8. Urban Development

8.1. Service Clearance

Within the project area there are a number of utility services, all of which have the potential to influence the feasibility of design options. This section outlines issues that need to be considered during construction in and around these services, including those located above and below ground.

Utility provider code of practice for Western Australia was used as guide to make sure no major damage and injury that caused by excavations along North Terrace in the project area.

The following acts, regulations, codes of practice and industry guidelines should be consulted when undertaking construction work near utility services;

- Gas Act 1997
- Electricity Act 1996
- Work Health and Safety Act 2012
- Water Industry Act 2012
- Telecommunications Act 1997
- AS 2648.1 1995 Underground Marking Tape
- AS 1345-1995 Identification of the contents of pipes, conduits and ducts
- AS 2566.2 2002 Buried flexible pipelines
- AS 1742.3 Traffic control devices for works on roads
- Code of Practice: Safety Precautions in Trenching Operations
- Code of Practice: Confined Spaces

To assist in identifying underground services, Table 81 outlines common pipe colours and markings. Based upon the type of service, standard clearances apply when undertaking construction, shown in Table 82.

Table 81 Common Colourations of Underground Services (UPSC 2010)

Service Types	Standard Colour
Gas	Yellow or Yellow Striped
Electrical	Orange pipe or Orange Striped
Traffic Signals	Orange
Roadside Lighting	Orange
ITS	Orange(power) and White
Telecommunications	White or White and Black Stripe
Water	Blue or Blue Striped
Sewerage	Cream or Grey or Cream/Grey Striped
'Third Pipe'/Effluent Reuse	Purple

Table 82: Standard Clearances from Services (UPSC 2010)

Types of Utility Underground Services	Clearance Zone for Powered Excavation	Typical Depths (mm)
Low pressure gas mains	300 mm	300 –450
Medium pressure gas mains	300 mm	450 – 750
High pressure gas services, mains and pipelines	300 mm	750 – 1200
Telecommunications cables [1]	500 mm	450 – 600 [2]
Water Supply	300 mm [3]	450
Sewer	300 mm [3]	600 - 10000
Notes: Potholing is the preferred method for identifying services **[1] Telecommunication service location requires specific conditions for undertaking identification of services (Worksafe Victoria 2004)** **[2] can be to 1200mm in depth** **[3] if pipe is 200mm or greater in diameter**		

Above ground services include street lighting, telephone boxes and electricity. Stobie poles and their associated power lines have strict requirements. To manage risks associated with construction the following needs to occur (as per AS2550);

- Identification of the electricity voltage;
- A documented risk assessment;
- The electricity network operator is informed and imposed condition complied with, and;
- A professional spotter (someone with experience, training or both with working around power facilities) supervising the operation at all times

The clearance zone required for operating machinery and working around power lines is shown in Figure 205

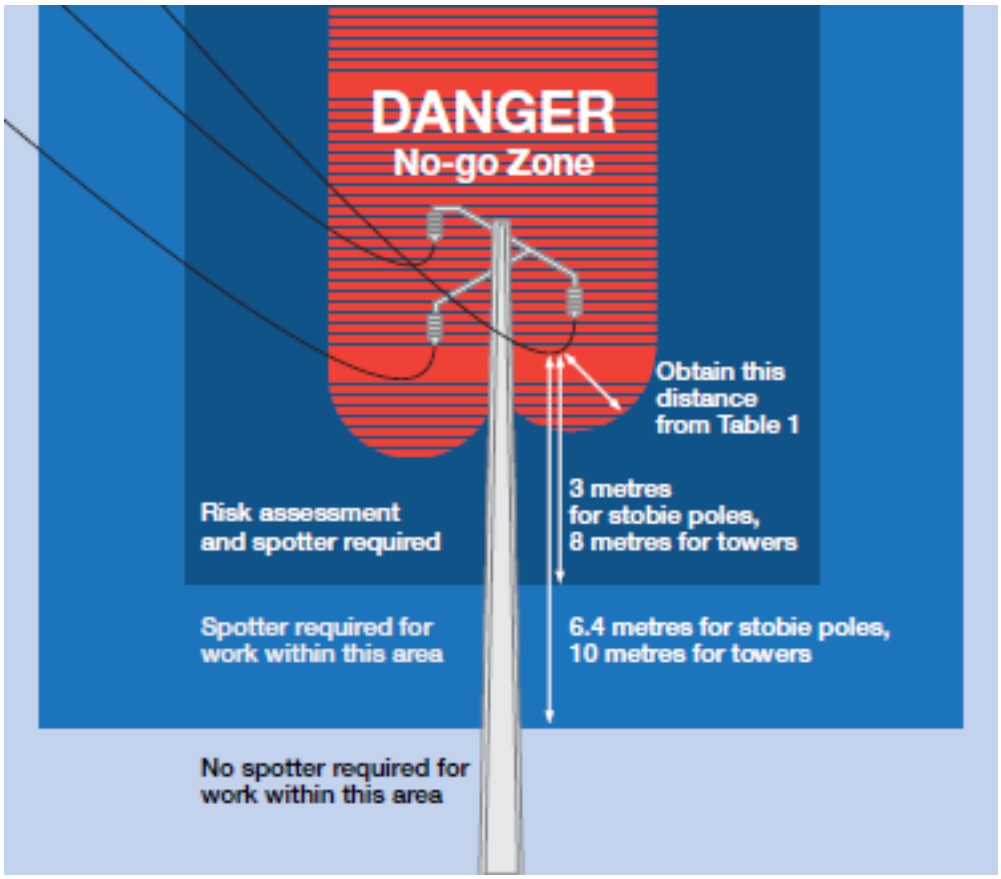


Figure 205 Clearance zones required for operating machinery near power lines (DPTI 2012)

Table 83 shows the clearance distances from power lines, measured from the position of the closet conductor (DPTI 2012):

Table 83 : Minimum clearances from power lines (DPTI 2012)

	Cranes AS 2550.1 Crane Code		Machinery Electricity Regulations 2012	Safe Approach Limits Electricity Regulations 2012		Buildings and Structures, including Scaffolds	
Voltage	No Spotter	Spotter required	Risk assessment and spotter required	Approach limit – normal persons	Approach limit – with risk assessment	Horizontal direction	Vertical direction
240	6.4m	3.0m	1.0m	3.0m	1.0m	1.5m	3.7m
415	6.4m	3.0m	1.0m	3.0m	1.0m	1.5m	3.7m
7600	6.4m	3.0m	1.5m	3.0m	2.0m	3.1m	5.5m
11000	6.4m	3.0m	1.5m	3.0m	2.0m	3.1m	5.5m
19000	6.4m	3.0m	1.5m	3.0m	3.0m	3.1m	5.5m
33000	6.4m	3.0m	3.0m	3.0m	3.0m	3.1m	5.5m
66000	6.4m	3.0m	3.0m	4.0m	4.0m	5.5m	6.7m
132000 pole	6.4m	3.0m	3.0m	5.0m	5.0m	15m	N/A
132000 tower	10.0m	8.0m	3.0m	5.0m	5.0m	20m	N/A
275000	10.0m	8.0m	4.0m	6.0m	6.0m	25m	N/A

8.1.1. Clearance between Underground Service

To reduce the influences between different types of underground services, a standard clearance between each services must be applied during the stormwater drainage system design which is based on the Australian Standard, Act and State requirements.

Table 84 Minimum clearance between underground services

Proposed Services	Minimum horizontal clearance between services[1,2] (mm)		Minimum vertical clearance between services[1,2] (mm)
	Existing pipe size		
	⩽ DN 200	>DN 200 to ⩽DN 200[3]	
Water pipes ⩽DN 375[3]	300	600	150
Electricity conduits and cables	1000	1000	225
Gas pipes **Telecommunication conduits and cables** **Stormwater drains**	300[4]	600	150
Waste water pipes[5]	1000/600	1000/600	500
Kerbs	300[6]	300[6]	N/A

1. Clearances apply in all situations except welded steel water pipes where the distance from the nearest point of another utility service to the centre line of a welded steel water pipe shall be not less than half the required minimum trench width for the water pipe plus 600 mm (to provide access for welding). In special cases, SA Water may consider reduced minimum clearances for which specific requirements will be advised.

2. If the existing water pipe is concrete encased or if the existing and/or proposed utility services are to be concrete encased, then the minimum clearances shall be measured from the outside of the encasement.

3. For water pipes larger than DN 375, advice on clearances is to be sought from SA Water.

4. For installations such as poles, pits and small structures, clearances to a water pipe may be reduced to not less than 150 mm for distances along the pipe of up to 2 m provided the structure is not likely to be destabilised by maintenance excavation work on the water pipe.

5. Wastewater pipes should always cross under water pipes. In cases where there is no alternative and the wastewater pipe must cross over the water pipe, construction shall be in accordance with SA Water's Standards. When a wastewater pipe is to be located adjacent to and at the minimum vertical clearance depth below the level of a water pipe (i.e. 500 mm), maintain minimum 1000 mm horizontal clearance between pipe barrels. The minimum horizontal clearance of 1000 mm may be progressively reduced to 600 mm as the difference in levels is increased to 750 mm.

6. Clearances from kerbs shall be measured from the outside of the barrel of the water pipe to the nearest point of the kerb.

Table 85 the minimum clearance between underground services for storm water

Proposed Services	Minimum horizontal clearance between services[1] (mm)		Minimum vertical clearance between services[1] (mm)
	Existing pipe size		
	⩽ DN 200	>DN 200 to ⩽DN 200[33]	
Water pipes[2]	1000/600	1000/600	500
Electricity conduits and cables	500	1000	225/300[3]
Gas pipes **Telecommunication conduits and cables** **Stormwater drains**	300[4]	600	150/300[3]
Waste water pipes[5]	300	600	150/300[3]

Notes:

1. If the existing wastewater pipe is concrete encased or either the existing and/or proposed utility services are to be concrete encased, then the minimum clearances shall be measured from the outside of the encasement.
2. Water pipes should always cross over wastewater pipes. In cases where there is no alternative and the water pipe must cross under the wastewater pipe, construction should be in accordance with SA Water standards. When a water pipe is to be located adjacent to and at a difference in level equivalent to the minimum vertical clearance above the level of a wastewater pipe (i.e. 500 mm), maintain minimum 1000 mm horizontal clearance between pipe barrels. The minimum horizontal clearance of 1000 mm may be progressively reduced to 600 mm as the difference in levels is increased to 750 mm.
3. A minimum vertical clearance of 300 mm applies if the size of either the existing or proposed service is >DN 300.

Also there is a minimum clearance requirement for the underground water service:

- The separation between any underground drain and a water service shall be at least 100mm.
- The separation between any underground drain and a communication cable shall be at least 100mm.
- The separation of any underground drain and a stormwater drain exceeding DN100 shall be at least 300mm.
- The separation of a non-drinking water service pipe and drinking water service pipe shall be at least 300mm.

8.2. Heritage Management plan

Maintaining the local heritage of the area is of upmost importance to the City of Norwood, Payneham and St Peters, in accordance with the Department of Planning, Transport and Infrastructure's (DPTI's) City Plan 2030.

In South Australia, places and objects of state and local heritage are protected under the Heritage Places Act 1993 and the Development Act 1993. A site inspection performed by Hydro-Future has found that, the project area contains 13 buildings that are on the local and state heritage listing, including 10 buildings on the northern side and 3 on the southern side of North Terrace. During construction, emphasis needs to be placed on protection of the heritage buildings.

Protection of heritage buildings during construction is a two-stage process, both during and after construction. During construction, extra fencing should be added around heritage sites, and once the construction is finished, the construction site should be cleaned and restored to its original state.

Based on guidelines produced by the NSW Heritage Office (2002, not only the main building on the site should be protected, but other elements of the site, such as paving, garden, outbuildings lamp standards and so on also should be on the protection list. As a result, fencing should be placed 0.5 meters from heritage site boundaries (NSW Heritage Office 2002).

During construction, if any archaeological significant material is identified appropriate experts in the area will need to be consulted, the experts may be either from Consultant Company or DOSAA (The Division of State Aboriginal Affairs). Section 8.2.1 shows photographs of each heritage site in the project area.

8.2.1. Heritage Buildings within Project Area

A number of the heritage buildings within the project area are shown below in Figure 206 through Figure 210.

Figure 206 Romilly House, at the intersection of the North Terrace and Hackney Rd (Hydro-Future, 2015)

Figure 207 37 North Terrace Hackney, SA (Hydro-Future, 2015)

Figure 208 33 North Terrace HACKNEY, SA (Hydro-Future, 2015)

Figure 209 23 North Terrace Hackney, SA (Hydro-Future, 2015)

Figure 210 39 and 41 North Terrace Hackney, SA (Hydro-Future, 2015)

Figure 211 2 North Terrace Kent Town, SA (Hydro-Future, 2015)

A summary of all heritage properties within the project area is shown in Table 1. This data includes the map number which references the location of heritage building on the map, the heritage number which references the Heritage listings in South Australia, the address and property details of the listing as well as the heritage class (state or local).

Table 86 Heritage Listed Building within the Project Area, all lie within the City of Norwood, Payneham and St Peters (SA government 2014)

Map No.	Heritage No.	Address	Details	Class
1	**5601**	1 North Terrace HACKNEY	Former Romilly House	State
2	**6394**	23 North Terrace HACKNEY	Dwelling ('Singleton')	Local
3	**6395**	31 North Terrace HACKNEY	Attached Dwelling	Local
4	**7867**	33 North Terrace HACKNEY	Attached Dwelling	Local
5	**6396**	37 North Terrace HACKNEY	Row Dwelling	Local
6	**7863**	39 North Terrace HACKNEY	Row Dwelling	Local
7	**7864**	41 North Terrace HACKNEY	Row Dwelling	Local
8	**6039**	2 North Terrace KENT TOWN	Royal Hotel	State
9	**5833**	58 North Terrace KENT TOWN	Victorian Masonry Cottage	Local
10	**5834**	60 North Terrace KENT TOWN	Victorian Sandstone & Bluestone Villa	Local
11	**6369**	85 North Terrace COLLEGE PARK	Row Dwelling	Local
12	**7804**	87 North Terrace COLLEGE PARK	Row Dwelling	Local
13	**7805**	89 North Terrace COLLEGE PARK	Row Dwelling	Local

8.2.2. Heritage Building Management Process

The following diagram shown in Figure 212 details the process required by the New South Wales Heritage Office when construction is required near heritage buildings, this has been adopted by Hydro-Future as it presents a rigorous and thorough process for the protection of heritage buildings.

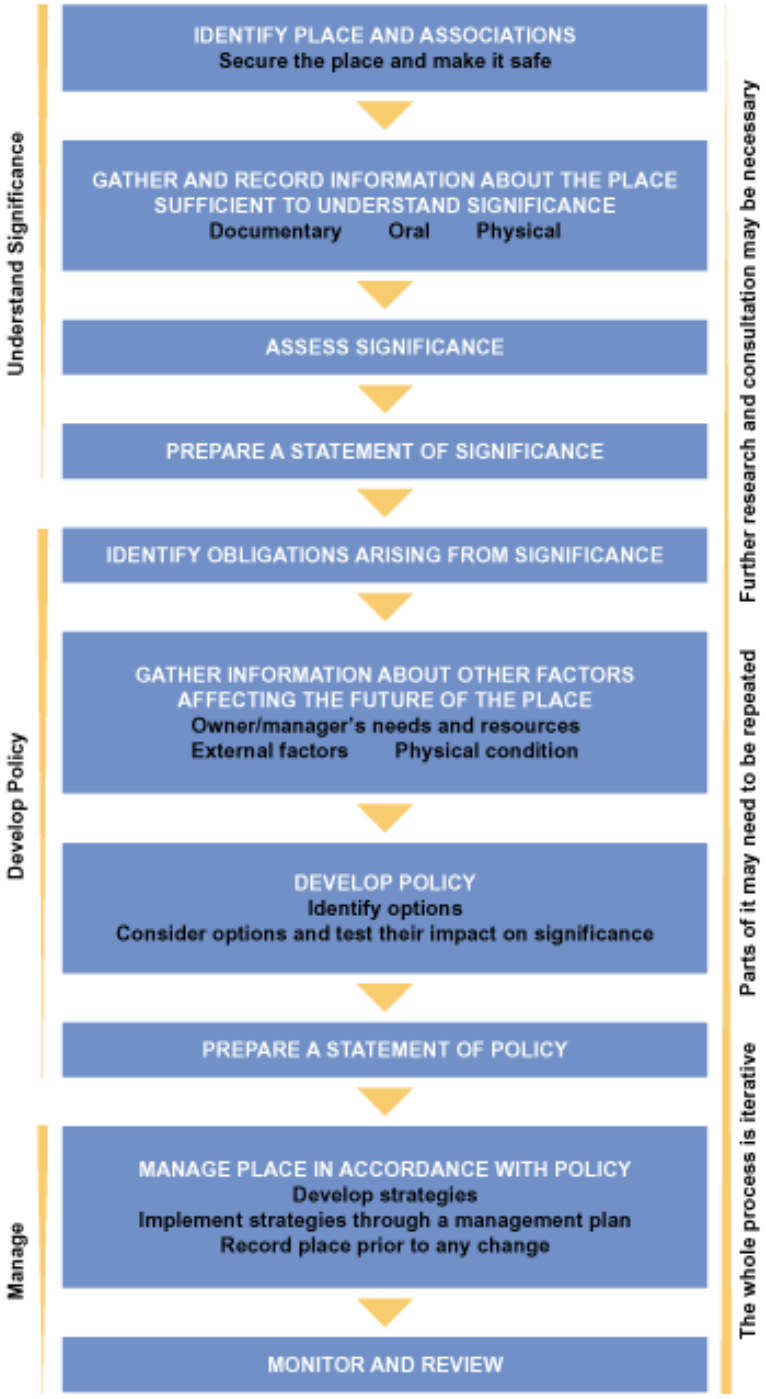


Figure 212 Flow chart process used for the protection of heritage buildings (NSW Heritage Office 2002)

8.2.3. Heritage Building in Project Area

The heritage buildings within the project area are shown in Figure 213 through Figure 214, with the identification numbering relating back to

Table 86.

