

## APPENDIX **H**

### Overland Flow Report



# Wagga Wagga Base Hospital Redevelopment

## OVERLAND FLOW REPORT

- Final
- 22 August 2011



# Wagga Wagga Base Hospital Redevelopment

## OVERLAND FLOW REPORT

- Rev 6
- 22 August 2011

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## 1. Executive Summary

The management of the stormwater runoff from the adjacent catchments to south and east of the site and the maintenance of the existing overland flow path regimes will be one the key issues for the redevelopment of Wagga Wagga Base Hospital (WWBH).

In order to address these issues, SKM have undertaken an assessment of four main conceptual stormwater systems, these include:

- Diversion of upstream catchment to Docker Street firstly via the continuation of Yathong Street and then via grassed swale south of Lewis House.
- Provide an underground On Site Detention (OSD) system at the corner of the proposed new Link Road and Yabtree Street underneath the new car park north of the new Mental Health Building.
- Provide a minor drainage pipe system within the new road proposed east of the Mental Health building from Yathong Street and linking this drainage up with Council's existing stormwater network in Edward Street.
- Diversion of Overland Flow (OLF) from adjacent catchment from Yathong Street, Yathong Lane and Yabtree Street away from main hospital entrance through doctor's car park requiring the section of kerb to be removed and the re-grading of the car park to convey the flow.



## 2. Introduction

SKM have been engaged by Health Infrastructure to provide technical input into the development of the Wagga Wagga Base Hospital Redevelopment.

This assessment identifies the issues and requirements for drainage and stormwater management associated with the redevelopment of the Wagga Wagga Base Hospital. The assessment includes the reviews concerning flood management, as the site is subject to flooding both from the Murrumbidgee River (to the north-west of the hospital) and the stormwater flows from the adjacent catchments (south-east of the hospital) bounded by Rawson Lane and Murray Street. It also addresses concerns relating to the management of the stormwater generated within the site that connects to the existing drainage infrastructure of Wagga Wagga Council.

The key stormwater issues identified will form part of the main aspect of the hospital redevelopment:

- Management of the stormwater runoff from the contributing adjacent catchments between the hospital site, Murray Street and Rawson Lane.
- Adjustment of the existing adjoining minor roads and car parks (east and north of the hospital site) to redirect the existing overland flow regime in order to keep the stormwater runoff away from the hospital.
- Installation of On Site Detention (OSD) system as part of the stormwater drainage system to mitigate the discharges into the existing Wagga Wagga drainage infrastructure.

In order to address the issues identified above, SKM have undertaken an assessment of four stormwater systems, these include:

- Diversion of upstream catchment to Docker Street firstly via the continuation of Yathong Street and then via grassed swale south of Lewis House.
- Provide an underground On Site Detention (OSD) system at the corner of the proposed new Link Road and Yabtree Street underneath the new car park north of the new Mental Health Building.
- Provide a minor drainage pipe system within the new road proposed east of the Mental Health building from Yathong Street and linking this drainage up with Council's existing stormwater network in Edward Street.
- Diversion of Overland Flow (OLF) from adjacent catchment from Yathong Street, Yathong Lane and Yabtree Street away from main hospital entrance through doctor's car park requiring the section of kerb to be removed and the re-grading of the car park to convey the flow.

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## 3. Background

### 3.1. Topography

In its existing state, the site is predominately impervious consisting of roadways, building and other paved areas.

The initial site survey indicates that the existing ground fall is in a northwesterly direction from Brookong Avenue and Murray Street in the southeast towards the intersection of Edward and Docker Street in the northwest.

### 3.2. Drainage Infrastructure

#### Drainage

The Wagga Wagga Base Hospital is impacted by stormwater inundation. The hospital is subject to stormwater flows from adjacent local catchments and is also subject to flooding from the Murrumbidgee River. Based on the Council's services plan and site investigations, the existing stormwater drainage system is located along Docker Street, Edward Street, Murray Street and Brookong Avenue.

Site investigations indicate a single pipe system along the eastern side of Lewis Drive, however it would appear Doris Roy Lane, Yabtree Street and Yathong Streets are not serviced by stormwater drainage system and rely on the road reserve to convey catchment flows.

#### Flooding from the Murrumbidgee River

The flooding of the Murrumbidgee River and the impact on the hospital has been addressed in the Flood Impact Assessment prepared by Webb, McKeown & Associates (WMA) dated September 2005 and Council's Floodplain Management Plan adopted in April 2009. WMA water has also completed a Draft Flood Impact Assessment dated December 2010. Table 1 below is a summary of the Murrumbidgee river flood levels at the hospital:

**Table 1**

| Flood Recurrence Interval    | 2005 Design Flood Level<br>(m AHD) | 2010 Riverine Flood Level<br>(m AHD) |
|------------------------------|------------------------------------|--------------------------------------|
| 100 Year ARI                 | 177.4                              | 177.4                                |
| 200 Year ARI                 | 181.3                              | 180.6                                |
| 500 Year ARI                 | 182.2                              | 181.8                                |
| 1000Y ARI                    | 183.1                              | 182.3                                |
| Probable Maximum Flood (PMF) | 186.0                              | 183.6                                |





### **Existing Overland Flow Path**

Under existing conditions Lewis Drive acts as the major OLF route located east of the Hospital and conveys the catchments draining to Yathong Street, Yathong Lane, Yabtree Street and Doris Roy Lane (all of which have no in-ground drainage).

