MERITON APARTMENTS

PROPOSED RESIDENTIAL APARTMENTS

BONAR STREET, ARNCLIFFE

DA REPORT

SEPTEMBER 2009

REVISION E
FOR DA APPROVAL

1.0 INTRODUCTION

Meriton Apartments are proposing to construct residential apartments in the Bonar Street master plan precinct. The subject site is located at the corner of Bonar Street and Hirst Street, Arncliffe NSW, and falls within Rockdale City Council.

Hughes Trueman has been commissioned by Meriton Apartments to prepare supporting civil engineering documentation for a Development Application for the proposal.

This report and associated civil engineering drawings address the following engineering components:

- Site access and proposed roadworks;
- Stormwater drainage layout and pipe sizes; and
- On-site Detention (OSD).

All civil works including road and stormwater drainage works have been designed in accordance with Rockdale City Council's *Stormwater Management DCP 78* and *Bonar Street precinct Master Plan DCP* 80 and the relevant Australian Standards.

Revision A of this report was originally submitted for DA approval in March 2009. Upon assessment of the DA, Rockdale City Council (RCC) then provided a letter with comments to Meriton Apartments on the 14th May 2009 (DA-2009/307).

Hughes Trueman have since attended two meetings (5th June 2009 and 30th July 2009) with RCC to discuss items raised and subsequently address councils concerns as part of revision B, C and D of this report. Refer to appendix C for meeting minutes and Section 4 for discussion.

2.0 SITE DESCRIPTION AND PROPOSED WORKS

The site is located approximately 9km south-west of the Sydney CBD at the corner of Bonar Street and Hirst Street, Arncliffe. The subject site is bounded by:

- Hirst Street along the southern boundary from west to east;
- Bonar Street along the eastern boundary;
- Loftus Street along the western boundary of the site; and
- Arncliffe West Primary School to the north.

The existing site contains industrial buildings and is almost completely impervious; it falls from west to east.

In accordance with DCP80, the proposal includes the following works external to the site:

- Road widening and beautification works to Bonar and Hirst Streets;
- Road beautification works on Loftus Street;
- Upgrades to the existing drainage system running from Hirst, beneath Bonar Street to the east (including GPT, outlet works, pipe and inlet pit upgrades); and
- Overland flow path accepting flows from Loftus Street and Arncliffe West public School.

Internal works addressed in this documentation include the on-site stormwater detention, site access and flood protection.

3.0 EXTERNAL WORKS

In addition to satisfying the requirements and standards of Rockdale City Council, all external work upgrades within the proposed site have been designed in accordance with Council's *Development Control Plan - No.80 Bonar Street Precinct (2005).*

3.1 Roadworks

In accordance with Council's Development Control Plan, the following roadwork upgrades are proposed for the Bonar Street development:

3.1.1 LOFTUS STREET

- Parallel parking bays;
- Tree bays within raised pavement between parking bays at 8m centres;
- New inlet pits adjacent to parking islands; and
- 2m wide paved shared footpath/cycleway adjacent to street in compliance with council standards (DCP 80 requires 1.8m wide path, but the minimum width of 2.0m has been documented in accordance with Austroads).
- Locally reconstruct a length of kerb and minor pavement regrading to relocate the existing sag in the kerb to coincide with the new swale entry..

3.1.2 HIRST STREET

- Widening of existing carriageway by 1.1m;
- Tree bays within raised pavement between parking bays at 21m centres (the proposal departs from the spacing documented in DCP 80 to maintain existing vehicular access to the private dwellings on the southern side of the street);
- New inlet pits and drainage upgrades; and
- 2m wide paved footpath adjacent to street in compliance with council standards.

3.1.3 BONAR STREET

- Creation of a sag opposite the future drainage easement to the east;
- Road level has been raised to protect surrounding developments from flooding by deflecting flow to the proposed drainage easement mentioned above;
- Construction of a vegetated bio-retention swale along the central median in accordance with water sensitive urban design practices;
- Widening of the existing carriageway by 3.43m;
- Variable width footpaths on both sides of the street;
- Parallel parking bays on both sides of the street;
- Tree grates within raised pavement between parking bays at 15m centres; and
- A raised pedestrian crossing opposite the proposed New Road West.

NOTE *that although this documentation package documents the full width of Bonar Street, the proponent is only obliged to construct "half road" in accordance with DCP 80. The extent of constructed works and Section 94 credits will be addressed by the project and Council's planners.*

3.2 Drainage Works

Council's policy requires improved water quality and no increase in the stormwater discharge from the developed site prior to discharge.