Figure 213 Heritage buildings in the Eastern section of the project area (Hydro-Future, 2015)

Figure 214 Heritage buildings in the Western section of the project area (Hydro-Future, 2015)

The location of all rain water tanks to be installed as part of the combined drainage option for the North Terrace Drainage Design by Hydro-Future are shown in Figure 215 through Figure 217.

Figure 215 Rain water tanks to be installed in the Eastern section of the project area (Hydro-Future, 2015)

Figure 216 Rain water tanks to be installed in the Western section of the project area (Hydro-Future, 2015)

Figure 217 Rain water tanks to be installed in the Central section of the project area (Hydro-Future, 2015)

The location of all bio-retention basins to be installed as part of the combined drainage option for the North Terrace Drainage Design by Hydro-Future are shown in Figure 218 and Figure 219.

Figure 218 Location of bio-retention basin 1 in the North Terrace Drainage Design by Hydro-Future (Hydro-Future, 2015)

Figure 219 Location of bio-retention basin 2 in the North Terrace Drainage Design by Hydro-Future (Hydro-Future, 2015)

Comparing the locations of the rain water tanks to be installed shown in Figure 215 through Figure 217, with the location of the heritage buildings in Figure 213 and Figure 214, it can be seen that heritage building number 8, the Royal Hotel, as shown in Figure 213 and

Table 86 is the only heritage building in conflict with the installation of rain water tanks and bio-retention basins. However, the installation of the new storm water pipe along the Southern side of the road will also mean that the heritage buildings 9 & 10, as shown in Figure 213 and

Table 86 are in conflict with constructions.

Figure 220 the location of Heritage building and stormwater drainage system in eastern section of project area (Hydro-Future, 2015)

Figure 221 the location of Heritage building and stormwater drainage system in western section of project area (Hydro-Future, 2015)

8.2.4. The Aboriginal Site Protection during the Construction

Aboriginal cultural heritage in South Australia is protected under the Aboriginal Heritage Act 1988. In some locations, such as near waterways, there is a likelihood that sites will be present even though there is no indications of cultural material on the surface. This is most common along the coast, creek and river banks and in coastal and inland sand dunes. In such areas it may be advisable for members

of the Aboriginal community, usually assisted by an archaeologist, to monitor initial soil disturbances during construction (DPTI 1999).

Before any construction activates, the Roadside Significant Sites Database (RSSD) should be consulted to ensure that known sites are avoided (DPTI, 1999).

If suspected Aboriginal heritage items, including stone artefacts, hearths or burials are exposed during any construction activities, work must stop. The Environmental Operations Unit and the Senior Cultural Heritage Officer of DOSAA (The Division of State Aboriginal Affairs) (Phone [08] 8226 8930) should be contacted immediately. DOSAA has undertaken to respond promptly to any requests. If human skeletal remains are found, these must immediately be reported to the nearest Police Station. If these remains are suspected to be of Aboriginal origin, DOSAA should also be advised.

8.3. Land Acquisition

Land acquisition in South Australia is governed by the Land Acquisition Act 1969. All land acquisition required for the North Terrace Drainage Design project will adhere to this standard with all steps and requirements fully adhered to. The land acquisition process will be started following the formal approval of the project by Council (Kentown), City (Norwood, Payneham and St Peters) & State (South Australia). The process through which Hydro-Future will pursue land acquisition, in accordance with the Land Acquisition Act 1969, is detailed in Sections 8.3.1.1 through 8.3.1.5. Through this process, the 'Authority' is Hydro-Future, or a representative nominated by the Hydro-Future Project Manager, for the purposes of acquiring land for the project.

8.3.1. Land Acquisition Process

Once formal project approval has been given, the 5 step process outlines by the Land Acquisition Act 1969 will be applied, which include:

- Notice of intention to acquire land
- Objections to land acquisition
- Application to acquire land
- Resumption notice of land acquisition
- Negotiation of Compensation for the acquisition of land

8.3.1.1. Notice of intention to acquire land

According to the Land Acquisition Act 1969, if the Authority proposes to acquire land, the Authority must give a notice of intention to acquire land to each person whose interest in the land is subject to acquisition, or such of those persons as, after diligent inquiry, become known to the Authority. The Authority is required to give a copy of the notice of intention to acquire the land to the Registrar of the ERD Court and the Commonwealth Registrar. The notice of intention to acquire the land must comply with following requirements:

- It must define the subject land with reasonable particularity
- It must state that the purpose of the acquisition is to confer rights or interests in relation to the land on the Crown or an instrumentality of the Crown

Also during the 'Notice of intention to acquire land' process, an explanation of the acquisition scheme may be required. According to the Land Acquisition Act 1969, a person who has an interest in the subject land may, within 30 days after notice of intention to acquire the land is given, required by the Authority, by written notice:

- To give an explanation of the reasons for acquisition of the land

- To provide reasonable details of any statutory scheme in accordance with which the land is to be acquired

The Authority may furnish the explanation and details by letter, or by making available model, plan, specifications or other relevant materials relation to the statutory land acquisition scheme

Within 30 days of the land owner receiving notice of intention to acquire land an explanation of the reasons for the acquisition is required. Within 30 days after this explanation has been provided, the land owner may contact the Authority with the following information:

- Request the Authority not to proceed with the acquisition of the subject land; Or
- Request an alteration in the boundaries of the subject land; Or
- Request that a particular part of the subject land be not acquired, or that further land be acquired.

Once the Authority receives notice from the land owner, within 14 days, the Authority must consider any request made by land owner and give a notice to the land owner indicating whether it accedes to, or refuses the request.

8.3.1.2. Objections to land acquisition

During the previous step, objections to land acquisition only apply if they are from the Authority or land owner.

The land owner can make a request within 30 days after being given the notice of land acquisition from the Authority. Following this, within 7 days of being served with a notice indicating that the Authority has refused the request, the land owner can write to the Minister for a review of the decision made by the Authority.

The application for review must be made in a manner and form determined by the Minister. The Minister will conduct the review or will appoint a suitable person to conduct the review on the Minister's behalf, if the Minister conducts the review, it must be completed within 14 days of the Minister's receipt of the application. If the review is conducted by a person on the Minister's behalf, the review must be completed, and the reviewer's report furnished to the Minister, within 14 days of his or her appointment. On completion of a review, the Minister may confirm, vary or reverse the decision the subject of the review. A decision made on a review or the manner in which a review is conducted, is not itself subject to review by a court or tribunal.

8.3.1.3. Application to acquire land

If the parties in previous step agree to the decision made by the Minister, the land acquisition process will be resumed. The Authority will then prepare all require document based on the Appendices, Section 5.1 'Checklist of information required for Acquisition application'.

8.3.1.4. Resumption notice of land acquisition

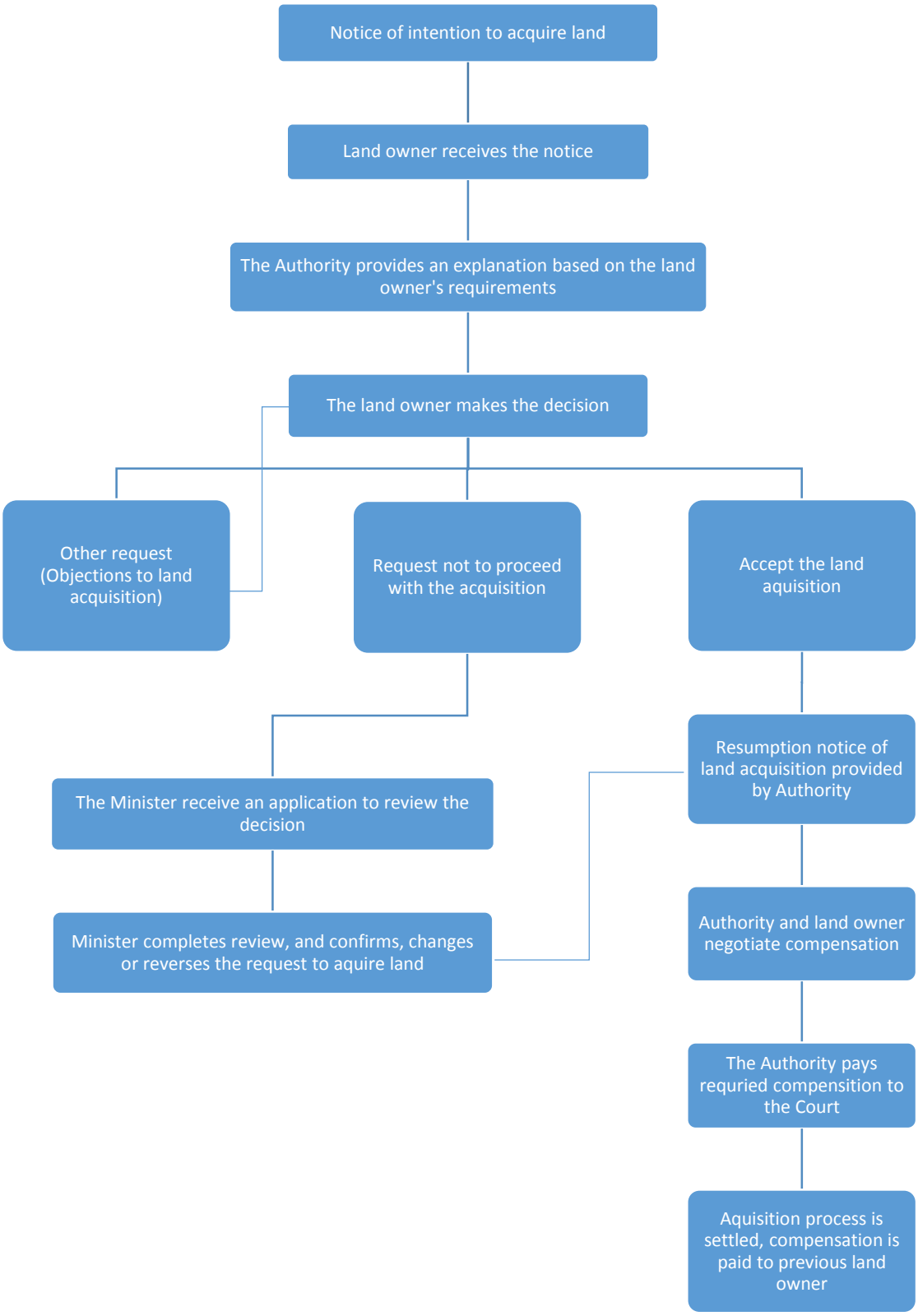
If the local council or state government approves the land acquisition, a resumption notice should be published in the Government Gazette (a copy of the notice is sent to all interested parties). On the date the notice is published, the Authority becomes the owner of the land (or easement). The previous owner's interest in the land converts to right to claim compensation.

8.3.1.5. Negotiation of Compensation for the acquisition of land

The Authority must negotiate in good faith with interested persons about the compensation payable for the acquisition of land under this Land Acquisition Act 1969. Also the Authority may offer non-money compensation such as the transfer of land, the provision of goods or services, or the carrying out of work for the re-instatement or improvement of land remaining in the claimant's ownership after acquisition.

When the Authority gives notice of the acquisition of land, it must make an offer to the person or persons whom it believes to be entitled to compensation for the acquisition, stating the amount of compensation the Authority is prepare to pay. Following this, if the land owner accepts the amount of compensation, the Authority must, within 7 days after making an offer of compensation, pay the amount offered to the South Australia Courts. These Courts will hold the compensation until the land acquisition has been settled.

8.3.2. Land acquisition model



8.4. Tank Installation Notification and Negotiation

The design option selected from the Feasibility Study of the North Terrace Drainage Design, the combined option requires the installation of 21 rain water tanks on privately owned properties. The notification and negotiation procedure between Hydro-Future and residents follows a three step process. This includes an initial communication via letter, secondary communication in person, or via phone or email, followed by a formal meeting with the project manager.

8.4.1. Initial notification

Prior to any community events, the residents whose properties have been identified as being appropriate for installation of a water tank will be sent an informal letter communicating the need for a rainwater tank to be installed on their property. This letter will make it clear that the installation of the tank will come at no cost to them personally.

This letter will also invite the resident to contact the Project Manager via email or phone, as well as to attend the community information event (community BBQ). Residents who do not respond to the letter or attend the community events will be contacted by Hydro-Future in person at their homes.

The purpose of this stage is to inform the residents about the needs for the rainwater tanks and the benefits to them and their community of having one installed. This process also enables Hydro-Future to collect contact details for the relevant residents to establish individual lines of communication for each resident.

8.4.2. Formal notification

The formal notification to the resident will be sent once contact has been made via informal letter or in person, a formal letter detailing the size, location and dates for installation will be sent to the required residents. A template for this letter is shown in Section 5.3.

8.4.3. Negotiation for tank installation

In repose to the formal letter, each resident is invited to nominate a time that suits them in which the Project Manager from Hydro-Future will visit each resident personally to discuss the installation of a rain water tank on their property. This discussion will highlight the benefits of the rainwater tank to the resident, as well as the requirement that the tank not be removed, disconnected or modified without the express permission from the City of Norwood, Payneham and St Peters.

This meeting will conclude with an arrangement with the resident of when the tank will be installed and will address any other issues in regards to the tank being installed such as property access or clearing of existing vegetation, etc.

8.4.4. Risk assessment

There is an associated risk when requiring the approval of third parties, in projects, that it may not be given. While Hydro-Future plans to approach a total of 30 residents, in order to install 21 rain water tanks on properties, there is a risk that some, or all, may reject the offer.

As such as risk analysis has been performed assuming *all* residents reject the offer to ensure the maximum impact to the project is considered. It has been found by Hydro-Future that the lack of rainwater tanks in the design will result in:

- *Increased catchment area*
- *Increased pipe size*
- *Increased cost*

8.5. Community Event

Community and stakeholder input on projects is very important to Hydro-Future. Prior to construction, Hydro-Future is holding 3 community events, in the form of a BBQ, to collect feedback which can then be summarised in a report to be submitted to the client prior to approval of the final design. During each of these events, a number of members of the Hydro-Future Management Team for the project will be present to interact with the community.

The dates of these events are spread out over two weeks, on different days to ensure all members of the community have the chance to attend. The events will be held in Richard's Park in Norwood as shown in Figure 222. This venue is beneficial given the large amount of on-street (free) parking as well as the large number of bus routes and stops in the area.

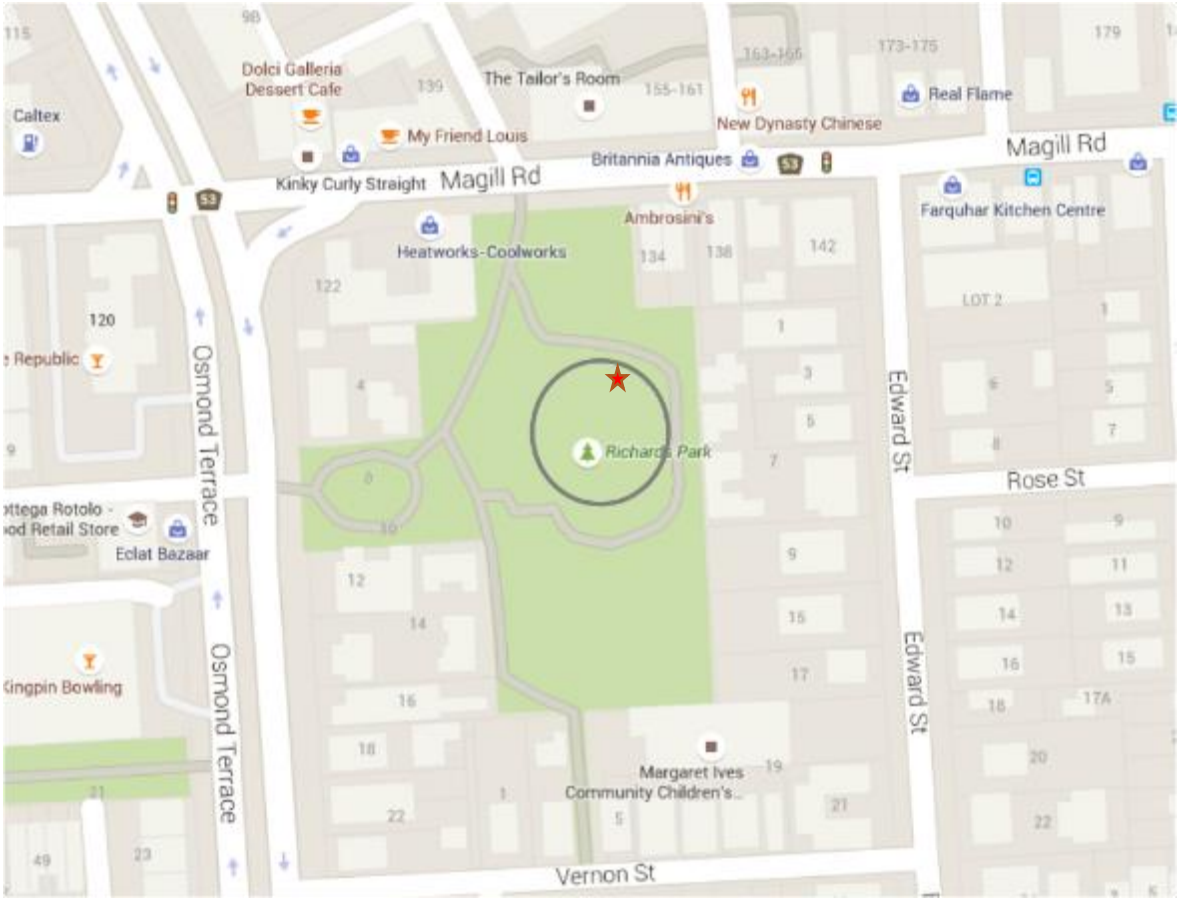


Figure 222 the location of BBQ part

8.5.1. Timing of the event

All community events will be held as the detailed design is being completed, before it is sent to the clients. This will enable Hydro-Future to ascertain public opinion in regards to the submitted design that can be provided to the client with the design. This timeframe will enable Hydro-Future to present the North Terrace Drainage Design to the community, with special emphasis on:

- The benefit of the project, specifically the improvement in storm water capacity and quality of water flowing into natural waterways
- Traffic impact on the local community during the construction and the Traffic Management Plan from Hydro-Future, as well as the timing of construction.
- The Environmental Management Plan, as well as other concerns such as the protection of Heritage Buildings during construction.
- The availability of Hydro-Future Management for contact throughout the project to allow the community to continually voice their concerns in regards to the project.
- Presenting the Project Questionnaire, show in Section 0, to the community.

