Facility Vehicle Access

AM2761

Contents

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0	Mar 2018	M.Lowe & R. Jagger	Preliminary draft for comment
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1 INTRODUCTION

1.1 Purpose

The purpose of this document is to provide information and requirements to enable facility designers to:

- Specify the vehicles that people working on behalf of SEW use to undertake operations and maintenance (O&M) at SEW facilities, and how those vehicles are used
- Select the most appropriate vehicle access point(s) for a facility from a public / private road.
- Provide for long term future road and land use plans when designing vehicle access, ie: cater for future road widening, roundabout construction, development.
- Design the trafficable areas (road and parking areas) within facilities to safely undertake O&M activities.
- Design suitable trafficable surfaces and structural support appropriate to the type and number of vehicles entering the site.
- Select and locate all items associated with the trafficable area such as: signs, barriers, bollards, kerb and drainage.
- Ensure that security infrastructure such as fences and gates is compatible with the traffic plan for the facility.

As with all standards, they cover typical situations and most scenarios. Where the designer believes that a better solution exists which does not comply with this standards, the designer should contact South East Water to discuss the solutions.

1.2 Scope

This document applies to all SEW water and sewage facilities such as water / sewage pump stations, water pressure reducing stations, water storages and water / sewage treatment plants, etc. It shall apply to the design of all potential trafficable areas such as roads and carparks.

1.3 Terms and Definitions

Term	Definition
Trafficable area	Anywhere where vehicles are likely to travel or rest
Parking area	Trafficable area designed for vehicles at rest
Pavement	Sealed or unsealed surface and underlying structural support of a trafficable area
Road	Trafficable area designed for vehicle travel
External Road	Road owned by an entity other than SEW (eg: VicRoads, council, private company or private individual)
Vehicle Movement Plan	Plan which indicates the motion and location of vehicles and required trafficable areas throughout the design area
Internal Road	Road owned by SEW
Erodibility	Ease and speed at which rain and weather will erode pavement

1.4 Key References

- Austroads guides to Road design- Parts 1 to 8
- VicRoads Supplements to Austroads guides to Road design
- Victorian Planning Authority (VPA) standards
- Erosion and Sediment Control on Unsealed Roads
  – NSW Government Office of Environment 2012

2 VEHICLE INFORMATION

SEW's maintenance is generally undertaken by contractors who provide their own vehicles. SEW neither owns nor specifies the requirements of these vehicles. This section describes vehicles that are currently in use. Whilst vehicles used by contractors will periodically change, SEW expects that future vehicles will be of a similar specification as they will service the same SEW sites. This section only describes those vehicles that are more difficult to accommodate.

2.1 Loader Crane Trucks

Contractors use crane trucks fitted with an extendable-boom loader crane and outriggers typically 5m in total width with pads 0.5m x 0.5m in size. Provision for the safe extension of outriggers to ground level shall be provided for all areas where crane trucks will likely park.

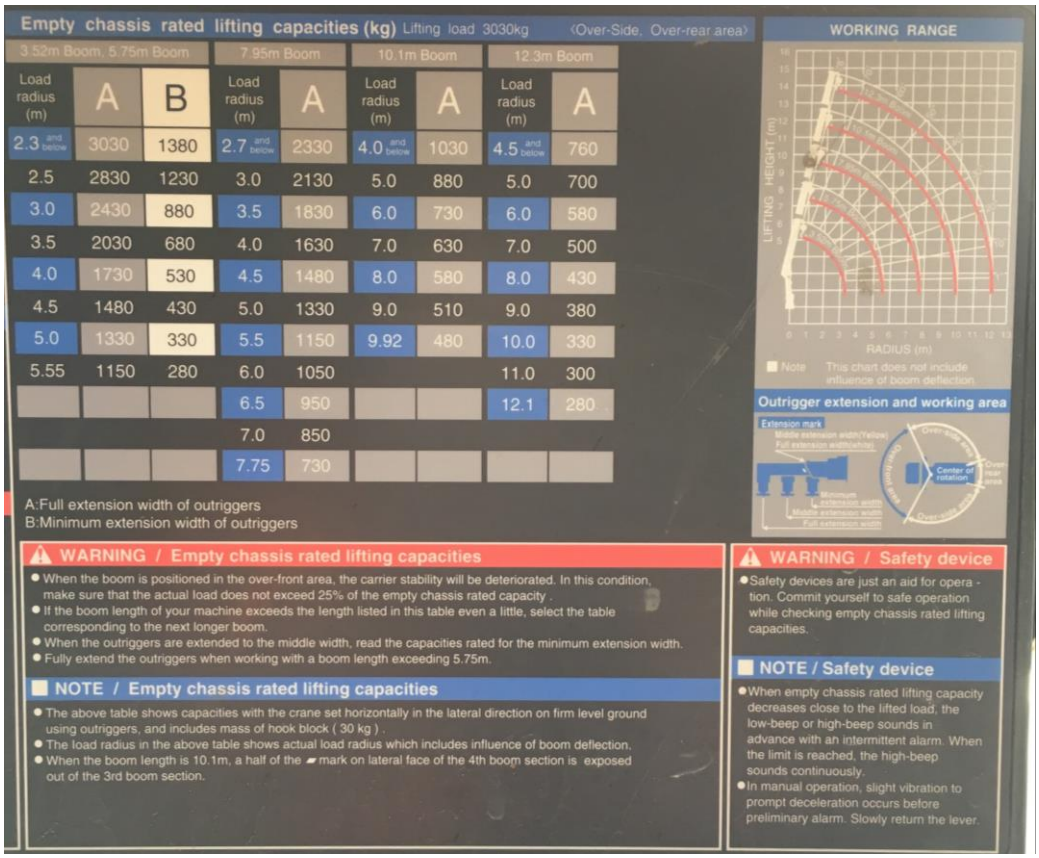
This section describes the largest truck crane currently in use, which has a Tadano ZE365HRS cargo crane fitted to the rear. A general description of this loader crane is at http://www.tadano.com/products/productstype/LC/TM-ZE360HRS-O/index.html and other information is at http://600cranes.com.au/shop/tadano/tm-ze365hrs/. The boom on this crane extends to 12.3m. All plant that requires crane truck removal shall be able to accommodate this vehicle where practical. Smaller trucks in the fleet with smaller cranes may be suitable should this not this vehicle not be able to access the site.

Figure 1 shows a crane loader truck parked adjacent to a pump station with its boom extended. Whist it may be possible to rotate 360 deg it's not good practise as the longer boom decreases the load that can be lifted and it becomes more problematic to land the load on the truck's tray.

Figure 1: Crane Truck with Outriggers

The load that the crane truck can lift depends on the reach of the crane boom as indicated in Figure 2. Lift weight allowable reduces rapidly as boom extension increases, so it is important that loads (especially heavy loads) are located as close to the truck as practical.

Figure 2: Tadano ZE365HRS Cargo Crane Truck Lift and Reach Limitations



Empty chassis rated lifting capacities (kg) Lifting load 3030kg 〈Over-Side, Over-rear area〉

3.52m Boom, 5.75m Boom			7.95m Boom		10.1m Boom		12.3m Boom	
Load radius (m)	A	B	Load radius (m)	A	Load radius (m)	A	Load radius (m)	A
2.3 and below	3030	1380	2.7 and below	2330	4.0 and below	1030	4.5 and below	760
2.5	2830	1230	3.0	2130	5.0	880	5.0	700
3.0	2430	880	3.5	1830	6.0	730	6.0	580
3.5	2030	680	4.0	1630	7.0	630	7.0	500
4.0	1730	530	4.5	1480	8.0	580	8.0	430
4.5	1480	430	5.0	1330	9.0	510	9.0	380
5.0	1330	330	5.5	1150	9.92	480	10.0	330
5.55	1150	280	6.0	1050			11.0	300
			6.5	950			12.1	280
			7.0	850				
			7.75	730				

A:Full extension width of outriggers
B:Minimum extension width of outriggers

WORKING RANGE

LIFTING HEIGHT (m)

RADIUS (m)

Note This chart does not include influence of boom deflection.

Outrigger extension and working area

Extension mark

Center of rotation

⚠ WARNING / Empty chassis rated lifting capacities

- When the boom is positioned in the over-front area, the carrier stability will be deteriorated. In this condition, make sure that the actual load does not exceed 25% of the empty chassis rated capacity .
- If the boom length of your machine exceeds the length listed in this table even a little, select the table corresponding to the next longer boom.
- When the outriggers are extended to the middle width, read the capacities rated for the minimum extension width.
- Fully extend the outriggers when working with a boom length exceeding 5.75m.

NOTE / Empty chassis rated lifting capacities

- The above table shows capacities with the crane set horizontally in the lateral direction on firm level ground using outriggers, and includes mass of hook block (30 kg) .
- The load radius in the above table shows actual load radius which includes influence of boom deflection.
- When the boom length is 10.1m, a half of the ▰ mark on lateral face of the 4th boom section is exposed out of the 3rd boom section.

⚠ WARNING / Safety device

- Safety devices are just an aid for opera - tion. Commit yourself to safe operation while checking empty chassis rated lifting capacities.

