-marked prior to going to site.

Structures

Rail Underbridge near Clare Burton Circuit

The proposed underbridge is well positioned in a wide median between Flemington Road’s northbound and southbound carriageways, and crosses Gungaderra Creek, vegetated creek banks, and a shared path.

Canberra Metro has avoided a central pier in the design. This will minimise construction temporary works, pedestrian staging and environmental impacts on the creek below. Eliminating the central pier also improves the safety of maintenance personnel, as they will not be required to work in Gungaderra Creek. A single 21.5m span Super Tee bridge structure supported on headstocks and piles has been designed, with a spill through type abutment. This solution negates the need for significant excavation works beneath the proposed underbridge, greatly reduces disruption to the shared path and reduces the construction program.

A portion of the median north and south of the proposed underbridge will be secured to form the construction site, with impact to traffic typically limited to the use of traffic controllers, to facilitate site vehicles movements, and a 40kph speed limit during construction activities. Environmental protection measures will be put in place to ensure the existing Gungaderra Creek is protected from contaminants. All necessary edge protection safety measures will be implemented.

Construction works will be relatively straightforward and primarily consist of piling works, construction of the headstocks, craning in the precast Super Tees, in-situ deck slab, precast barriers/parapets, and scour protection works.

Bridge culvert structure at depot entrance

Construction works will be staged to maintain water flows and the existing concrete lined flood channel at the entrance to the depot. Enabling works will primarily be undertaken from the depot side of the current concrete lined channel limiting access off the main northbound lane in Flemington Road. Works include the demolition of the eastern portion of the existing concrete lined channel to accommodate the proposed culvert as well as upstream and downstream transitions between the culvert profile and the existing channel profile.

Upon geotechnical validation of bearing capacity and possible proof rolling, a 50mm thick layer of blinding concrete shall be poured to maintain a scour free flow path and provide a suitable working surface.

In order to maintain a flow path and a dry working surface, the eastern foundations associated with the eastern culvert and transition channels shall be constructed first, while upstream flows are directed to the western half. Upon installation of the eastern precast culvert cell and transitions, the flow path will directed through the eastern cell to facilitate the construction of the western foundations and installation of the western culvert cell and ‘link slab’. The last stage of work includes:

- filling and compaction at each culvert and embankment interface

- pouring of the decking slab, transition slabs and barriers
- installation of track
- pouring of infill slabs to achieve the typical embedded track profile.

Bridge structure north of Randwick Road

Environmental protection measures will be put in place to ensure the existing nearby watercourse is protected from contaminants. All necessary edge protection safety measures will be implemented.

Bored piles will be installed prior to the abutments and will extend to interface with the existing adjacent northbound carriageway bridge abutments. Access to bearings will be provided as the laminated elastomeric bearings have a typical design life of 30 years. Care will be undertaken to not impact the existing 132kV aerial located to the north of the proposed northern rail underbridge abutment.

“Super-tees” will be installed upon the abutment headstock by cranes located upon the reinstated earthworks behind the new abutments. Precast integrated parapets / impact barrier will be installed prior to the pouring of the 200mm thick decking slab. The decking slab ties the adjacent Super-tees together and forms the embedded track profile.

Service conduits and track drainage items will be set into position, prior to the pouring of deck slab. The track will then be installed and vegetation on the medians and beneath the bridge reinstated.

Bridge culvert structure near Morphett Street

The condition and structural capacity of this existing culvert structure built in the 1950s is difficult to ascertain. Therefore an independent bridge structure supported by new piles is proposed for the new bridge structure. The new bridge structure is designed to carry the LRV tracks without relying on the structural capacity of the existing culvert structure. The new structure will be cast on a compressible layer on the existing concrete deck to avoid transferring load to the existing structure.

Retaining walls

Based on Canberra Metro’s current design, retaining structures are limited to the depot with a:

- rock bolted shotcrete type cut wall at the western end of the stabling roads, and
- post and panel wall to the west of the maintenance shed.