The stormwater drainage has been designed to comply with the following guidelines:

- *Rockdale city Council's DCP 78 – Stormwater management;*
- *Australian Rainfall and Runoff* 2001; and
- Managing Urban Stormwater: *Soils and Construction*, Volume 1, 4th Edition, March 2004.

The following stormwater management upgrades are proposed for the external works development.

3.2.1 LOFTUS STREET

- Where the construction of new islands creates a reduction of road capacity, HT propose (a) gap in island to be provided to allow low flows to continue to the sag; and (b) new kerb inlet pits shall also be provided over the existing reinforced concrete pipes.
- There is an existing sag point in the eastern kerb of the street which allows overland flows to enter the subject site in the extreme storm events. A new swale drain and drainage easement are proposed to convey these flows to the east towards Bonar Street (refer to Section 4.1 for further information).
- The proposed works in Loftus St includes relocating the existing sag in the kerb to the new swale entry by reconstructing a length of kerb and minor localised pavement regrading. Along with a lowered crest width of 15m at the boundary, this will allow flows to enter the swale more effectively than the existing scenario.

3.2.2 HIRST STREET

- Install additional stormwater pits to ensure pipes are "running full" and to minimise flood hazard for vehicular and pedestrian traffic;
- Redirect/upgrade the existing 1200mm dia stormwater pipe beneath Bonar Street to maintain flood levels at the existing levels (minimum requirement) when taking into account the creation of the new sag point and crest in Bonar Street; and
- Hirst Street is currently signposted as "No Heavy Vehicles". The proposed roundabout at the intersection with Bonar Street has, however been designed to accommodate an 8.8m service vehicle.

3.2.3 BONAR STREET

- The creation of a new sag in the eastern kerb of Bonar Street near the intersection of Hirst Street. This sag point is to be located approximately 20m from the existing boundary of the opposite site and generally opposite the 'future drainage easement' shown on the master plan documentation. As this site does not form part of the master plan precinct area it must be protected from increased flood levels, during and after construction.
- The raising of the Bonar Street road levels to deflect flows in an easterly direction to the proposed 'future drainage easement';
- Bonar Street cross-fall is to be inverted to direct flows to a new bio-retention swale. Large inlet pits inside the swale have also been included to ensure that flood levels across Bonar Street are reduced, or at worst maintained at existing levels.

- Upgrade and realign existing 1200mm stormwater pipe to take into account flows as determined by future flood modelling, the location of the 'future drainage easement' and protection of existing adjacent sites;
- Remove the connection of the existing twin Ø750mm pipes to the Ø1200mm pipe beneath Bonar Street and connect directly to the new headwall outlet in the Bowling Club site via a new 1.8m wide x 0.75m deep reinforced concrete box culvert (RCBC). This will increase the capacity of the Hirst Street drainage system by approximately $2m^3/s$. The exact configuration of this connection and flow capacity increase will be confirmed during detailed design.
- Upgrade inlet capacities at the location of surface flooding as identified in future flood modelling (refer important note below);
- A Gross Pollutant Trap (GPT) will be located at the outlet from upgraded pipe system beneath Bonar Street prior to discharge into the 'future drainage easement'. The location of this GPT has been arranged to maximise the catchment treated and to allow access for maintenance; and
- Upgrade the existing stormwater drainage pit/pipe system in the northern section of Bonar Street where the newly created overland flow easement discharges to the road reserve.

3.3 Flood Modelling

Two-dimensional flood modelling has been undertaken by WMA water to determine the proposed grading requirements of Bonar St and all associated stormwater drainage upgrades in the vicinity of Bonar / Hirst Streets (refer Appendix D – Flood Modelling).

Following discussions with Rockdale City Council (refer meeting minutes in Appendix C), Hughes Trueman developed a series of digital terrain models (DTMs) which incorporated various alternatives for the location of the proposed crest in Bonar Street that would deflect flood flows to the east, through the bowling club site in accordance with the approved master plan.

WMA water undertook an analysis on the DTMs to assess the effect of:

- Moving the crest in a northerly direction to lower water levels and reduce the impact on flood levels crossing the rear yard of 43 Bonar Street; and
- Reconfiguring the connection of the Hirst Street drainage system (twin Ø750mm pipes) to the Bonar Street Drainage system (Ø1200mm pipe) to determine if the subsequent flow reduction assisted in maintaining existing flood levels.

