MIDDLETON GRANGE TOWN CENTRE

STORMWATER MANAGEMENT STRATEGY

Manta Group Pty Ltd

August 2017

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Integrated Management System

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GLOSSARY OF TERMS

12D Model is a powerful terrain modelling, surveying and civil engineering software package used to develop the underlying surface for the 2D modelling.

Airborne Laser Survey (ALS) is a technique for obtaining a definition of the surface elevation (ground, buildings, power lines, trees, etc.) by pulsing a laser beam at the ground from an airborne vehicle (generally a plane) and measuring the time taken for the laser beam to return to a scanning device fixed to the plane. The time taken is a measure of the distance which, when ground truthed, is generally accurate to + 150mm.

Annual Exceedance Probability (AEP) is the chance or probability of a natural hazard event (usually a rainfall or flooding event) occurring annually and is usually expressed as a percentage.

Average Recurrence Interval (ARI) means the average statistical interval (in years) between occurrences of floods, storms and flows of a particular magnitude.

Australian Rainfall and Runoff (AR&R) refers to the current edition of Australian Rainfall and Runoff published by the Institution of Engineers, Australia.

CatchmentSIM is a 3D-GIS application specifically tailored to hydrology based applications. CatchmentSIM is used to delineate a catchment, break it up into sub catchments, determine their areas and spatial topographic attributes and analyse each sub catchment's hydrologic characteristics to provide insight into the rainfall response of various catchments and the resultant assignment of hydrologic modelling parameters.

Dam Safety Committee (DSC) is a NSW statutory body aligned with Department of Primary Industries. Its function is to ensure the safety of dams within the state.

Digital Terrain Model (DTM) is a spatially referenced three-dimensional (3D) representation of the ground surface represented as discrete point elevations where each cell in the grid represents an elevation above an established datum.

DRAINS is a Stormwater Drainage System design and analysis program. The RAFTS runoff routing model was used within the DRAINS software package. It has been widely used for urban stormwater system design and analysis in Australia and New Zealand.

Exceedances per Year (EY) is the number of times a year that statistically a storm flow will be exceeded.

Floodplain Development Manual (FDM) and Guidelines (April 2005), the FDM is a document issued by DECCW that provides a strategic approach to floodplain management. The guidelines have been issued by the NSW DoP to clarify issues regarding the setting of FPL's.

Hyetograph is the distribution of rainfall over time.

Hydrograph is a graph that shows how the stormwater discharge changes with time at any particular location.

Hydrology The term given to the study of the rainfall and runoff process as it relates to the derivation of hydrographs for given floods.

J. Wyndham Prince Pty Ltd (JWP) Consultant Civil Infrastructure Engineers and Project Managers undertaking these investigations

MUSIC is a modelling package designed to help urban stormwater professionals visualise possible strategies to tackle urban stormwater hydrology and pollution impacts. MUSIC stands for Model for Urban Stormwater Improvement Conceptualisation and has been developed by Cooperative Research Centre (CRC),

Peak Discharge is the maximum stormwater runoff that occurs during a flood event

Probable Maximum Flood (PMF) is the greatest depth of precipitation for a given duration meteorologically possible for a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends." largest flood that could be

Triangular Irregular Network (TIN) is a technique used in the created DTM by developing a mass of interconnected triangles. For each triangle, the ground level is defined at each of the three vertices, thereby defining a plane surface over the area of the triangle

TUFLOW is a computer program that provides two-dimensional (2D) and one dimensional (1D) solutions of the free surface flow equations to simulate flood and tidal wave propagation. It is specifically beneficial where the hydrodynamic behaviour, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be awkward to represent using traditional 1D network models.

XP-RAFTS runoff routing model that uses the Laurenson non-linear runoff routing procedure to develop a sub catchment stormwater runoff hydrograph from either an actual event (recorded rainfall time series) or a design storm utilising Intensity-Frequency-Duration data together with dimensionless storm temporal patterns as well as standard AR&R 1987 data.

1 INTRODUCTION

J. Wyndham Prince has been engaged by The Manta Group to further assess the flood impacts of a section of the Southern Creek within Middleton Grange.

As part of the original masterplan the section drainage reserve that drains through the Town Centre was to be an open channel with a series of road crossings. As part of the current gateway proposal being considered by Liverpool City Council, this section through the Town Centre is proposed to be "piped". The piping of this channel will allow approximately 2900 m² of additional land to be used, enhancing the urban outcome of the Middleton Grange Residential Precinct.

The main purpose of this report is to gain Council's 'in principle' support to alter the proposed S7 trunk drainage element from a channel to a box culvert. This in turn will satisfy the requirements of the Gateway Determination and allow for exhibition of the Precinct.

J. Wyndham Prince previously completed a simplified, one dimensional flow analysis in May 2017. The assessment in this has to be a more sophisticated, two dimensional (TUFLOW) model in order to address a series of concerns raised by Liverpool City Council with previous assessments.

This Assessment has been completed using best industry practice and provides the necessary flood constraint information and a water treatment solution to support the current planning proposal submission to Liverpool City Council.

2 PREVIOUS STUDIES

2.1 Hydrological and Hydraulic Study Southern Hoxton Park Aerodrome Precinct Report, (J. Wyndham Prince 2004)

A Hydrological and Hydraulic Study for the Southern Hoxton Park Aerodrome Precinct, which includes the subject site, was prepared by J. Wyndham Prince Pty Ltd in 2004. The study made key recommendations relevant to this report, outlined below:

- Detention basins be sized to restrict post development discharges for storms up to the 1% AEP design event to pre-development levels to ensure no impact on surrounding properties and properties further downstream. As documented in the *Cabramatta Creek Flood Study and Basin Strategy Review* (Bewsher, September 2011), these detention basins have since been constructed.

Therefore, development within the study area will not result in significant flood impacts to other properties, as appropriate mitigation measures have already been considered as part of a broader regional strategy.

The southern creek has been modified and realigned in the past with little original riparian vegetation currently present. While it was proposed in the *Hydrological and Hydraulic Study Southern Hoxton Park Aerodrome Precinct Report* that this watercourse be reconstructed as a natural channel, the piping of this section will not affect any existing riparian areas.

2.2 Southern Creek Hydraulic Study – Southern Hoxton Park Aerodrome Precinct (J. Wyndham Prince Pty Ltd , 2004)

This report details the procedures used and presents the results of investigations undertaken by J. Wyndham Prince Pty Ltd in determining existing flood levels on the Southern Creek Watercourse.

2.3 Water Cycle Management Facilities Design Report: Middleton Grange, (J. Wyndham Prince, 2005)

This report detailed the procedures used and presents the results of an assessment of a hydrological and hydraulic analysis of the proposed detention basins Central Creek and Southern Creek riparian corridors. It was prepared in support of an application for a Construction Certificate that was made to Liverpool City Council. (Plan reference 7576/E1 to 7576/E35).

The hydraulic assessment for this report was undertaken in HEC-RAS and the hydrologic assessment was undertaken in XP-RAFTS.

These models were used as the basis for the models in this report.

2.4 "Piped Option for Southern Creek Section S7" (J. Wyndham Prince, May 2017)

In 2017, J. Wyndham Prince wrote a letter addressed to Liverpool City Council outlining the advantages of piping 'Section 7' of the channel, the portion the divides the town centre.

This letter used 1D modelling originally undertaken as part of the *Hydrological and Hydraulic Study Southern Hoxton Park Aerodrome Precinct Report* (J. Wyndham Prince, 2004) to support the assessment. While this modelling showed that there were no additional adverse impacts in the town centre as a result of the piping of Section 7, Council required an assessment of large stormwater events to be undertaken.

This report identified that the site is located well clear of regional flooding and based on contours in the area, evacuation could easily occur towards a higher area with a rising grade. On this basis, this report noted that many of SES's comments in their letter to Liverpool City Council, dated 10th February 2017, were not applicable to the site and are therefore satisfied.

3 BACKGROUND

The Southern Creek drains to Hinchinbrook Creek, which forms part of the greater Cabramatta Creek system and runs through the southern section of Middleton Grange. The original plan for its construction was as a bio-engineered natural channel along its entire length. It is now proposed that Section S7, approximately 170m of the southern creek adjacent to the proposed town centre is piped.

Section S7 is described in the Hydrological and Hydraulic Study Southern Hoxton Park Aerodrome Precinct Report as an 18 m wide landscaped open channel. Plate 3.1 shows the Section S7 provides an overview of S7 within the Middleton Grange Precinct, while Plate 3.2 shows its existing LEP zoning.

In August 2016, The Manta Group received advice from the Gateway Determination (issued by the Department of Planning and Environment), that the reallocation of land for public purposes under S117 Direction 6.2 (i.e. a culvert arrangement) was acceptable, so long as the outcome 'facilitates better design outcomes'.

Subsequent advice from Liverpool City Council indicated that if Manta Group intends to proceed with channel modifications, full details of the proposed modification works with justification would be required including:

1. Hydraulic impact assessment assessing the impact of the proposed update on final Developed Conditions (full range of design flood events up to the probable maximum flood (PMF)).