The cut wall is reasonably quick construction to accommodate the bulk excavations program. Rock bolts rows and columns are envisaged to be spaced at 1500mm for both orientations, but will be confirmed by Canberra Metro’s Design Site Geotechnical Representative (DSGR) during the works.

A post and panel wall arrangement is needed to maximise space between the boundary and maintenance shed to locate the depot’s primary internal two-lane access road. The wall design includes 250UC posts at 3m centres, with 200 thick precast infill panels transferring the lateral loads to the ground embedded posts. It will be similar to the standard design developed for Sydney Trains. Construction will be quick and will not adversely impact the adjacent service road’s operations.

Overhead wiring

Mast installations will be carefully coordinated with concurrent works. Once the foundation installation is complete, the mast installation will commence. Cantilever support attachments will be installed at the correct height and in accordance with design. Pre-fabricated cantilevers will also be installed in accordance with the approved design.

The head span wire arrangements that are required along parts of the routes and within the stabling and depot areas will be installed using lifting platforms and Overhead Wiring (OHW) specialists.

The installation of new isolators will be completed using lifting platforms and OHW specialists in accordance with design cross-sections, design layouts and allocation design drawings. All work will be completed under the authority of an engineer.

The installation of jewellery and preparation work for wiring activities will then be completed in order to minimise wiring time, complexity and risk. The wiring activities for the main and depot lines will be undertaken and section insulators will be installed.

Bonding works will be carried out in accordance with the approved bonding plan. The construction team will undertake a survey of all completed OHW works, with support from an engineer during finalisation and assurance.

Landscaping

The planting of mature trees, shrubs, smaller stock and turf will be completed as areas are made available and are no longer subject to construction traffic or materials laydown. The placement of larger growing understorey planting species adjacent to the trackform will provide a deterrent to unregulated pedestrian movement across the light rail corridor.

Replacement of soils will be limited to those areas where soft landscape performance is required i.e. high visibility areas and in close proximity to high traffic pedestrian areas. Existing soils and salvaged green waste from corridor tree removal for mulches and soil organic additives will be used wherever possible. Topsoils for will be prepared as weed free for reuse in the new landscape works.

5.5 Construction scheduling

The construction program runs from October 2016 to the end of 2018. The detailed program is in the process of being completed.

6. Proposed Hoardings

The peak noise impact will be during the excavation phases. Canberra Metro has gone to considerable lengths to ensure the staging of these works reduces noise impacts as much as is possible.

Hammering activities will be kept to a minimum. In-ground works will be coordinated to avoid clashes with rock that requires removal with hammering equipment, wherever possible. Respite periods will be implemented for long-duration high noise/vibration activities.

The construction worksite will be protected with a combination of approved concrete barriers, some with mesh fence panels, and ATF fence panels with shade cloth. These physical barriers will protect and separate vehicles, plant and people. This method provides a strong visual and physical deterrent and is more visually appealing compared to traditional barrier fences. Temporary acoustic fencing/barriers around the perimeter of prolonged noise generating activities will be considered where feasible and reasonable to effectively mitigate off-site noise levels.

Water will be sprayed to dampen soil during excavation and to prevent dust particles from stockpiles, haul trucks and access roads spreading into the surrounding environment. Other precautions include the covering of all haulage trucks with tarpaulins and monitoring of weather conditions. The use of shade cloth on fencing and privacy screening will be considered during construction in consultation with the CMA and key stakeholders.

7. Proposed Roads Occupation

Indicative traffic lane occupations are shown below.