The dates and times of the Community Events are shown below, at Richard's Park, Norwood:

Monday 25th May

2pm-6pm

Sunday 31st May

11am-3pm

Thursday 4th June

2pm-6pm

Saturday 6th June

10am-2pm

8.5.2. Advertising the event

A newspaper add and letterbox flier is produced to invite the community to the BBQ event. The flier is distributed to all residents in the community, two weeks before the first event (Monday 11th May). The newspaper add is run in the East Torrens, Eastern Courier and Mitcham & Hills, versions of the Messenger newspaper. The flier and newspaper add can be found in Appendix 5.5.

8.5.3. Organising the event

As the number of attendees to community notification and information events can be very difficult to estimate, a catering company is used that can vary the amount of food made available is used.

Given the timing of the event is in winter, Hydro-Future will set up temporary enclosed pavilions to shelter both the attendees from effects of the weather.

In order to attract passers-by, in addition to invited attendees, large promotional banners for the project, as well as Hydro-Future and the City of Norwood, Payneham & St Peters, will be erected to generate public interest in the event.

8.5.3.1. Culturally diverse foods

Given the cultural diversity of residents in the community, the catering company is instructed to provide foods that cater to everyone, including vegetarian, vegan and halal, with consideration given to common allergies.

The foods will include cooked BBQ meats and vegetarian options, salads including a range of traditional and cultural dishes and a range of breads. The amount of these foods that can be provided is variable, with the catering company using a refrigerated truck to store additional foodstuffs.

Hydro-Future will provide beverages for the event including soft drinks, juices, coffee and tea and water.

8.5.3.2. The environment of the event

The project staff will ensure the environment of the party is friendly and inclusive, inviting all to contribute to discussions regarding the project. This will be done by raising previously identified concerns with the community, in-line with the issues raised in the project questionnaire.

The questionnaire will also be distributed throughout the event to ensure both public and private opinion is being collected. Both the project website and Facebook page will be advertised at the event to encourage the community to continually give feedback on the project as it progresses.

8.5.3.3. Event safety

To ensure safety at the event, the BBQ's being used will be provided and operated by the catering company only, according to their own, council approved policies and procedures.

It is expected that the community will openly discuss the project. Given the diversity of opinion, and the different ways the project will affect each resident, there is a possibility of passionate discussion between the project staff and community, as well as within the community. It is the responsibility of the project staff to ensure this discussion is respectful to all members of the community.

Though it is small, there is risk that the event could become disruptive, as such the Norwood Police have been advised of the events; this is considered sufficient in terms of risk mitigation given the close proximity of the event to the Norwood Police Station.

8.6. Amenities Required for the Construction Site

8.6.1. Location of Site Office, Facilities and Site Yard

The site office and facilities for workers are required during the construction. Along the North Terrace site area, there are two open area, where can be considered to locate the site office and facilities, the Clark Rubber carpark and Royal Hotel Kent Town carpark. However, the Royal Hotel Kent Town carpark would not be appropriate to locate the site office and facilities due to not enough parking space for Royal Hotel's customers. Moreover, workers would be access to the facilities and office frequently during the day and night time, hotel's customers would be interrupted.

On the other hand, the Rubber Clark carpark is more appropriate to locate the site office and facilities. Surrounding the Rubber Clark carpark, most of the buildings are commercial offices and stores. Furthermore, the carpark has a big open space so that only half area of the carpark will be used to locate the office and facilities. There will still have a large area for commercial staff to park their cars. Hence, Hydro-Future decides that the site office and facilities will be located in the Clark Rubber carpark (Figure 223).

Figure 223 Location of the site office and facilities (Google Maps, 2015)

The site office and facilities will be rented from Coates Hire, which is Australia's largest equipment hire company. The size of the rental site office is 9.6m x 3m (Figure 224Figure 224), it includes:

- Single entry door
- 3 windows with security grills
- 3 twin 1200mm 40 Watt fluorescent lights
- 5 double 10 AMP GPO's (GPO stands for 'General Power Outlet)
- 3 single 10 Amp GPO's (GPO stands for 'General Power Outlet)
- Electrical distribution board
- 2 wall mounted r/c air conditioner

Inside the office, there will be 2 office desks and 2 swivel chairs prepared for the site supervisor and site engineer, as well as chairs for visitors. Figure 224 below, shows the layout of the site office.

Figure 224 Site office similar to what will be used by Hydro-Future for the project (CHC 2015)

During the construction, a site yard is also required by Hydro-Future to place construction materials and machineries. Surrounding the construction area, there is no any large open space available due to the oversized machineries and large about of construction materials. Hence, Hydro-Future decides

that the site yard will be located in a 55m x 50m vacant block of land, where is located in Fisher St (Figure 225). That is the nearest large open area to the North Terrace construction site.

Figure 225 Location of the site yard (Google Maps, 2015)

Moreover, the fencing (Figure 226Figure 226) must be set up around the site office, toilets, lunchroom as well as the site yard.

Figure 226 Temporary security fencing around construction site, similar to what will be used around the site yard and site office (CHC 2015)

Furthermore, since the site office will be located in Rubber Clark carpark and the site yard will be located beside residential houses in Fisher St, a dilapidation survey (section 5.7) need to be organized in order to make sure that any damaged to the car park would be fixed after the construction.

After the construction, all equipment and construction materials should be removed, once it's been removed, a damage inspector will be invited along with construction company representative and property owner or owner's representative to inspect there are any damaged to the Rubber Clark carpark and site yard where located beside residential houses in Fisher St. The inspector should fill out the dilapidation report (section 5.7), and give the final report to the construction company and land owner or owner's representative. And then there will be a negotiation meeting between construction company representative and land owner or owner's representative to discuss how the damage to be fixed.

8.6.2. Facilities for meal, storage and shelter

During construction, facilities for shelter, storage and meals are required for worker, they should be readily accessible, but not interfere with operations.

Floor area for the lunch room (Figure 227) is 28.8 square meters, which is for 27 workers on site.

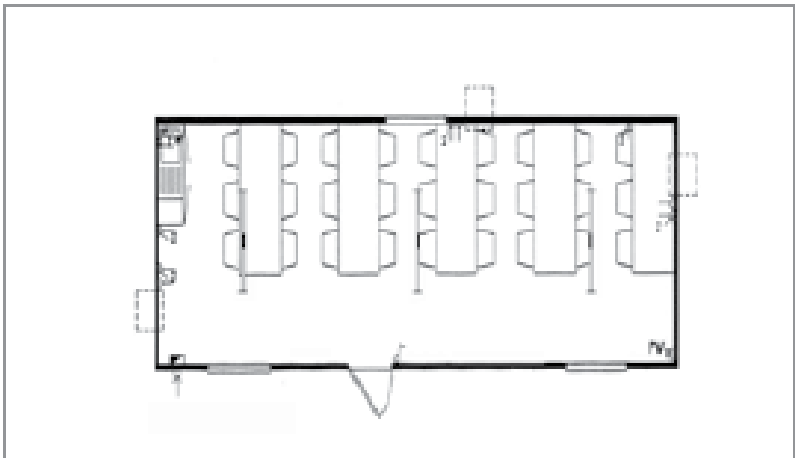


Figure 227 Layout of the lunch room for maximum 27 occupants (CHC 2015)

The facility include:

- single entry door
- 3 windows with security grills
- 3 twin 1200mm 40 Watt fluorescent lights
- 5 double 10 AMP GPO's (GPO stands for 'General Power Outlet)
- 3 single 10 Amp GPO's (GPO stands for 'General Power Outlet)
- Electrical distribution board
- 5 tables
- 27 stacker chairs
- 1 sink/bench
- 1 hot water urn
- 1 ple oven/food warmer
- 1 bar fridge
- 1 microwave
- 1 wall mounted r/c air conditioner

Hydro-Future requests a lunch van business that would be contracted to provide food at both morning tea break and lunch time, as well as for any night workers working at night.

8.6.3. Toilets facilities

The unisex toilet facilities on site will be 4.8m x 3.0m multi-pan toilet for 21 – 35 people on site (Figure 228).

The facilities include:

- Lockable entrance door with lock box
- High vent sliding sash windows
- Electrical works to SAA standards
- Waste harness with single connection point
- Individual toilet cubicles
- Stainless steel urinal
- Hand basins with hot & cold taps
- Toilet roll holders, paper towel dispenser and mirrors

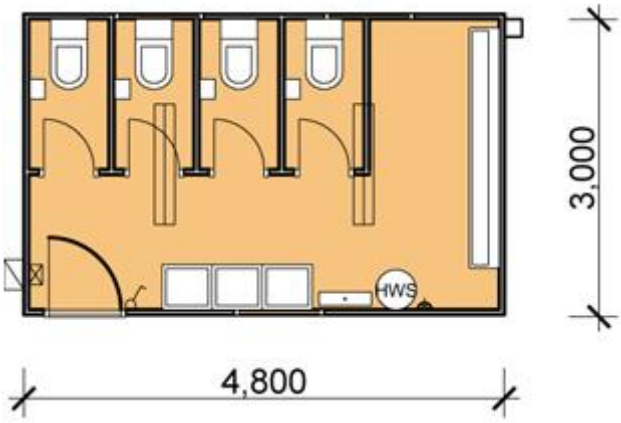


Figure 228 Layout of toilet blocks as requried for site amenities (CHC 2015)

8.7. Fencing

When there is development in peri-urban areas, there is a need for adequate security measures to ensure the safety of the public and the project contractor and staff. In order to have a safe construction environment, strict guidelines must be followed; everything must be done in accordance with WHS standards.

Security must be guaranteed during the period of road construction along North Terrace. Barriers should be set to alert drivers and protect contractors at the same time. To redevelop the drainage system there is a need to excavate on and along the roadway. Wire fencing or solid fencing is needed to be used at North Terrace to block off the site and will accompany the work in the construction

period. Solid fencing creates a good and safe barrier and gives less diversion. Especially when road cannot be fully closed, to reducing the danger as much as possible is very important. Solid fencing is an ideal choice to avoid people being distracted by the site while driving or walking. 580 fencings should be enough for the project. A budget of $20010 is approximately needed for fencing to be hired.

8.7.1. Fencing location

- Dig trench, excavation and removal of material
- Installation and connection of pipe
- Resealing of road surface

  All above work need to closure of 2 lanes inbound (Figure 229).

Figure 229 fencing location

- Dig trench for connection to mains system and repair pavement

  For this work, Full road will be closed for two night (Figure 230).

Figure 230 fencing location

- Remove surface soil for installation of bio-retention basin and construction of system

  The green area which is outside of royal park hotel car park will be closed (Figure 231).

Figure 231 fencing location

- Implementation of second bio-retention basin

  The outside of school park will be closed (Figure 232).

Figure 232 fencing location

- Installation of gross pollutant trap

  For this work need to closure of 2 lanes inbound for one day (Figure 233)

Figure 233 fencing location

- Placing concrete and allowance for curing

  1 lane inbound will be closed (Figure 234).

Figure 234 fencing location

- The other plans produced

  1 lane closed outbound (Figure 235)

Figure 235 fencing location

8.7.2. Dimension

Table 87 the size of fencing required based on the construction size

Work	Area(m^2)
Dig trench, excavation and removal of material	720*4=2880
Installation and connection of pipe	Same as above
Resealing of road surface	Same as above
Dig trench for connection to mains system and repair pavement	720*9=6480
Remove surface soil for installation of bio-retention basin and construction of system	37*3=111
Implementation of second bio-retention basin	2880
Installation of gross pollutant trap	2880
Placing concrete and allowance for curing	1440

8.7.3. Fencing type

Figure 236 Temporary Mesh Fencing

The robust design and ability to meet the requirements of most situations makes our temporary mesh fencing perfectly suited for use on construction sites or at events.

All fence panels are manufactured from high quality galvanized steel with mesh infill, weighing in at approximately 31 Kg and measuring 2500 mm in diameter and 2000 mm tall.

Our mesh fencing panels are designed and manufactured to fully comply with all government and local council legislation requirements.

Including, Australian Standard AS 4687-2007 for temporary fencing and hoarding.

Green plastic safety blocks with concrete infill and clamps are provided with all temporary mesh fence packages. (Thomas, 2009)

For this project, we need to rent temporary mesh fencings for three month.

Figure 237 temporary mesh fencing with cloth cover

And for temporary mesh fencing, we should use cloth to cover it, to avoid any potential opportunity of causing any traffic accident, and keep stone and dust inside.

8.8. Maintenance

Maintenance of the stormwater drainage network includes inspection, cleaning and repair of open and piped drains, pits, treatment devices, detention basins and outfall structures (VSC, 1999). This network needs to be regularly cleaned to maintain its performance (US EPA, 2001).

Stormwater drainage systems collect large amounts of pollutants such as, litter, branches, and leaves and other materials which have the potential to block the drainage system. This can temporarily reduce the capacity of drainage systems during rainfall events, especially during the heavy rainfall events, leading to potential flooding.

The US EPA (2001) reported that regular cleaning of the stormwater drainage network can increase dissolved oxygen levels in stormwater, reduce levels of bacteria and reduce the load of common stormwater pollutants entering receiving waters (e.g. sediment, nutrients, litter, organic matter). Thus, regular cleaning of the stormwater drainage network provides an opportunity to remove pollutant loads that would otherwise enter receiving water bodies after heavy rainfall. In addition to transporting pollutants, drains with accumulated pollutants may also overflow, leading to localised flooding and erosion, as well as risks to human safety and constructed assets.

Each of the various components of the North Terrace Drainage Design by Hydro-Future requires its own specialised maintenance (AMG 2002). These various components and the required maintenance are shown in Sections 8.8.1 through 8.8.4.

8.8.1. Bio-retention basin

Bio-retention systems consist of an excavated basin or trench that is filled with porous media and planted with vegetation. These systems provide water quality treatment by removing fine sediment, trace metals, nutrients, bacteria and organics (Davis et al. 1998). Bio-retention systems are structural stormwater controls that capture and either retain or temporarily detain stormwater runoff before the water is released to the environment. These systems can reduce the volume of runoff from a drainage area, reducing the required size and cost of downstream stormwater management facilities, by promoting at-source infiltration.

Maintenance of bio-retention basins require inspection of all stormwater drains and detention basins at least once a year, preferably immediately prior to the wet season. For the North Terrace Drainage Design, bio-retention basin maintenance will be checked every six months. These inspections must include:

- Sediment accumulation at inflow points
- Litter within basin

- Erosion at inlet or other key structures
- Traffic damage present
- Evidence of dumping (eg. commercial or residential waste)
- Vegetation condition (density, weeds, etc)
- Any necessary changes in watering of vegetation,
- Any required replanting
- Clogging of drainage points (sediment or debris)
- Evidence of ponding, damage/vandalism to structures
- Surface clogging visible
- Clogging or degradation of drainage system
- Resetting of bio-retention system

Water Corporation's Drainage Maintenance Standards (2004)

During inspection, identify the pollutant or sediment accumulation 'hot spots' during or before wet season. The frequency of inspection of these 'hot spots' should be increased to minimise the risk of flooding during the heavy rainfall events (WA Water 2004).

One of the primary maintenance requirements for bio-retention systems is to inspect and repair or replace the treatment system components. Generally this involves periodic maintenance of the landscaped area. Pesticide and fertiliser application to the plants should be limited during the establishment phase and avoided during the operation phase of the system. Regular watering of the vegetation may be required in the establishment phase. Bio-retention system components should blend over time through plant and root growth, organic decomposition and the development of a natural soil horizon. These biological and physical processes will lengthen the facility's life span and reduce the need for extensive maintenance.

A critical maintenance consideration is the monitoring of sediment accumulation at the inlet points. Depending on the catchment activities, the deposition of sediment can smother plants and reduce the available ponding volume. Should excessive sediment build-up occur, it may impact on plant health and lead to a reduction in their capacity to maintain the infiltration rate of the filter media. Regular sediment removal and inspection and repair of any scour and erosion areas should be undertaken, including assessment after large storm events. Rubbish and other debris should also be removed from the surface components, including inlet structures, culverts and overflow pits. Routine maintenance should include health evaluation and the subsequent removal of any dead or diseased vegetation. Diseased vegetation should be removed by hand. Diseased plants may indicate inappropriate species selection, and the choice of plants should be reconsidered under these circumstances.