NOTE / Safety device

- When empty chassis rated lifting capacity decreases close to the lifted load, the low-beep or high-beep sounds in advance with an intermittent alarm. When the limit is reached, the high-beep sounds continuously.
- In manual operation, slight vibration to prompt deceleration occurs before preliminary alarm. Slowly return the lever.

The workers need to safely access the tool cabinets on both sides of the truck shown below.

Figure 3: Crane truck tool cabinets

2.2 Tanker Trucks

Tanker trucks which remove and store sewage are also known as eductors, eduction trucks or vacuum trucks. Water and sewage tanker trucks are of similar weight and size and can be considered as equivalent for the purposes of this document.

SEW moves water or sewage when its built assets are unable to do so such as:

- in the event of an emergency failure/breakdown,
- to empty or fill a storage vessel for cleaning or maintenance purposes
- to by-pass an asset during a planned outage to facilitate maintenance works or a site upgrade

As these vehicles use sizeable hoses to convey water / wastewater to and/or from the truck they need to be parked close to the SEW asset. This is particularly important for sewage eduction trucks because their on-board pumps are better able to lift debris laden sewage up and out of underground storages if the hose run is kept short.

The number and size of tanker trucks required to by-pass an asset will be a function of:

- The volume flow rate required to service SEW's network at that particular time
- The time required to fill the tanker including site access and set-up of hoses
- The traffic conditions along the route between the pick-up and drop-off points. (This includes the time to get into and out of SEW's site.)
- The time required to empty the tanker
- The size of the tankers that are available at the time

SE Water will engage a small tanker(s) for a site that only has a small volume requirement, i.e. the layout of small sites need NOT cater for large tankers.

Figure 4: Small tanker (left) and large tanker (right).

2.3 Tray Trucks

Mobile plant, such as a temporary emergency generator, may be delivered to site on the back of a tilt tray truck. A generator needs to be landed on an all-weather surface (e.g. crushed rock) close to the switchboard's generator connection point, but it shouldn't obstruct the movement of personnel for normal activities. The tray truck will reverse to this location to deposit the generator immediately behind the truck. Tray trucks are typically rigid trucks such as that used for the crane trucks.

3 MAINTENANCE INFORMATION

3.1 Facility Set Out for Crane Truck Operation

SEW's first preference is to use truck mounted loader cranes to lift the plant given that they are part of the maintenance fleet. Mobile cranes are hired so will only be considered after it has been demonstrated that a loader crane truck is unsuitable.

SEW records the weight of each maintainable rotatable, e.g. pump, mixer, etc. The maintenance crew adds a weight margin to any rotable that has been in raw sewage to provide for ancillaries such as the lifting chain and for any sewage debris that may be entangled inside the pump or wrapped around the outside.

As the lifting capacity of any crane depends on the reach of the crane's boom to the pump, the site layout needs to allow the truck to be positioned close to the item being lifted, such that:

- neither the truck's wheels nor its outriggers rest on the cover slab of an underground structure
- above ground structures such as a switchboard, tree, etc. don't obstruct the movement of the item being lifted between its normal position, any position where it may be landed, and the truck's tray.

The most preferred set-up location for a crane truck, from most to least preferred, is as follows:

a) On a vehicle road (i.e. off a cover slab) behind a permanent barrier such as bollards, etc.
b) Just off a vehicle road after removable lockable bollards, that usually protect a suitably design cover slab, have been set aside by the maintenance crew
c) On a suitably designed cover slab.

The load capacity table in Figure 2 is used to determine acceptable loader crane truck positions, noting that this load may be to the side or to the back of the loader truck. Section 3.3 describes the requirements associated with overhead electrical power lines.

Error! Reference source not found.5 shows a maintenance truck with a small loader crane attending to a mechanical issue at a pump station, e.g. a pump blockage, etc. The truck has a hoist on the back to lift a pump out of the wet well and has tool cabinets on both sides with doors hinged to swing upward. The ability to position the loader crane truck close to the item being lifted is essential. Both the wet well and electrical cabinet are open when a pump is going to be lifted, so the facility layout requires sufficient space around these assets for the crew to move around safely. Figure 5 shows two other smaller vehicles in attendance. Whilst this particular site provides space for these vehicles next to the loader crane truck, it is permissible for these vehicles to park on the street provided it is safe to do so.

Figure 5: Facility set out during pump removal works

3.2 Facility Set Out for Cleaning Operation

Figure 6 shows a cleaning crew removing raw sewage from a pump station before they wash it down. The ability to position the eduction tanker truck close to the asset being emptied is essential as described in section 3.1. After this has occurred the truck with the pressure washer needs to get close to the asset being cleaned. At this site it is possible to locate both the tanker truck and the washer truck next to the wet well, but at other sites the tanker truck may need to move away so the washer truck can get closer. The third truck holds supplies and other equipment.

Figure 7: Facility set out during wet well cleaning

Some inquisitive members of the public will want to get close to the "action" and in so doing will put themselves and therefore the crew at risk. When a site has a perimeter fence to keep it secure the fence will also serve to keep the public distant to the job site. As the site in **Error! Reference source not found.**4 and 5 is unfenced, the crew has set up barriers and signage to keep the public out of harm's way. Note that this particular site fronts a car-park so traffic management isn't

required. Traffic management can be complicated to organize and expensive to run so is the least preferred alternative.

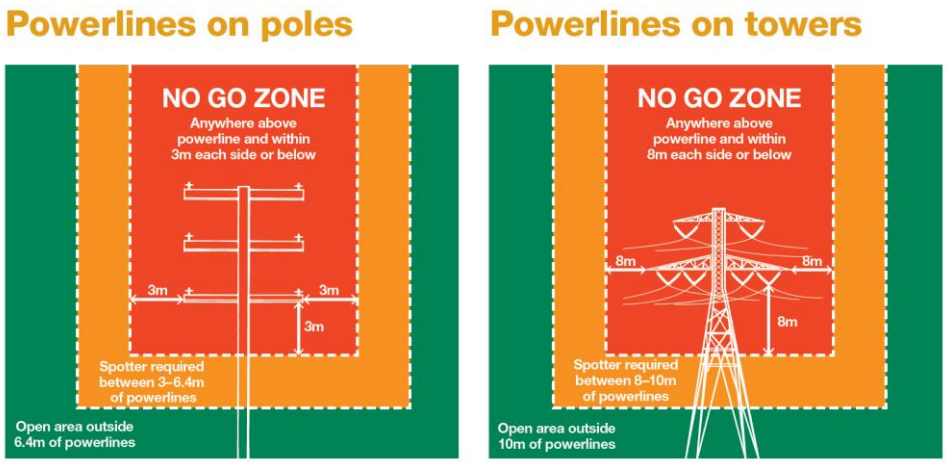
Where the work area overlaps a public thoroughfare the site design needs to consider where the public will be redirected during works. If the public thoroughfare is expected to be well utilized and its foot and bicycle traffic cannot be readily redirected, this issue may render the location as unsuitable for a SEW facility.

3.3 No Go Zones for Overhead Power Lines

Refer to Workcover Victoria and Energy Safe Victoria publications in regards to "No Go Zones for Overhead Electrical Power Lines" available at http://www.esv.vic.gov.au/technical-information/electrical-installations-and-infrastructure/no-go-zones/. Machinery operators and people working near powerlines. Workers and equipment must:

- Never work within 3 metres of overhead powerlines or poles
- Use a spotter when working between 3 and 6.4 metres of powerlines
- Never work within 8 metres of powerline towers
- Use a spotter when working between 8 and 10 metres of powerline towers.

Figure 8: Powerline No Go Zones (source: Energy Safe Victoria)



4 DESIGN PROCESS

Vehicle access to and within a facility and the use of each vehicle is a critical consideration in the general arrangement design of a facility. It needs to be considered at the earliest phase in the design process when the facility layout is being determined.

All aspects of facility design relevant to vehicle movement and usage shall be determined in consultation with SEW O&M using the following process, which tends to be iterative as the design evolves:

1) Planners need to consider the likely current and future vehicle movements at the facility and ensure that an appropriate size and shaped parcel of land is specified for purchase.
2) Consider current and future road changes and how this will impact on optimum design. It is expected that designers will contact the current and future road owners (council and VicRoads) on their plans for the relevant roads. This should consider future road widths, expected median strip placement, bicycle paths, road speed limits etc.
3) Land associated with facilities needs to consider vehicle access and usage as part of negotiating and deciding on the size and location of land to be provided.
4) Assess the required activities that vehicles will be required to perform (eg: eduction, lifting of plant, fire fighting, mobile generator installation)

5) Determine the maximum size (weight and turning circle), number and frequency of vehicles likely to enter the facility.
6) Establish vehicle parking requirements.
7) Develop Vehicle Movement Plans for all vehicular movements around the facility.
8) Establish optimum entry / exit points to external roads and any associated external road works required.
9) Establish the optimum size and alignment of internal driveways.
10) Select and design all pavement, including all associated drainage works.
11) Design all signage, blind spot mirrors, barricades, bollards, gates and fencing required to enable safe and easy vehicle use.