As such, without the presence of a minor drainage system (in-ground drainage network as defined by Australian Rainfall and Runoff) during relatively minor storm events runoff accumulates quickly within Lewis Drive and leads to considerable gutter flows.

This gutter flow situation is particularly undesirable given the main entrance to the Hospital is at the corner Yabtree Street and Lewis Drive. Refer Figure 2.2 below for an example of the gutter flow experienced in Lewis Drive following a minor rainfall event.



**Figure 2.2 – Lewis Drive Gutter Flow**



## **4. Proposed Development**

### **4.1. General**

Phase 1 of the hospital redevelopment consists of a new Mental Health building to be located over the existing Lewis Drive road reserve and adjacent gravel car park between Yabtree Street and Yathong Street, which has the effect of blocking the existing OLF path for the southeast portion of the hospital site.

As such, a new means of dealing with this OLF will have to be incorporated within the development during Phase 1 and subsequent phases.



## 5. Overland Flow (OLF) Systems

In accordance with the major/ minor system as described within the Australian Rainfall and Runoff guidelines (AR&R) a minor pipe system is usually designed to cater for 1 in 20-year ARI storm event and the overland flow system be designed to cater for the 1 in 100 year ARI storm event.

In order to deal with blocking of the existing OLF path (being Lewis Drive) and improve the flooding situation at the Hospital's main entrance at the corner of Yabtree Street and Lewis Drive during the 1 in 100 year Average Recurrence Interval (ARI) storm event, four stormwater systems have been identified and are described below.

### 5.1. Diversion of upstream catchment to Docker Street

Currently the existing catchment arriving at the Hospital's main entrance (which will now be referred to as point X as shown in Figure 1, Appendix D) was determined to be 3.44 hectares. Based on the ILSAX method from DRAINS a flow of 1.19 m<sup>3</sup>/s for the 20 year ARI storm and 1.65 m<sup>3</sup>/s for the 100 year ARI storm was determined.

The redevelopment of the new Mental Health building is to be located over the existing Lewis Drive road reserve, which has the effect of blocking the existing OLF path for the southeast portion of the hospital site. The OLF path will now travel North West along Yathong Street towards the loading dock of the Wagga Wagga Hospital. Minor road regrading will be required to force the water away from the loading dock to an open channel between Lewis house and the public car park towards Docker Street. Refer to Appendix A for the plan showing the described OLF diversion system.

#### Road Re-grading and Bunding

To facilitate this diversion a section of the existing bitumen road west of the existing Schofield Centre will need to be altered and regraded to achieve 0.5% longitudinal fall towards the grassed area south of the existing Lewis House. The road works will involve re-configuration of the road cross falls and levels to direct OLF west rather than its current route north towards the loading dock.

Associated with the road re-grading is the raising of a section of the road past the bend adjacent to the Oxygen Store by approximately 300mm (including any necessary bunding around the Oxygen Store and landscaping area). It is necessary to raise the road and provide the bund to ensure OLF travels west towards Docker Street rather than north through the loading dock.



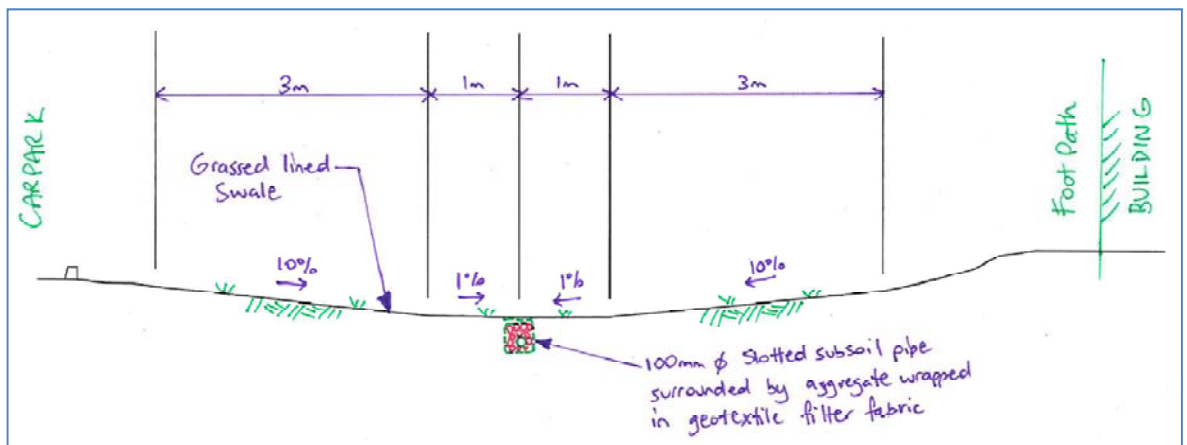
SKM note that any modifications to the entrance road to the loading dock can be achieved using longitudinal road grades below 5%, which will not affect the use of this entrance for delivery trucks etc.