In addition, bio-retention systems can be susceptible to invasion by aggressive weeds, which can reduce infiltration and conveyance capacity if not routinely maintained. Vegetation may need to be pruned to maintain conveyance and the appearance of the system. Highly organic and often heavily vegetated areas in standing shallow water can create a breeding ground for mosquitoes. Routine inspection for areas of standing water and corrective measures to restore proper infiltration rates are necessary to prevent water ponding for more than four days, to eliminate these breeding environments. Mulch replacement is recommended when erosion is evident or when the site begins to look unattractive (Cooperative Research Centre for Catchment Hydrology 2003).

8.8.2. Rainwater tanks

Roof catchments should be kept clean and clear of leaves and debris. Overhanging branches should be removed. Gutters should be regularly inspected and cleaned if necessary. The use of screens/guards should be considered and all screens should be cleaned regularly. Water ponding in gutters must be prevented as it can provide breeding sites for mosquitoes and could lead to eggs being washed into tanks. Tanks should not be allowed to become breeding sites for mosquitoes. If mosquitoes are detected in a tank, the entry point should be located and closed. For most types of tanks mosquito breeding can be stopped by adding a teaspoon (5 mL) of domestic kerosene.

Tanks should be examined for accumulation of sludge at least every 2-3 years. If sludge is covering the bottom of the tank it should be removed by siphon or by completely emptying and rinsing the tank. Professional tank cleaners are available in some areas. Excessive sludge is a sign of inadequate maintenance of the catchment area (roof and gutters). This information will be provided to the owners of properties having tanks installed by Hydro-Future as part of the North Terrace Drainage Design.

Regular disinfection should not be necessary. If it is suspected that water in the tank is contaminated, it can be disinfected using 40 mL of liquid sodium hypochlorite (12.5% available chlorine) or 7 grams of granular calcium hypochlorite per 1000 litres of water (SA Health 2008).

8.8.3. Drainage pipe

Below is shown the drainage pipe maintenance flow chart.

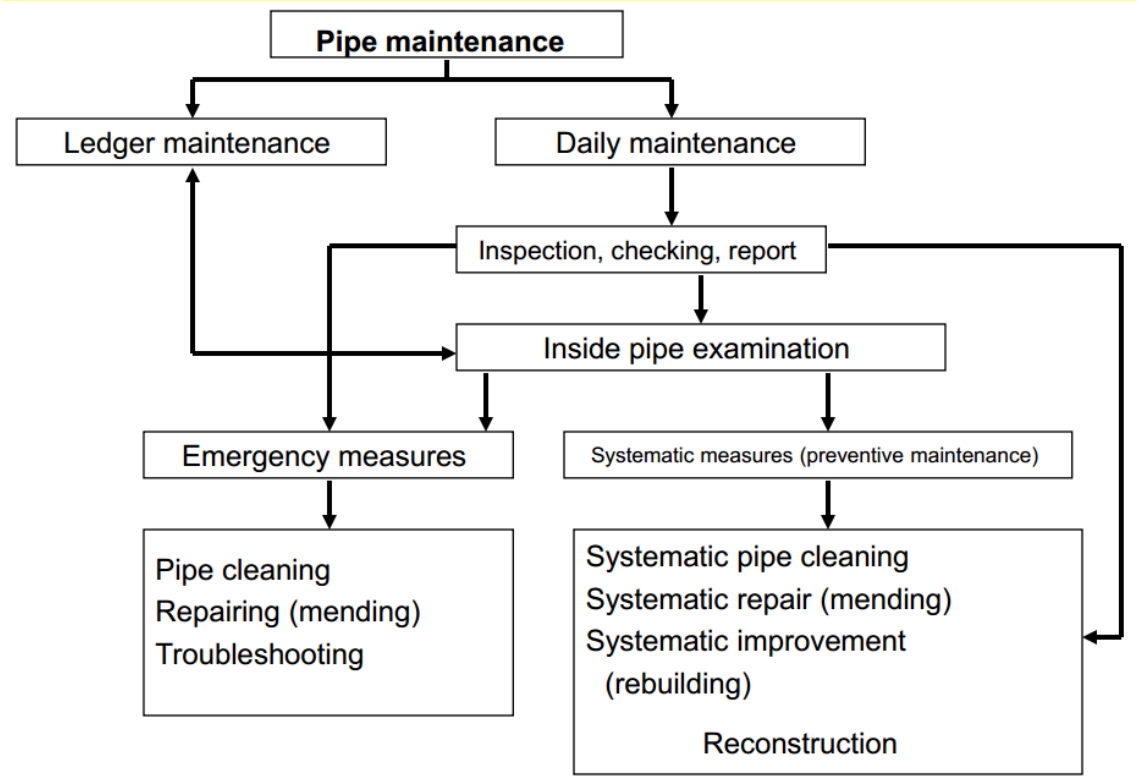


Figure 238: Stormwater drainage pipe maintenance flow chart (Kitou & Sakino, 2015)

From the flow chart shown in Figure 238 it can be seen that pipe maintenance consists of two parts, including daily maintenance and ledger maintenance. Ledger maintenance is usually conducted once per year and inspection will be required of 5 main components.

1. Grease build-up or foreign object clogging.
2. Cracked or broken water pipes from ground shifting, settling, or tree roots in sewer line.
3. Joints which are leaking due to substandard installation and/or damaged sealing.
4. Corroded pipes
5. Any change in water quality

If any problems are found during inspection, pipe cleaning, repairs, or replacement will be required.

Daily maintenance refers to the ability of the general public to contact the council should any maintenance issues become apparent, the reporting of an issue by a member of the general public will initiate an additional inspection, following the same procedure as the ledger maintenance.

8.8.4. Pits

Stormwater manhole covers are generally located in roads, footpaths and parks. They are used for inspection and maintenance access to stormwater systems. Maintenance of the manhole cover/lid may be required if the manhole cover has been removed or damaged and requires replacement, or the manhole cover in the road has shifted or the surround has deteriorated, and is a noise nuisance when vehicles drive over it.

When a resident or builder requires a stormwater manhole/pit in their property to be raised or lowered to ground level, this is referred to as Private Works and is a quotable job by Roads and Drains Department (Moreton Bay, 2015).

The maintenance of side entry, on grade and sag pits is completed, at minimum, annually or as required by the City of Norwood, Payneham and St Peters. It is recommended that the cleaning of pits take place at the beginning of winter to ensure the leaf and plant matter that is collected during the summer and autumn months be removed before they cause blockages during winter stormwater flows.

Maintenance activities include the following:

- Removal of debris (including trash as well as plant materials, etc.) and silt from inlets so that water can freely enter the stormwater system.
- Ensuring the pavement around the inlets and manholes is as constructed and has water-tight joints, which prevents deterioration of the structure.

8.8.5. Gross pollutant trap

The maintenance of the Gross Pollutant Trap (GPT) has been defined by Hydro-Future as per the design engineer's requirements. The required maintenance of the GPT is detailed in Section 5.8.

8.9. Vegetation Management

8.9.1. Introduction

Hydro-Future has developed a Vegetation Management Plan that ensures any vegetation that must be removed during a project is done so in accordance with the Development Act 1993. This Act requires the identification of a tree, or other vegetation as Regulated, Significant or neither, and has specific requirements based upon this classification. Except in prescribed circumstances, the Development Act 1993 requires approval for undertaking a 'tree damaging activity' in relation to a 'regulated tree' or a 'significant tree'.

The process required to identify vegetation as Significant or Regulated, as well as the requirements for removing Significant or Regulated vegetation is detailed in Section 8.9.2 through Section 0.

8.9.2. Regulated tree

A Regulated Tree is either:

(a) a tree (within the designated area set out in S6A of the Development Regulations 2008) that has a trunk with a circumference of 2m or more or, in the case of trees with multiple trunks, that have trunks with a total circumference of 2m or more and an average circumference of 625mm or more, measured at a point 1 metre above natural ground level, or a tree within a class of trees, declared to be regulated by the regulations (whether or not the tree also constitutes a significant tree under the regulations); or

(b) a tree declared to be a significant tree by a Development Plan (whether or not the tree is also declared to be a regulated tree, or also falls within a class of trees declared to be regulated trees, by the regulations)

Development Act 1993

8.9.3. Significant tree

(a) a tree declared to be a regulated tree by the regulations (ie it falls within the designated area, is not of a specified species, is not located 10m from an existing house or in-ground pool, is not Native Vegetation under the Act, and is not part of a plantation), which has a trunk with a circumference of 3m or more or, in the case of a tree with multiple trunks, has trunks with a total circumference of 3m or more and an average circumference of 625mm or more, measured at a point 1 metre above natural ground level; or

(b) a tree declared to be a significant tree by a Development Plan (whether or not the tree is also declared to be a regulated tree, or also falls within a class of trees declared to be regulated trees, by the regulations).

Development Act 1993

8.9.4. The Development Assessment Commission

For the majority of projects undertaken by the Department of Planning Transport and Infrastructure (DPTI), the Development Assessment Commission (DAC) is the relevant authority for determining applications for consent to clear regulated and significant trees under the Development Act 1993. The DAC is serviced by the Development Assessment Branch of Planning SA.

Development Act 1993

8.9.5. Protection of Regulated and Significant trees

The controls which apply to a regulated or significant tree prevent removal, killing or destruction, major pruning, ringbarking or topping, or any other substantial damage to the tree, including its root system. Major pruning is considered a 'tree damaging activity' if it removes more than 30% of the crown of the tree. In circumstances where pruning removes less than 30% of the crown of a tree and is required to remove–

(i) dead or diseased wood; or

(ii) branches that pose a material risk to a building; or

(iii) branches to a tree that is located in an area frequently used by people and the branches pose a material risk to such people development approval is not required.

The controls for regulated and significant trees apply to all parts of Metropolitan Adelaide, including the project area for the North Terrace Drainage Design.

Development Act 1993

8.9.6. Exemptions

Schedule 3(17) of the Development Regulations specifically excludes certain tree damaging activities from the definition of 'development' (and therefore from the requirement to gain DAC approval). No approval is needed to impact a Regulated Tree (including a Significant Tree) in the following circumstances:

(a) The tree is within 1 of the following species of trees:

Melaleuca styphelioides (Prickly-leaved Paperback)

Lagunaria Patersonia (Norfolk Island Hibiscus); or

(b) the tree is within 20 metres of a dwelling in a Bushfire Protection Area identified as Medium Bushfire Risk or High Bushfire Risk in the relevant Development Plan (measured from the base

of the nearest trunk of the tree to the dwelling to the nearest part of the dwelling at natural ground level); or

(c) The tree is on land under the care and control of the Minister for Environment & Conservation; or

(d) The tree is on land under the care and control of the Board of the Botanic Gardens and State Herbarium; or

(e) The tree is dead.

Development Act 1993

8.9.7. Hazards

In an emergency situation work involving a regulated or significant tree can be undertaken without first having received a development approval. As soon as practicable after the emergency work is undertaken DAC must be notified in accordance with S54A of the Development Act.

Development Act 1993

8.9.8. Development application

The process for obtaining approval is outlined below:

1. Is the tree 'regulated' or 'significant'?

- Obtain a Vegetation Survey.
- Check to see if the tree is listed in the State Heritage Register. If so, liaise with the Heritage Branch of the Department for Environment and Heritage; and
- Liaise with the relevant local council with regard to the removal/ pruning of the significant tree and any associated vegetation removals.

Development Act 1993

2. Complete the details on the Crown Development Application form (Appendix E)

Attach a description of the nature of the proposed development:

- Include a plan showing the location of trees and a description of the nature of any proposed infrastructure works,
- Include photographs and a description of the tree species and their health (Vegetation Survey),
- Describe the proposed actions in relation to the trees, i.e. pruning, removal, relocation, etc.;
- Provide a description of any mitigation works, e.g. landscaping proposal. If it is proposed to make a payment into the Planning & Development Fund in lieu of providing replacement plantings, make sure this is specified in the application;
- Include a copy of the outcomes of liaison with the local council

Development Act 1993

3. Submit the Development Application to the Senior Environmental Management Officer

For endorsement before it is sent to the Development Assessment Commission (DAC).

Development Act 1993

4. Lodge three copies of the application, and one electronic copy (on CD) with the DAC, using the following contact details:

Table 88: Contact details of Development Assessment Council (Development Act 1993)

Secretary **Development Assessment Commission** **Level 6, Roma Mitchell House** **136 North Terrace** **ADELAIDE SA 5000**	**Secretary** **Development Assessment Commission** **GPO Box 1815** **ADELAIDE SA 5001**

8.9.9. The approval process

The application will be assessed pursuant to Section 49 of the Development Act 1993, taking into account the policies in the relevant Development Plan, specifically:

- Development should have minimum adverse effects on regulated trees
- A regulated tree should not be removed or damaged other than where it can be demonstrated that one or more of the following apply:
  - The tree is deceased and its life expectancy is short
  - The tree represents a material risk to public or private safety
  - Development that is reasonable and expected would not otherwise be possible
  - The work is required for the removal of dead wood, treatment of disease, or is in the general interests of the health of the tree
- Tree damaging activity other than removal should seek to maintain the aesthetic appearance and structural integrity of the tree

Development Act 1993

DAC notifies the relevant Council when the application has been lodged, and Council must respond within two months of receipt of the notice or it will be conclusively presumed that the Council does not intend to report on the matter. The Commission then considers the application with the comments (if any) from the council and relevant agencies whose views it has sought (i.e. Heritage Branch at Department for Environment and Heritage). If the council opposes the application, Commission officers will usually initiate discussions with the State agency to see whether alterations can be made to the proposal to meet the council's concerns.

The Commission then prepares a report to the Minister. This must be done within three months of the date of receipt of the application. In most cases the time will be less. Time taken to seek additional information under Section 49(4), and to receive it, is not included in the three months. In such cases, the time limit is only extended by the amount of time it takes for the applicant to supply the additional information. After receiving the report from the Commission, the Minister may then approve (with or without conditions) or refuse the development proposed.

The Minister may delegate his or her powers to nominated officers to assess and approve some types of application. This would reduce the time taken for decisions particularly for minor applications, or where Council support is obtained.

No public consultation is required in respect of the application and there are no third party appeal rights in respect of the decision made (Development Act 1993).

8.9.10. Exceptions

The Development Act 1993 requires that approval be sought prior to removing or damaging 'Regulated' trees (including 'Significant' trees) in an area subject to the Act or for any development that will affect a registered State Heritage Place. A State Heritage Place may include a garden or trees. Approval is required from the Development Assessment Commission (DAC).

DAC approval to impact a Regulated tree is not required in some circumstances (internal approval still required):

1. Schedule 3(17) of the Development Regulations specifically excludes certain tree damaging activities from the definition of 'development' (and therefore from the requirement to gain DAC approval). No approval is needed to impact a Regulated Tree (including a Significant Tree) in the following circumstances:

   (a) The tree is 1 of the following species of trees:

   - Melaleuca styphelioides (Prickly-leaved Paperback)
   - Legendaria Patersonia (Norfolk Island Hibiscus); or

   (b) the tree is within 20 metres of a dwelling in a Bushfire Protection Area identified as Medium Bushfire Risk or High Bushfire Risk in the relevant Development Plan (measured from the base of the nearest trunk of the tree to the dwelling to the nearest part of the dwelling at natural ground level); or

   (c) The tree is on land under the care and control of the Minister for Environment & Conservation; or

   (d) The tree is on land under the care and control of the Board of the Botanic Gardens and State Herbarium; or

   (e) The tree is dead.

Development Act 1993

8.9.11. Legislative and approval requirements

Table 89 Legislative and approval requirements (Development Act 1993)

Development Act 1993

Pruning or removing vegetation incidental to:

- New works (refer Section 4.1)
- Maintenance (refer Section 4.2)

Approval required if pruning or removing:

- A Regulated or Significant tree under the Development Act
- Vegetation that forms part of the setting of State Heritage Place or is listed on the SA Heritage Register and/or the Local Government Development Plan

Note:

- In the context of Regulated or Significant Trees (as defined in the Development Act 1993), pruning does not constitute a tree-damaging activity (and therefore does not require DAC approval) when:
  - ❖ The root system is pruned such that the health or stability of the tree will not be impacted; or
  - ❖ Less than 30% of the tree crown is removed AND pruning is undertaken to remove:
    - Dead/diseased wood, or
    - Branches that pose a materials risk to a building, or
    - Branches to a three that is located in an area frequently used by people and the branches pose a materials risk to such people

  Internal approval is still required when pruning more than 10% of a tree crown
- DAC should be notified retrospectively of urgent works in relation to a Regulated of Significant tree

2:1 offset for Regulated trees

3:1 offset for Significant trees

For non-regulated, non-significant trees, refer to offset requirements under Vegetation Removal Policy section below

For native veg subject to NV Act, refer to Table 6.1

DAC should be notified retrospectively if any Regulated or Significant trees have been removed or damaged to address an emergency situation (Development Act 1993)

8.9.12. Remediation requirements under the Development Act

As shown in Table 89, where approval is required under the Development Act to remove a regulated or significant tree, an offset of 2:1 (for regulated trees) or 3:1 (for significant trees) will be required. The Development Assessment Commission may stipulate a certain type of replacement. This will be set out in the conditions of approval.

If it is not feasible to provide replacement plantings on-ground, a payment of $75 per tree may be made into the Planning & Development Fund in lieu of replanting. The intention to make a payment in lieu of replanting should be indicated in the development application.

This amount should be based on the following rates: $75 per tree.