5 DESIGN REQUIREMENTS

5.1 Assess the Facility's Vehicle Access Requirements

Determine:

- The likely maintenance requirements of vehicles, how the crews will set up the site and the space and clearances they will need (refer section 3).
- What facility items will require support from what type and size of vehicle.
- The distance from the item that the vehicle will need to park (refer Figure 2)
- The areas in the facility where workers will typically work and the maximum likely number of workers that will work there concurrently. This will indicate the location and extent of required vehicle parking area(s).
- The vehicles that will likely visit the site and the characteristics of the vehicle (refer table 1).

Areas that require vehicle access typically contain:

- plant and equipment, workshops, offices, amenities such as meal rooms / toilets. Workers concentrate in these areas and parking facilities are required for them.
- items or structures that will be installed of removed by a crane truck (eg: pumps, generators).
- sewage that will need to be educted (removed by vacuum into a tanker truck).
- items that may need cleaning using a "combo" or jet truck.
- Water tanker connection points
- Structures that contain combustible materials may require fire truck access.

Determine the likely size of required vehicles in consideration of Table 1 and Figure 1.

Table 1: Facility Vehicle Requirements

Facility	Possible Vehicles	Vehicle Spec	Max Wheel Loading (Rear axle max kg /no. rear wheels)	Max truck W & L (m x m)	Min Turning Circle	Typical number of support vehicles
Small SPS (Q < 80 l/s). WPS. PRV station.	Small Eductor or combo truck (SPS). **Crane truck to lift plant.** Flat bed truck for generator.	Rigid ≤ 6 x 4 GVM = 23,000 kg	16,500 /4 = 4,150 kg	2.2 x 9.0	17 m	2
Large SPS (Q ≥ 80 l/s) or pumps > 100 kW). Treatment Plants	Crane truck to lift plant. **Large Eductor or Combo truck for eduction & cleaning.** Flat bed truck for generator.	Rigid 8 x 4 and long semi-trailer GVM = 32,000 kg	26,000 / 4 = 6,500 kg	2.5 x 11.4 Truck and trailer =2.5 x 21 (SPS & TPs only)	24 m	3 (SPS) Up to 10 or more at Treatment Plants
Water Reservoir or elevated tank. Metered Filling Station	Crane truck or mobile crane (high lift to reach to the top of the elevated tanks). **Water Tanker.**	Rigid 8 x 4 GVM = 32,000 kg	26,000 / 4 = 6,500 kg	2.5 x 11.4	24 m	2

Table 1 Notes:

- Largest truck likely to enter the facility is highlighted in bold text.
- Turning Circle is diameter wall to wall (m)
- W = Width is chassis width in m (may need to allow for extra width for mirrors)
- L = Length is full length including chassis overhang (m)
- A height of 4m shall be allowed for all vehicles
- GVM is maximum loaded weight of the vehicle (excluding trailer). Wheel loading may need to be considered during pavement design.
- Quoted number of support vehicles are utility vehicles in addition to any large truck.

5.2 Development of Vehicle Movement Plan (VMP)

Produce a VMP that shows:

- Consideration of preferred pavement widths as outlined in section 5.5.
- The location of all existing or proposed:
  - above ground structures,
  - trees including the extent of their canopy,
  - plant and equipment,
  - no go areas which have above ground hazards (eg: suspended cables)
  - Refer to Section 3.3 in regards to Energy Safe Victoria's publication "No Go Zones for Overhead Electrical Power Lines".
  - Below ground non trafficable structures.

- The location of items that will require crane truck access, the expected weight of these items and the maximum distance that the crane truck can be located from these items (using Figure 1).
- The location of parking areas which provide good worker access to the areas where work will more commonly occur.
- The Swept Path Envelope (vehicle's movement path outline) which:
    - Connect the external access road to internal paths within the facility.
    - are of a width and radius of curvature appropriate to the largest vehicle that will access the relevant area of the facility.
    - provide adequate proximity of the vehicle to the item it is accessing.
    - provide adequate visibility of all or the most likely pedestrian or vehicle locations, taking into account trees and structures that may obstruct lines of sight.
    - provide practical and safe entry and exit to/from each area requiring vehicle access in accordance with the preferences in Table 2.
    - enables vehicles to overtake each other along any of the main access routes of the facility.
    - enable a safe and effective set up of all required vehicles to facilitate maintenance. Examples of facility maintenance set up are provided in section 3.
    - avoids no go zones where practical. Should the available land be limited, underground structure cover slabs may need to be designed to allow for vehicles to drive over them.
    - avoids vertical constraints such as overhanging trees, bearing in mind that vehicles to a height of 4m shall be allowed for.
- The extent (area) and boundary of the trafficable area(s) required to support the proposed vehicle movements path(s) and parking areas.

Example VMPs are shown in Appendix A.

Table 2: Vehicle Swept Path Preferences

Preference	Description	Comments
1	One way travel with single entrance / exit (eg: via turning circle, parking bay)	One way travel reduces reversing and therefore risk of collision. One way travel preferred for larger vehicles.
2	One way travel via separate entry and exit points	Requires two gates and connections to access roads. One way travel preferred for larger vehicles.
3	3 point turn	Requires drivers to reverse which increases collision risk
4	Perpendicular parking	May require a spotter or temporary road closure. It is not acceptable for a truck to have to reverse to or from a road with a speed limit > 60 km/hr. May be the only viable option for small land parcels

Ideally, the VMP / trafficable area plan should be established concurrently with the layout design of structures, plant and equipment at the facility. This will ensure that the overall best solution for trafficable areas, plant and equipment, structures and landscaping is obtained in consideration of all of the requirements for the facility.

5.3 Vehicle Access Into and Out From the Facility

The optimum point of access to and from the facility should be determined in consideration of the following.

Internal facility considerations:

- VMP options under consideration.
- The locations of trees and structures within the facility which might render an access point impractical.
- The ability of a worker to safely exit a vehicle parked outside of the facility's fenced area and open or close any facility gate.

Existing external road considerations:

- The ability of vehicles to safely enter and exit the facility, with all possible vehicles or pedestrians having full visibility of each other in all weather and lighting conditions. This will need to take into account:
  - Bends, dips or rises in the road
  - Obstructions such as trees, poles, buildings etc
  - Direction from which the sun will likely rise and set
  - Angle of incidence of the facility's access road and the public road.
- The ability to enter the facility from any direction (or as many as possible north, south, east or west) and any obstructions or visibility problems or double lines.
- On high speed roads, when turning left into the facility, whether the road owner may require an egress lane (slip lane) to be constructed adjacent to their road.
- Existing traffic levels.
- Existing speed limit.
- Continuous single or double white lines on the external access road at the turnoff to the facility.
- The near proximity of a round-about 180 degree turn which might enable safe vehicle entry to the facility from the other direction.
- Possible modifications which could be made to the external access road to enable safer access into or out of SEW's facility (eg: road signage, road markings).

Future external road considerations:
This is particularly relevant where facilities will be initially constructed in areas which are not yet developed or are only partially developed.

- Proposed future intersections which may affect safe access to the facility.
- Proposed wide widening, median strip creation etc
- Expected future traffic levels.
- Likely future traffic limit.

Intersections of SEW facility access points with VicRoads roads shall be designed and constructed in accordance with VicRoads requirements by Vicroads approved consultants and contractors. Intersections of SEW facility access points with council roads shall be designed and constructed in accordance with council requirements.

Access barriers at the entrance to the facility shall be designed in accordance with the security requirements for the site (refer SEW Facility Security Specification). Access barriers should be selected in consideration of the options indicated in table 3.

Table 3: Access Barrier Options

Description	Typical situation of use
No barrier	Access to facilities open to the public which are usually located in public land and/or where other authorities such as council require vehicle access
Rail gate or removable bollard(s) locked with SEW lock	Access to low security facilities where pedestrian access is acceptable but non SEW vehicle access is not preferred
Manually operated gate, locked with SEW lock	Facilities that have fences
Automatic Boom Gate	Access to facilities mostly occupied during working hours. Should be used in conjunction with manually operated gates which can be locked out of normal working hours.

5.4 Long Internal Driveway Alignment (> 50m)

Where significant lengths of new access road (track or driveway) (ie: > 50m) are required to reach a facility, the optimum alignment of the road shall be selected to:

- Provide optimum integration with the VMP and overall facility design.
- Minimise road length.
- Minimise the road width and construction footprint.
- Minimise longitudinal road gradient.
- Avoid road construction on steep slopes (especially > 60%).
  Use full-bench construction where slopes over 60% cannot be avoided.
  Cut and fill roads on slopes flatter than 1 in 1.
- Minimise drainage issues and costs.
- Minimise cuts, fills and vegetation clearing.
- Stay away from streams, wet lands or gullies where possible.
- Take into consideration the properties of native soils available with each alignment.
- Take into account the locations of trees and structures within the facility which might affect visibility and therefore safety along the road. Trees and other vegetation may need to be removed to improve pedestrian and driver visibility. Alternatively, speed limits may need to be reduced.
- Optimise horizontal curve radius.
  Minimum preferred horizontal curve radius is 150m for any internal access road.
- Optimise vertical alignment grade.
  Maximum preferred grade is 10%. Absolute maximum grade is 20%.
  Lengths of unsealed roads of different grades shall be limited as per Table 2 of NSW Government Office of Environment's 2012 publication, erosion and sediment control on unsealed roads. This limit shall also depend on the soil's erodibility as described in the subsequent table.
- Optimise slope (of the land at the driveway).
  Maximum preferred land slope is 3 (run) : 1 (rise) where driveways are located.