Following an engineering review of the various options, Hughes Trueman has selected "Run 10" as the most appropriate solution as it:

- Maintains acceptable road cross falls in accordance with the relevant road design standards, particularly through the proposed roundabout;
- Adequately protects no 43 Bonar Street from any increase in flood levels adjacent that property; and
- Maintains adequate freeboard to the existing dwellings on the western side of Hirst Street.

Option 10 includes the following:

- The crest in Bonar St is located approximately 64.4m from the centre of the new Bonar St / Hirst St Roundabout;
- There is an assumed subtraction of $2m^3/s$ of overland flow down Hirst Street;

3.3.1 RESULTS - FLOOD LEVELS AT 43 BONAR STREET

Results show (refer Appendix D – Flood Modelling) primarily a reduction in flood levels across 43 Bonar Street (i.e. improvement in flooding conditions).

3.3.2 RESULTS - FLOOD PROTECTION (FREEBOARD) TO 1/8 & 2/8 BONAR STREET

The following table presents a summary of the freeboard for 1/8 & 2/8 Bonar Street and shows that although minor isolated increases in flood levels do occur in Hirst Street, adequate freeboard has been maintained at all times.

Property	Finished Floor Level (RL)	Q_{100} Flood Level (RL)	Q_{100} Flow Depth (m)	Freeboard Provided (m)	Freeboard Required (m)
1/8	10.28	9.90	0.30	0.38	0.30
2/8	10.54	10.20	0.30	0.34	0.30

4.0 INTERNAL SITE WORKS

4.1 Overland Flow from Loftus Street / Arncliffe West Primary School

Hydrologic modelling was undertaken using *DRAINS* software package (Version 2009.05 Unsteady version, Watercom) in order to determine peak flows through the easement and subsequently determine habitable floor levels.

The preparation of the DRAINS model considered those items raised by council's concerns raised in Item 8(b) (DA2009/307) and subsequent meetings, which is discussed in Section 4.1.4.

In particular, modelling was undertaken in order to:

(a) Model the trunk pipe system beneath Hirst St operating at 50% capacity and subsequently determine the amount of surface flows conveyed along Hirst St from its upstream catchment;

(b) Estimate the volume of surface flows which may be directed towards the Loftus St sag point from either (i) its intersection with Hirst St; or (ii) through the easement from the sag in Edward St; and

(c) Design the proposed swale based on this flowrate;

(d) Design of piped system beneath Bonar St to convey 100yr flows to the downstream property.

4.1.1 METHODOLOGY

The following methodology was forwarded to RCC on the 16/06/2009:

- Site visit by HT to assess all intersections considered critical
- Create a drains model to represent the trunk pipe system and overland flowpath along Hirst St. Model shall include:
  - Catchment areas to Hirst St, up to and including Duff St.
  - The upstream trunk system flowing with 50% blockage
  - Levels based on existing survey information (where available) plus contours from council records and topographic imagery.
  - Discharge from Industrial area on Loftus directed to trunk pipe, with overflow to Loftus.
- Determine surface flows along Hirst St at intersection with (a) Broe Avenue; and (b) Loftus St.
- Undertake either a mannings calculation or unsteady modelling within DRAINS at both intersection of Hirst with Broe and Loftus to determine applicable flow 'splits'.
- Here, the flow split at intersection with Loftus will consider flows entering Loftus, Kelsey and along Hirst.
- Re-document swale to extend to lowpoint of Loftus.
- Provide weir calculations to allow water to enter swale from lowpoint of Loftus.
- Ensure swale has capacity to convey the new flowrate
- Confirm depth of flow along channel and determine floor levels based on councils variable freeboard guidelines and document on long section.

4.1.2 DRAINS MODEL DEVELOPMENT

In order to estimate the 100yr peak flow at the Loftus St sag point (which will be conveyed through the proposed swale and beneath Bonar St to the downstream property), HT developed a DRAINS model.

Here a network of pits and pipes were created to represent the trunk pipe system beneath Hirst St. By assigning road cross section and surface levels, the unsteady modelling was then able to estimate surface flows in excess of piped flows (at 50% capacity).

The overall catchment directed to Loftus St was determined based on RCC stormwater plans and contours (received 3rd June 2009). Refer catchment plan in Appendix A. Here surface levels and grades were interpolated from contours, while pipes were assumed to follow the same profile.