Development Act 1993

8.9.13. Vegetation Management Plan for the North Terrace Drainage Design

The analysis of vegetation along North Terrace between College and Hackney Roads for the North Terrace Drainage Design has shown there are no Significant or Regulated trees that are in conflict with construction and need to be removed. However, in line with Hydro-Future's commitment to environmental protection to our projects, all trees that are removed during construction will be replaced where available, with those that cannot be replaced due to conflicts with new services being replanted in another location.

A detailed description of the trees within the project area for the North Terrace Drainage Design, including plan for the removal and relocation of all trees is shown in the Environmental Management Plan document, separate to this report.

8.10. Bill of quantity

Bill of Quantity
Client: Tokin Consulting
Project: The North Terrace Stormwater Drainage System
Department: Urban Planning

#	Item name	Catalogue reference or special specification (if needed)	Unit	Quantity	Rate	Cost ($)
Subject: Fencing protection						
1	Temporary Mesh Fencing	2500mm L X 2000 mm H	m	580	9	15,660
2	Cloth	Cover the fencing	m	1450	3	4,350
			Sub-total (1)			20,010
Subject: Vegetation management						
1	Tree removal		number	31	75	2,325
			Sub-total (2)			2,325
Subject: Community event						
1	Community poster	601 X 847 mm	number	10	18.99	190
2	Community poster	286 X 439 mm	number	150	6.99	1,049
3	Community poster	A4 size	number	150	2.26	339
4	BBQ event	Food, drink, supporting facilities	number	150	40	6,000
5	Employees	Running the events	hours	4	220*2*3	5,280
6	Construction poster	Sign produced and installation	Hours	6	60*2	3,720
			Sub-total (3)			16,578
Subject: Maintenance						
1	Employees	6 months inspection	months	6	500	3,000

#	Item name	Catalogue reference or special specification (if needed)	Unit	Quantity	Rate	Cost ($)
2	Dilapidation surveys	Third party contractor	hours	2	400*2	1,600
3	Site amenities	3 site offices (3 ramps and 1*10x1 m roof) and fencing & gates rent from Coates Hire company	Months	3	7,000*3	63,000
			Sub-total (4)			67,000

8.11. Safety assessment

Task Specific Safety Assessment Form	
Department/Section:	**Urban planning**
Task/ stage Name:	**Tree removal**
Brief Description of works to be undertaken	
• **Temporary work platforms operation** • **Crane operation** • **Digging around the tree** • **Trees branches pruning** • **Trees lifting**	
Summary of major risks or hazards	
• **Are branches intruding from other trees nearby** • **Is the crown leaning heavily** • **Is the crown concealing nests or insect colonies** • **Are there vines or creepers in the crown** • **Are there any dead or diseased branches** • **Are nails, wire or spikes embedded in the tree** • **Is the tree stable in the ground** • **What is the three species, what special consideration must be given to it**	
Mitigation strategies	
• the integrity of the tree—every tree should be inspected before work begins • the site is safe to use a crane, e.g. crane is not on unsuitable sloping, uneven or soft ground	

- so far as is reasonably practicable no person, plant or thing will come within an unsafe distance of an electric line
- access by people and managing traffic
- animals and insects are managed
- workers hold relevant licences, e.g. a dogging licence and relevant crane licence
- workers are adequately trained including in emergency procedures, work near electric lines, equipment, work tasks and communication
- weather conditions including wind speed are suitable to start the job and are monitored to ensure they are suitable to continue working
- an experienced observer is on the ground monitoring the worker accessing the tree with radio communication between the worker accessing the tree, the crane operator, the observer and a dagger controlling the load—if this person is different to the observer
- the crane, all lifting devices and ancillary equipment are fit for purpose and are inspected before starting the work

Safety equipment required & number

Personal Protective Equipment (PPE):

Steel-toe Safety Boots

Safety glasses

Safety gloves

Safety masks

Safety ear muffs

high vis clothing/vests

Task Specific Safety Assessment Form	
Department/Section:	**Urban planning**
Task/ stage Name:	**Community event**
Brief Description of works to be undertaken	
• **Traffic control during the events** • **Event equipment carrying** • **Cooking in the public area** • **Installation of platforms, marquees, stalls, vans or other temporary structures** • **Work at heights – banner, flags or signs erection**	
Summary of major risks or hazards	
• **Food handling safety** • **Potential traffic accident** • **Dangerous goods such as gas cylinder** • **Injury due to installation of temporary structures** • **Injury due to work at heights**	
Mitigation strategies	
• Small volume gas cylinders are used wherever possible • All staff and volunteers are trained to assess each task and use safe technique when lifting or carrying • Loads are able to be delivered as close as possible to area using vehicle or mechanical aids (e.g. trolley) • All tasks to be undertaken by staff and volunteers are checked for the right PPE required and PPE is provided if needed (e.g. gloves, aprons, earplugs, closed toe shoes, waterproof jacket, etc) – Separate risk assessments may be required for high risk tasks. • High visibility safety clothing conforming to AS/NZ4602 must be worn by event staff at all times when it is important for a person in a situation to be easily seen.	

- Ladders are well maintained and suitable for work undertaken & weight – (industrial rated)
- Assistance of a second person is provided where required when work at heights
- All stages are signed off by a certified rigger/scaffolder and are erected by personnel with appropriate training and certifications
- First Aid Stations suitably located, clearly signed and accessible
- Emergency Response personnel trained to carry out plan for event emergency
- Adequate signage for entries, exits, toilets facilities, waste or recycling bins etc
- Traffic management staff wear appropriate high visibility protection and carry communication devices
- Adequate parking areas to cater for the expected vehicle numbers attending the event
- Adequate training of traffic management staff, and are traffic management staff are positioned in the correct location as planned

Safety equipment required & number

Personal Protective Equipment (PPE):

Steel-toe Safety Boots

Safety glasses

Safety gloves

Safety masks

Safety ear muffs

high vis clothing/vests

Task Specific Safety Assessment Form	
Department/Section:	**Urban planning**
Task/ stage Name:	**Maintenance**
Brief Description of works to be undertaken	
• **Storm water drainage system maintenance (pipe, pits etc.)** • **Rainwater tank inspection and maintenance** • **Bio-retention basin maintenance** • **Desilting and pollutant removal operations** • **Mowing and other types of mechanical vegetation maintenance** • **Use of herbicides for weed control**	
Summary of major risks or hazards	
• **Toxic materials handing** • **Working in confined space** • **Working in oxygen deficit area** • **Potential injury due to traffic accident** • **Potential injury due to poisonous insects**	
Mitigation strategies	
• Treatment process vessels, such as: digesters and grease traps must be cleaned if it improves hygiene and ease of movement. Refer to AS / NZS Handbook HSB 213 Guidelines for safe working in a confined space for guidance • A warning sign must be displayed if air quality hazards are not within the safe limits in HSG-512. For example: 'Danger - Confined Space - Hazardous Atmosphere – Check Oxygen Level Before and During Entry' • Breathing apparatus (BA) must be used if entry can't be avoided and non-flammable air quality hazards can't be controlled to within the safe limits listed in HSG0512 • All tasks to be undertaken by staff are checked for the right PPE required	

- Adequate training of traffic management staff, and are traffic management staff are positioned in the correct location as planned
- Traffic management staff wear appropriate high visibility protection and carry communication devices
- Workers are trained and hold relevant licences when handing toxic materials

Safety equipment required & number

Personal Protective Equipment (PPE):

Steel-toe Safety Boots

Safety glasses

Safety gloves

Safety masks

Safety ear muffs

Breathing apparatus

high vis clothing/vests

Task Specific Safety Assessment Form	
Department/Section:	**Urban planning**
Task/ stage Name:	**Amenities & fencing**

Brief Description of works to be undertaken

- **Delivery structure (site office, fences, gates etc.)**
- **Placement of structure (cranes is required)**
- **Connection of services (electricity , water, sewer)**
- **Trenching for connect services**
- **Construction of ramps and roof**
- **Putting up fencing**
- **Unloading fencing and other structure (cranes is required)**

Summary of major risks or hazards

- **Potential injury due to traffic accident**
- **Injury due to installation of temporary structures**
- **Injury due to work at heights**
- **People falling from height**

Mitigation strategies

- All tasks to be undertaken by staff are checked for the right PPE required
- Adequate training of traffic management staff, and are traffic management staff are positioned in the correct location as planned
- Traffic management staff wear appropriate high visibility protection and carry communication devices
- Workers are trained and hold relevant licences when handing toxic materials
- All workers are trained to assess each task and use safe technique when lifting or carrying
- Using a work box to lift and position workers
- A visual inspection of the crane and associated environmental and operational conditions in which the crane is intended to be installed, erected and used

- Erect and maintain protective hoardings to protect people near the work
- Preventing an object from falling freely

Safety equipment required & number

Personal Protective Equipment (PPE):

Helmets

Steel-toe Safety Boots

Safety glasses

Safety gloves

Safety masks

Safety ear muffs

Breathing apparatus

high vis clothing/vests

9. References

Acoustic Filter Enclosure, 2012, *Noise Reduction Performance of a Swimming Pool Filter/Pump Ventilated Acoustic Enclosure*, Noise and Sound Devices, viewed 26 May 2015, http://www.acousticfilterenclosure.com.au/sites/acousticfilterenclosure.com.au/files/Acoustic_Report_NadaMfg_nss21749.pdf

Ahammed, F 2014, *Stormwater Drainage Design*, CIVE 3010, University of South Australia, Adelaide, 6 August 2015

Alcoa, 2010, *5052 and 6061 Aluminium Sheet,* accessed online 28th May 2015, <https://www.alcoa.com/mill_products/catalog/pdf/Alcoa_Insert_5052and6061_FINAL.pdf>

APA Group, 2010, Gas Pipeline Location Inquiry, Dial before you Dig, South Australia. Viewed on 15 May 2015.

Arcement, G, Schneider, V, 1989, *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Floodplains,* US Geological Survey, accessed online 12th May 2015, <http://pubs.usgs.gov/wsp/2339/report.pdf>

Arid, 2008, *Rainwater Tank Design and Installation Handbook*, viewed 26 May 2015, <http://www.nwc.gov.au/__data/assets/pdf_file/0016/10753/RAINWATER_handbooknwc_logo.pdf>

Asset Maintenance Guidelines (AMG), 2002, *Drainage Maintenance Guidelines*, vol. 8, accessed online 30 March 2015, p. 8. <http://www.tmr.qld.gov.au/~/media/busind/techstdpubs/Asset%20maintenance%20guidelines/AMG_Part8_Drainage.pdf>

Australian Valve Group, 2013, Backflow Prevention Pricelist – GST Exclusive, Backflow Prevention, viewed 26 May 2015, < http://avg.net.au/wp-content/uploads/2013/12/BackflowPricelist.pdf>

Bunnings, 2015, Our Range, Bunnings Warehouse, viewed 26 May 2015, <http://www.bunnings.com.au/ozito-600w-transfer-water-pump_p4816178>

Bureau of Meteorology – *Australian Government, IFD – Design Rainfall Intensity Chart for AR&R87 IFDs, viewed 5May,2015,* <http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml>

Bureau of Meteorology, 2015, *Daily Rainfall: Adelaide (Kent Town)*, accessed online 10th May 2015, <http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=&p_c=&p_stn_num=023090>

City of Norwood Payneham & St Peters, 2012, *CityPlan 2030 Shaping Our Future*, viewed on 30th March 2015, <http://www.npsp.sa.gov.au/files/1363_city_plan_2030_2013.pdf?v=643>

Coates Hire Company (CHC), 2015, Portables Building Brochure, viewed 30th May 2015, <http://www.coateshire.com.au/getattachment/bf2e2e1f-63aa-4fe5-90a8-26f8a8934be8>

Concrete Pipe Association of Australasia 2011, Concrete Pipes Foreman's Laying Guide, Rocla Pty Ltd, viewed 26 May 2015, <http://www.roclagroup.com.au/Rocla/ProductLiterature/Concrete_Pipes_Foremans_Laying_Guide.pdf>

Concrete Pipe Association of Australasia, 2015, *PipeClass v2.0.22: Online Help,* computer program, Concrete Pipe Association of Australasia, Pymble, New South Wales.

Cooperative Research Centre for Catchment Hydrology, 2003, *Model for Urban Stormwater Improvement Conceptualisation (MUSIC) User Guide,* Version 2.0, December 2003.

Craig, R, 2004, *Craig's Soil Mechanics,* 7th edition, Spon Press, UK.

Davis, A. P., Shokouhian, M., Sharma, H. and Minani, C. 1998*, Optimisation of Bioretention for Design for Water Quality and Hydrologic Characteristics, Final Report to Prince George's County,* Maryland, United States of America.

Department of Environment, Water and Natural Resources (DEWNR), 2014, First Creek Wetland to help secure water for Botanic Garden, accessed online 10th May 2015, <http://www.environment.sa.gov.au/botanicgardens/Whats_on/News_Events_Listing/131122-first-creek-wetland>

Department of Irrigation & Drainage Malaysia 2012, Urban Storm Water Management , Ministry of Natural Resources and Environment, Malaysia, viewed 25 May 2015, <http://www.water.gov.my/home/56/1201-msma-manual?lang=en>.

Department of Planning and Local Government, 2010, Water Sensitive Urban Design Technical Manual for the Greater Adelaide Region, Government of South Australia, Adelaide

Department of Planning Transport and Infrastructure 2014, Roadworks Stormwater Design - DD300, Government of South Australia, viewed 27 May 2015, <http://www.dpti.sa.gov.au/__data/assets/pdf_file/0005/148568/DOCS_AND_FILES-9004072-v2-Technical_Standards_-_Stormwater_-_Roadworks_Stormwater_Design_DD_300.pdf>

Department of Planning, Transport and Infrastructure (DPTI), 2012, *Pavement Reinstatement Configurations,* Government of South Australia, Adelaide.

Department of Planning, Transport and Infrastructure (DPTI), 2012, *Working safely near overhead power lines*, Government of South Australia, Adelaide.

Department of Planning, Transport and Infrastructure (DPTI), 2013, *Specification: Part R07 Trench Excavation and Backfill,* Government of South Australia, Adelaide.

Department of Planning, Transport and Infrastructure, 2012, *SA Standards for Workzone Traffic Management,* DPTI, South Australia.

Department of Planning, Transport and Infrastructure, 2012, *Traffic Control Devices for Workzone Traffic Management-Field Guide,* DPTI, South Australia.

Department of Water (WA Water), 2004, *Stormwater Management Manual for Western Australia*, viewed 30th March 2015, <http://www.water.wa.gov.au/PublicationStore/first/84981.pdf>

DRAINS Results Prepared 23rd May, 2015, from Version 2013.02

Environmental Protection Agency (EPA), 1999, *Storm water technology fact sheet: Infiltration Trench*, viewed 22nd May 2015, <http://water.epa.gov/scitech/wastetech/upload/2002_06_28_mtb_infltrenc.pdf>

Environmental Protection Authority, 2008, Noise Control Guidelines, Guidelines, viewed 26 May 2015, <http://www.epa.vic.gov.au/~/media/publications/1254.pdf>

eWater Ltd, MUSIC software package, Version 5.1(Build 16),MUSIC result prepared 24th May 2015, version 5.1. < http://www.ewater.com.au/products/music/>

Frederick-University (2006). Connections In Timber Structures. Frederick University; BATECH08.

Galli, J. 1992, *Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland.* Metropolitan Washington Council of Governments. Washington, DC.

Geofabrics, 2013, *Case Study: Cambridge Crossing – Low River Flow Crossing – Reno Mattress Scour Protection*, accessed online 13th May 2015, <http://d6cbwp89cp4qo.cloudfront.net/documents/CS586-Cambridge-Crossing-QLD.pdf>

Global Synthetics, nd, *Link™ Gabions and Mattresses Design Booklet,* accessed online 12th May 2015, <http://www.globalsynthetics.com.au/download/Gabion-&-Rock-Mattress-Design-Booklet>

Gold Coast Planning Scheme Policies 2005, Policy 11: Land Development Guidelines, Our Living City, viewed 26 May 2015, <http://www.goldcoast.qld.gov.au/gcplanningscheme_policies/attachments/policies/policy11/SS5_stormwater_drainage_construction.pdf>

Humes, 2009, Concrete Pipes Reference Manual, Holcim (Australia) Pty Ltd, viewed 20 May 2015, <http://www.humes.com.au/fileadmin/templates/HUMES/doc/Brochures/Humes_ConcretePipeManual.pdf>

Humes, 2009, *Concrete Pipes: Reference Manual,* Holcim, Australia,

Humes, 2012, Stormwater pits Installation Guide, Holcim (Australia) Pty Ltd, viewed 20 May 2015, <http://www.humes.com.au/fileadmin/templates/HUMES/doc/Brochures/Installation_guides/Stormwater_pit_installation_guide_Humes.pdf>

Kitou & Sakino, *Basics of Sewer maintenance*, viewed 22nd May 2015, <http://www.asianhumannet.org/db/datas/0912-e/sewerage-maintenance.pdf>

Komatsu, 2015, *Komatsu: PC88MR-8 – Compact Hydraulic Excavator,* accessed online 11th May 2015, *<http://www.komatsu.com.au/AboutKomatsu/NewsAndPublications/Brochures/New%20Equipment%20Brochures/Excavator/PC88MR-8/PC88MR-8_CEN00322-02_201304.pdf>*

Larapedia 1998, 'Pressure formula notes', viewed 22 May 2015, <http://www.alanpedia.com/physics_pressure/pressure_formula_notes.html>.