2. Water quality management strategy using MUSIC model, under full catchment development conditions.

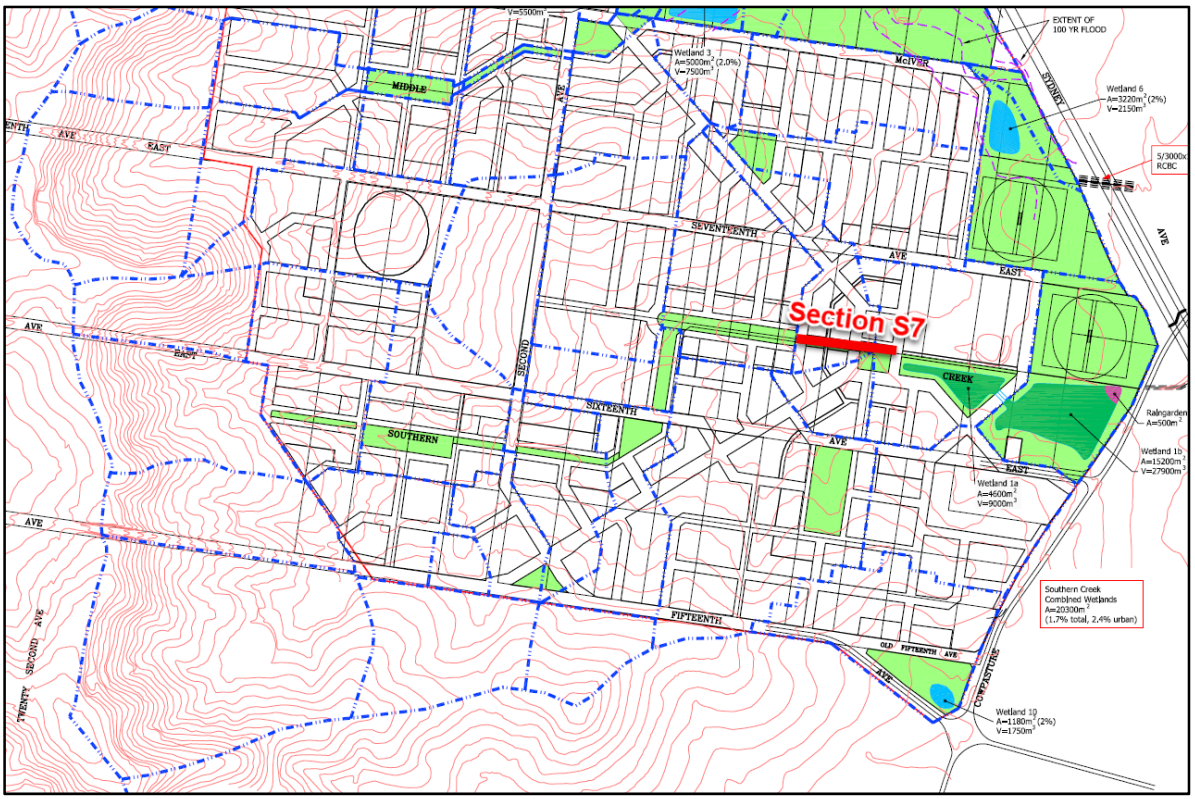

Plate 3.1 – Site Locality

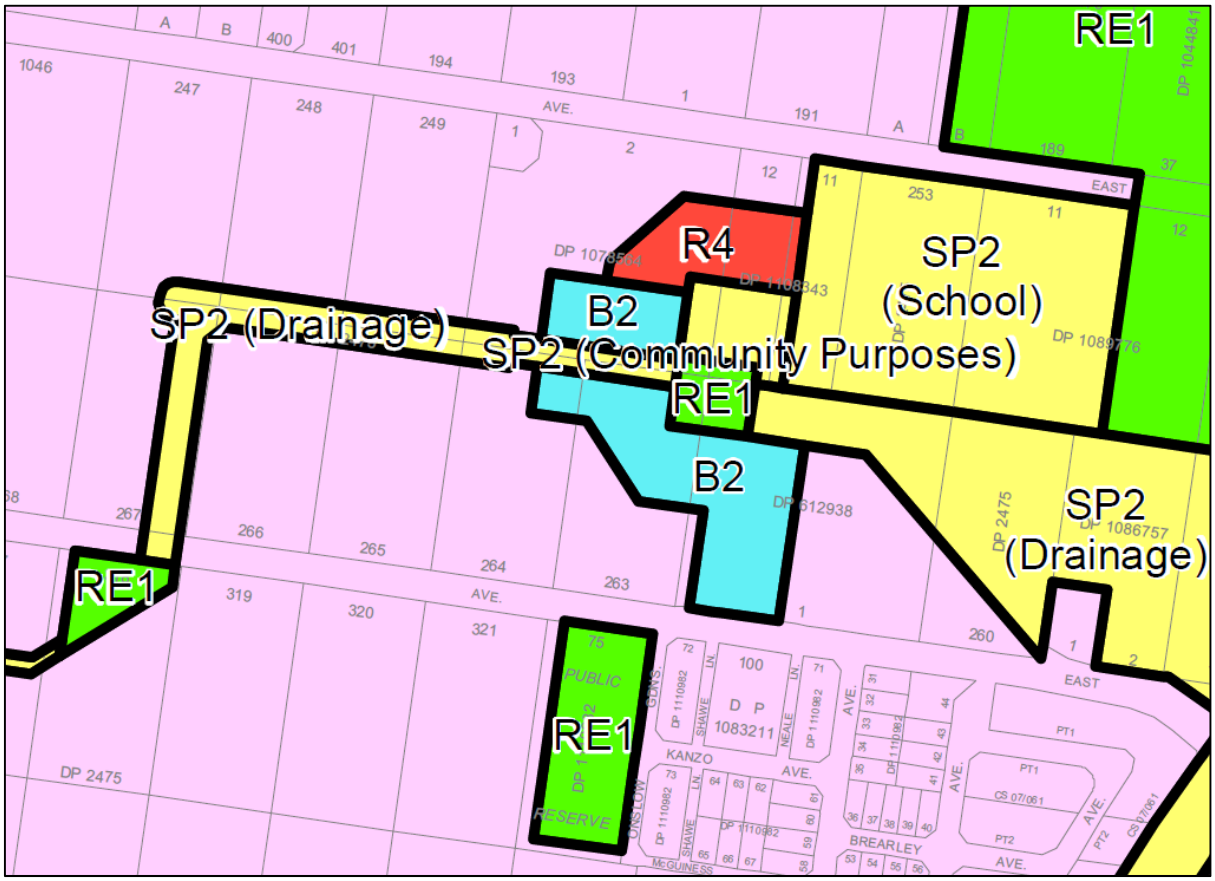

Plate 3.2 – Liverpool City Council Zoning Map Extract

3.1 Middleton Grange Town Centre

The proposed Middleton Grange Town Centre will be located on either side of the trunk drainage element. The planning proposal anticipates approximately 912 dwellings, 20,240 m² of retail floor space and 2,533 m² of other commercial uses. Plate 3.3 shows the proposed Town Centre Masterplan.

On 11 July 2008, Construction Certificate (CC) plans were submitted to Council (in relation to DA 9014/DA02) and sought approval for road works, excavation, drainage and sewer construction. Council subsequently reviewed and approved the CC plans. The design included culvert sized to accommodate the 1% AEP event flood scenario including all drainage downstream. Part of these works was completed in 2009.

It is noted that the existing stormwater system downstream of Section 7 was designed to accommodate future 1% AEP development flows regardless of whether the channel is “open” or “piped”. Therefore, the piping of this section would not result in any adverse impacts on any property in terms of flooding in the future development scenario. The existing stormwater system on site has been approved as part of a previous DA.

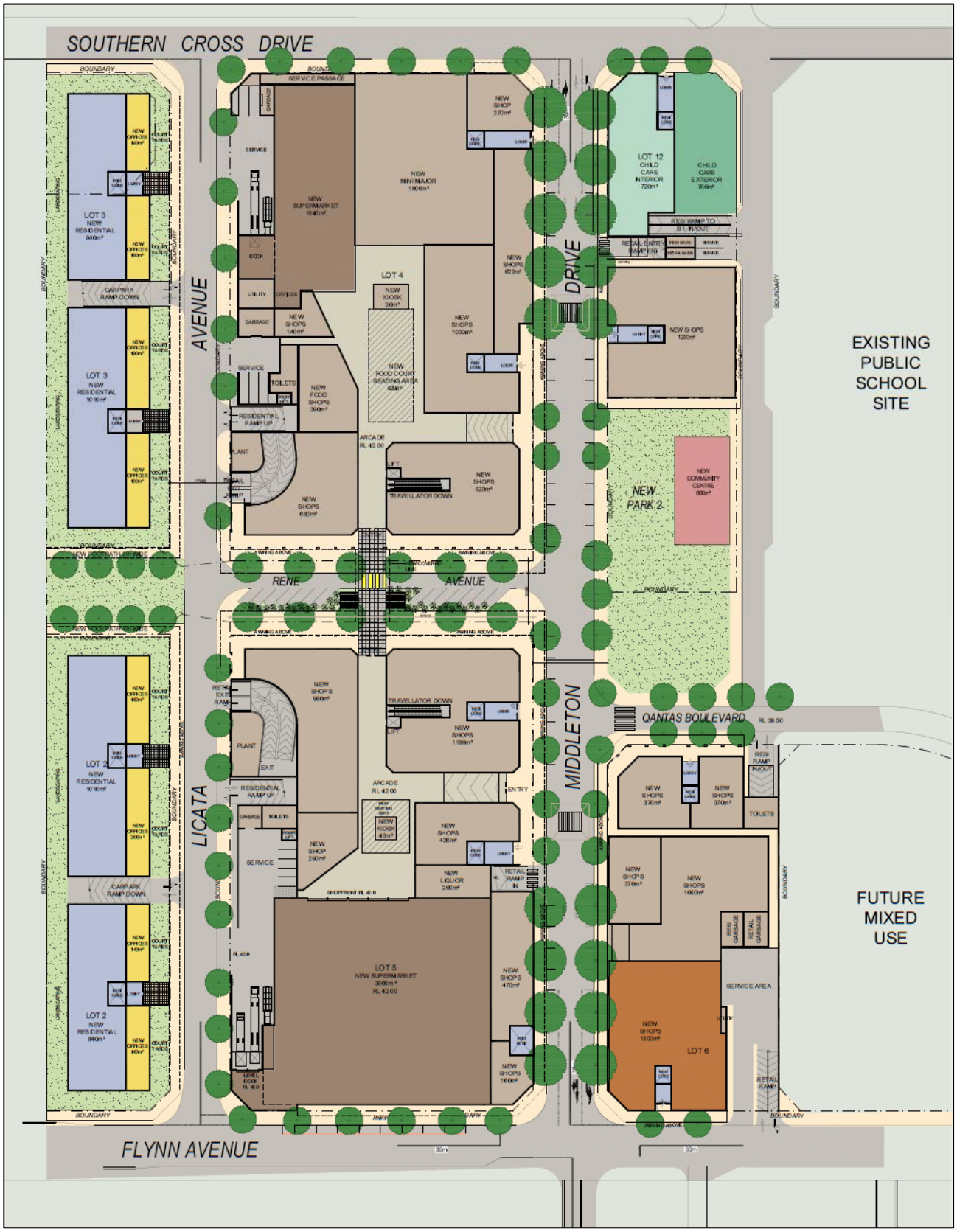

Plate 3.3 – Proposed Middleton Grange Town Centre

4 PROPOSED CULVERT ARRANGEMENT

The system has been designed to manage the 1% AEP event. The system captures (via an inlet structure on the upstream side of Road No.7) the 1% AEP flow of 15 m³/s. Flows are conveyed via three (3) 3600 x 900 mm reinforced concrete box culverts (RCBC's) at a grade of 0.5% to the future wetland and discharge at a level, RL of 37.3.