This section is not relevant to pavement around facility assets (ie: drive ways only)

5.5 Long Internal Driveway and Parking Area Pavement Type Selection

Less frequently accessed facilities (eg: pump stations, PRV stations, Odour Control stations etc) shall be provided with an unsealed single lane access road, unsealed parking area(s) and open drainage. Roads shall be designed and constructed to the Vicroads supplement to Austroads guidelines- Figure V4.6: AADT 1-50, with 3m pavement with 2 x 1.5m shoulders. Where space is limited, road shoulders may be narrowed to 1m and South East Water may consider having a road shoulder on one side only.

More frequently access facilities shall be provided with the vehicle access described in Table 4.

Table 4: Non-standard Access and Pavement Requirements

Regularity of access	Road Type Preferred	Relevant Standard
Facilities occupied regularly (ie: > once a month) and road length is not excessive (<50m)	Sealed single lane access road, unsealed parking area(s) and open drainage	Vicroads supplement to Austroads guidelines- Figure V4.6: AADT 51-150 (4m pavement with 2 x 1.5m shoulders)
Facilities mostly occupied during working hours (eg: larger treatment plants) and road length is not excessive (<50m)	Sealed two lane access road(s). Concrete kerb, concrete footpaths, sealed parking area(s) and underground drainage required around active work areas	Vicroads supplement to Austroads guidelines- Figure V4.6: AADT >150 (6.2m pavement with 2 x 1.5m shoulders). Kerb, footpaths and vehicle crossings to Victorian Planning Authority (VPA) standards

Notes regarding Table 4 items:

- All trafficable surfaces shall have a cross fall grade of 3 to 8 % (normal is 3.5%).
- All unsealed road shoulders shall have a cross fall grade of 3 to 12% (normal is 5%).

Where decisions about the alignment, number of lanes and type of pavement are not straight forward, viable options shall be considered in consultation with South East Water.

Pavement type selection shall be based on:

- The pavement area requirements identified in the VMP
- The required design life of the pavement
- Cost of construction
- Cost of maintenance (higher for unsealed roads)
- Degree of traffic expected
- Collision risk of each access option (based on pavement width and ease of visibility)
  The minimum preferred sight distance is 100m (of oncoming traffic / pedestrians) for any internal access road.
- The amount of pavement below the 1 in 100 year flood level.
  All pavement shall be above the 1 in 5 year flood level, with a clearance of at least 0.5m between the flood level and the pavement's surface at its lowest point.
- Natives soils available along the alignment.
- Criticality of the facility, and
- The potential risk of loss of access to the facility.

5.6 Pavement Detailed Design

This section is relevant to driveways, parking areas and pavement adjacent to facility assets.

One of the pavements in Table 5 shall be selected for each distinct trafficable area. The designer shall refrain from swapping between one type of pavement and another more than once or twice.

Table 5: Pavement Specifications

Road Type	Surface Coarse (40mm thick)	Base Course	Sub-base Course	Subgrade (foundation)
Unsealed pavement (gravel surface)	At least 80% gravels 0.075 to 20mm in size. No surface course required if Class 4 base.	> 150mm thick graded high density material free of voids, with low fines (ie: < 10% particles < 0.075mm) and a reasonable fraction (ie: >20%) of angular large particles (20 to 70mm), **or** > 100mm of 20mm Class 4 crushed rock		All top soil, vegetation and tree roots shall be removed prior to construction of pavement. Found roads on native soils with adequate strength and low plasticity. Thicker base courses shall be provided over a subgrade which is of low strength and/or high plasticity (eg: silty sands and clays).
Spray Seal surfaced sealed pavement	2 layers of Class 170 bitumen & aggregate	> 100mm thick 20mm Class 2 crushed rock	> 100mm thick 20mm Class 4 crushed rock or crushed concrete	
Asphalt Bitumen surfaced sealed pavement (only for the treatment plants with regular traffic)	2 layers of Class 320 bitumen asphalt	> 100mm thick 20mm Class 2 crushed rock	> 100mm thick 20mm Class 3 crushed rock, & > 100mm thick 20mm Class 4 crushed rock or crushed concrete	

Notes regarding Table 5 items:

- All quarry products shall be SEW approved as indicated in the MRWA Products Portal.
- All materials shall be applied and tested as per Austroads Guide Part 3.
- Asphalt pavement requires Type 1 subsurface drainage as per VicRoads standard drawing SD 1601 and Austroads Guide Part 10, or Victorian Planning Authority (VPA) standards.
- All concrete footpaths and vehicle crossings to be constructed to Victorian Planning Authority (VPA) standards.
- All layers to be compacted to min 97% Modified.

5.7 Unsealed Pavement Native Soil Assessment

Where pavement areas are to be small, specialist geotechnical advice may not be warranted and pavement soils may be selected where they clearly meet the base course / surface course specification.

Where native soils are proposed to be used in any significant way (ie: > 100m^2 of pavement) to form the sub-base or surface course of unsealed trafficable areas, road specialist geotechnical advice should be obtained to determine the following characteristics of the native soil(s) at the facility:

- the strength (load bearing capacity) at different moisture contents
- the plasticity (change of shape with load) at different moisture contents
- the suitability of the material for use as a subgrade (foundation)
- the erodibility and suitability of the material for use as a sub-base course
- the erodibility and suitability of the material for use as a surface course

Only base course soils with suitable strength, durability and plasticity (at all likely moisture contents) to support the vehicles likely to attend the facility (refer section 3) shall be used in pavement construction.

5.8 Paved Area Drainage Design

Land future surface level shall be indicated on design plans which make is clear how surface waters will drain away from paved areas. Access covers and electrical boards shall be located at high points so surface water drains away from these areas. Surfaces shall be profiled to ensure that work areas and paved areas do not pond or pool. This is usually achieved be draining surface waters across surfaces of a suitable grade, rather than by installing closed or open drainage systems.

Drainage of paved areas shall be designed in consideration of the following:

- Keep the road base and sub-base as dry as practical. Drainage shall be designed to maintain the water level below the sub-base.
- Open and closed channel drainage systems shall be designed to 1 in 100 year Average Recurrence Interval (ARI) rain events.
- Kerb and closed drainage systems (typically required in conjunction with sealed asphalt roads) shall be designed and constructed to Victorian Planning Authority (VPA) standards with semi-mountable kerbs.
- Open drainage (spoon drains / table drains / culverts) shall be designed and constructed in accordance with Austroad Guide Part 5B: Drainage- Opens Channels, Culverts and Floodways and the NSW Government Office of Environment's 2012 publication, Erosion and Sediment Control on Unsealed Roads.
- Open drains shall not be constructed of highly erodible soils such as dispersive clays (which "dissolve" in water) or silty sand. Where such native soils are present, open drains shall be lined to a depth of 100mm with the materials described for unsealed road base course in Table 4.
- All open channels > 1 in 10 grade in native soils and any drops into structures shall be stabilised with rock beaching, cement, sandbag or concrete stabilised surfaces.
- Unsealed roads shall slope with the fall of the land (out-slope) where practical.
- Install unsealed road with rolling dips on out-slope roads whenever practical. Dips should be spaced at 30-150m separation. At the lowest section of dips, rock beaching shall be installed between the road shoulder and the road drain to prevent erosion of the shoulder.
- Where out-sloped unsealed areas are not practical, install catch drains on the inside drainage system and culverts to cross the pavement.
- Line the collection and discharge points of the culvert with rock beaching to prevent erosion at the culvert ends. Construct as per VicRoads standard SD 1700 and SD 1811.

5.9 Contaminated Storm Water Discharge

Designers should consider which areas of the facility and pavement should drain to the stormwater system and which areas should drain to the sewerage system. Typically water contaminated with sewage or biosolids (eg: washdown areas and biosolids truck standing areas) shall be provided with separated drainage catchments which shall then normally drain to the sewerage system. All pavement which may drain to the sewerage system shall be sealed and all drains in such areas shall be buried.

Collection points for this water shall have the option of being configured to discharge to the stormwater or sewerage system via the operation of a single knifegate valve which is safely operable from surface. Where this drainage water cannot practically gravitate to the sewerage system, a pump station compliant with SEW Sewage Pump Station standards shall be constructed to enable this water to be the sewerage system.

5.10 Anytime Facility Access

SEW requires access to its facilities at all times and external entrances to facilities shall always be kept clear. Parking restrictions may need to be applied to external roads as indicated in Figure 9. Note that the No Standing area corresponds to the amount of space required to undertake maintenance activities (refer sections 3.1 and 3.2).