SKM also note that the feasibility of this option is based on the existing site survey.

### Grassed Swale

Following the re-grading of the roadway and modification to the loading dock entrance, a grassed swale will need to be constructed south of Lewis House to convey OLF from the road towards Docker Street.

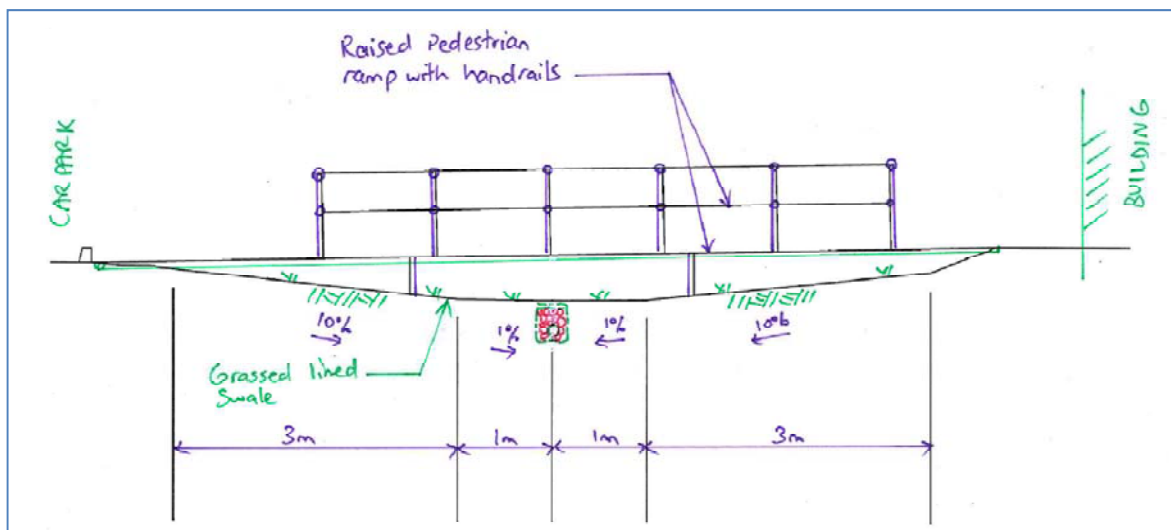
This swale will be approximately 8m wide at the top, 2m wide at the base, 310mm depth with side batter slopes of 1 in 10 and a longitudinal grade of 0.5% minimum. Refer Figure to 5.1.1 below.



**Figure 5.1.1 – Swale Section**

The swale will necessitate the relocation of the demountable building between the car park and Lewis House and will need to be co-ordinated with the landscaping and pedestrian pathways and linkages adjacent to Lewis House.

The design of the grassed swale will also need to consider the existing pedestrian linkages between Lewis House and the car park to the south of this building. These linkages will need to be maintained at minimum grades in accordance with AS 2890.1 as Lewis House is currently utilised for maternity patients. The design proposes to construct a raise pedestrian footpath and provide handrails to allow the 100 year ARI storm event to continue underneath the pedestrian footpath and travel towards Docker Street. Refer to figure 5.1.2 below.



**Figure 5.1.2 – Swale Section through raised pedestrian footpath**

At the western edge of the swale west of Lewis House, the swale will terminate with a surface inlet pit consisting of a raised grate, concrete apron and a level spreader prior to connecting to the existing drainage network in Docker Street. Two surface inlet pits are required within the swale to completely capture the 1 in 20 year ARI storm event, with an outlet pipe of Ø 450mm Reinforced Concrete Pipe (RCP). SKM note that there is not enough survey of the drainage system along Docker Street and the pipe dimension are unknown.

### Reduction in OLF

As a result of the implementation of the diversion of the upstream catchment to Docker Street this will divert 0.62 hectares of the upstream catchment area that previously drained down Lewis Drive to Docker Street. Refer Appendix D, Figure 2 for the Catchment Plan. The OLF path also drains the any catchment flowing towards the open channel, resulting in a combined catchment of 1.48 hectares.

Based on the ILSAX method from DRAINS a flow 0.28 m<sup>3</sup>/s have been diverted resulting in a reductions of 17% of OLF arriving at Point X. (1.65 m<sup>3</sup>/s reduced to 1.37 m<sup>3</sup>/s).

### Safety of OLF

SKM note that the diverted OLF from the upstream catchment can be contained within a typical 8.0m wide road section and the proposed swale section at a safe velocity depth of less than 0.4 m<sup>2</sup>/s.



## 5.2. On Site Detention (OSD) System

An underground On Site Detention (OSD) system to be provided at the corner of the proposed new Link Road and Yabtree Street underneath the new car park north of the Mental Health building.

This new OSD system is not to be confused with the decentralised OSD systems that have previously been proposed at the various stages of construction for the Hospital's redevelopment, for the purpose of ensuring that the post development site stormwater discharges are the same or less than the existing situation.