Table 2 Road Occupation Schedule – traffic lanes (Indicative)

Road Occupation Zone (Traffic Lane)	Commencement of Occupation (Indicative)
Hibberson Street	March 2017
Flemington Road (Between Kate Crace Street and Manning Clarke Crescent)	October 2016
Flemington Road (Between Manning Clarke Crescent and Well Station Drive)	October 2016
Flemington Road (Between Well Station Drive and Sandford Road)	October 2016
Flemington Road (Between Randwick Road and Sandford Road)	November 2016
Flemington Road (Between Randwick Road and Federal Highway)	October 2016

Road Occupation Zone (Traffic Lane)	Commencement of Occupation (Indicative)
Federal Highway	June 2017
Northbourne Avenue (Between Mouat / Antill and Barton Highway)	July 2017
Northbourne Avenue (Between Mouat / Antill and MacArthur / Wakefield)	August 2017
Northbourne Avenue (Between Alinga Street and MacArthur / Wakefield)	May 2017

Canberra Metro has developed a traffic management strategy that minimises the disruption to road users by applying traffic management on a daily or nightly basis, removing provisions before peak traffic times. Intersection works will be closed to cross traffic during slab track construction across the width of the median (Figure 17) to maintain traffic parallel with the light rail corridor.

Re-profiling of intersections and installation of linear rail systems such as rail and overheads, will be carried out during overnight intersection closures. As these closures will be fully removed before morning peak traffic, we have not considered these closures as road occupations.

Figure 17: Through traffic parallel to rail corridor will be maintained during works at intersections

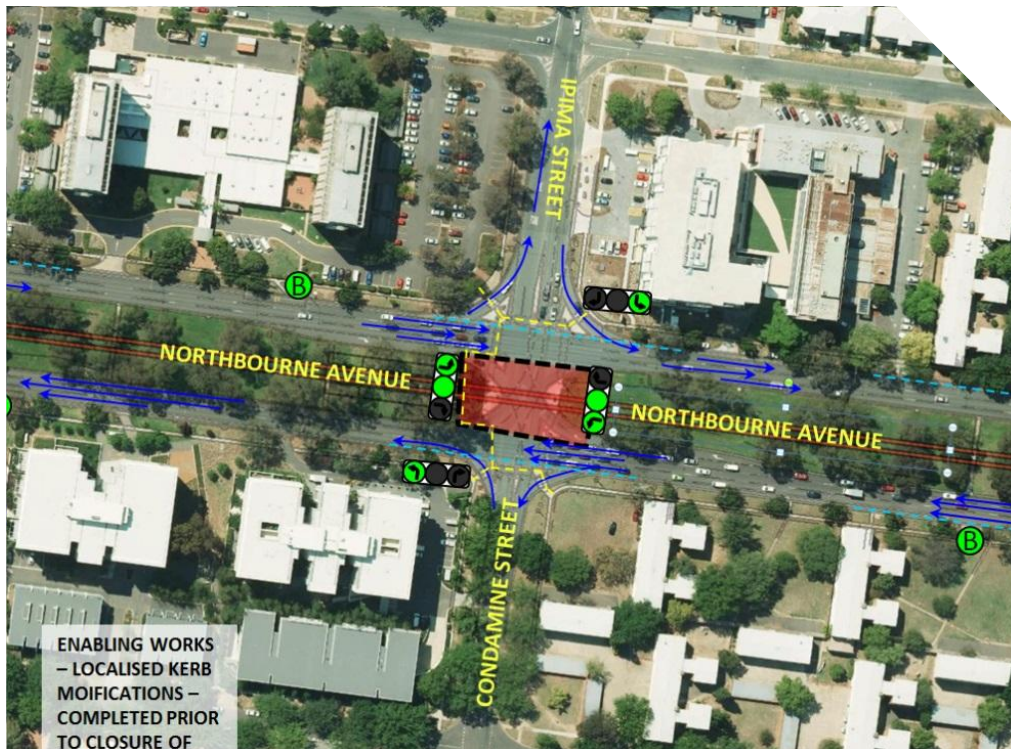


Table 3: Base Road Occupancy – intersections (Indicative)

Road Occupation Zone (Intersection)	Commencement of Occupation (Indicative)
Hibberson and Hinder	May 2017
Hibberson / Flemington and Kate Crace	March 2017
Flemington and Manning Clarke / Hamer	February 2017
Flemington and Wizard	February 2017
Flemington and Mapleton / Manning Clarke	November 2016
Flemington and Nullarbor Avenue	November 2016