Given the existing downstream basin has already been constructed and thus a fixed constraint and that the original gradient of the upstream channel is also 0.5%, the proposed culvert is anticipated to be constructed 0.5% grade also. As Figure 6.10 and 6.18 of this report indicate, the proposed culvert provides adequate flow conveyance for all modelled events at a grade of 0.5%.

During the DA assessment for this infrastructure, more frequently occurring storm events will be analysed (i.e. 0.5 EY) to ensure that this culvert can achieve self-cleaning velocities, and as such will not require excessive maintenance by council long term. At DA stage, a comprehensive operation and maintenance manual will be prepared for the proposed culvert, and the design would ensure that there are no additional maintenance burden of Council over and above normal culvert maintenance.

Further 1% AEP flows of 9.73 m³/s enter the box culverts via a special inlet structure upstream of road No10. Refer to Plate 4.1. The Details of the proposed arrangement are provided in Appendix C.

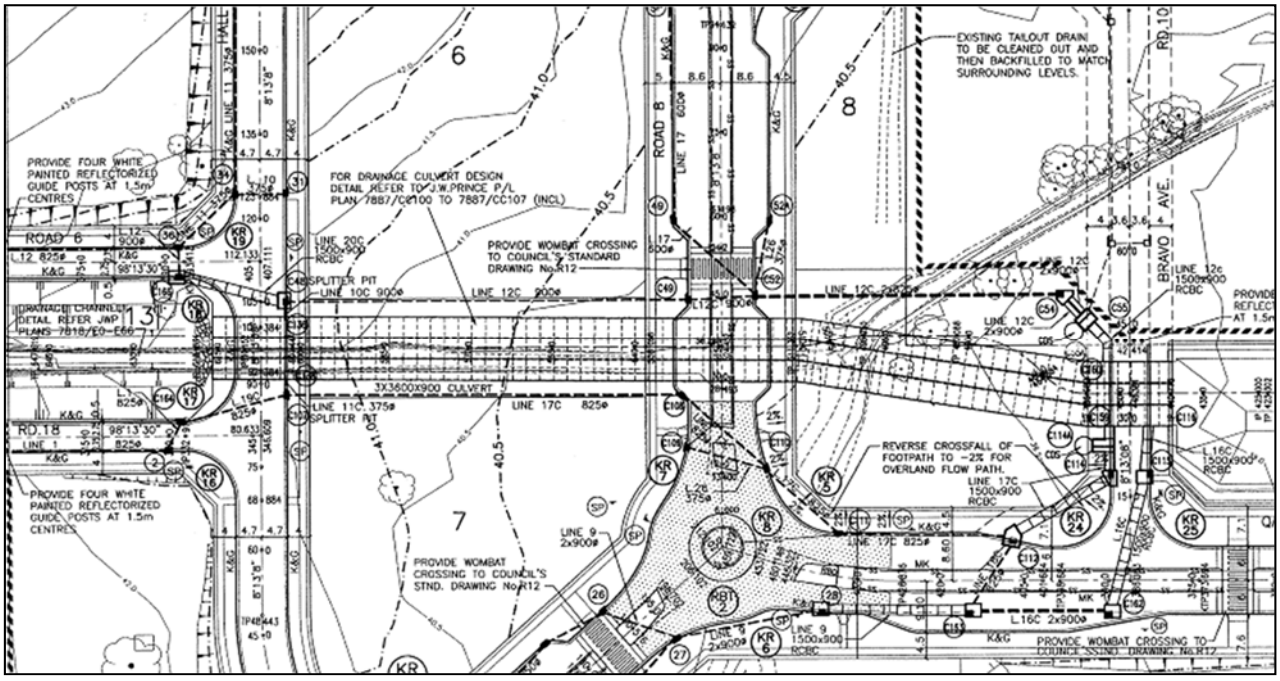

Plate 4.1 Proposed Piped Arrangement

Flows in excess of the 1% AEP event will be conveyed overland. Detailed results are provided in Appendix B.

5 HYDROLOGIC ANALYSIS

The hydrologic analysis for the local catchments was undertaken using the rainfall - runoff flood routing model XP-RAFTS (Runoff and Flow Training Simulation with XP Graphical Interface) (Willing, 1996 & 1994). The hydrologic analysis was undertaken to determine flow hydrographs for the local catchments in the Southern Creek.

For the purposes of the assessment, the 1% AEP and the PMF events have both been assessed, each with a range of storm durations analysed to determine the critical storm duration for each sub-catchment.

5.1 Modelling Inputs and Assumptions

Sub-catchment areas contributing to this drainage system were adopted from the Water Cycle Management Facilities Design Report (J. Wyndham Prince, 2005). These subcatchments were established through site investigations, detail survey, and generally consistent with the approved CC plan for the culvert option. Details of the area, slopes and assumed percentage impervious are provided below in Table 5.1 from the original 2005 assessment. Refer to Figure 5.1 for the XP-RAFTS model layout.

Table 5.1 –Catchment Description

Catchment Name	Area (Ha)	Slope	Percentage Impervious
1	15.38	8%	10%
1.15	2.91	1%	38%
7	3.1	1%	80%
6.01	1.23	1%	87%
1.14	9.1	2%	70%
1.09	3.431	3%	80%
2.01	1.551	3%	80%
6	12.98	3%	80%
1.06	7.55	3%	80%
8	7.45	3%	80%
1.02	1.131	4%	80%
1.04	3.23	4%	80%
2	5.15	4%	30%
1.12	3.67	4%	86%
1.11	6.44	4%	80%
4	4.885	4%	96%
4.01	6.766	4%	97%
3.02	6.514	5%	80%
3.03	4.78	5%	96%
1.01	4.59	8%	10%
5	2.46	8%	80%
3	3.39	10%	10%
3.01	6.01	12%	10%

A review of these subcatchments was undertaken to determine if they were fit for use in the TUFLOW model. The original catchments were largely kept consistent with the original catchments with the following minor adjustments:

- The impervious percentage of each subcatchments was then adjusted to reflect the most current LEP land use.

Where land use changes occur within individual subcatchments, the percentage impervious was average.

Table 5.2 –Percentage Impervious Area

Land Use	Percentage Impervious
Open Space	5%
Residential	80%
Commercial/industrial	90-100% (varies)

- Minor adjustments of the catchments boundaries were undertaken to ensure that they were suitable for use in the TUFLOW model.

XP-RAFTS modelling was undertaken using a standard initial and continuing loss rate model. The values adopted for XP-RAFTS modelling are as follows:

Table 5.3 –Loss Values

	Initial Loss (mm)	Continuing Loss (mm/hr)
Pervious areas	10	2.5
impervious areas	1.5	0

Standard PMP parameters for the Sydney Basin were used in a Generalised Short Duration Method (GSDM).

Table 5.4 –PMP parameters

PMP Parameters	
Moisture adjustment factor	0.7
Elevation adjustment factor	1
Percentage defined as 'rough'	0

5.2 Hydrologic Model Calibration

It is normal practice for flood routing models such as XP-RAFTS to be calibrated with historical rainfall and stream flow data for the catchment being investigated in order to produce the most reliable results. The model parameter values are adjusted so that the model adequately reproduces observed hydrographs. As no streamflow records are available for this location, calibration was previously undertaken in the 2005 *"Watercycle management facilities Design Report"* by comparing the results from a number of recognised flow estimation techniques and adjusting the XP-RAFTS model to provide similar results. The (Bx) value determined by this calibration process was 1.5. The Storage Non-linearity exponent (n) was set at the default value of -0.285. Our assessment has kept the hydrological model consistent with the original assessment, so these values have been maintained.

The results of the hydrologic XP- RAFTS model do vary from the original model. Software updates within XP-RAFTS, the refined catchment boundaries and the increase in impervious area are attributed to account for this difference.

6 FLOOD MODELLING

The flood modelling undertaken to assess both mainstream and major overland flooding within the southern creek catchment has been completed using TUFLOW. TUFLOW is a computational engine that provides two-dimensional (2D) and one-dimensional (1D) solutions of the free surface flow equations to simulate flood and tidal wave propagation (TUFLOW 2016). TUFLOW is specifically beneficial where the hydrodynamic behaviour in coastal waters, estuaries, rivers, floodplains and urban drainage environments have complex 2D flow patterns that would be difficult to represent using traditional 1D network models.

Most flows within the southern creek catchment were modelled as 2D flows with the channel also represented in the 2D domain. A 2D model provides a better estimation of the effects of momentum transfer between in-bank and overbank flows and the energy losses due to meanders or bends in creeks. ID connections were used to represent the culverts within the model. MapInfo, a GIS based software tool, was used for interrogating and plotting the results as well as creating the flood extents maps and the flood level difference maps.

The TUFLOW Analysis was undertaken to determine flood extents within Middleton Grange Town Centre for post developed conditions, both with the piped option and the open channel option. The assessment has analysed the 1% AEP and PMF flood events, with a range of storm durations assessed to determine a “peak of peaks” for flooding within the catchment.

6.1 TUFLOW Model Development

The TUFLOW model used in the assessment was adopted from the existing HEC-RAS model. Refer to Figure 7.1 for the TUFLOW model layout. For the purposes of this assessment, a number of assumptions were made to the model the catchment. These assumptions are outlined below:

6.1.1 Terrain

A grid size of 2 m was adopted to provide an accurate definition of the area. The underlying digital terrain model (DTM) was based on survey information and a design surface of the southern creek.

The “channel” option assessed is based on the originally arrangement of a channel through the Proposed Middleton Grange Town Centre with three (3) road crossings based on the originally proposed design surface.