Mabey, 2013, *Product User Guide: 5m Standard Pinned Strut Dragbox System – Issue 6*, accessed online 30th May 2015, <http://support.mabeyhire.co.uk/edata/data/Product%20User%20Guides/5m%20Long%20Standard%20Dragbox_4_3_April%201999.pdf>

May, R, Ackers, J, Kirby, A, 2002, *Manual on Scour at Bridges and Other Structures,* CIRIA, UK

Moreton Bay*, Drainage - stormwater*, viewed 25th May 2015, <https://www.moretonbay.qld.gov.au/general.aspx?id=690>

New Hampshire Department of Environmental Services, 2006, *Chapter 3: Fundamentals of Stormwater Management,* New Hampshire Stormwater Manual

New South Wales Heritage Office (NSW Hertiage Office), 2002, *HOW TO CARRY OUT WORK ON HERITAGE BUILDINGS & SITES*, p. 15, <http://www.environment.nsw.gov.au/resources/heritagebranch/heritage/infocarryoutwork.pdf>

Northern Virginia Regional Commission (NVRC), 2007, *Maintaining Stormwater Systems*, viewed 30th March 2015, <https://www.novaregion.org/DocumentCenter/Home/View/1675>

NSW HSC n.d, 'Engineering Students – Testing and monitoring of civil structures', viewed 26 May 2015, <http://www.hsc.csu.edu.au/engineering_studies/application/civil/3828/civil_stuctures.htm>.

Onesteel 2014, Reinforcing – Mesh, viewed 27 May 2015, <http://www.reinforcing.com.au/our-products/mesh>.

Patrick, D, Steve, S 2013, Rainwater, Water – Rainwater, viewed 26 May 2015, <http://www.yourhome.gov.au/sites/prod.yourhome.gov.au/files/pdf/YOURHOME-5-Water-2-Rainwater-(4Dec13).pdf>

Rain Harvest Systems, 2015, Rain Harvesting Pty Downspout First Flush Diverter, RainHarvest Systems LLC, viewed 26 May 2015, <http://www.rainharvest.com/rain-harvesting-pty-downspout-first-flush-diverter.asp>

Rainwater Tanks Direct, 2013, Huge Savings on Large Rainwater Tanks, Rainwater Tanks Direct, viewed 3 March 2015, <http://www.rainwatertanksdirect.com.au/water-tanks/large-tanks.php>

Rawlinsons, 2015, *Rawlinsons Australian Construction Handbook,* Rawlinsons Publishing, Western Australia

SA Health, 2008*, Rainwater tanks: Maintenance and water care*, viewed on 22nd May 2015, <http://www.health.sa.gov.au/pehs/PDF-files/ph-factsheet-rainwater-tanks.pdf>

SA Water, 2006, Rainwater Plumbing Guide, Government of South Australia, viewed 26 May 2015, <http://www.sawater.com.au/nr/rdonlyres/e49ea34c-3400-40c9-9634-1b6f7966e7fa/0/rainwaterplumbingguide.pdf>

SA Water, 2006, Sewer construction manual – Page C1 – General information underground services, protection of existing trees/environment and dewatering, accessed online 31st May 2015, <http://www.sawater.com.au/NR/rdonlyres/9893459C-7FC6-4D14-85B6-6B978FCD8599/0/DrgSetC.pdf>

SA Water, 2010, Alterations to SA Water Infrastructure for Road Works undertaken by the Commissioner of Highways , Technical guide 120, Government of South Australia. Viewed on 15 May 2015 <http://www.sawater.com.au/NR/rdonlyres/9B58CB92-F0A1-4E7D-9CE8-95B4689DA22F/0/TG120.pdf>

SA Water, 2010, Water Supply Code of Australia Agency Requirements, Part 1- Design, South Australian Water Corporation. Viewed on 14 May 2015 <http://www.sawater.com.au/NR/rdonlyres/93475BF6-63C7-436B-8E57-5F4461D0AA85/0/S2WSAADesign.pdf>

SA Water, 2010, Water Supply Code of Australia Agency Requirements, Part 2- Construction, South Australian Water Corporation. Viewed on 15 May 2015 <http://www.sawater.com.au/NR/rdonlyres/64252DB0-53D1-4940-BA6F-F1D368840685/0/Construction.pdf>

SA Water, 2011, *Technical Guideline: Trenching and Ground Support Systems,* Government of South Australia

Safe Work Australia, 2012, *Excavation Work: Code of Practice,* Australian Government.

Schalk, K. , 2011, North Terrace Stormwater Upgrade, Stormwater Plan & Long Section CHN 0.00 to 140, , North Terrace, Kent Town, Tonkin Consulting. Viewed on 15 May 2015, <https://mymailunisaedu.sharepoint.com/sites/civildesignproject-detaildesign/Shared%20Documents/Long%20Section%201.pdf>

Schalk, K. , 2011, North Terrace Stormwater Upgrade, Stormwater Plan & Long Section CHN 280.00 to End, North Terrace, Kent Town, Tonkin Consulting. Viewed on 15 May 2015 <https://mymailunisaedu.sharepoint.com/sites/civildesignproject-detaildesign/Shared%20Documents/Long%20Section%202.pdf>

Smith, I, 2006, *Smith's Elements of Soil Mechanics,* Blackwell Publishing, UK

South Australian Legislation 2014, Water Industry Legislations 2012 Version 1.7.2014, Government of South Australia, viewed 26 May 2015, <http://www.legislation.sa.gov.au/lz/c/a/water%20industry%20act%202012/current/2012.10.un.pdf>

Standards Association of Australia 1991, Australian standard for *Bridge Design – Part 2 Design Loads*, *AS5100.2 – 2004*

Standards Association of Australia 1991, Australian standard for *Concrete Structures*, *AS3600*

Standards Association of Australia 1991, Australian standard for *Methods of Testing Concrete – Slump Test*, *AS1012.3.1*

Standards Association of Australia 1991, Australian standard for *Precast Reinforced Concrete Box Culverts*, *AS1597.2*

Standards Association of Australia 1991, Australian standard for Specification and Supply of Concrete, *AS1379*

Standards Association of Australia 1991, Australian standard for *Steel Structures Culverts*, *AS4100 - 1998*

Standards Australia, 1998, *Steel Structures,* AS 4100 – 1998, Australian Standard.

Standards Australia, 2000, *Steel Shoring and trench lining equipment: Part 1 – Design,* AS 4744.1 – 2000, Australian Standard.

Standards Australia, 2004, *Bridge Design: Part 2 – Design Loads,* AS 5100.2 – 2004, Australian Standard.

Standards Australia, 2007, *Design for installation of buried concrete pipes,* AS/NZS 3725:2007, Australian Standard

Standards Australia, 2010, *Timber Structures Part 1 : Design Methods,* AS 1720.1 – 2010, Australian Standard

Standards Australia, 2014, *Specifications for rainwater goods, accessories and fasteners – Metal shape or sheet rainwater goods, and metal accessories and fasteners,* AS/NZS 2179.1:2014, Australian Standard

Sydney Water, 2003, Plumbing Requirements – Information for Rainwater Tank Suppliers and Plumbers, Guidelines for Rainwater Tanks on Residential Properties, viewed 26 May 2015, <http://www.rainkeepertanks.com.au/downloads/RainwaterTanksGuidelines.pdf>

Team Poly – water solutions for life 2015, 'Tank product catalogue', viewed 26 May 2015, <http://www.teampoly.com.au/downloads/teampoly-products-nsw-sa.pdf>.

Thomas Brenton 2009, *Temporary Mesh Fencing, Rent a fence PTY LTD*, viewed on 1st June 2015, <http://www.rentafence.com.au/temporary-fencing-mesh.html>.

U.S. Environment Protection Agency (US EPA), 2001, National Menu of Best Management Practices for Storm Water Phase II, viewed 30th March 2015, <www.epa.gov/npdes/menuofbmps/menu.htm>

United Nations Environment Programme (UNEP), 2015, *Stormwater treatment,* Division of Technology, Industry and Economics,viewed 30th March 2015, <http://www.unep.or.jp/ietc/publications/freshwater/sb_summary/9.asp>

University of Washington, nd, 'Pressure Vessels: Combined Stresses', viewed 20 May 2015, <http://courses.washington.edu/me354a/chap12.pdf>.

Utility Providers Services Committee (UPSC), 2010, Utility Providers Code of Practice, The Government of Western Australia, viewed 30th March 2015, <https://www.mainroads.wa.gov.au/Documents/Utility%20Providers%20Code%20of%20Practice%20For%20WA%20February%202010%20-%20Web%20Version%20-%20Published%2011%20August%202010.u_2857014r_1n_D10%5E2318.PDF>

Vallentine, H, Hattersley, R, Cornish, B, 1961, *Low Cost Scour Control at Culvert Outlets,* University of New South Wales, Australia

Victorian Stormwater Committee (VSC), 1999, *Urban Stormwater - Best Practice EnvironmentalManagement Guidelines,* CSIRO Publishing, Melbourne, Victoria

WaterCom Pty Ltd – DRAINS Software Package, Version 2013.02, http://www.watercom.com.au/whatsnew.html

WaterPlex, 2015, *AQUAPLATE® steel,* accessed online 31st May 2014, <http://waterplex.com.au/media/Brochure/Waterplex_Steel_Tanks.pdf?forceDownload>

Wire Industries, January 2011, *Price List,* Viewed on the 30/05/2015, Available at: <http://www.wireind.com.au/cgi-bin/user.pl?download_file=1&file=1>

Wium-Andersen, T., Nielsen, A. H., Hvitved-Jacobsen, T., Brix, H., Arias, C. A., & Vollertsen, J. (2013). Modeling the eutrophication of two mature planted stormwater ponds for runoff control. Ecological Engineering, 61, 601-613.

Work Health and Safety Regulations 2012, Government of South Australia.

Worksafe Victoria Construction & Utilities, 2002, Amenities Required On Greenfield Developments And Minor Civil Construction And Maintenance Sites, viewed 30th March 2015, pp. 1-4, < https://www.worksafe.vic.gov.au/forms-and-publications/forms-and-publications/amenities-required-on-greenfield-developments-and-minor-civil-construction-and-maintenance-sites>

Worksafe Victoria, 2004, *GUIDE FOR UNDERTAKING WORK NEAR UNDERGROUND ASSETS*, viewed 30th March 2015, <https://www.worksafe.vic.gov.au/__data/assets/pdf_file/0019/21808/ngz_guide_under.pdf>

WSAA, 2015, WSA02-2002, Water Services Association of Australia, viewed 26 May 2015, <https://www.wsaa.asn.au/AboutUs/Pages/default.aspx#.VW1n4dKqpHw>

Xing-Ma, D. (2015). Analysing a support frame system. LBMI - Civil Engineering. M. Renko.

DPTI, 2013, *Prequalification for Transport and Building Infrastructure,* viewed 25/05/2015, <http://www.dpti.sa.gov.au/contractor_documents>

Appendices

1. Appendix 1

Client	Tonkin Consulting	Date: 26/05/2015
Project	North Terrace Drainage System	Sheet no: 73 -79
Subject	Flo calculations	By: Mohsen Alnami ,Anne Wickramaratne
Reviewed By:	Anne Wickramaratne	Date: 08/05/2015
Approved By:	Eriny Abdelraouf	Date:10/05/2015

1.1. Flow Rate Calculations

1.1.1. Sub-catchment areas

For each sub-catchment both the total residential and the road areas were obtained using the Google area calculator tool. The sub-catchment areas which are contributing to the runoff were calculated, subtracting the roof areas which are selected to implement rain water tanks for water harvesting.

$$Residential\ Area\ = Total\ \ Residential\ Area - Roof\ Area$$

$$Total\ Area\ = Residential\ Area + Road\ Area$$

Therefore the total impervious area for each sub-catchment was calculated as below considering 90% impervious area;

$$Total\ Impervious\ Area\ (paved)\ (\%) = \frac{0.9 \times Residential\ Area + Road\ Area}{Total\ Area} \times 100$$

$$Total\ Pervious\ Area\ (\%) = 100 - Total\ Impervious\ Area\ \%$$

The calculation was done using Excel spread sheet and the obtained results are included in Table 2. An example calculation for Sub-catchment 1 was done as below;

$$\text{Total impervious area } (\%) = \frac{(0.9 \times 0.16) + 0.04}{0.20} \times 100 = 92\%$$

$$\text{Total Pervious area } (\%) = 100 - 92 = 8\%$$

1.1.2. Time of Concentration

Calculated travel times for using each Sub-Catchment is included in below table. Microsoft Excel was used for the calculations.

Table 90: Time of concentration for each sub-catchment

Sub-Catchment	Travel time for pervious area (min)	Travel time for gutter to pit (min)	Total time of concentration (min)
1	3.9	5	8.9
2	5.4	5	10.4
3	6.3	5	11.3
4	6.4	5	11.4
5	4.3	5	9.3
6	4.6	5	9.6
7	4.1	5	9.1
8	4.3	5	9.3
9	5.9	5	10.9
10	4.9	5	9.9
11	4.3	5	9.3
12	6.0	5	11.0
13	8.2	5	13.2
14	5.4	5	10.4
15	5.6	5	10.6
16	5.4	5	10.4
17	4.3	5	9.3

1.1.3. Rain fall Intensity

According to the obtained travel time as in Section 4.1.5 the rainfall intensity for each sub-catchment was calculated using IFD graph and IFD table in Figure 239 and Figure 240.

Intensity-Frequency-Duration Table

Location: 34.925S 138.625E NEAR.. Kent Town Adelaide Issued: 30/5/2015

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

	Average Recurrence Interval						
Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	45.9	61.4	83.6	99.7	121	154	182
6Mins	42.7	57.1	77.7	92.6	113	143	169
10Mins	34.5	46.0	62.2	73.9	89.7	113	133
20Mins	24.6	32.6	43.7	51.5	62.2	78.0	91.4
30Mins	19.6	26.0	34.6	40.7	49.0	61.2	71.6
1Hr	13.0	17.2	22.6	26.4	31.7	39.3	45.8
2Hrs	8.53	11.2	14.6	16.9	20.2	24.8	28.8
3Hrs	6.67	8.73	11.3	13.0	15.5	19.0	21.9
6Hrs	4.37	5.69	7.27	8.33	9.82	12.0	13.7
12Hrs	2.80	3.63	4.60	5.25	6.17	7.48	8.56
24Hrs	1.69	2.20	2.80	3.20	3.77	4.58	5.25
48Hrs	.957	1.25	1.61	1.85	2.19	2.68	3.09
72Hrs	.671	.882	1.14	1.31	1.56	1.91	2.21

(Raw data: 17.77, 3.79, 0.91, 35.01, 6.8, 1.72, skew=0.56, F2=4.47, F50=14.98) © Australian Government, Bureau of Meteorology

Figure 239: Intensity-Frequency-Duration Table for Kent Town (Bureau of Meteorology, 2015)

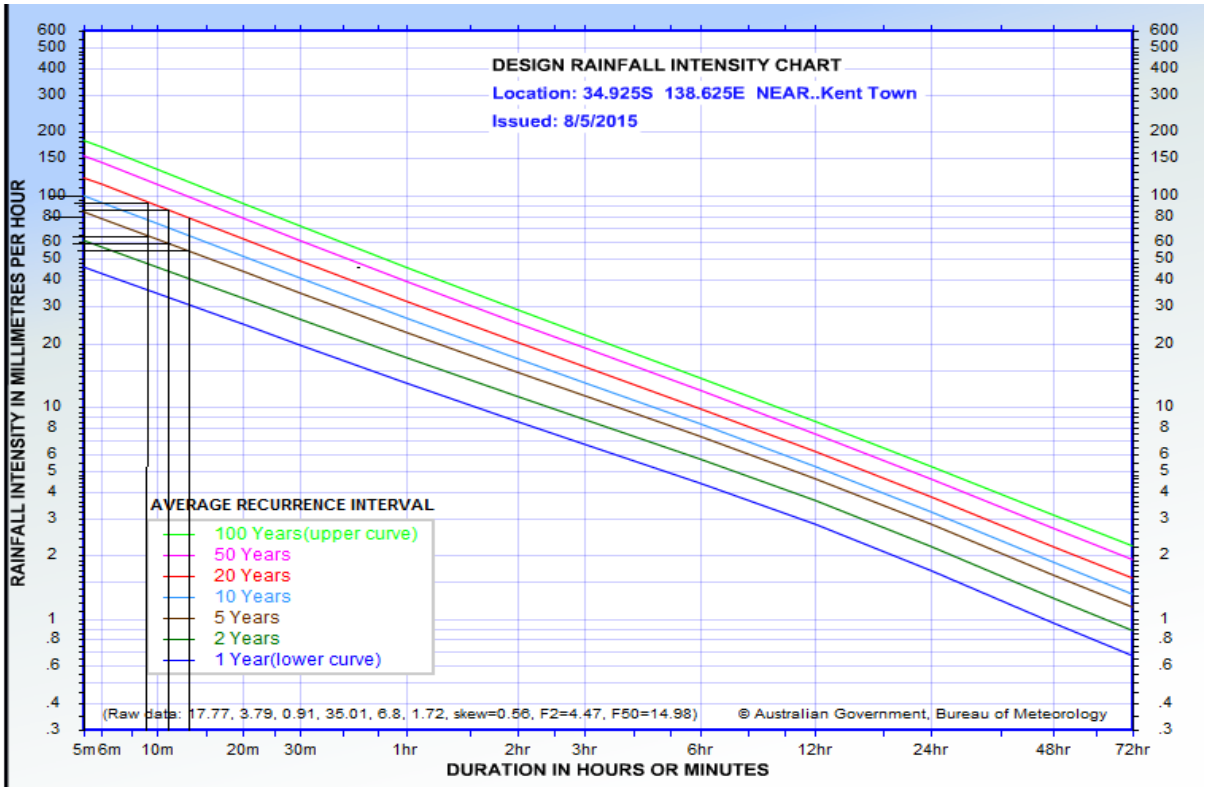


Figure 240: Intensity-Frequency-Duration Chart for Kent Town (Bureau of Meteorology, 2015)