Road Occupation Zone (Intersection)	Commencement of Occupation (Indicative)
Flemington and Well Station Drive	July 2016
Flemington and Lysaght Street	August 2017
Flemington and Morriset Road / Sandford Street	June 2017
Flemington and Randwick Road	July 2017
Flemington and Federal Highway	August 2017
Flemington and Federal Highway	September 2017
Federal Highway and Phillip Avenue	July 2017
Northbourne Avenue and Barton Highway	July 2017
Northbourne Avenue and Barton Highway	August 2017
Northbourne Avenue and Swinden Street	August 2017
Northbourne Avenue and Mouat / Antill	September 2017
Northbourne Avenue and Murdoch Street	November 2017
Northbourne Avenue and Morphett Street	September 2017
Northbourne Avenue and Wakefield / MacArthur	September 2017
Northbourne Avenue and Condamine / Ipma	August 2017
Northbourne Avenue and Masson / Girrahween	July 2017
Northbourne Avenue and Gould / Elouera	July 2017
Northbourne Avenue and Barry / Cooyong	June 2017
Northbourne Avenue and Barry / Cooyong	July 2017
Northbourne Avenue and Rudd / Bunda	June 2017

8. Alternative Delivery for Tree Removal

Canberra Metro has developed a strategy which has fewer trees being removed during initial stages along Northbourne Avenue without significantly impacting construction activities. This will minimise the visual impact of tree removal during construction.

We propose to undertake construction activities in four stages. The construction period between the last tree removal and the re-instatement of trees is currently anticipated to be a maximum of just over three months.

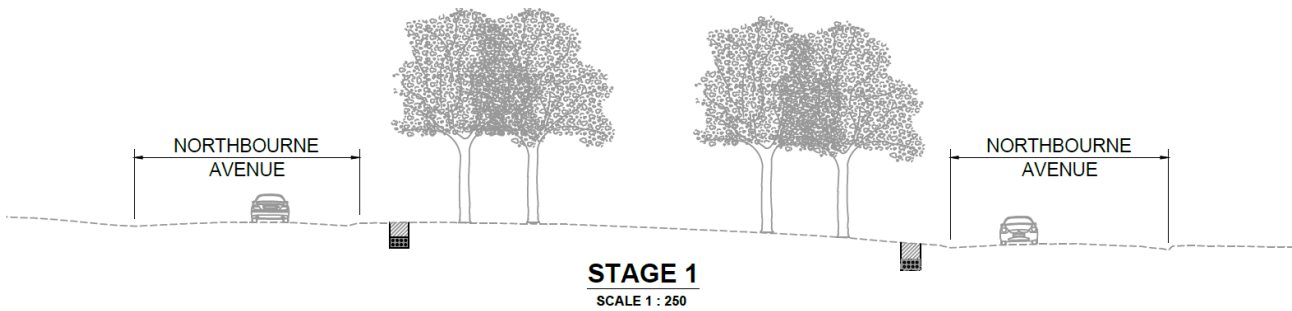
Stage one

During the utility services relocation, conduits will be installed into shared trenches on either side of the median. The existing trees will not be impacted, as illustrated in Figure 18. Canberra Metro will conduct a detailed study using a qualified arborist to confirm such works are able to be undertaken without impacting the existing trees current arrangement or stability. Local specialists, dsb Landscape Architects, have undertaken an initial tree assessment and have concluded that tree removal from Flemington Road to Alinga Street will be in keeping with original Territory intentions.

Methods of trenching near the trees will include sucker truck around the existing tree roots and then excavating carefully around the trees roots. Pending arborist advice, some minor tree roots might be cut when it is deemed safe and acceptable without impact on the existing tree.

Trees will be protected from accidental damage by installing barriers around the main trunk and using excavators with height not impacting the tree canopy, along with planned access and manoeuvring for plant to avoid impact.