The “culvert” option is consistent with the current masterplan which includes a revised road layout. This layer is typically at a higher RL than the originally proposed culvert layout.

Refer to Figure 6.1 and 6.2 for a surface comparison between the two events.

6.1.2 Flows and Upstream Boundary Conditions

Flow hydrographs were applied to represent flows entering the model from both upstream and local catchments within the southern creek catchment. Flow hydrographs were applied either as a “Source Area” (SA) input or a one dimensional boundary condition in situations where flows will be captured and conveyed to the culvert by an appropriately designed street drainage network. Flow hydrographs from the XP-RAFTS model were used for the flood modelling.

6.1.3 Downstream Boundary Conditions

The downstream boundary condition for the southern creek was set as a “HT” (Height versus Time) relationship. The selected water level at the downstream boundary of the model was determined from the flood information in the *Water Cycle Management Facilities Design Report (J. Wyndham Prince)* and set to the tailwater level in the downstream basin of RL 35.6 mAHD.

6.1.4 Material Roughness

Various material were defined within the model based on review of aerial imagery and the Masterplan for the Middleton Grange Town Centre development. Material roughness was consistent between the channel and piped options with the exception of the area directly above the culvert. Refer to Figure 6.3 for further details.

6.1.5 Initial Water Level

To account for antecedent rainfall in the catchment, the downstream basin was filled to the outlet level. This conservatively fills the basin reservoir to the spillway level prior to storm flows occurring in the catchment, and is likely to be the catchment conditions prior to both a 1% AEP and a PMF event.

6.1.6 Culvert Blockage

To account for any debris that may block the culverts, all events were modelled with all culverts at 50% blockage in addition to being modelled with no blockages.

6.2 Discussion of Flood Modelling Results

Flood depth and level mapping has been completed for the 1% AEP and PMF flood events under both “channel” and “piped” conditions. The flood depth, level and extent mapping for the southern creek is shown in Figure 6.4 to 6.19. Results indicate the following:

Under “Channel” conditions:

During the 1% AEP event, flows break out of the channel at the final culvert crossing in the town centre, while this was not reported in the previous HEC-RAS model. This is for two (2) reasons:

The impervious area percentage for many of the upstream catchments in this assessment has been increased from the original assessment to incorporate Council’s advice, which has increased peak flows through the channel.

The last culvert crossing is permanently submerged as a result of the 38.7mAHD weir in the basin. The HEC RAS model freely discharges into the basin with no downstream condition.

During the PMF event, much of the town centre is flooded as expected.

Under “Channel” conditions with 50% blockage:

A blockage scenario of the originally proposed channel has been provided for comparison. As the culverts become blocked, there is a greater proportion of flow breaching the banks of the channel through the town centre.

During the PMF event, much of the town centre is flooded and there is little difference between the unblocked and blocked conditions for this event.

Under “Piped” conditions:

During the 1% AEP event, results demonstrate that flows are fully contained within the culvert, and do not overtop the road or flow into the town centre. The outlet of the proposed culvert is higher than the weir that divides the basin, therefore the downstream end of the pipe is not initially in submerged conditions. This allows a higher peak flow of water through the culverts. Additionally, there is no impact on the flow upstream of the channel location. The development housing typography will ensure that a minimum of 0.5m freeboard will be incorporated in to housing design.

Under “Piped” conditions with 50% blockage:

During the 1% AEP event, flows break out of the channel, but are contained within the future road networks. There is less flooding during a blocked event using a piped configuration than there would be during channel conditions.

7 URBAN OUTCOME

The piping of this channel will provide both Liverpool City Council and the local community with an active, useable space.

The proposed design, which has a one-way street with parking, has evolved from discussions with RMS & the Liverpool Council traffic department. Typically, town squares without shorter roads, around 80m to 120m in length, tend to have lower interaction between the public and nearby cafes & restaurants. The additional off-street parking for shoppers and increased mobility of traffic will provide a better outcome for the town centre.

There is no intention to use the allocated SP2 land for anything other than the public interest. The main intent of piping this channel is to provide a better urban outcome for Liverpool City Council and the local residents.

The proposed piping of this channel will not only provide the required drainage solution, but will also provide additional space for use by local residents of Middleton Grange.

8 WATER QUALITY ASSESSMENT

As the pollutant loads for an open channel are comparable to the proposed an open space area, there will be no additional pollutants generated this alternate arrangement. Therefore, the existing water quality solution will be sufficient to cater for the new culvert arrangement.

9 FLOOD EVACUATION

Following a review of the *Liverpool City Local Flood Plan EMPLAN (2012)*, we note that the plan does not list Middleton Grange as a flood prone area and does not include a specific evacuation plan for this locality. The Cabramatta Creek Flood Study and Basin Strategy Review shows all flood extents within the Cabramatta Creek Catchment but does not include the southern creek tributary, presumably since it does not significantly impact flooding in Hinchinbrook Creek. There also does not appear to be existing flood evacuation plan for the SES in this area.

Based on a review of these documents, we understand that there is currently no evacuation plan for this locality. We also note that the site is located well clear of regional flooding and based on contours in the area, evacuation could easily occur towards a higher area with a rising grade. On this basis, we note that many of SES's comments in their letter to Liverpool City Council, dated 10th February 2017, are not applicable to the site and are therefore satisfied.

10 SUMMARY/CONCLUSION

This report details the investigation completed in order to gain Council's 'in principle' support to alter the configuration of Section S7 of southern creek from a landscaped channel to a box culvert arrangement.

The XP-RAFTS hydrologic modelling adopted has remained consistent with the original approach, with minor updates to better reflect current conditions. The assessment indicates that proposed arrangement of three (3) 3600 x 900 mm RCBC's will be sufficient to convey flows for Section S7. Detailed design of trunk drainage element S7 are provided in Appendix C

TUFLOW modelling results show that the proposed piping of the channel will result in an improved outcome for the town centre, as the proposed open channel no longer provides an appropriate means of conveying flows through the Town Centre due to a modification in the assumed catchment conditions. The allocated land will be used in the public interest, and will be a better use of the space for the community than the open channel.

As discussed in Section 9, the concerns raised by the SES have been addressed since the development is well clear of Cabramatta Creek and there is no current SES strategy in the area. Consequently, an emergency response is not required due to proximity of the site, absence of an SES plan in the area and rising grade from the site.

OEH comments have been addressed as follows:

- 1% AEP and PMF results of flooding are provided in Appendix B
- Flood Impacts are provided in Appendix B and show no impact to the surrounding properties.
- It is noted that no mitigation works are required to support this development since there is no impact on surrounding areas.
- The site is not located in flood prone land from Cabramatta Creek (Bewsher 2011) and therefore does not affect flood storage nor require compensatory works.

We trust that this provides Council with the necessary confidence that piping section S7 is a feasible option that provides a number of benefits over an open channel arrangement.

Should there be any queries regarding this matter please do not hesitate to contact David Crompton on 4720 3340 or dcrompton@jwprince.com.au

Yours faithfully
J. WYNDHAM PRINCE

DAVID CROMPTON
Manager – Stormwater & Environment

11 REFERENCES

1. Bewsher Consulting, (2011), *"Cabramatta Creek Flood Study and Basin Strategy Review"*
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4. J Wyndham Prince, (2005), *"Water Cycle Management Facilities Design Report: Middleton Grange."*
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Appendix A – XP-RAFTS Model Layout