Figure 9: Example of No Standing Area and associated signage

5.11 Protecting Assets from Vehicular Damage

The designer shall identify areas of the facility where vehicles must not enter (No Go areas). This may be due to the presence of one of the following in or near to a trafficable area:

- above ground cables
- below ground structures that cannot support vehicle weight
- smaller less visible or collision susceptible structures, plant or equipment.

Threats to such structures may come from one of the following sources:

- SEW authorized vehicles
- Neighboring land owners, such as councils, who may use ride-on mowers and other maintenance equipment to maintain their land immediately adjacent to the SEW facility.
- Members of the public who may either intentionally or unintentionally drive a vehicle at a facility. This is more likely in unfenced facilities which are open to the public.

Protection may take the form of:

- Locating traffic vulnerable structures such as buildings, poles and electrical cubicles distant to trafficable areas.
- Locating less vulnerable items as fences and kerbs between trafficable areas and vulnerable assets. Note that non mountable kerb may prevent vehicle access but they can also affect the movement of surface water and can present a trip hazard.
- Installing dedicated traffic barriers such as bollards and Armco railing between trafficable areas and vulnerable assets. Barriers have the advantage of also stopping vehicles from parking on structures and they can (if designed well) protect operations and maintenance personnel from an open hole when working at the site. Barriers can look unsightly in publicly visible facilities and care shall be taken to ensure they do not hinder the movement of people around the cover slab. For a specification on bollards, refer to SEW's Facility Security specification.

- Ensuring that underground structures in trafficable areas are strong enough to support trafficable loads. Openings to such structures shall be covered as per the SEW specification, underground chamber cover selection. Limited land availability sometimes means that the only way to get to the further asset is to drive over an underground structure. Barriers may not be suitable in such instances.
- A facility perimeter fence. This control may be visually obtrusive, restrict movement and hinder other party's from accessing their land. Council approval may also be required and not forthcoming.

Bollards and barriers shall:

- Be selected, designed, constructed and installed as per AS/NZS 3845.
- Be located in such a way that they do not cause a significant traffic hazard. Bollards are only for low speed areas. Barriers are required for high speed areas.
  Where bollards or barriers would present an unacceptable traffic hazard, consider locating at risk assets underground in a chamber covered by trafficable covers.
- It is preferred that bollards are direct buried and concreted into the surface where practical and where the bollard is to be located in native soil or crushed rock.
- Bollards fixed to concrete slabs are not preferred because the concrete slab is damaged when the bollard is hit. Where this cannot practically be avoided, bollards in concrete slabs shall be readily replaceable.
- Not interfere with the operation of the asset (ie: opening of doors or covers or regular O&M activities).
- Locate bollards far enough away from assets being protected so that if the bollard is hit, it does not damage the asset it is protecting.
- Refrain from distancing bollards from plant which will require crane truck removal. Crane loads are reduced when the crane can be located close to the asset being lifted.
- Satisfy all conditions of the land owner where they will be located in the reserves. Wooden or recycled plastic bollards may be specified by the land owner.
- Bollards in SEW owned land shall be constructed of galvanized or zinc coated mild steel or 304 stainless steel. Bollards shall be powder coated Canary Yellow to AS2700, colour Y11 where this would not have a negative visual impact on the local environment. Polished 304 stainless steel construction or powder coated Eucalyptus Green to AS2700, colour G52 should be used where a brighter colour would have negative visual impact on the local environment.
- Installed in compliance with the manufacturer's installation instructions.
- Installed at 1.5m separation.
- Be $\geq$ 1000mm high.

"Standard" bollards and barriers on SEW owned land shall:

- Prevent vehicle access to all sensitive assets from any likely direction of travel
- Be $\geq$ 110mm outside diameter with $\geq$ 5mm wall thickness, or

"Heavy duty" bollards and barriers on SEW owned land shall:

- Prevent vehicle access to all sensitive assets from all possible directions of travel.
- Be $\geq$ 160mm outside diameter with $\geq$ 5mm wall thickness, or
- Be $\geq$ 140mm outside diameter with > 6mm wall thickness

Fences and gates shall be designed and installed as per SEW's Facility Security specification.

5.12 Road Signage, Markings and Devices

Once the pavement alignment and boundaries have been determined and the preferred location of all buildings plant and equipment has been finalised, the designer shall prepare a Traffic Management Plan (TMP). The TMP shall be produced in consultation with SEW Customer Service Delivery and shall comply with the methodology and principles outlined in:

- the Victorian Road Management Act Code of Practice for Worksite Safety – Traffic Management.
- AS 1742.3 Manual of Uniform Traffic Control Devices (Part 3).

While this code of practice and Australian Standard has been produced with temporary works at public roads in mind, they still form a sound foundation on which to produce a TMP for a permanent facility.

The designer and contractor shall undertake the hazard management process described in the Victorian Road Management Act Code of Practice for Worksite Safety – Traffic Management, namely:

1) Determine Worksite Hazard Rating
2) Determine Required Level of Planning
3) Determine Hazards at the Worksite
4) Consider Hazard Control Measures that Could be Used – Hierarchy of Safety Controls
5) Determine the Hazard Control Measures to be Implemented
6) Prepare and Implement Traffic Management Plan
7) Review the Traffic Management Plan in Practice

The TMP shall identify, assess and control risks in consideration of the following:

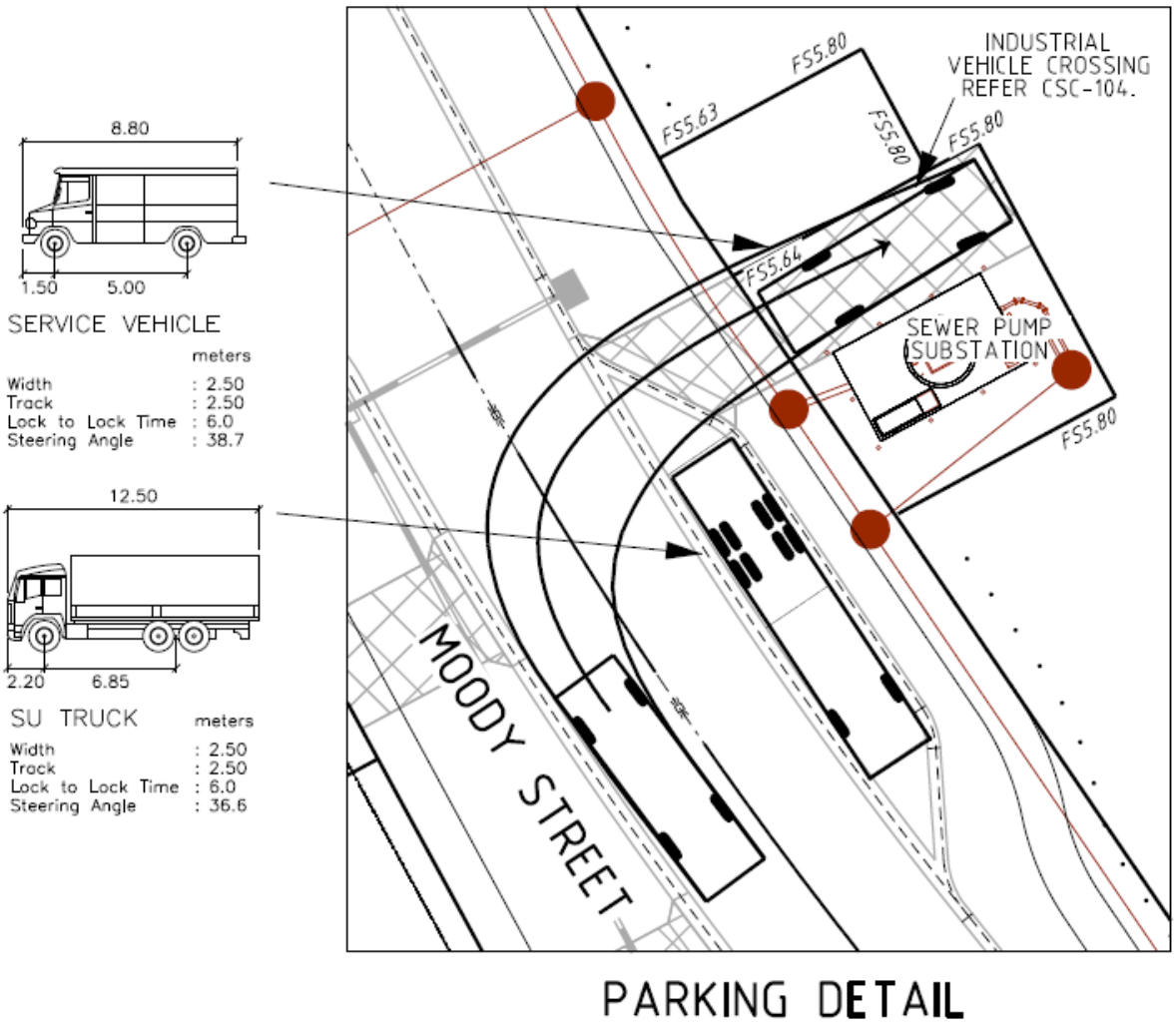
- The areas of the facility where pedestrian / worker movement is more likely to occur on a regular basis. These areas, high activity areas, would normally be present where plant, equipment or facilities are located.
- Speed limits within different areas of a facility.
  Speed limits within SEW facilities shall be indicated. Speed limits in high activity areas would normally be lower (ie: 10 to 20 km/hr), especially where blind spots may be present or workers / pedestrians will be working near roads.
- Placement and specification of signs.
  Give way signs, stop signs, pedestrian crossing signs and speed signs etc shall be installed as required to control risks at intersections and at the entry and exit points of high activity areas. Signs shall comply with AS 1743 Road Sign Specifications and the VicRoads Supplement to AS 1743.
- Placement and specification of road humps.
  Road humps shall be implemented at or prior to reductions in speed limits or to aid in imposing speed limits in high activity areas. Where road humps area required, they shall be Type 2 road humps as per AS2890.1 Parking Facilities and they shall be adopted at spacings between 10 and 50m.
- Placement and specification of pedestrian crossings.
  Where high activity areas are located adjacent to each other on both sides of a road, consideration should be given to installing a signed and marked pedestrian crossing (ie: "zebra crossing").
- Placement and specification of barricades.
  Road barricades may be required to separate work areas from roads where they are close to each other. They shall comply with AS 1742.3.
- Road markings.
  Road markings such as parking bay lines, centre lines, intersection lines and pedestrian crossings shall be used to help safely direct and separate vehicles and pedestrians. All road