The proposed OSD system is aimed at attenuating and over-detaining surface runoff intercepted from the upstream catchment and Mental Health Building so that the surface flows arriving at the hospital's main entrance are reduced. SKM has proposed a raised pedestrian crossing just west of the intersection of Yathong Street and the New Link Road to control the OLF path and force the surface runoff to travel onto the New Link Road in lieu of Lewis Drive. The catchment collected by the OSD system is 1.62 hectares. Refer Appendix D, Figure 2 for the Catchment Plan.

Associated with the below ground storage would require inlet structures and stormwater pipes in Yathong Street and the New Link Road to capture the surface flows, as well as the connection of the OSD system to the existing drainage in Edward Street.

Based on the ILSAX method from DRAINS the OSD system is designed to capture the 100 year ARI storm event with a Permissible Site Discharge (PSD) of 0.1 m<sup>3</sup>/s for the 20 year ARI storm event and 0.12 m<sup>3</sup>/s for the 100 year ARI storm event, SKM have determined that the required OSD volume in this location is approximately 445 m<sup>3</sup>.

The OSD is also sized to capture any roof water downpipes from the Mental Health and adjacent buildings that could be piped directly to the OSD tank.

The below ground OSD volume could be achieved using variety of technologies and would have basic dimensions of 43m long x 9m wide by 1.15m deep. Depending on construction cost and maintenance considerations, technologies that could be considered to provide the required storage include:

- Modular plastic system such as Atlantis Cells or Invisible Structures
- Cast in-situ or block work reinforced concrete tank
- Modular precast concrete units such as Humes StormTrap
- Precast underground storage tanks or Reinforced Concrete Box Culverts (RCBC) units

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In accordance with the Environmental Sustainable Development (ESD) initiatives to be incorporated into the hospital's redevelopment, an underground rainwater tank could also be provided below or adjacent to the OSD storage to minimise excavation costs.

### **Reduction in OLF**

As a result of the implementation of the OSD system this will capture the runoff from 1.62 hectares of the upstream catchment area that would otherwise drain to the Hospital's main entrance (Point X) capturing a flow of approximately  $0.69 \text{ m}^3/\text{s}$ , and discharge this flow to Council's Edward Street drainage network at a rate of approximately  $0.12 \text{ m}^3/\text{s}$  for the 100 year ARI storm event.

The construction of the OSD tank would result in a 42% reduction in the amount of OLF arriving at Point X ( $1.65 \text{ m}^3/\text{s}$  reduced to  $0.96 \text{ m}^3/\text{s}$ ).

### **5.3. Minor drainage pipe system**

The stormwater drainage of the proposed Hospital redevelopment of pit and pipe drainage system in accordance with the Wagga Wagga Council Engineering Guidelines (part 3 – stormwater drainage design, draft December 2008). The proposed drainage system is located in the new proposed road east of the Mental Health building from Yathong Street travelling north and linking the drainage system to the existing drainage infrastructure of Wagga Wagga Council located along Edward Street.

However, according to the site survey and available Council records, the existing stormwater network in Edward Street adjacent to Lewis Drive consists of a single  $\text{Ø } 375\text{mm}$  Reinforced Concrete Pipe (RCP) which travels west along Edward Street approximately 120m then changes to a single  $\text{Ø } 675\text{mm}$  RCP. On the basis that the receiving pipe system is a  $\text{Ø } 375\text{mm}$  RCP, it is common practise within the stormwater industry to not provide a larger pipe size upstream of the connection point even though it may be warranted to convey the 1 in 20-year ARI flows.

Based on the Colebrook-White equation, a  $\text{Ø } 375\text{mm}$  RCP has an approximate capacity of  $0.2 \text{ m}^3/\text{s}$  at a 1.0% grade which represents only a 15% and 11% reduction in surface flow for the 1 in 20-year and 1 in 100-year ARI upstream catchment flows respectively.

SKM note however the construction of a  $\text{Ø } 375\text{mm}$  RCP minor system to Edward Street would assist controlling surface flows during the majority of rainfall events up to the 1 in-5 year ARI storm event.





#### **5.4. Diversion of the adjacent catchment through existing carpark to Edward Street**

The diversion of OLF from adjacent catchment from Yathong Street, Yathong Lane and Yabtree Street away from main hospital entrance through the doctor's car park requires a section of kerb to be removed at Yabtree Street and Doris Roy Lane. The roadway cross fall at the intersection of Yabtree Street and the New Link Road and the intersection of Doris Roy Lane and the eastern end of the car parks as well as the re-grading of the existing car park to convey the 100 year ARI flow. Refer to Appendix B.

Following construction of the proposed new road east of Mental Health building during Phase 1 (which now refer to as Road 1) the existing residential allotments draining to Yathong Lane and Yabtree Street will drain to Point X via Road 1.

The diversion of the OLF involves breaking the existing kerb and footpath area (refer Figure 5.4.1 below) to create a 6.0m wide OLF path depression on the northern side of Yabtree Street at the location of the proposed intersection between Road 1 and Yabtree Street.



**Figure 5.4.1 – Broken Kerb/ Footpath on Northern Side of Yabtree Street**

As shown in Figure 5.4.1 a pram ramp could be provided either side OLF path depression to maintain pedestrian connectivity to the Hospital.