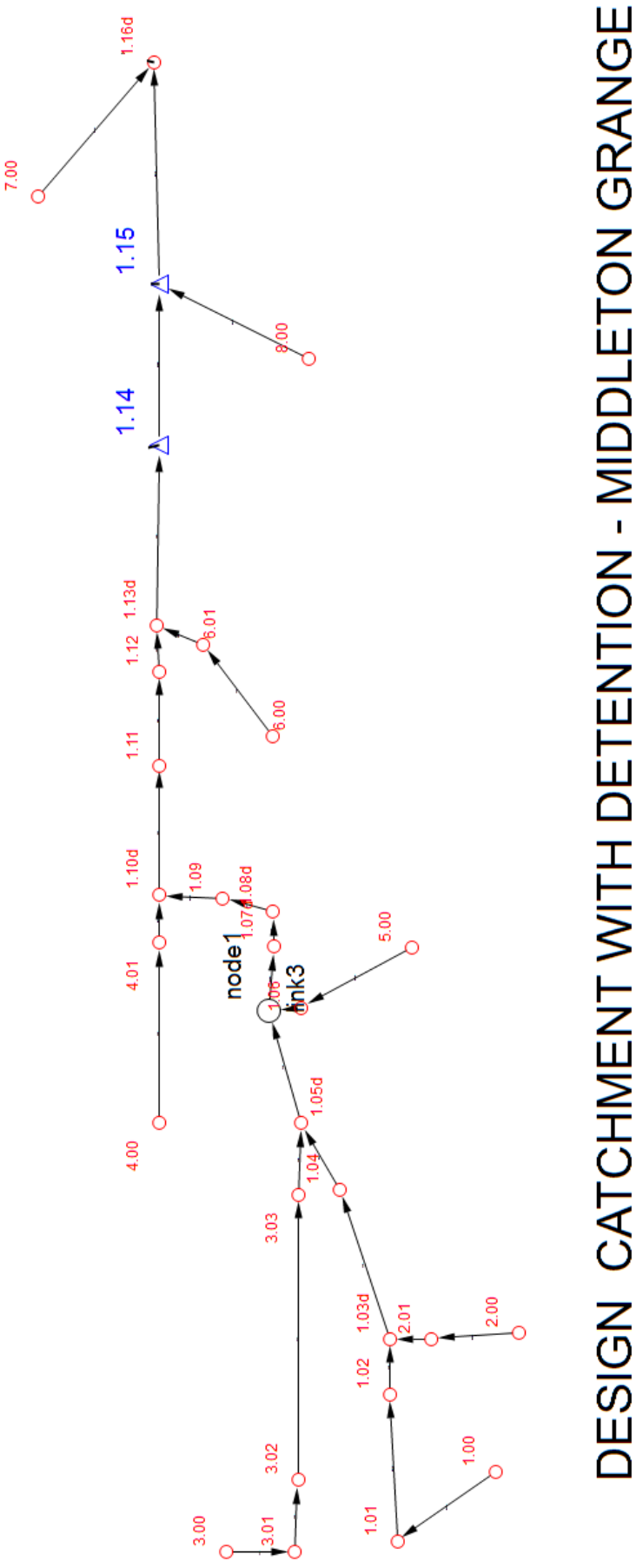
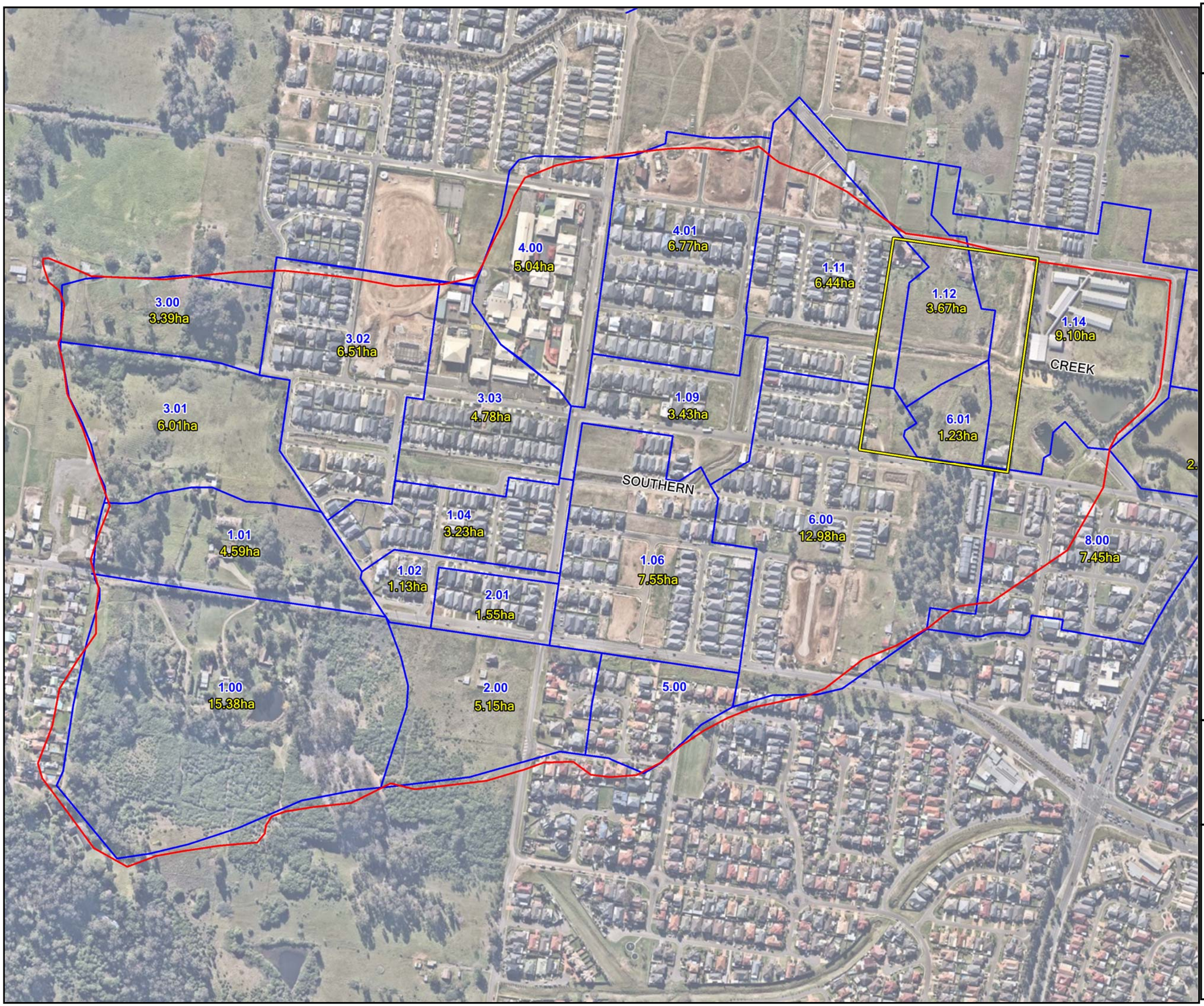


Plate A.1 – **DRAINS Model Layout** – **Pre Developed Conditions**

(ref: 109979RA05_imperv_updated.xp)

APPENDIX B

Appendix B – Figures



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LEGEND

- Site Boundary
- TUFLOW Model Boundary
- XP-Rafts Catchments
- 4.01 XP-Rafts Node ID
- 3.43ha Catchment Area

N

0 200
meters
Scale 1:5,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 5.1

Middleton Grange Town Centre

XP-Rafts Model Layout

Date: 11/08/17 Issue: A

File Name: Fig_5.1_XP-Rafts Layout.WOR

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LEGEND

- Site Boundary
- TUFLOW Boundary
- Source Area (SA)
- 1D Pipe Network
- 2D Model Output
- 1D Model Output
- 1D Model Input

Elevation

35 mAHD

80 mAHD

N

0 200

meters

Scale 1:5,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.1

Middleton Grange Town Centre

TUFLOW Model Layout
Channel Option

Date: 11/08/17 Issue: A

File Name: Fig_6.1_TUFLOW Surface Channel

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LEGEND

- Site Boundary
- TUFLOW Boundary
- Source Area (SA)
- 1D Pipe Network
- 2D Model Output
- 1D Model Output
- 1D Model Input

Elevation

35 mAHD

80 mAHD

N

0 200

meters

Scale 1:5,000 @ A3

Projection: GDA 1994 MGA Zone 56

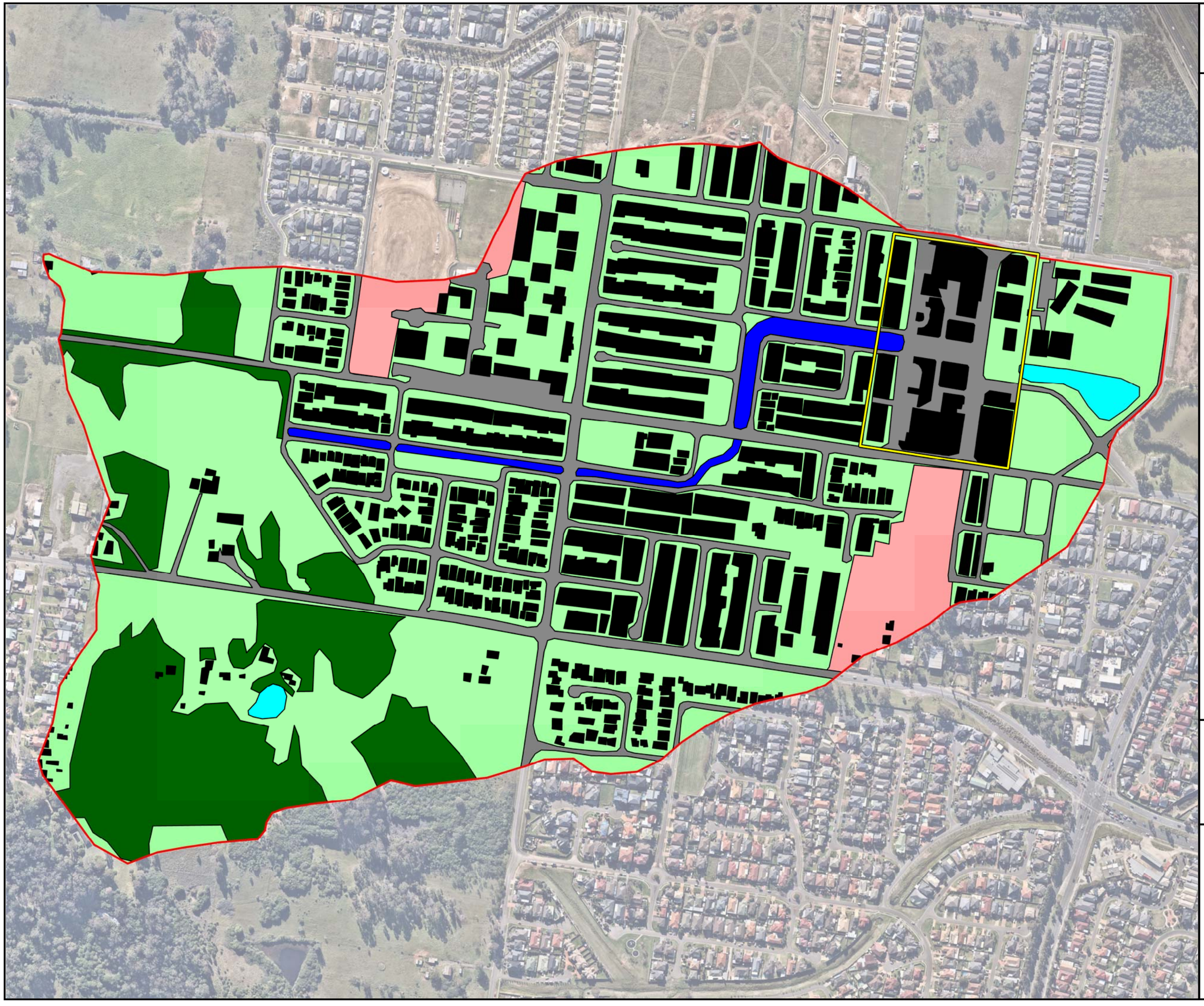
Figure 6.2

Middleton Grange Town Centre

TUFLOW Model Layout
Culvert Option

Date: 11/08/17 Issue: A

File Name: Fig_6.2_TUFLOW Surface Culvert



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LEGEND

- Site Boundary
- TUFLOW Boundary
- Buildings, n = 3.0
- Lots, n = 0.1
- Channel, n = 0.03
- Road/Pavement, n = 0.02
- Light Vegetation, n = 0.04
- Heavy Vegetation, n = 0.1
- Waterbody, n = 0.02

N

0 200
meters
Scale 1:5,000 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.3