pavement markings shall comply with AS/NZS 4049.3 Paints and related materials, Road Marking Materials.

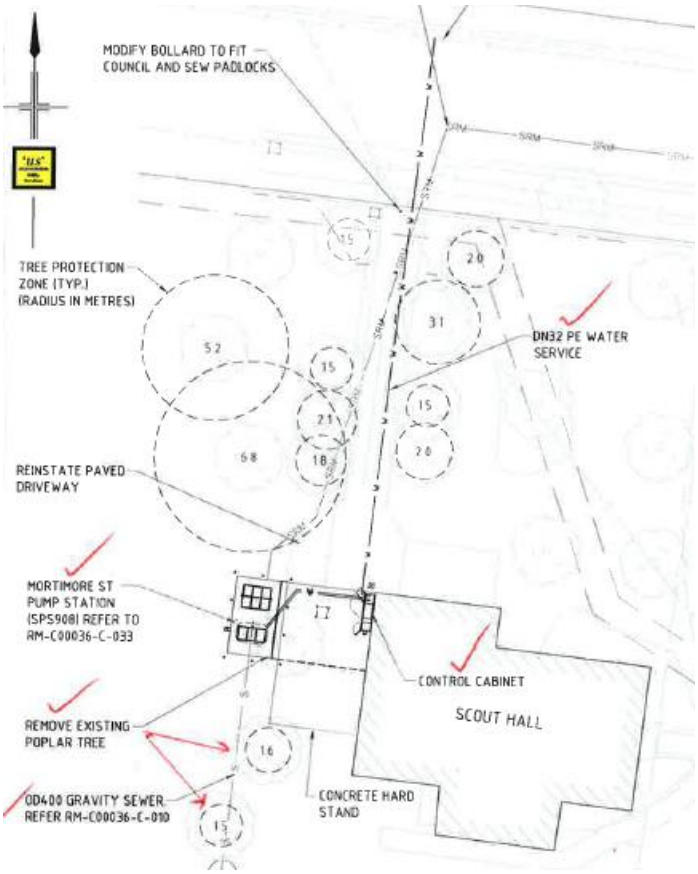
- Requirements for visibility.
  As much as practical, sight distance shall be maximised. Blind corners (corners which have a reduced line of site to other vehicles or pedestrians) shall be avoided, visual obstructions minimised and road radius optimised.
- Management of blind corners.
  Where blind corners cannot be avoided, specific risk controls shall be adopted which may include the placement of convex mirrors and reduced speed limits. Where buildings or plant and equipment exacerbates the risk of blind corners, the designer shall reconsider the location of these assets to reduce the traffic risk.

6 APPENDIX A: Example VMPs

Moody St East SP914 (shown below) is an example of a small asset located on a low-speed side street. A rigid heavy vehicle is able to reverse in from the street to lift pumps, clean the wet well, etc. A longer vehicle is able to park in separate bay so that it doesn't obstruct this narrow street or its footpath. SEW has many assets with a similar arrangement.



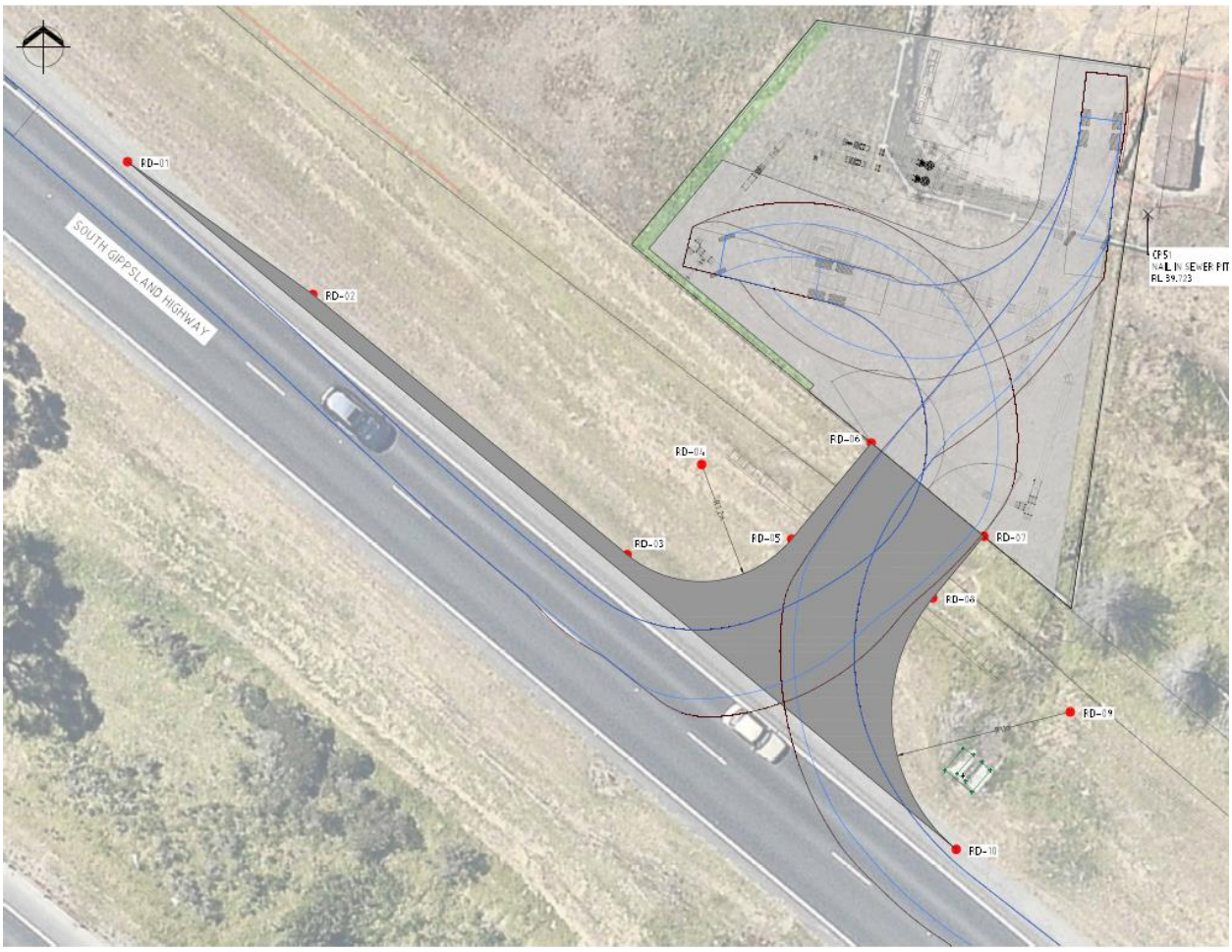
Mortimore St SP908 is a similar “reverse in” driveway arrangement to Moody St East SP914. It was built in a pre-existing unfenced public recreation park that had protected fauna. Vehicles can only access the driveway entrance by removing a locked bollard using a council or SEW key.