By providing an OLF path through the kerb and constructing a raised speed bump threshold just west of the proposed intersection, will divert the upstream runoff through the doctor's car parking area thereby by-passing the Hospital's main entrance (Point X). Refer to figure 5.4.2 below.

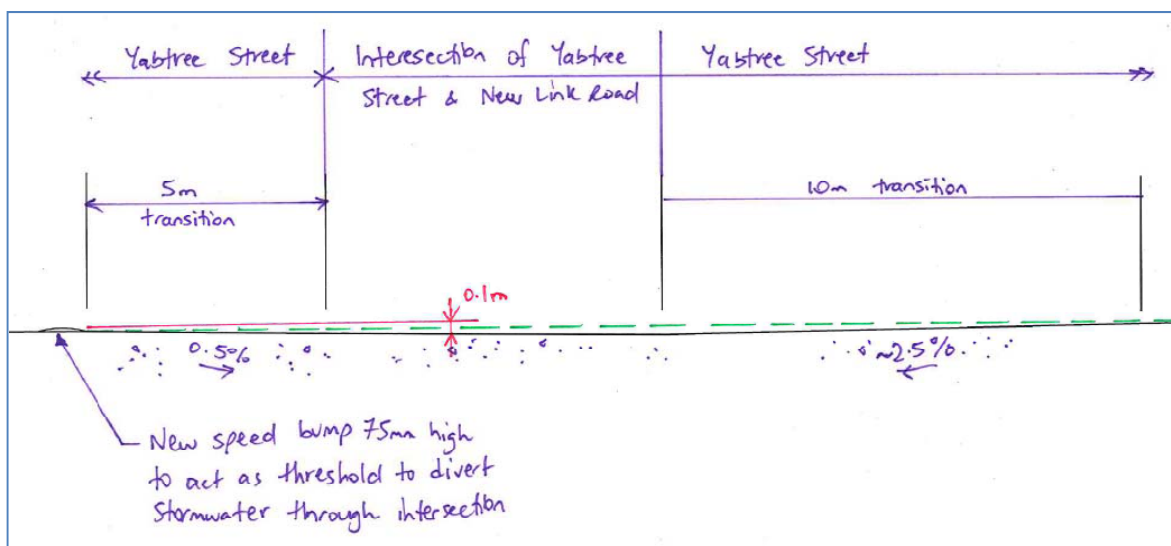


Figure 5.4.2 – Elevation through intersection of Yabtree Street and New Road.

### Street and Car Park Adjustments

Associated with these works will involve modifications to the Yabtree Street road levels at the intersection of the two roads and alterations to the car park to direct the OLF to the desired location.

Based on the existing survey information, it appears that the northern section of the car park can be reconfigured with a central depression to convey the OLF to Edward Street.

The car park adjustments described above could all be designed to comply with the maximum grades and cross falls as required by AS2890.1. Refer to figure 5.4.3 below.

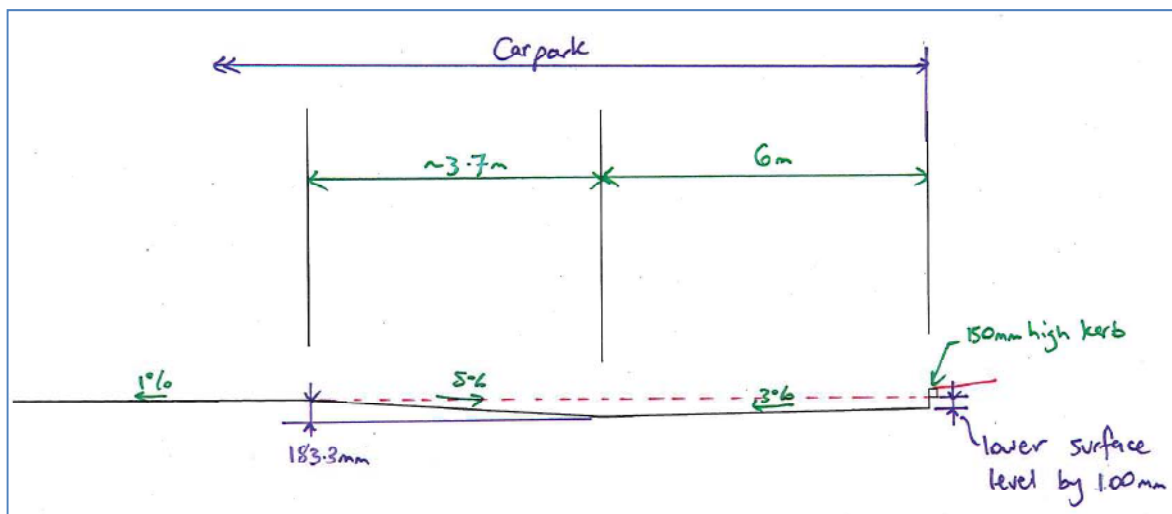


Figure 5.4.3 – Car park reconfiguration for the 100 year ARI OLF storm event .