Middleton Grange Town Centre

TUFLOW Model Material Mapping

Date: 11/08/17 Issue: A

File Name: Fig_6.3_TUFLOW Materials

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.4

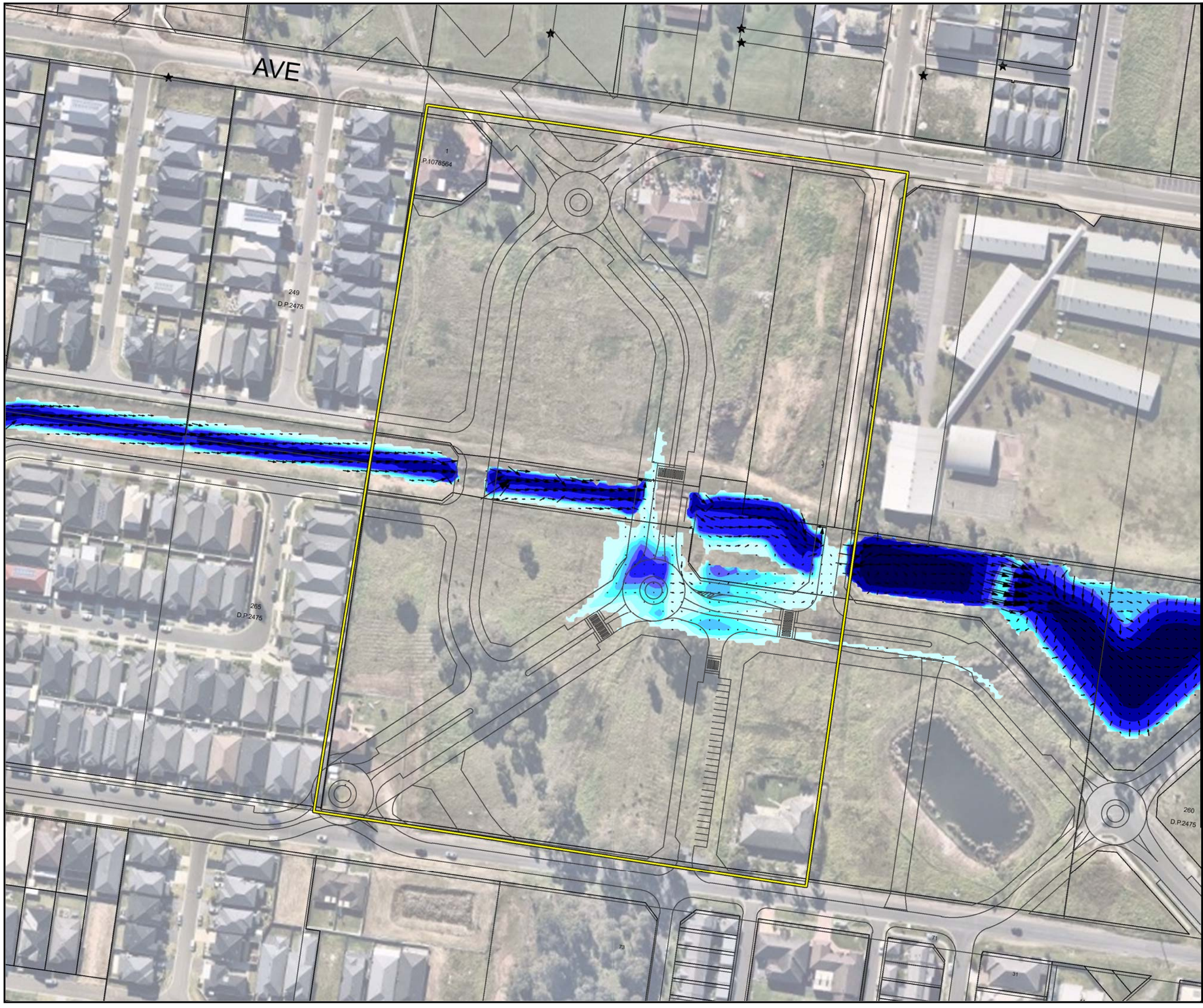
Middleton Grange Town Centre

1% AEP Channel

Flood Depth and Velocity

Date: 11/08/17 Issue: A

File Name: Fig_6.4_100_Channel_DepVel



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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60

meters

Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.4

Middleton Grange Town Centre

1% AEP Channel

Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.4_100_Channel_DepVel

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.6

Middleton Grange Town Centre

1% AEP Culvert

Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.6_100_Culvert_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.7

Middleton Grange Town Centre

1% AEP Culvert

Flood Height

Date: 21/08/17 Issue: B

File Name: Fig_6.7_100_Culvert_Height

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.8

Middleton Grange Town Centre

1% AEP Channel
Culverts w/ 50% Blockage Applied
Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.8_100_Channel_Block_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.9

Middleton Grange Town Centre

**1% AEP Channel
Culverts w/ 50% Blockage Applied
Flood Height**

Date: 21/08/17 Issue: B

File Name: Fig_6.9_100_Channel_Block_Height

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.10

Middleton Grange Town Centre

1% AEP Culvert
Culvert with 50% blockage applied
Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.10_100_Culvert_Block_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

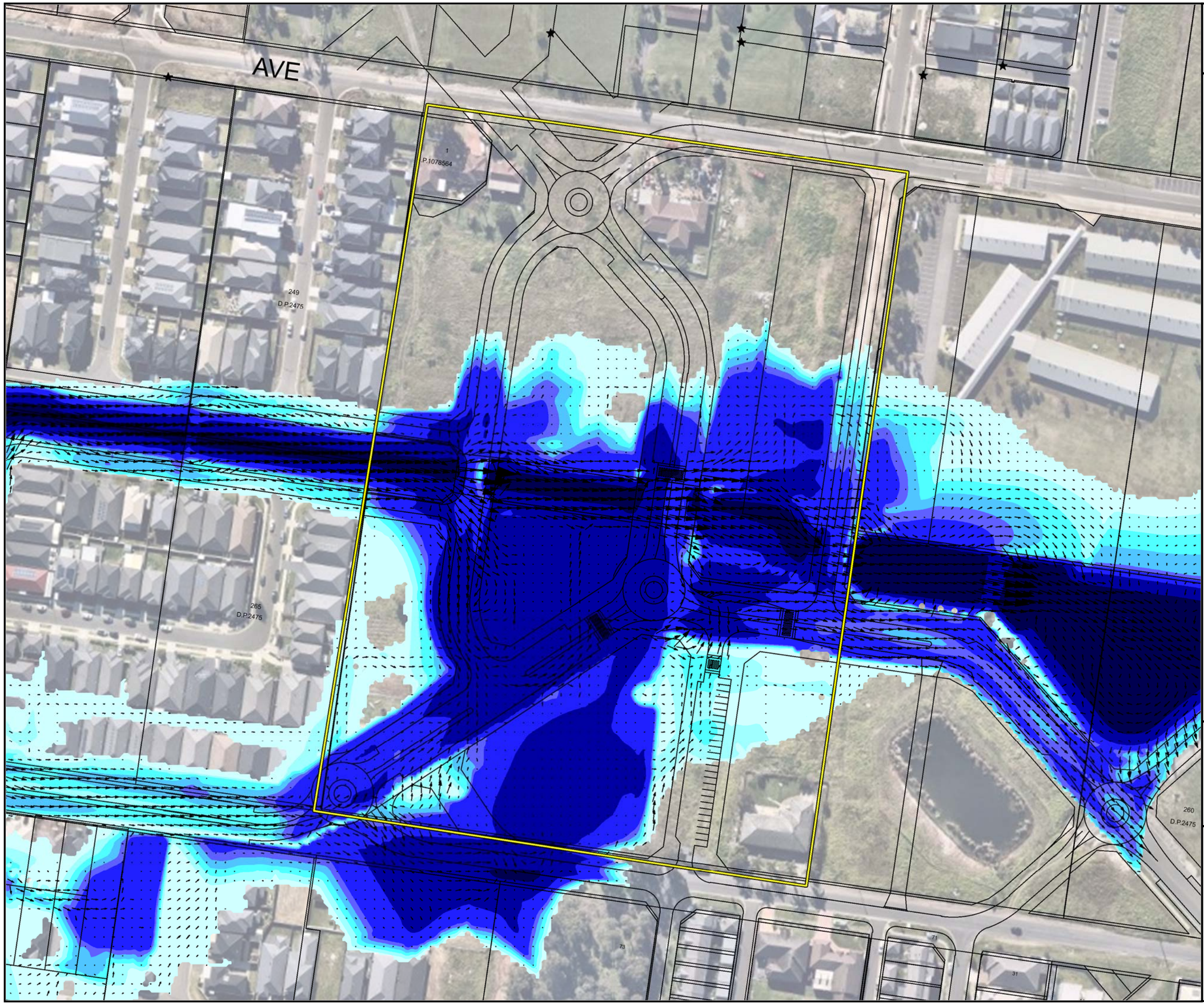
Figure 6.11

Middleton Grange Town Centre

1% AEP Culvert
Culvert with 50% blockage applied
Flood Height

Date: 21/08/17 Issue: B

File Name: Fig_6.11_100_Block_Culvert_Height



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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.12

Middleton Grange Town Centre

PMF Channel
Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.12_PMF_Channel_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.13

Middleton Grange Town Centre

PMF Channel

Flood Height

Date: 21/08/17 Issue: B

File Name: Fig_6.13_PMF_Channel_Height

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.14

Middleton Grange Town Centre

PMF Culvert
Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.14_PMF_Culvert_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.15

Middleton Grange Town Centre

PMF Culvert

Flood Height

Date: 21/08/17 Issue: B

File Name: Fig_6.15_PMF_Culvert_Height

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.16

Middleton Grange Town Centre

PMF Channel
Culvert with 50% blockage applied
Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.16_PMF_Block_Channel_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.17

Middleton Grange Town Centre

PMF Channel
Culvert blockage of 50% applied
Flood Height

Date: 21/08/17 Issue: B

File Name: Fig_6.17_PMF_Block_Channel_Height

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.18

Middleton Grange Town Centre

PMF Culvert
Culvert with 50% blockage applied
Flood Depth and Velocity

Date: 21/08/17 Issue: B

File Name: Fig_6.18_PMF_Block_Culvert_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.19