Example from South Gippsland Hwy SP936 below illustrates:

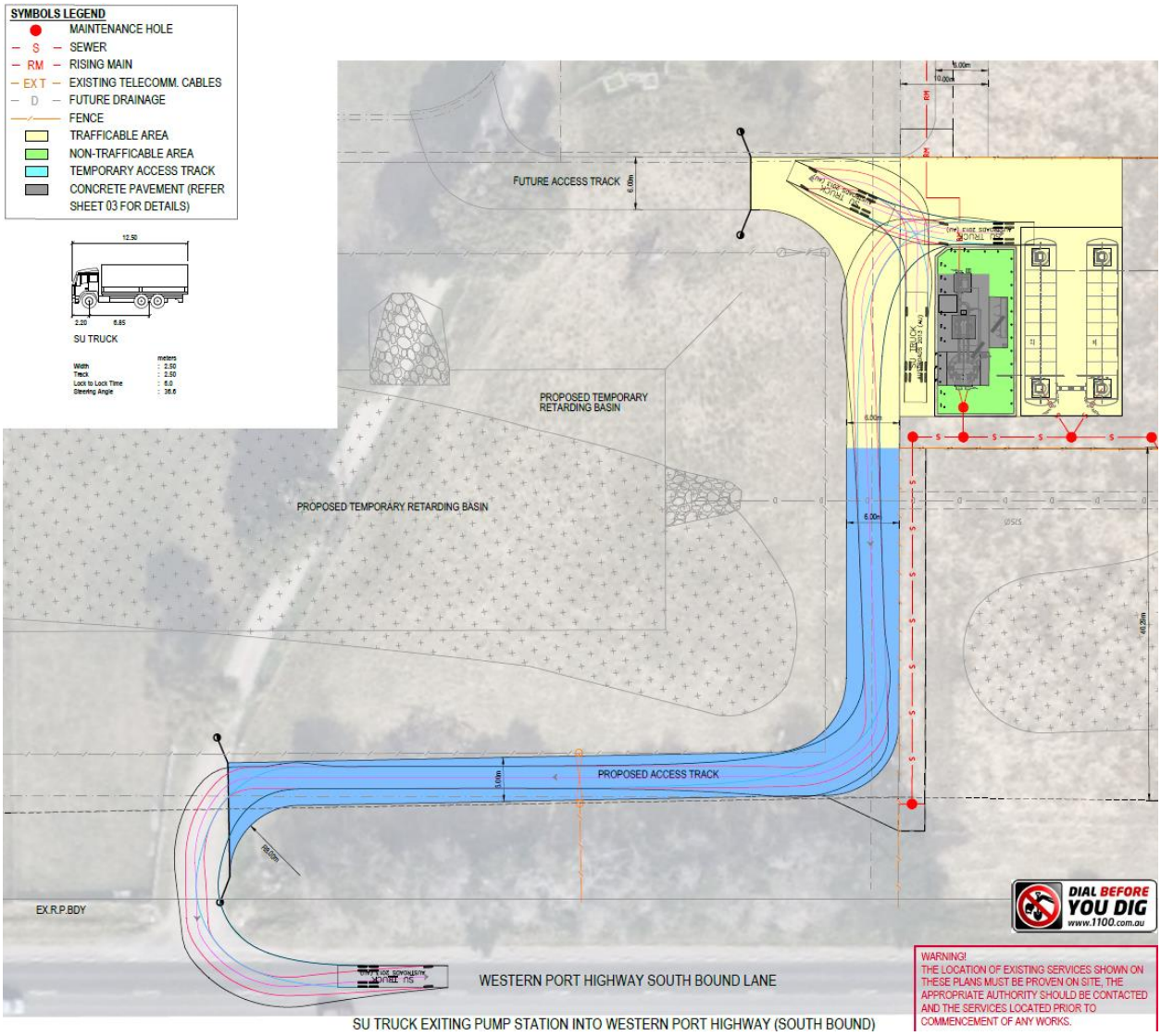
- Egress lane from 100kph South Gippsland Highway southbound lanes
- Space for vehicle to pull over whilst a worker unlocks / locks the access gate
- Three point turn within site for dual drive axle heavy vehicle
- Arc to exit
- Access gate width to provide for entry and exit, with sufficient room to swing gates clear

Note that site will eventually have a northern or western entry from a future property development that is currently undefined.



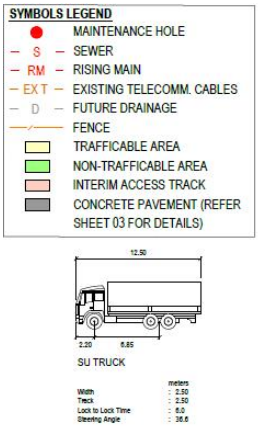
Hereunder is an example from Westernport Hwy SP940 that illustrates a multi-stage development.

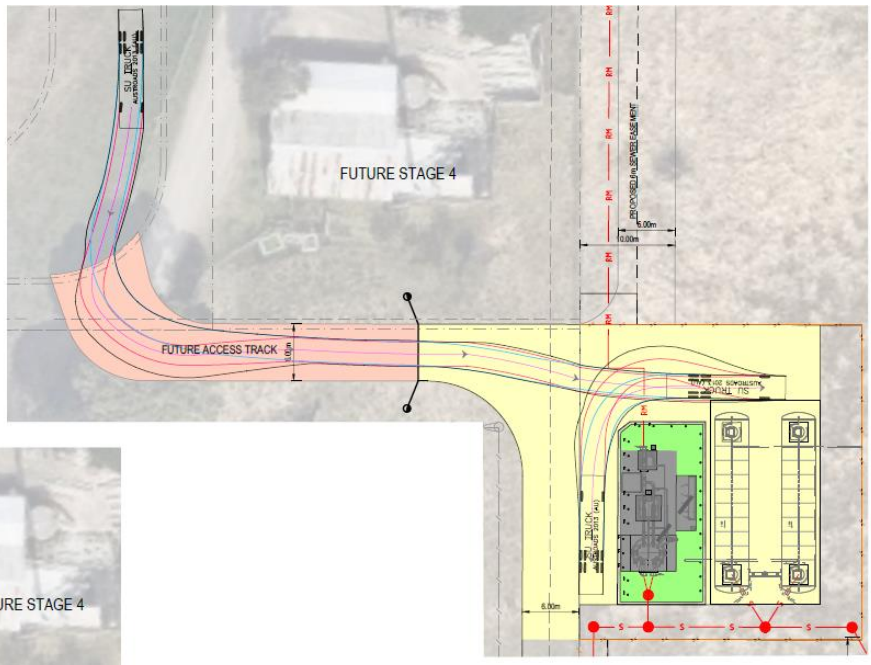
Diagram below shows Stage 1 temporary access from Westernport Highway south bound lane before property development works occur



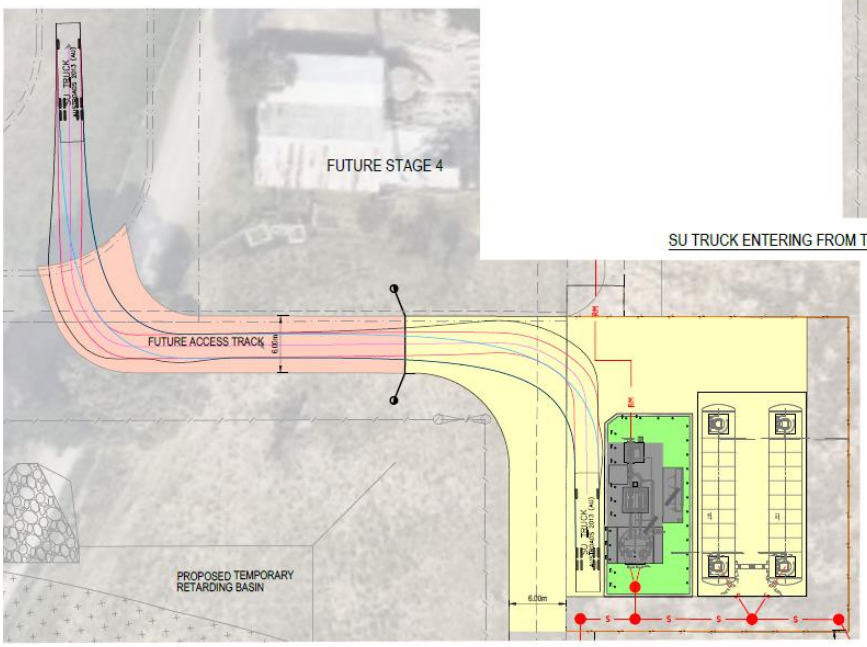
SU TRUCK EXITING PUMP STATION INTO WESTERN PORT HIGHWAY (SOUTH BOUND)

Diagram below shows Stage 2 access from road in property development works that will occur in the near term. Interim Stage 1 access from highway will be abandoned so that area can be redeveloped into a storm water retarding basin.