### Reduction in OLF

As a result of the implementation of this work this will divert 1.19 hectares of the upstream catchment area flow that contributes to Yabtree Street and Lewis Drive. Thereby reducing the depth of flow at the hospitals main entrance, refer Appendix D, figure 2 for Catchment Plan.

Assuming the OLF diversion route is constructed during Phase 1 of the project and based on similar ILSAX method from DRAINS described in previous sections, the OLF path should divert  $0.53 \text{ m}^3/\text{s}$  results in a 32% reduction in the amount of OLF arriving at Point X ( $1.65 \text{ m}^3/\text{s}$  reduced to  $1.12 \text{ m}^3/\text{s}$ ).

### Safety of OLF

SKM note that the diverted OLF from the upstream catchment can be contained within the section detailed in figure 5.4.2 and figure 5.4.3 OLF path depression through the northern kerb and footpath area in Yabtree Street as well as the modified car park section at a safe velocity depth of less than  $0.4 \text{ m}^2/\text{s}$ .



**5.5. Total reduction of flow to the entrance of Wagga Wagga Hospital from all proposed mitigation works**

|                                                       | Flow captured by proposed systems |
|-------------------------------------------------------|-----------------------------------|
| Diversion of upstream catchment to Docker Street      | 0.28 m <sup>3</sup> /s            |
| Provide an underground On Site Detention (OSD) system | 0.69 m <sup>3</sup> /s            |
| Diversion of OLF to Edward Street                     | 0.53 m <sup>3</sup> /s            |
| TOTAL                                                 | 1.5 m <sup>3</sup> /s             |

Resulting in a total reduction of 92% of OLF arriving at the entrance to Wagga Wagga Hospital (1.65 m<sup>3</sup>/s reduced to 0.15 m<sup>3</sup>/s).



## 6. Consultation with Council

At the recent WWBH presentation held at City of Wagga Wagga Council's offices (3 March 2011) the Overland Flow systems discussed within this report were tabled as ways managing the stormwater runoff from the contributing adjacent catchments between the hospital site, Murray Street and Rawson Lane.

Council were generally supportive of the OLF systems and raised no objects to their implementation.

Council did however highlight the importance of maintaining an overland flow path along the eastern side of the hospital site. This situation has been addressed from early on in the planning of the redevelopment of the WWBH site, with the proposal to provide a new road along the eastern side of the hospital site (this road has been referred to as Road 1 within this report).

The inclusion of Road 1 will serve to maintain the existing overland flow regime previously performed by Lewis Drive (between Yathong and Tabtree Streets). Road 1 will also provide a space to facilitate the diversion of the existing sewer carrier main currently located in Lewis Drive.

Wagga Wagga Council also mentioned the need to maintain the current status quo by limiting post development site stormwater discharges to that of existing levels. This will be achieved by incorporating On-site Stormwater Detention (OSD) facilities within the various phases of the hospital redevelopment.



## 7. Recommendations

Following completion of the assessment SKM would recommend that all OLF mitigation systems for dealing with OLF from the adjacent catchment be further developed during the detailed design phases of the WWBH redevelopment.

The final drainage solution that addresses OLF will incorporate all main systems discussed herein to achieve the best value permanent solution that will benefit the operators of the site, the users of the site and the community at large.

SKM note the calculations, discussion of systems and cost estimates presented herein are preliminary in nature and should not be interpreted as being definitive. Each of the systems will require further development during detailed design and will be subject to Council approval.



## **8. Appendix A – PLAN - Diversion of upstream catchment to Docker Street**

 PROPOSED INLET PIT

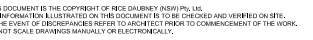
--- PROPOSED PIPE

 PROPOSED OPEN CHANNEL

— EXISTING PIPE

EXISTING INLET PIT

AREA OF ROADWAY TO BE RE-GRADED



## PLAN

[illegible]

50% SCHEME DESIGN DRAWINGS ARE BASED ON THE ARCHITECTURAL SCHEME DESIGN DRAWINGS RECEIVED 25.05.11 & THE RE-ISSUED FOR SCHEME DESIGN DRAWINGS RECEIVED 10.06.11

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SUBJECT:  
WAGGA WAGGA BASE REDEVELOPMENT  
PHASES 1 & 2  
HOWARD STREET  
WAGGA WAGGA, NSW, 2650