Pits A6 and A7 are representative of upstream pipe systems, consequently special inlet parameters were incorporated to represent 50% blockages for the network. Here 825mm dia pipe at 3.0% with a capacity of 2.48m^3/s was restricted to 1.24m^3/s (between pits A6 and A5). 50% blockages were then applied on all other pits in the network.

Topographic contours indicate that a portion of flows being conveyed along Hirst St will likely be directed towards the sag in Edward St. This flow split is conservatively estimated at 50% (1.77m^3/s each way) and is modelled at "Edward Node 1".

RCC records indicate that there is an easement which bisects the buildings and conveys flows from the sag point in Edward St (Pit B3) to the sag point in Loftus St (Pit B1 and B2). Levels indicate that ponding will breach the kerb and verge at the sag point (Pit B3) prior to re-entering Hirst St (Pit A4).

The flow split at the Hirst – Loftus St intersection is considered the critical point. Here flows are either split to Kelsey St, Loftus St or continue along Hirst St.

In order to model this area, existing contours were assessed to determine both road cross sections and levels at crucial points (refer to sketch in Appendix A). Here road cross sections were modelled at sections 1-6 and applied in the model. Levels were assessed in order to represent when each section will start to function in the unsteady modelling. DRAINS modelling incorporated these via a series of dummy nodes and links at the roundabout. See figure 4.1.

The future industrial redevelopment area on the northern side of Loftus St is assumed to discharge to the trunk pipe system in Hirst St with overflows being directed to Loftus via the flow split.

The proposed swale was also modelled within drains from the relocated sag point in Loftus St to the headwall outlet at Bonar St.

Here swale includes:

- CH0.00 to Ch11 → 1.2m wide by 1.0m deep swale concrete lined (n = 0.015). Retaining walls to form sides of channel. Refer detail on drawing C130.
- CH11– CH86 → 5.0m wide by 0.7m deep swale with planting (n = 0.05). Building face to form one side of the channel with 1V:2H batter slopes offset 0.5m from fence forming the other side of the channel. Refer detail on drawing C130.
- CH86 – CH145 → 5.0m wide by 0.7-1.9m deep swale with planting (n = 0.05). Retaining walls to form sides of channel with varying height to match existing boundary levels. Refer detail on drawing C130.
- Minimum 1% longitudinal grade.
- Tailwater conditions were dictated by the proposed pipe in Bonar St. Here tailwater levels for the Q_{100} were assumed 0.15m below grate level at pit "NBonar 1" (surcharge pit in adjacent property for future connection).

To allow surface flows to effectively be conveyed from the Loftus Sag to the swale, a 15m wide weir is modelled within the verge. Here, once ponding occurs and overtops the kerb, surface flows can then directly enter the swale. Refer to Section 1 on drawing C130.

The following weir parameters were used to model the opening to the swale using the unsteady modelling component of DRAINS (Pit B1 - SwaleN1):

- 15m wide opening at RL11.71;
- Weir Equation $C*L*H^{3/2}$ (C = 1.7 broad crested weir).