Figure 16: Stage one – installation of shared trench without impact to trees

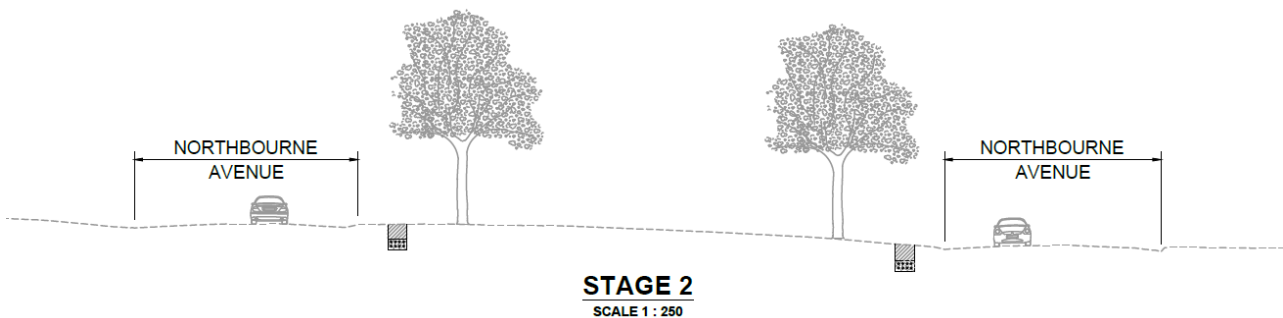


Stage two

Upon completion of the utility relocation works, the first stage of tree clearing will commence. The clearing in this stage will only impact the inner row of trees as illustrated in Figure 19. The trees will only be removed to stump level close to existing ground level. This will ensure that the tree removal will not impact on the existing underground live utilities as existing underground utilities relocation and cut-over will not have been completed.

The inner row tree clearing works would occur late 2016. This work will be undertaken during daytime off-peak hours, with minimal impact on existing traffic. The median lane will be closed under temporary traffic control during the off peak and normal working hours to ensure the safety of work crews and road users.

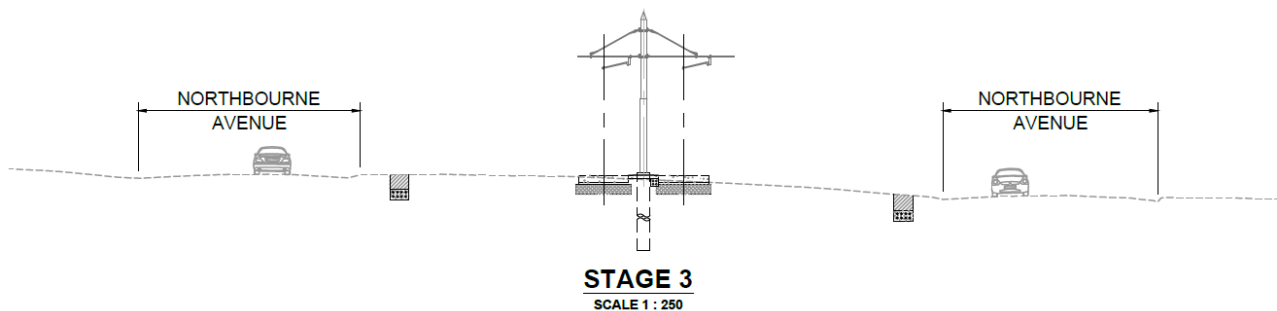
Figure 19: Stage two – inner row tree clearing works occur during daytime off-peak hours



Stage Three

The second phase of tree removal for the remaining outer row of trees will take effect in the period commencing in mid-2017. It will start from the south end and proceed towards the north, as the work fronts open up. This will allow the remaining trees to remain in place as long as possible prior to the planned commencement of each work front, as highlighted in the base case program. The tree removal in this stage will follow the same method of minimising impact on traffic as adopted in Stage Two above.

Figure 20: Second phase of tree removal for the remaining outer row of trees



Stage Four

The construction period between the tree removal in Stage Three and the re-instatement of the trees as per the landscape design is currently anticipated to be a maximum of 3-4 months. The landscaping works, including tree planting, is scheduled to commence as construction works in each area come to a close.

Figure 21: Final phase - planting