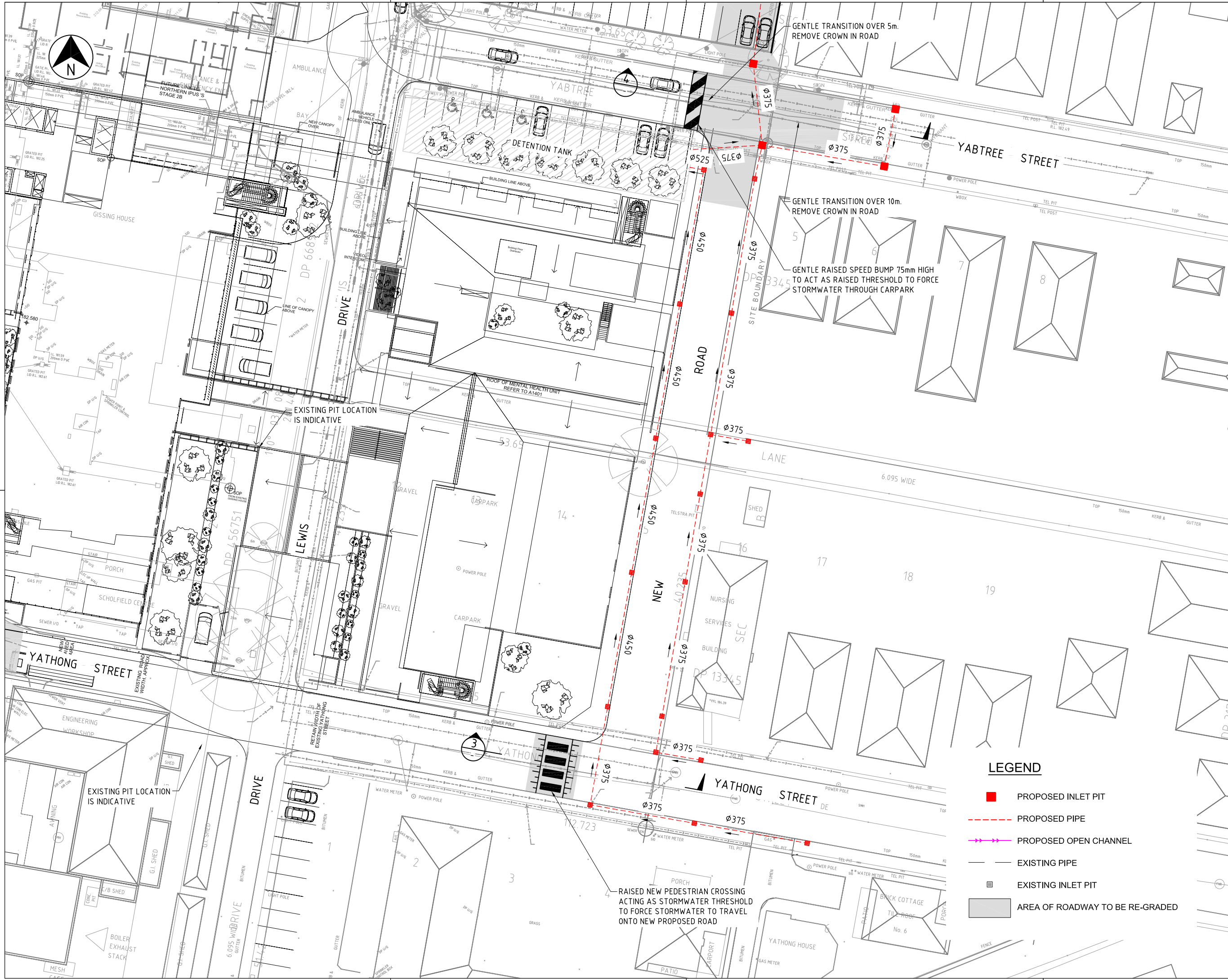
# STORMWATER MANAGEMENT PLAN

|                         |                   |                                |
|-------------------------|-------------------|--------------------------------|
| Design: SC              | Designed: DS      | Reviewed: Project Manager: CA  |
| Check: BS               | Design Review: LD | Approved: Project Director: TE |
| PROJECT NUMBER: NB11292 |                   | ISSUE: NB11292-C-SK-01 A       |
| SCALE                   |                   |                                |



## **9. Appendix B – PLAN - Provide an underground On Site Detention (OSD) system**





NORTH POINT

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DO NOT SCALE DRAWINGS MANUALLY OR ELECTRONICALLY.

KEY PLAN

| REV | DESCRIPTION OF CHANGE | DRAWN | CHECK | DATE     |
|-----|-----------------------|-------|-------|----------|
| A   | ISSUED FOR PART 3A    | SC    | BS    | 30.06.11 |

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PROJECT:

**WAGGA WAGGA BASE REDEVELOPMENT PHASES 1 & 2**  
**EDWARD STREET**  
**WAGGA WAGGA, NSW, 2650**

DRAWING TITLE:

**STORMWATER MANAGEMENT PLAN**

|                 |                   |              |
|-----------------|-------------------|--------------|
| Drawn: SC       | Designed: DS      | Reviewed: CA |
| Check: BS       | Design: LD        | Approved: TE |
| PROJECT NUMBER: | DRAWING NUMBER:   | ISSUE:       |
| NB11292         | NB11292-C-SK-02 A |              |
| SCALE: SCALE    |                   |              |