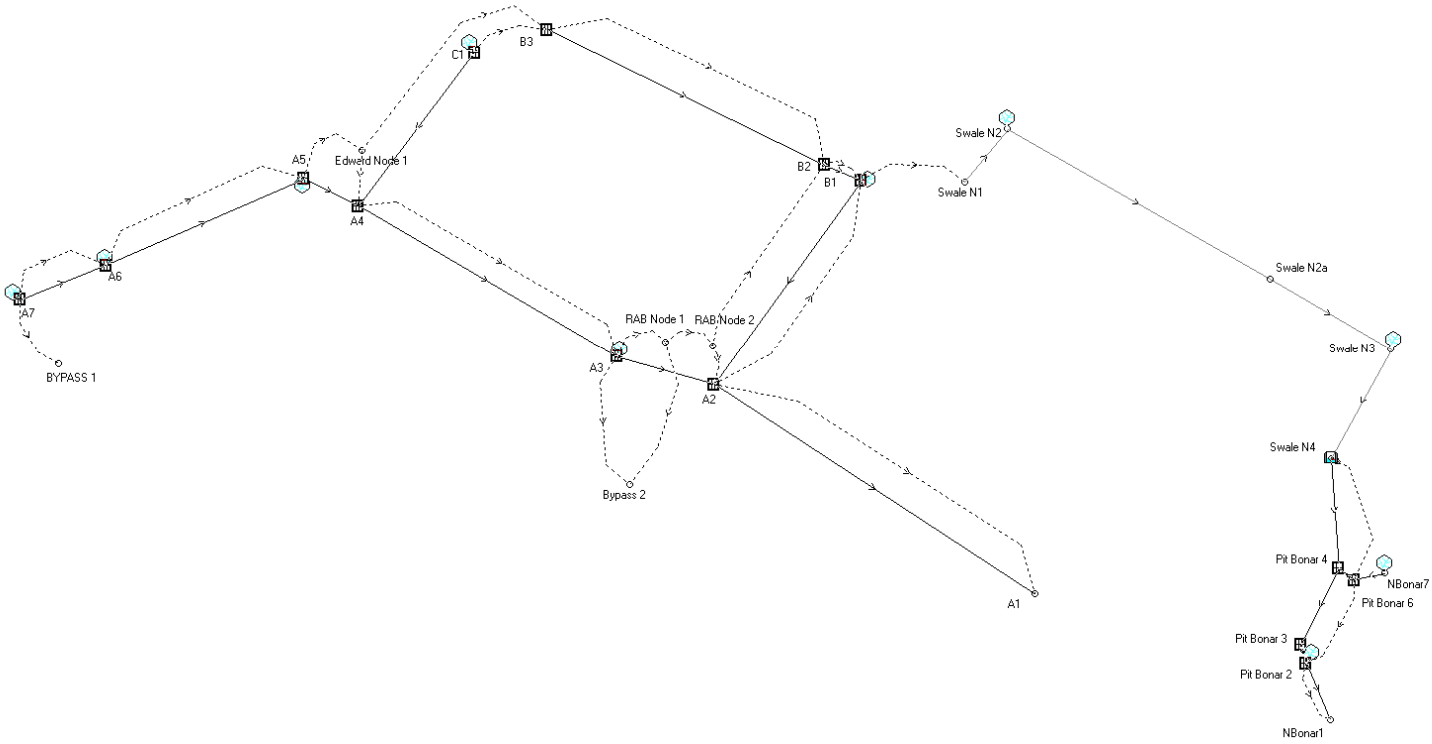

Figure 4.1 – DRAINS Network

4.1.3 DRAINS RESULTS

Refer to sketch SK02 in Appendix A. By incorporating 50% blockage in the trunk piped system, results indicate that 3.55m^3/s is directed overland (1.24m^3/s piped) along Hirst St towards the intersection with Edward St (Pit A5-A4)

By incorporating the 50% split at the intersection, 1.77m^3/s of overland flow continues along Hirst St towards the Hirst-Loftus St roundabout (between pit A4 and A3) while the remaining 1.77m^3/s is directed to the sag in Edward St (Pit A4-B3)

Due to the two-way crossfall on Hirst St north of the roundabout, when flows exceed crest level at the centreline, a portion of flows are then conveyed to the west (0.6m^3/s) and bypass to Kelsey St (at "RAB Node 1").

(This also occurs at the Hirst St intersection with Broe St. Here by incorporating a crest level 0.15m higher than kerb level, 1.36m^3/s bypasses down Broe St).

Those flows which continue around the roundabout are then further split between Hirst St and Loftus St at "RAB Node 2" (0.84m^3/s and 0.42m^3/s respectively).

Topographic contours indicate that ponding in Edward St will breach the kerb and verge at the sag point (Pit B3) prior to re-entering Hirst St (Pit A4). Here results indicate that 2.02m^3/s of overland flow is directed towards the sag in Loftus St.

100 year ARI peak discharges were subsequently determined at key nodes along the overland flow path.

- Sag in Loftus Street (Swale N1) 3.70m^3/s
- Overland Flow Swale N2 3.93m^3/s
- Overland Flow Swale N3 4.39m^3/s

Table 4.1 – DRAINS results

	Node (m^3/s)		
Time (min)	Swale N1	Swale N2	Swale N3
5	2.46	2.57	2.77
10	3.08	3.28	3.71
15	3.46	3.68	4.17
20	3.65	3.88	4.36
25	**3.7**	**3.93**	**4.39**
30	3.59	3.81	4.28
45	3.36	3.58	4.08
60	3.42	3.64	4.13
90	3.42	3.64	4.12
120	3.39	3.62	4.11
180	2.17	2.31	2.67

These flow rates were analysed within the swale using the unsteady modelling component of DRAINS.(refer to Appendix A).

Here results indicate that 100yr flows are contained within the proposed swale (refer details on drawing C111, C114 and C130). The following TWL were achieved for the Q_{100} yr event.