SU TRUCK ENTERING FROM THOMPSONS BASE - STAGE 4 INTO PUMP STATION



SU TRUCK EXITING PUMP STATION

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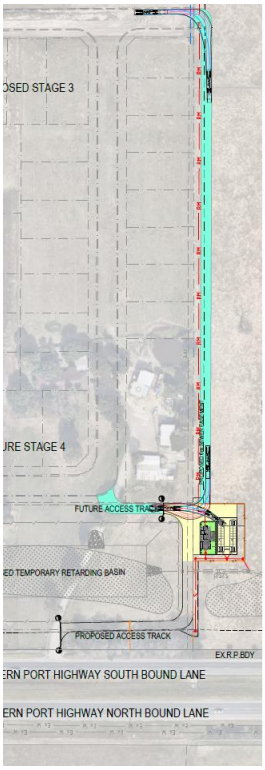
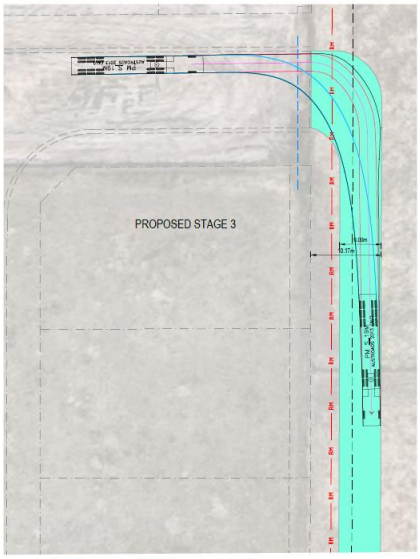
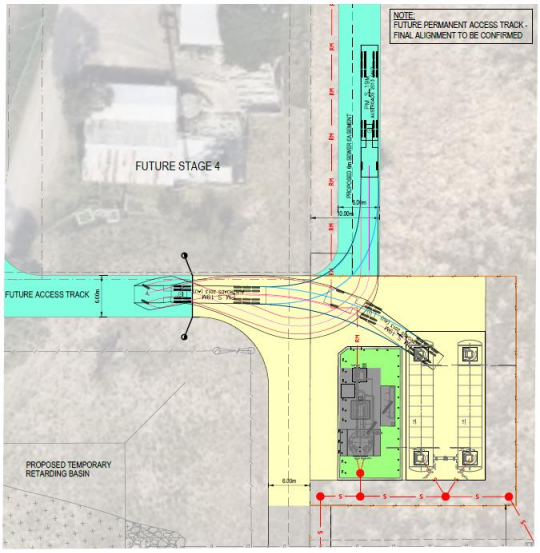
WARNING!
THE LOCATION OF EXISTING SERVICES SHOWN ON THESE PLANS MUST BE PROVEN ON SITE, THE APPROPRIATE AUTHORITY SHOULD BE CONTACTED AND THE SERVICES LOCATED PRIOR TO COMMENCEMENT OF ANY WORKS.

Diagram below shows final stage 3 access when all roads in future property development are available.

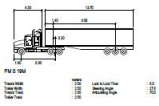


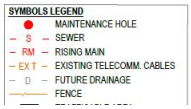


PM S 19m ENTERING FROM THOMPSONS BASE - STAGE 3
INTO PERMANENT ACCESS TRACK

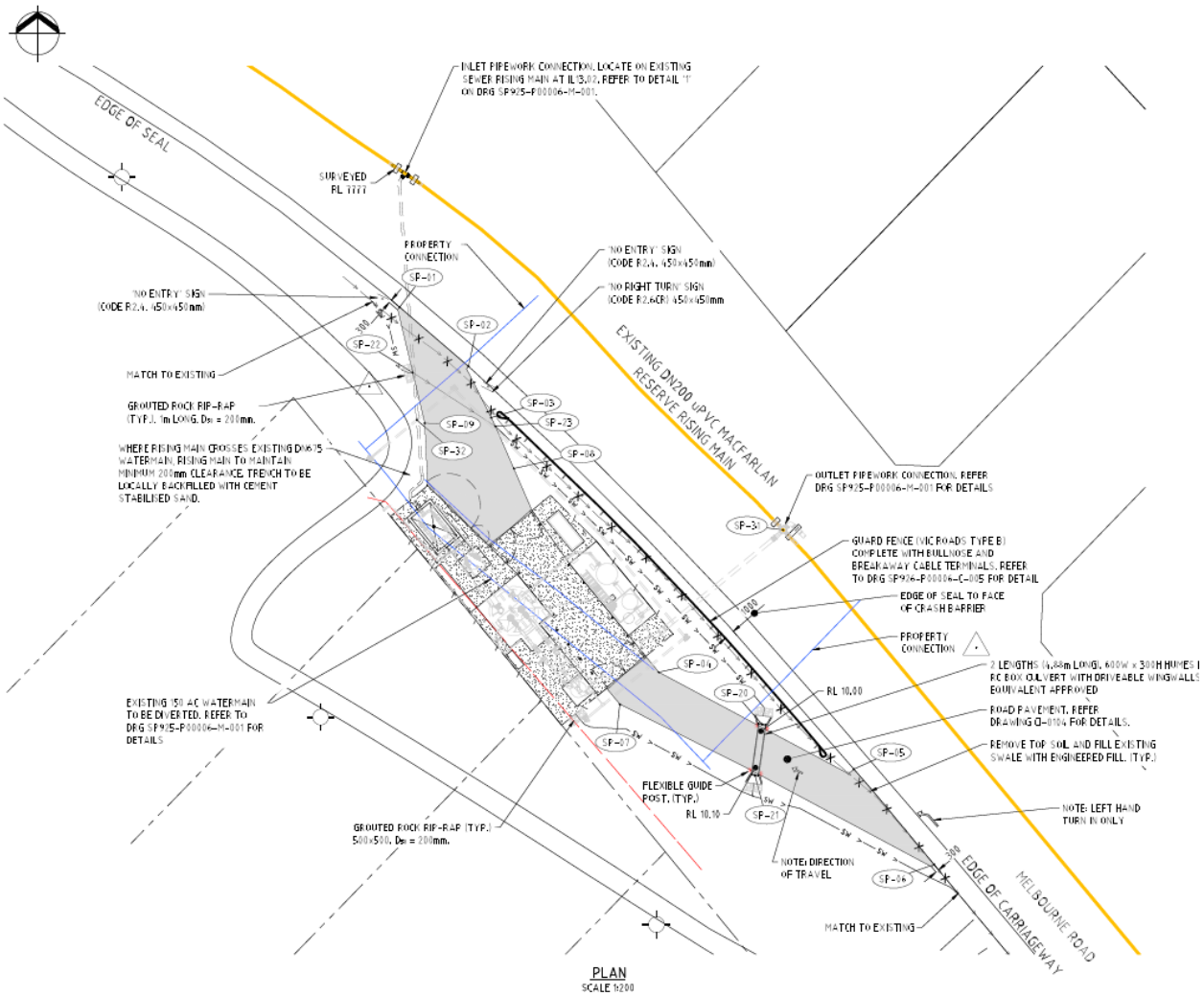


PM S 19m ENTERING FROM PERMANENT ACCESS TRACK
INTO PUMP STATION





Melbourne Rd Sth SP925 was built in an area that was already mostly developed. The sole available site could only be accessed from the northbound land of Melbourne Rd; it isn't possible to drive in from the southbound lane. The diagram below shows how the site layout design provides for a drive through access track. The second diagram below shows that space is provided before the entry gate so that the truck can safely park whilst the worker unlocks and opens the entry gate. It also shows how the truck can park after exiting the fenced area, whilst the worker closes and locks the exit gate.



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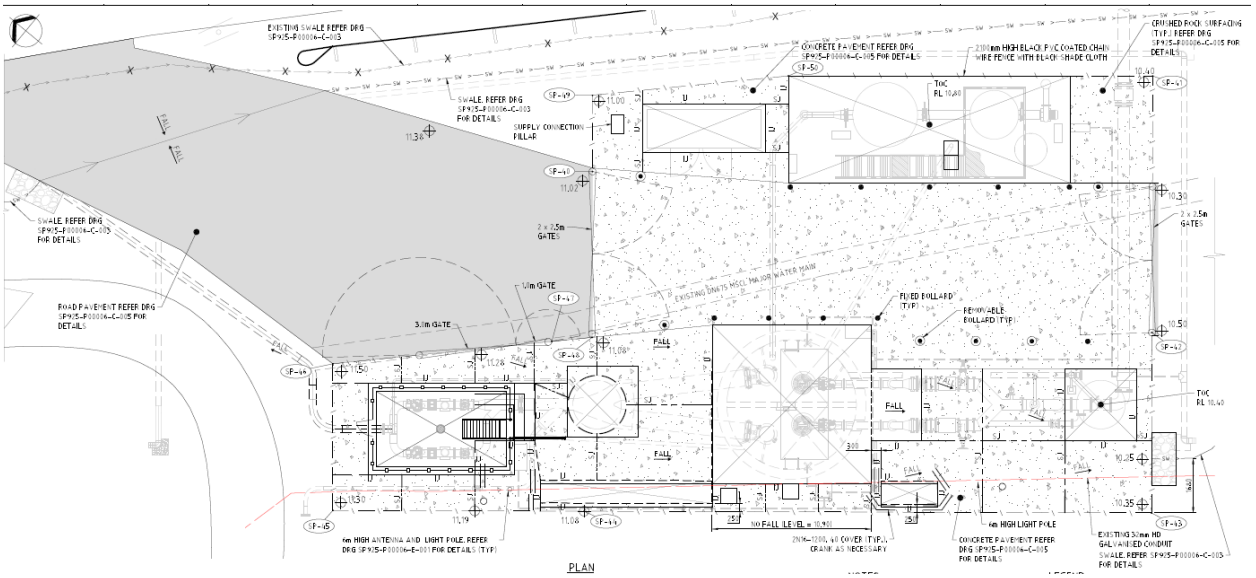

PLAN