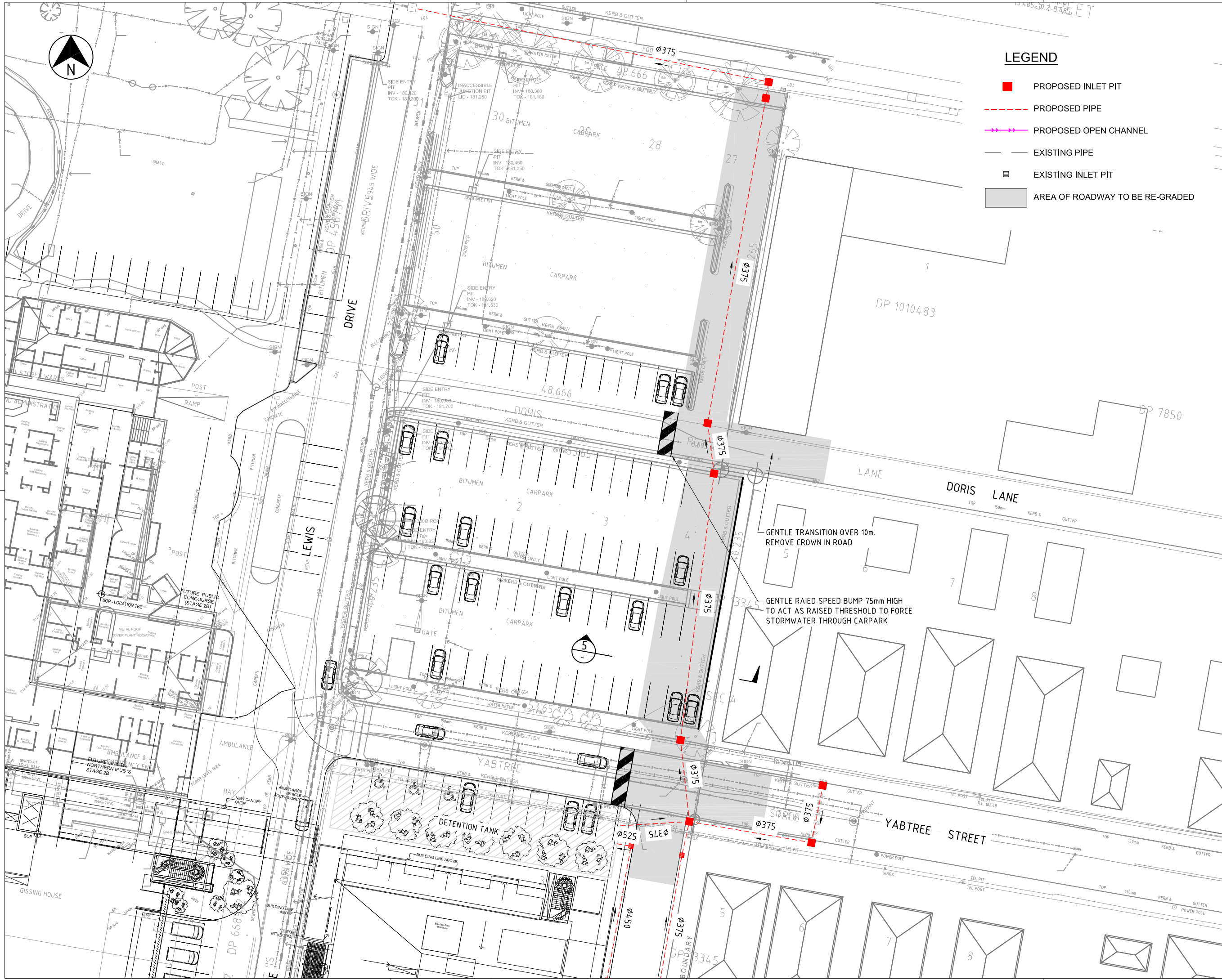
LEGEND

- PROPOSED INLET PIT
- PROPOSED PIPE
- PROPOSED OPEN CHANNEL
- EXISTING PIPE
- EXISTING INLET PIT
- AREA OF ROADWAY TO BE RE-GRADED



## **10. Appendix C – PLAN – Underground stormwater system & diversion of OLF to Edward Street**





LEGEND

- PROPOSED INLET PIT
- PROPOSED PIPE
- PROPOSED OPEN CHANNEL
- EXISTING PIPE
- EXISTING INLET PIT
- AREA OF ROADWAY TO BE RE-GRADED

NORTH POINT

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KEY PLAN

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|------|-----------------------|-------|-------|----------|
| RV01 | ISSUED FOR PART-3A    | SC    | BS    | 30.06.11 |

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PROJECT: WAGGA WAGGA BASE REDEVELOPMENT PHASES 1 & 2 EDWARD STREET WAGGA WAGGA, NSW, 2650

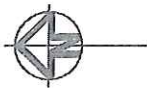
DRAWING TITLE: STORMWATER MANAGEMENT PLAN

|                         |                                   |              |
|-------------------------|-----------------------------------|--------------|
| Drawn: SC               | Designed: DS                      | Reviewed: CA |
| Check: BS               | Design: LD                        | Approved: TE |
| Project Number: NB11292 | Drawing Number: NB11292-C-SK-03 A | Issue:       |
| Scale: SCALE            |                                   |              |

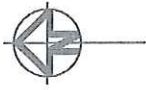


## **11. Appendix D – Catchment Plan**









### Legend

-  Catchment to OLF (2.54 ha)
-  Catchment to OSD Tank (1.62 ha)
-  Catchment to OLF (1.48 ha)

Figure 2 - New Catchment to Stormwater Management Systems



## **12. Appendix E – DRAFT WMA 1 in 100 Year ARI Flood Depth Mapping**