Table 4.2 – DRAINS results

Chainage	TWL	Swale IL	Top Swale
0	11.29	10.45	11.71 (verge)
11	10.92	10.34	11.71 (verge)
120	9.76	9.25	10.0 (11.92 top wall to match boundary)
145	9.67	8.30	10.20 (top wall to match boundary)

In accordance with council's freeboard guidelines, a variable freeboard of 0.2-0.5m is applied dependent on depth of flow. Refer to long section on drawing DAC130 for minimum heights of habitable floor levels.

Table 4.3 – Swale Opening / Building Frontage Results

Invert of weir	TWL	Min FL (with variable freeboard)	Floor Level incorporated
11.71	11.88	12.05	12.50
Invert of kerb	**Ponding RL**	**Min FL (with variable freeboard)**	**Floor Level**
11.61	12.03	12.45	12.50

DRAINS results along the NW frontage of the proposed development (i.e ponding at the lowpoint of Loftus and the opening to the swale) indicate that surface flows are conveyed across the verge and into the swale in accordance with RCC standards. Here results indicate that variable freeboard is satisfied to the habitable floor level of RL12.50.

Refer to Table 4.3 and Section 1 on drawing C130 for results.

4.1.4 DISCUSSION OF COUNCIL ITEMS

Reference is made to the items raised by council in Appendix C. Here the following has been incorporated in this report:

5th June 2009

- HT has modified modelling to suit the larger catchment areas as required;
- Additional catchment areas raised in item 8 (b) (iii) are included in the revised catchment area;
- Crest of road at the intersection of Willington St and Loftus St is modelled to drain into Loftus St;
- The redeveloped industrial area is modelled to discharge to the trunk pipe system since the whole area draining to the system is modelled. Overflows provided to Loftus by means of the flow split;
- 50% blockage factors applied to Loftus St sag pit;
- 50% blockage factors applied to Hirst St pits;
- Unsteady modelling has been undertaken to determine flow splits at the Roundabout and other intersections;
- Proposed methodology and minutes were forwarded to RCC;
- HT has reviewed the swale design and relationship to the Loftus St sag. Design revised to shift sag to front of swale by means of pavement / kerb reconstruction;
- Similarly opening of blisters for low flows along kerbline; and
- Variable freeboard incorporated (refer plan and long section on drawing C111, C114 and C130.

30th July 2009

- HT has modified the drains modelling to incorporate the sag in Edward St and subsequently assessed the implications on the overall flowrate at the swale. Here a 50% flow split was considered towards the Edward St sag (1.77m3/s). The effect that this split has on the model is (a) less water is directed overland towards the Loftus St / Hirst St roundabout - which effects the associated flowsplit at the RAB; and (b) more water is directed towards the easement and then onto Loftus St.

  Results indicate that by taking into consideration the sag in Edward St, the overall flowrate at the swale is increased by $0.54m^3/s$ to $3.70m^3/s$. Results also indicate that less surface flow is directed to Kelsey St from the RAB.
- HT has prepared a section through the verge at the opening to the swale within Loftus St (refer Section 1 on drawing C130), while weir calculations were performed within drains (refer table 4.3). Here results demonstrate that (a) surface flows are conveyed across the verge and into the swale without entering the building; and (b) variable freeboard is achieved to the habitable floor level of RL12.50.

  Analysis indicated that a flood protection wall or relocated entry is not required at this entry point.
- Position of swale has been shifted to be flush with the proposed building. Here the edge of building shall form one side of the swale, while a batter 1V:2H shall transition to existing levels on the other.
- Pipe system has been designed to convey 100yr flows from the swale headwall and discharge within the downstream property. Piped system incorporated 1.8m x 0.9m box culverts, refer to drains results and drawing C113. Full details to be provided in detailed design stage.
- Protection grid provided over the headwall entry. Full details to be provided in detailed design stage.

4.2 On-Site Detention Systems

The proposed on-site detention (OSD) system has been designed in accordance with Council's DCP 78 and consists of three (3) below ground tanks located in the basement parking levels of the development.

The site falls within the Bonnie Doon catchment area with a 50 year ARI SSR of 285m^3/ha and a PSD of 210l/s/ha. The corresponding 2 year ARI SSR is 128.25m^3/ha and PSD is 73.5l/s/ha. Refer to Appendix B – OSD calculation spreadsheets for details.

APPENDIX A

DRAINS MODELLING AND RESULTS