Table 91: Rain fall intensity for each sub- catchment

Sub-Catchment	IFD for 20 ARI (mm/hr)
1	95
2	83
3	85
4	85
5	85
6	89.7
7	95
8	95
9	85
10	89.7
11	95
12	85
13	80
14	89.7
15	85
16	83
17	85

1.1.4. Runoff Coefficient

FREQUENCY CONVERSION FACTOR F_y

ARI(years)	1	2	5	10	20	40	60	80	100
Conversion factor, F_y	0.8	0.85	0.95	1.00	1.05	1.13	1.17	1.19	1.20

Figure 241: Frequency Conversion factors (Argue, 1986, Table 5.5 on pg 32]

Surface Classification	Northern Aust. zone	Southern Aust. zone
First grade connected paved areas: - roadways) - roofs)	C_{10} = 0.90	C_{10} = 0.90
Second grade connected paved areas, e.g. - sealed carparks,) driveways, paved) outdoor areas,) etc.)	C_{10} = 0.75	C_{10} = 0.75
Unconnected paved areas) and) Pervious areas:) - mixed with paved areas) as in residential land) use) - major urban open space) areas, parks, etc.)	C_{10} = 0.70	C_{10} = 0.10

Figure 242: Runoff coefficient values (Argue, 1986, Table 5.3 on pg 31]

Table 92: Weighted Runoff Coefficients

Sub-Catchment	Run off Coefficient (1:20)
1	0.878
2	0.884
3	0.887
4	0.877
5	0.895
6	0.9
7	0.9
8	0.9
9	0.9
10	0.9
11	0.878
12	0.880
13	0.793
14	0.892
15	0.886
16	0.884
17	0.895

1.2. Stormwater System Design – DRAINS

1.2.1. DRAINS Model inputs

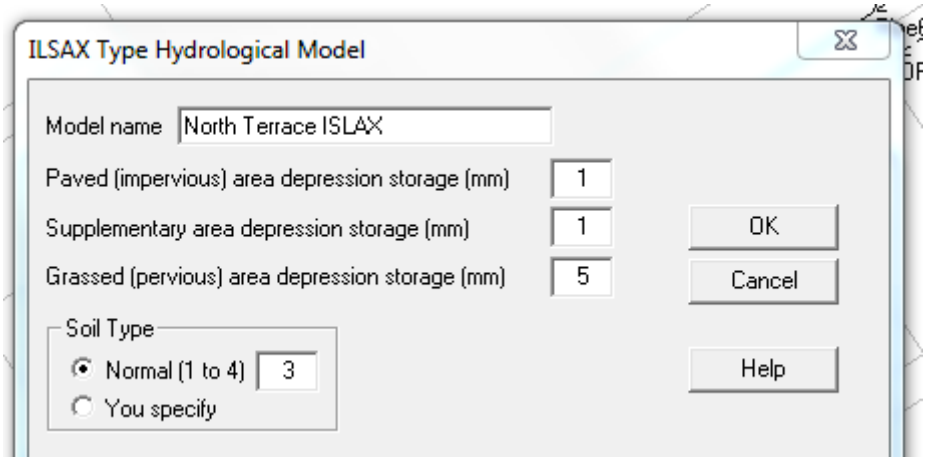


Figure 243 -ILSAX Model Properties

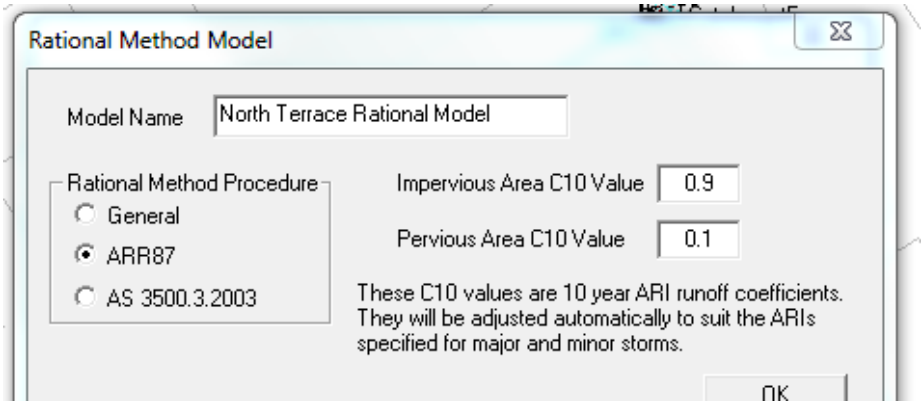


Figure 244 - Rational Method Properties

An initial part of setting up the DRAINs model also included the input of the relevant IFD data. IFD data for North Terrace, Kent Town was sourced from the Bureau of Meteorology website and was input manually in the model. The following screen shots showed the process for adding the IFD data for the most critical storm, 50 year ARI last 2 hours.

Step 1 involves selecting the appropriate rainfall zone and storm duration.

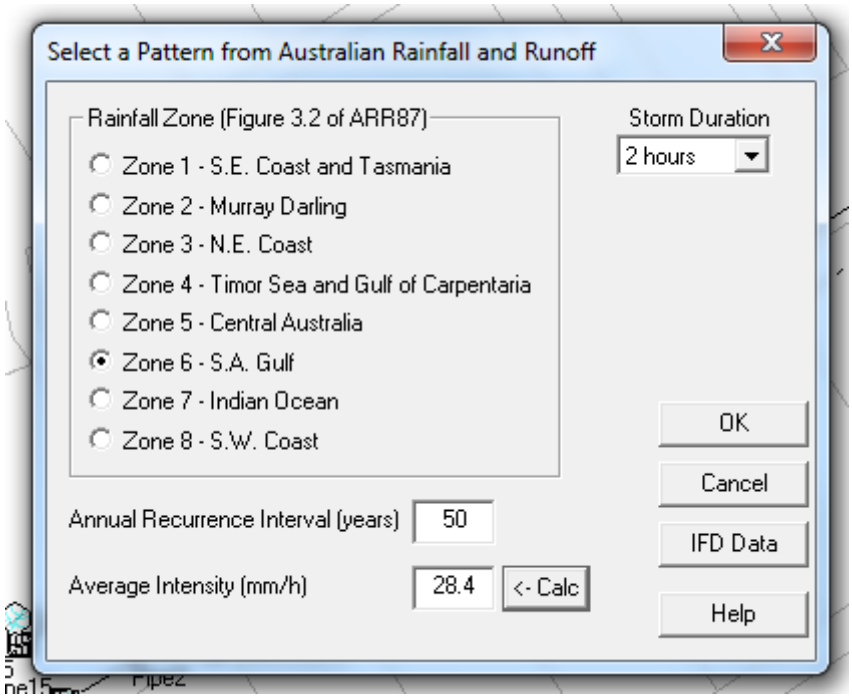


Figure 245 - DRAINS IFD Data Input - Rainfall Zone, Storm Duration & ARI

Step 2 is selecting the IFD Data button and transferring the IFD data from the BOM website into the model.

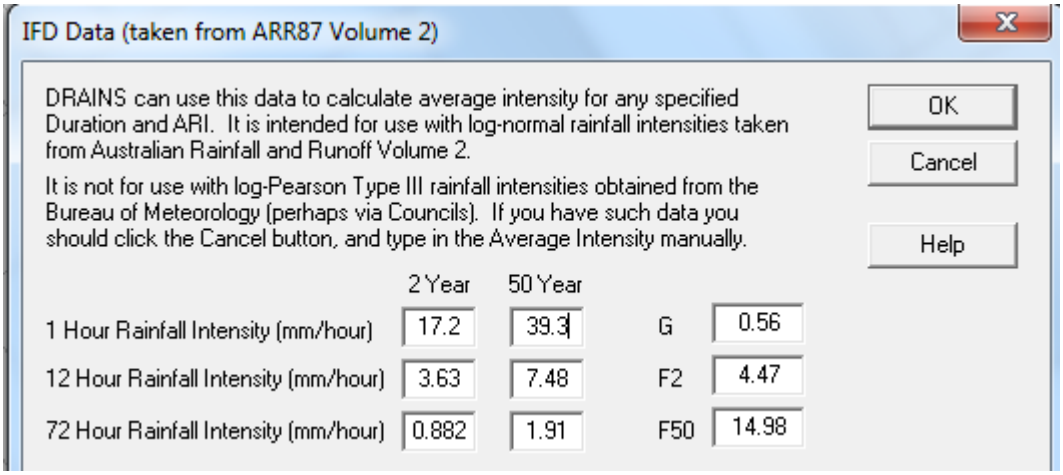


Figure 246 - DRAINS IFD Data Input from BOM

The storm information can now be found in the rainfall data shown in Figure 8. This process was repeated for all other storm considerations.

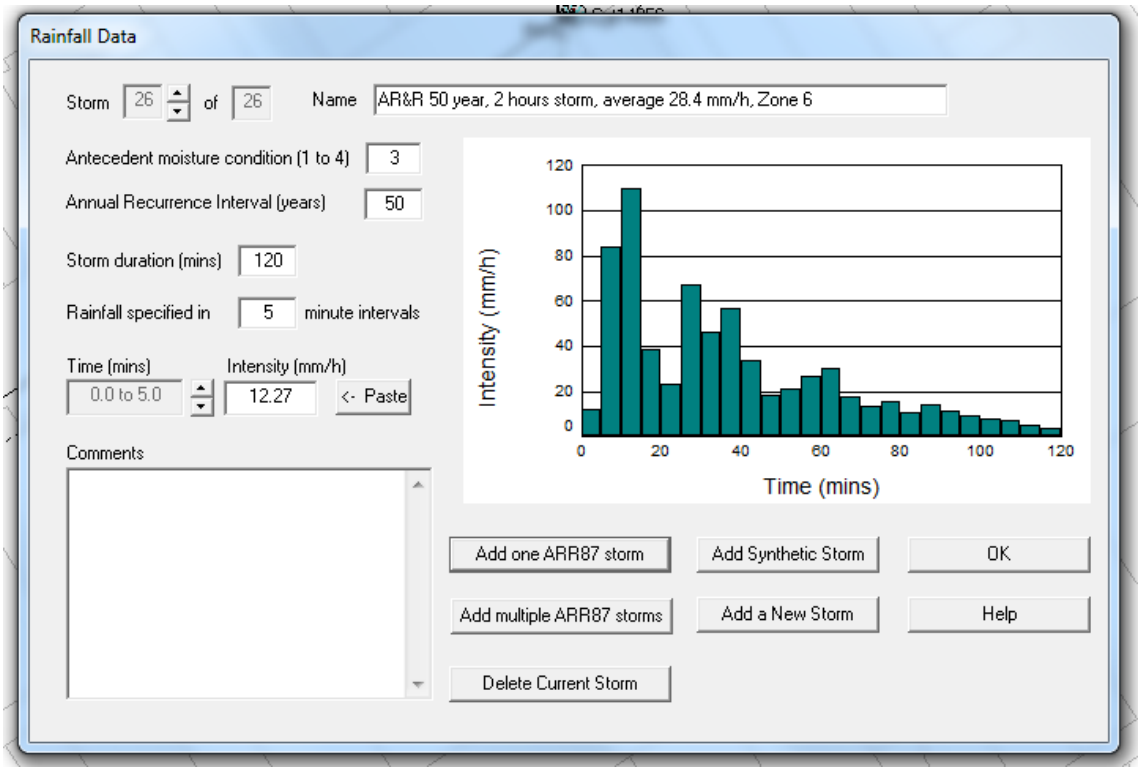


Figure 247 - DRAINS Rainfall Data

To make analysis easier and more relatable to the project area, a DXF background was imported to shown the stretch of North Terrace that we are designing for. From here pits, pipes, nodes, and catchments were inserted and given the appropriate design specifications as shown previously in this section. The following screenshots have been included as examples of how different inputs were

included for the nodes, pipes, and catchments in the project area. DRAINS input for pits can be seen in Figure 249 and Figure 250.

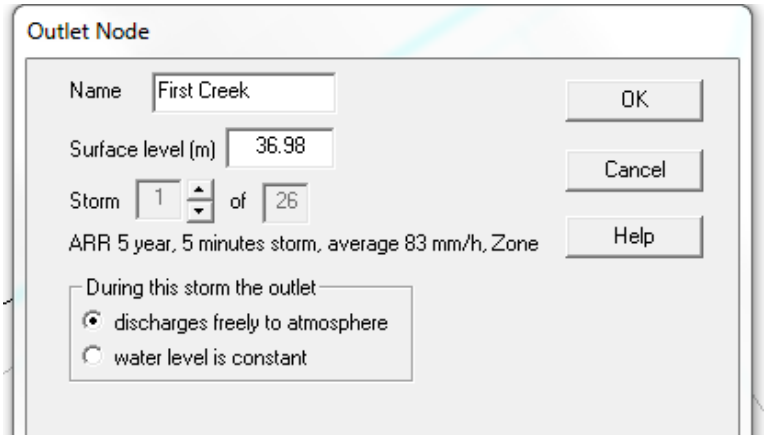


Figure 248 - First Creek Outlet Node Design Details

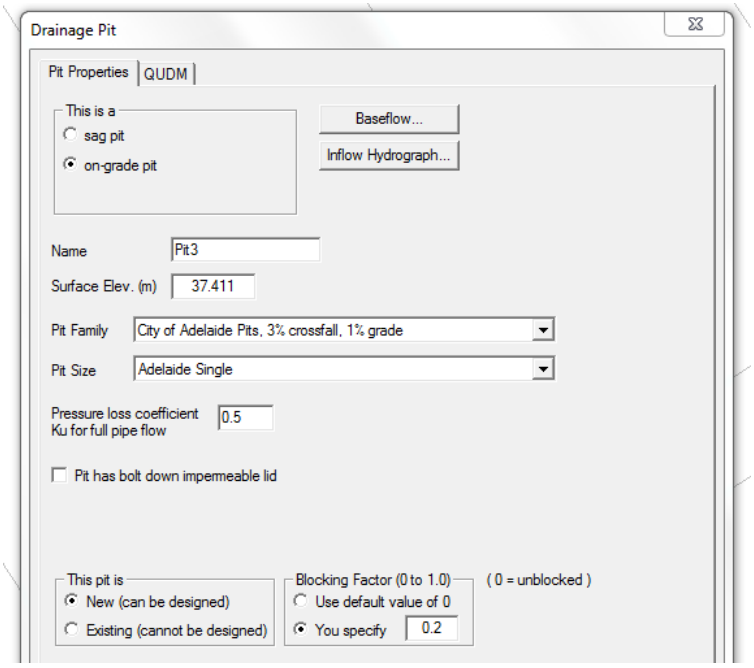


Figure 249 – DRAINS typical On-Grade Pit Input

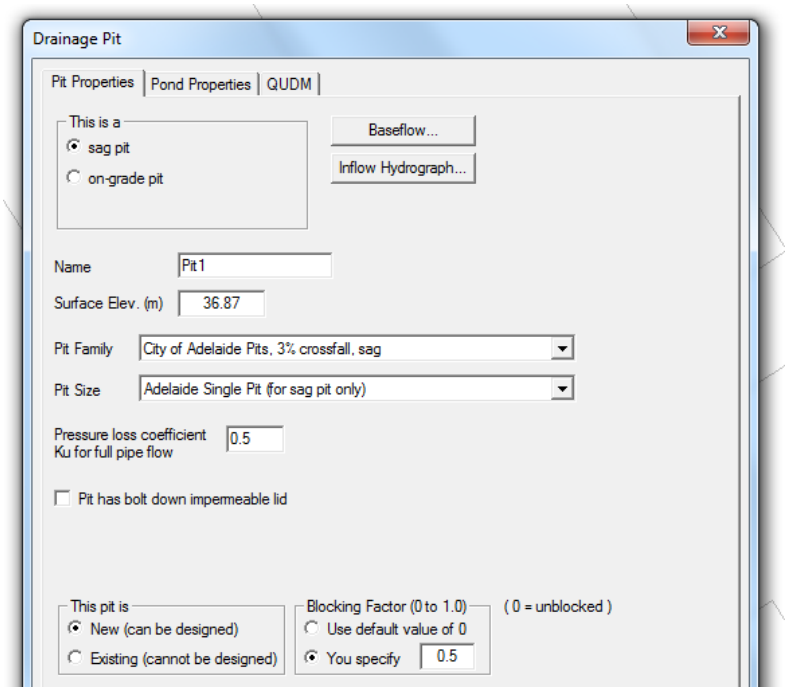


Figure 250 – DRAINS typical Sag Pit Input

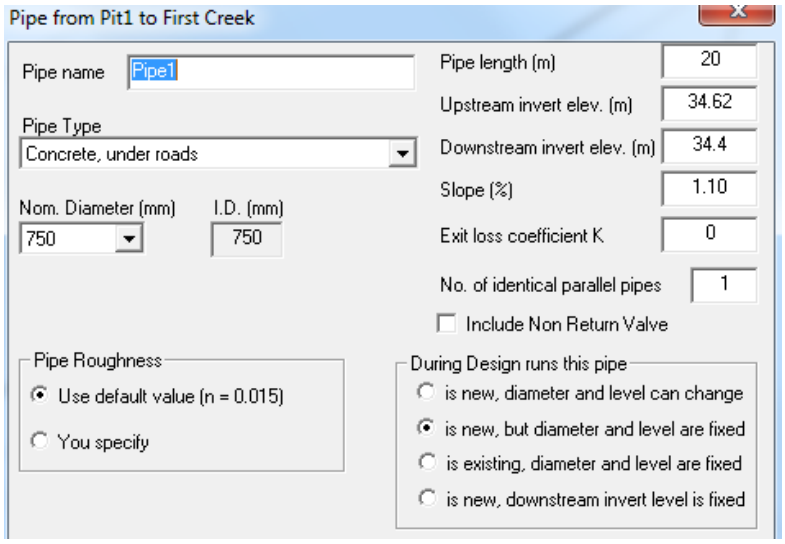


Figure 251 - Pipe 1 Design Details

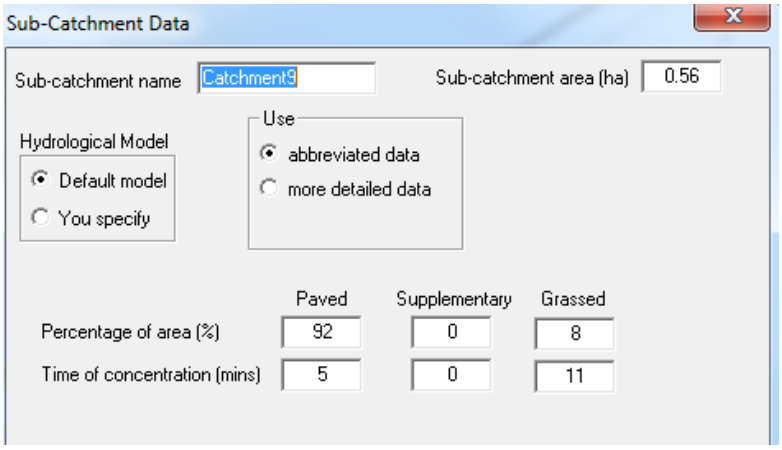


Figure 252 – Catchment 9 Design Details

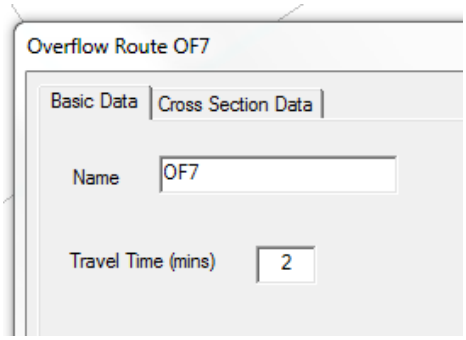


Figure 253 - Overflow Route Design Details

Once all design parameters had been inputted into the model and it was checked, minor and major storms needed to be defined.

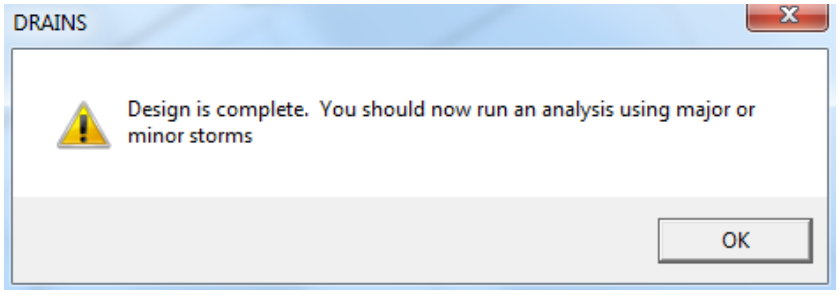


Figure 254: Design completion note

In our analysis we considered a total of 26 storm events. As we were designing up to an ARI of 50 years this would be a worst case scenario and was used as the major storm. The minor storm scenario was selected for 20 year ARI. Screenshots on selecting these storm events are shown below in Figure 13 and Figure 14.

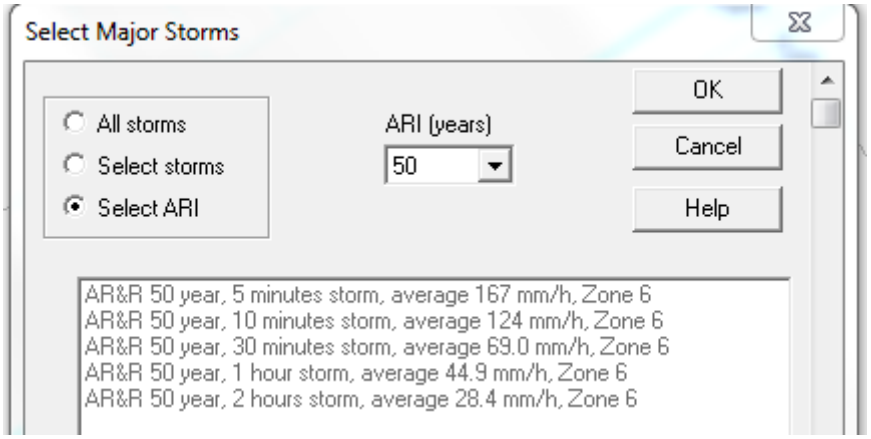


Figure 255 - Major Storm Event

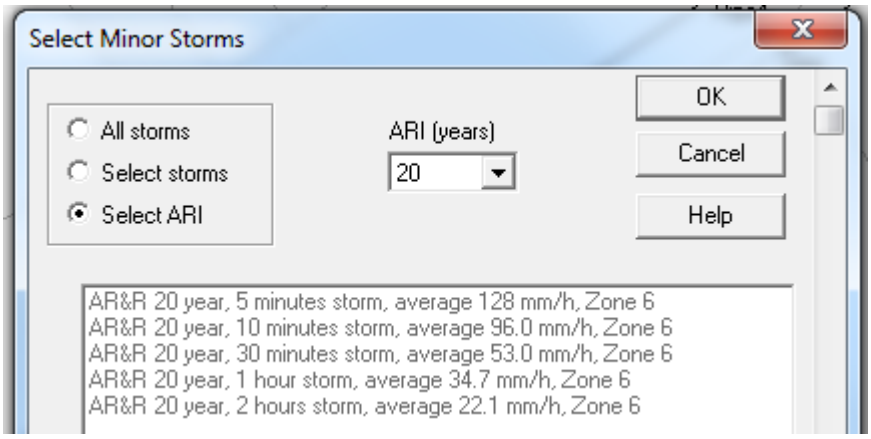


Figure 256 - Minor Storm Event

The finalised model prior to analysis can be seen in Figure 3 and Figure 4 in section 1.2.

1.2.2. DRAINS Model – Excel Output

This page is intentionally left Blank for Excel attachments

This page is intentionally left Blank for Excel attachments

This page is intentionally left Blank for Excel attachments

This page is intentionally left Blank for Excel attachments

1.2.3. Service Check

To determine the slope of the bioretention outlet pipe towards the stormwater, slope calculations are undertaken as shown below. There are three types of equations done to find the slope properties (Arch Media 2015):

To estimate the slope, using velocity requirements (1~4m^3/s) the following formula was used:

$$S = \left(\frac{V}{\frac{1}{n} \times R^{\frac{2}{3}}}\right)^2$$

Where: n = Manning's roughness coefficient (For concrete 0.015)

R = Hydraulic Radius $\left(\frac{Pipe\ Diameter}{4} = \frac{0.375}{4} = 0.09375m\right)$

Therefore, the range of Slope gradient is 0.53%~8.45%.

S = slope $\left(\frac{Starting\ IL - Finishing\ IL}{Length\ of\ Pipe}\right)$

- Bioretention basin 1

  The horizontal length are measured in Engineering Drawing HF-103, 1.369m for part1 and 4m for part2. Design vertical length for part 1 is 0.1m and 0.3m for part2.

  Slope check:

  Part 1: S = $\frac{0.1}{1.369} = 0.073 = 0.73\%\ , (OK)$

  Part 2: S= $\frac{0.3}{4} = 0.075 = 0.75\%, (OK)$

  Invert level:

  Part 1: FSL=36.9m, depth of GP is 1.1m

  Starting IL=36.9-1.1=35.8m

  Finishing IL= Starting IL –pipe length ×slope = 35.8-1.369×0.073=35.7m

  Part 2:

  Starting IL=35.7m

  Finishing IL= Starting IL –pipe length ×slope = 35.7-4×0.075=35.4m

  The finishing IL of part 2 is higher than IL of side pit 2(34.95m), the gravity flow can form, the design is adopted.

Service check:

A telecommunication service line is 2m away from bioretention basin 1 outlet pipe. The safety RL of which is FSL-RL (service) - clearance (0.6m) =36.9-0.6-0.6=35.7m. At that point the RL of pipe can be estimated as the equation shown:

$$\frac{35.7-35.4}{4}\times 2 = 35.55m < 35.7m(ok)$$

- Bioretention basin 2

The horizontal length are measured in Engineering Drawing HF-103, 15.894 m for part1 and 4.5m for part2. Design vertical length for part 1 is 0.2m and 0.05m for part2.

Slope check:

Part 1: S = $\frac{0.2}{15.894} = 0.01258 = 1.26\%\,,(OK)$

Part 2: S= $\frac{0.05}{4.5} = 0.011 = 1.11\%,(OK)$

Invert level:

Part 1: FSL=42.456m, depth of GP is 1.1m

Starting IL=42.456-1.1=41.356m

Finishing IL= Starting IL –pipe length ×slope = 41.356-15.894×0.01258=41.156m

Part 2:

Starting IL=41.156m

Finishing IL= Starting IL –pipe length ×slope =41.106m

The finishing IL of part 2 is higher than IL of side pit 11(41.056m), the gravity flow can form, the design is adopted.

Service check:

A telecommunication service line is 3.1 m away from bioretention basin 2 outlet pipe. The safety RL of which is FSL-IL (service) - clearance (0.6m)=42.456-0.6-0.6=41.256m. At that point the IL of pipe can be estimated as the equation shown:

$$\frac{41.156-41.106}{4.5}\times 3.1 = 41.256m < 41.122m(ok)$$

A gas service line is 2.5 m away from bioretention basin 2 outlet pipe. The safety RL of which is FSL-IL(service)- clearance(0.m)=42.456-0.6-0.45=41.406m. At that point the IL of pipe can be estimated as the equation shown:

$$\frac{41.156 - 41.106}{4.5} \times 2.5 = 41.256m < 41.128m(ok)$$

1.2.4. Provided Drawings by Tonkin Consulting

The attached two long section drawings were used to obtain surface levels of the project area from First Creek up to College road.

THIS PAGE HAS BEEN LEFT INTENTIALLY BLANK

Figure 257: Long section (Chainage 0-140)

THIS PAGE HAS BEEN LEFT INTENTIALLY BLANK for

Figure 258: Long Section (Chainage 280-382.5)

1.2.5. Cross section drawings

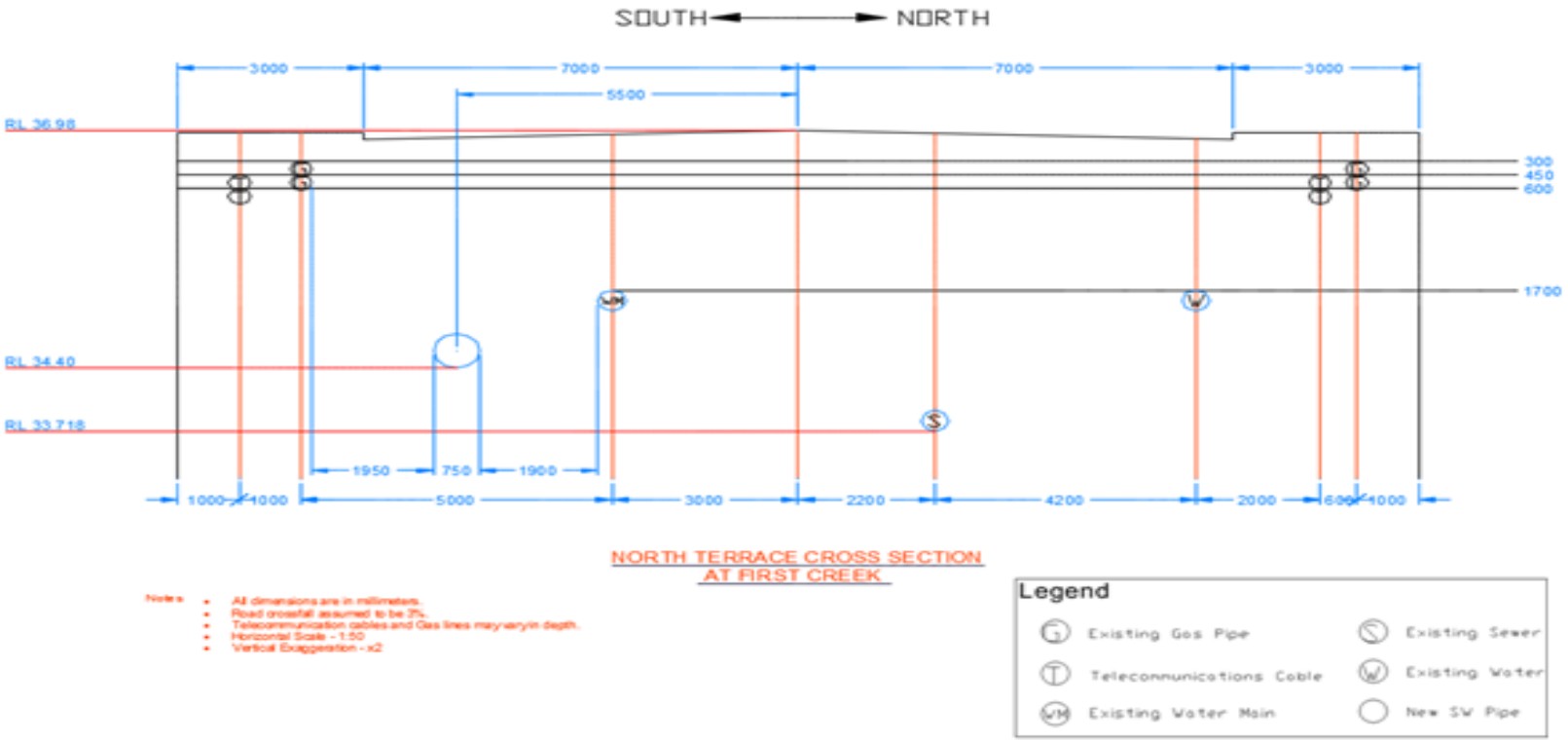


Figure 259: North Terrace Cross Section at First Creek

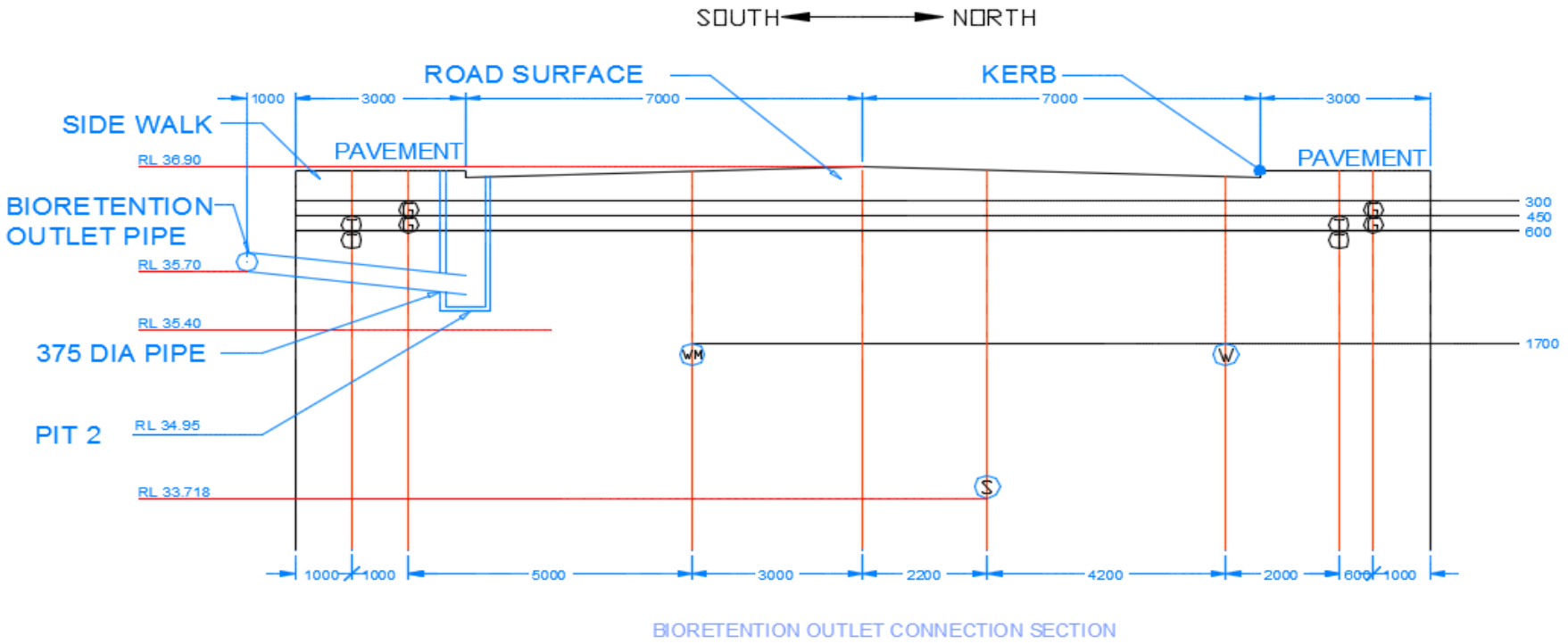


Figure 260 Bioretention 1 Cross Section View