Middleton Grange Town Centre

PMF Culvert
Culvert with 50% blockage applied
Flood Height

Date: 21/08/17 Issue: B

File Name: Fig_6.19_PMF_Block_Culvert_Height

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LEGEND

Site Boundary

INCREASE IN FLOOD LEVELS (m)

	-0.3+		0.10
	-0.25		0.12
	-0.20		0.14
	-0.18		0.16
	-0.16		0.18
	-0.14		0.20
	-0.12		0.25
	-0.10		0.30+

-0.01 to +0.01

Areas Now Flood Free in Modelled Event

Areas Now Flood Affected in Modelled Event

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.20

Middleton Grange Town Centre

1% AEP
Flood Difference Map
Culvert vs Channel (no blockages)

Date: 15/09//17 Issue: A

File Name: Fig_6.20_100_Flood_Diff

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LEGEND

Site Boundary

INCREASE IN FLOOD LEVELS (m)

-0.3+	0.10
-0.25	0.12
-0.20	0.14
-0.18	0.16
-0.16	0.18
-0.14	0.20
-0.12	0.25
-0.10	0.30+

-0.01 to +0.01

Areas Now Flood Free in Modelled Event

Areas Now Flood Affected in Modelled Event

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.21

Middleton Grange Town Centre

PMF
Flood Difference Map
Culvert vs Channel (no blockages)

Date: 10/10//17 Issue: A

File Name: Fig_6.21_PMF_Flood_Diff

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LEGEND

- Site Boundary
- Velocity Vectors

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.22

Middleton Grange Town Centre

1% AEP Culvert - Sensitivity
Culvert with 100% blockage applied
Flood Depth and Velocity

Date: 15/09//17 Issue: A

File Name: Fig_6.22_100_Culvert_100Block_DepVel

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LEGEND

Site Boundary

Height (mAHD):

- 36.5 to 37.5
- 37.5 to 38.0
- 38.0 to 38.5
- 38.5 to 39.0
- 39.0 to 39.5
- 39.5 to 40.0
- 40.0 to 40.5
- 40.5 to 41.0
- 41.0 to 41.5
- 41.5 to 42.0
- 42.0 to 42.5
- 42.5 to 43.0
- 43.0 to 43.5
- 43.5 to 44.0
- 44.0 to 44.5
- 44.5 to 45.0
- 45.0 to 45.5

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.23

Middleton Grange Town Centre

1% AEP Culvert - Sensitivity
Culvert with 100% blockage applied

Flood Height

Date: 15/09/17 Issue: A

File Name: Fig_6.23_100_Culvert_100Block_Height

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LEGEND

- Site Boundary
- Height Contours

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.24

Middleton Grange Town Centre

1% AEP Culvert
Culvert with 50% blockage applied
Flood Depth and Heights

Date: 10/12/17 Issue: A

File Name: Fig_6.24_100_Culvert_Block_DepHght.WOR

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LEGEND

- Site Boundary
- Height Contours

Depth (m):

- 0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.4
- 0.4 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.25

Middleton Grange Town Centre

PMF Culvert
Culvert with 50% blockage applied
Flood Depth and Heights

Date: 10/12/17 Issue: A

File Name: Fig_6.25_PMF_Block_Culvert_DepHght

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& PROJECT MANAGERS
P 02 4720 3300
www.jwprince.com.au

LEGEND

Site Boundary

INCREASE IN FLOOD LEVELS (m)

-0.3+	0.10
-0.25	0.12
-0.20	0.14
-0.18	0.16
-0.16	0.18
-0.14	0.20
-0.12	0.25
-0.10	0.30+

-0.01 to +0.01

Areas Now Flood Free in Modelled Event

Areas Now Flood Affected in Modelled Event

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.26

Middleton Grange Town Centre

1% AEP
Flood Difference Map
Culvert vs Channel (50% blockage)

Date: 10/12//17 Issue: A

File Name: Fig_6.26_100_Flood_Diff_50%blocked

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& PROJECT MANAGERS
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www.jwprince.com.au

LEGEND

Site Boundary

INCREASE IN FLOOD LEVELS (m)

-0.3+	0.10
-0.25	0.12
-0.20	0.14
-0.18	0.16
-0.16	0.18
-0.14	0.20
-0.12	0.25
-0.10	0.30+

-0.01 to +0.01

Areas Now Flood Free in Modelled Event

Areas Now Flood Affected in Modelled Event

N

0 60
meters
Scale 1:1,500 @ A3

Projection: GDA 1994 MGA Zone 56

Figure 6.27

Middleton Grange Town Centre

PMF
Flood Difference Map
Culvert vs Channel (50% blockage)

Date: 10/12//17 Issue: A

File Name: Fig_6.27_100_Flood_Diff_50%blocked

APPENDIX B

Appendix C– Trunk Drainage Design Plans

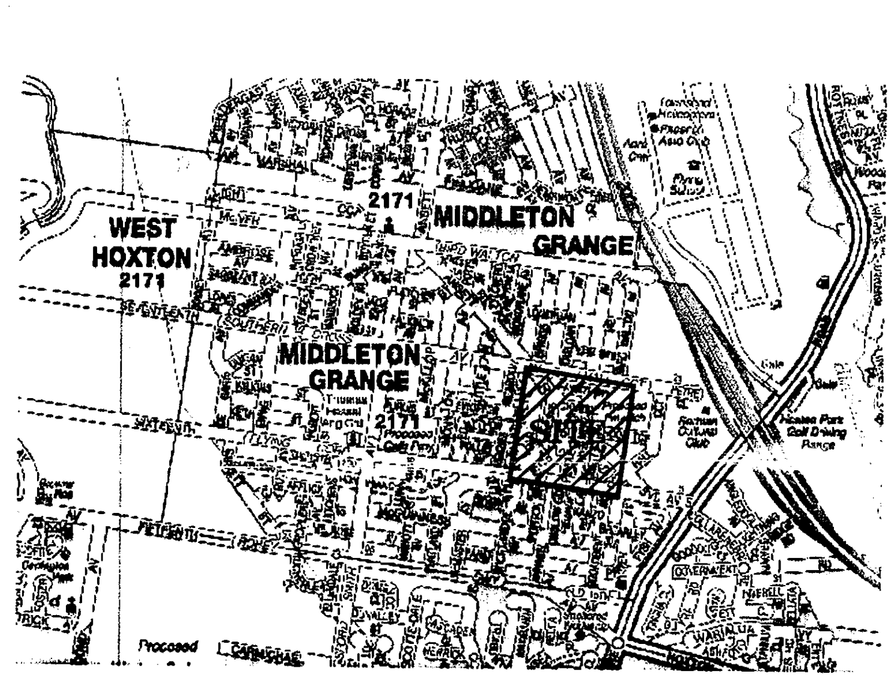
LIVERPOOL CITY COUNCIL

STATELAND DEVELOPMENTS

MIDDLETON GRANGE - PRECINCT 2
TOWN CENTRE
TRUNK DRAINAGE CULVERT PLANS

COUNCIL REF: DA64/2007

SUBDIVISION OF LOTS 263 & 264 DP. 2475
LOTS 1 D.P.612938 & LOT 2 D.P. 1078564



LOCALITY SKETCH

Prepared By:

J. WYNDHAM PRINCE PTY.LTD.

CONSULTING CIVIL ENGINEERS & PROJECT MANAGERS
P.O. Box 4366, Penrith Westfields. 2750
Ph. (02) 4732 3366 Fax (02) 47217638 DX 8032
REF No: 7887/CC100

CC 31/2008.
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K.
ENGINEER
11 JUL 2008
DATE

ISSUED FOR CONSTRUCTION APPROVAL
SIGNED S. Anderson DATE 12/2/08

ROAD No.6

ROAD No.7

ROAD No.8

ROAD No.10

LINE 12

LINE 1

LINE 12C

LINE 17C

100YR OVERLAND FLOW DISCHARGE POINT SEE DETAIL

PROPOSED CHANNEL SEE DRG'S 7818/E0-E66 FOR DETAIL

1500x900 RCBC

3x3600x900mm BOX CULVERT

SPLITTER PIT SEE DRG CC42 FOR DETAIL

SPLITTER PIT SEE DRG CC35 FOR DETAIL

3 x 900x900 INSPECTION PITS WITH STEP IRONS

SPECIAL CULVERTS SEE DRG CC105 FOR DETAIL

REFER DETAIL SHEET CC43

INLET STRUCTURE No.1 SEE DRG CC103 FOR DETAILS

HANDRAIL TO ARCHITECTS DETAILS

INLET STRUCTURE No.2 SEE DRG CC104 FOR DETAILS

OUTET STRUCTURE SEE DRG CC104 AND CC107 FOR DETAIL

REFER DETAIL SHEET CC44

REFER DETAIL SHEET CC34

REFER DETAIL SHEET CC40

REFER DETAIL SHEET CC37

BASIN 1A SEE DRG'S 7818/E0-E66 FOR DETAIL

DRG CC102

CONTINUES BELOW

CONTINUES ABOVE

TYPICAL 100 YR OVERLAND FLOW DISCHARGE POINT
1:50

SECTION A-A
N.T.S

SECTION B-B
N.T.S

BIDIM A44

1:200 (AT A1)

METRES

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DATUM: A.H.D.
ORIGIN:

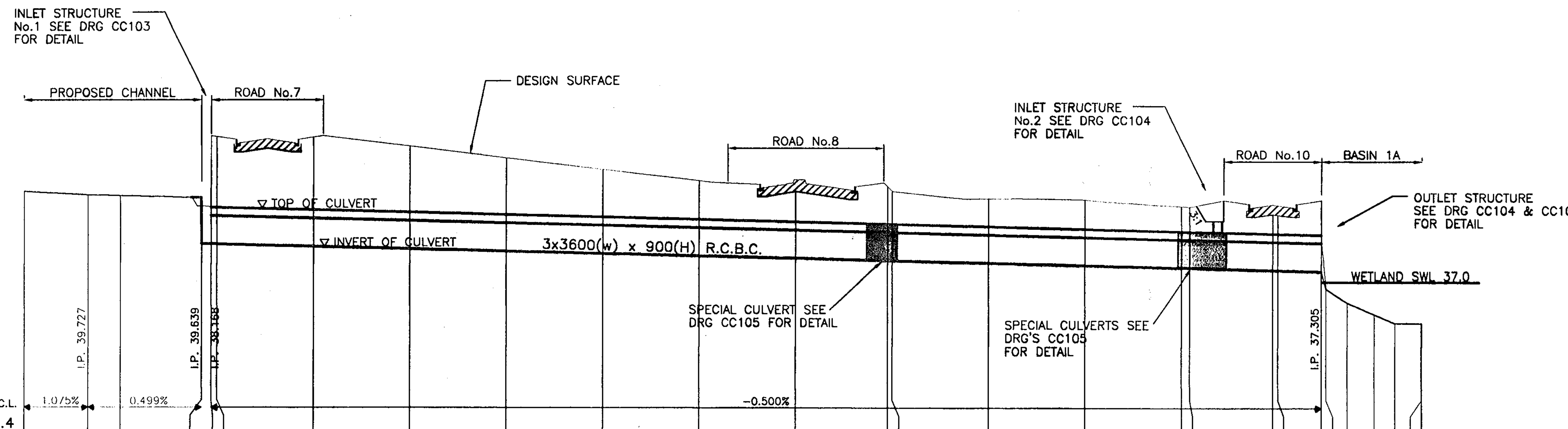
SCALES: 1:200

CLIENT: STATELAND DEVELOPMENTS

MIDDLETON GRANGE – PRECINCT 2
TOWN CENTRE

BOX CULVERT PLAN

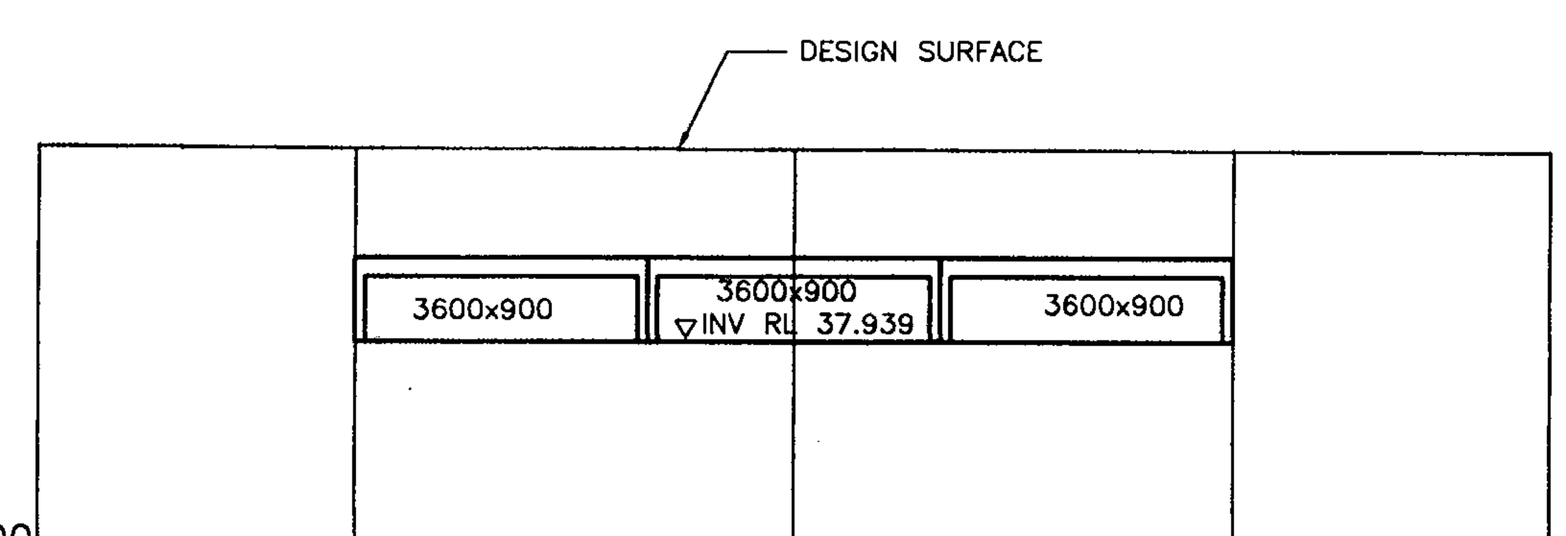
PLAN No. 7887CC101 B
FILE No. 7887CC101
SHEET 1 OF 7 SHEETS



Chainage	Design C.L.	Design Surface
0.000	39.834	39.834
9.949	39.727	
15.000	39.702	39.702
27.600	39.639 38.174	
29.100	38.168	40.868
30.000	38.163	41.590
45.000	38.088	41.567
60.000	38.013	41.282
75.000	37.938	40.914
90.000	37.863	40.547
105.000	37.788	40.180
120.000	37.713	40.187
134.305	37.642	39.984
135.000	37.638	39.846
150.000	37.563	39.603
165.000	37.488	39.572
180.000	37.413	39.362
181.268	37.407	39.343
194.191	37.343	39.421
195.000	37.338	39.397
201.791	37.304	38.321
202.507	36.800	
205.782	36.385	
210.000	36.020	36.024
213.219	35.742	
217.321	35.748	
217.363		35.748

CULVERT LONGITUDINAL SECTION

SCALES: HORIZ 1: 500
VERT 1: 100



R.L. 34.900					
Design Surface	40.672	40.645	40.616	40.599	40.593
Offsets	-10.000	-5.805	0.000	5.805	10.000

TYPICAL SECTION A–A

SCALE 1:100 NATURAL

LIVERPOOL CITY COUNCIL
CERTIFIED APPROVED COPY
K. [signature] ENGINEER
11 JUL 2008 DATE

1:100 (AT A1) 2 1 0 1 2 3 4 5 6 7 8 9 10 METRES

1:500 (AT A1) 10 0 10 20 30 40 50 METRES

ISSUED FOR CONSTRUCTION APPROVAL

SIGNED [signature] DATE 12/2/08

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DATUM: A.H.D.
ORIGIN:

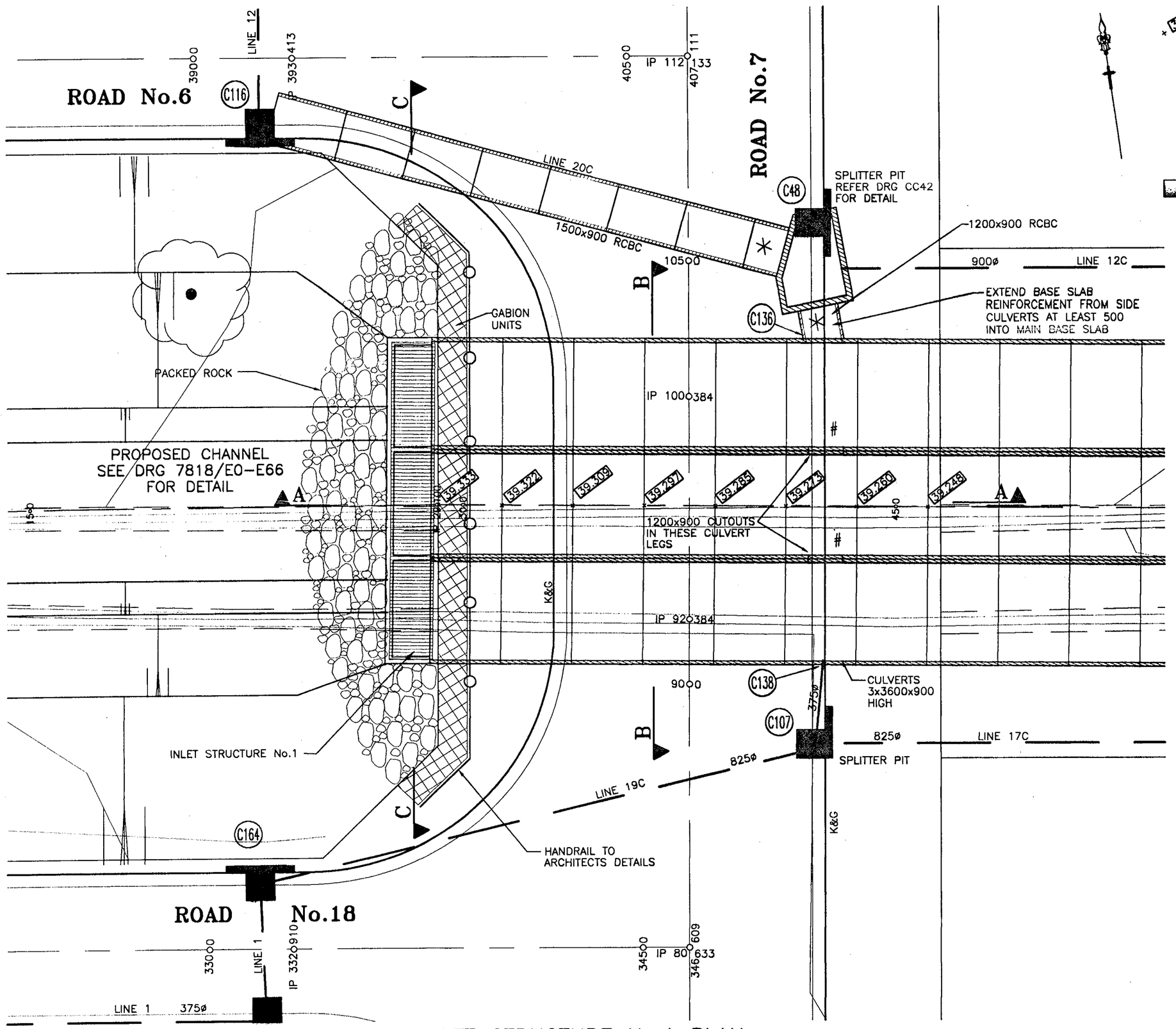
SCALES: 1:500 (H) 1:100 (V)

CLIENT: STATELAND DEVELOPMENTS

MIDDLETON GRANGE - PRECINCT 2
TOWN CENTRE

CULVERT LONGITUDINAL SECTION AND TYPICAL SECTION

PLAN No. 7887CC102 B
FILE No. 7887CC102
SHEET 2 OF 7 SHEETS



INLET STRUCTURE No.1 PLAN
SCALE 1:100

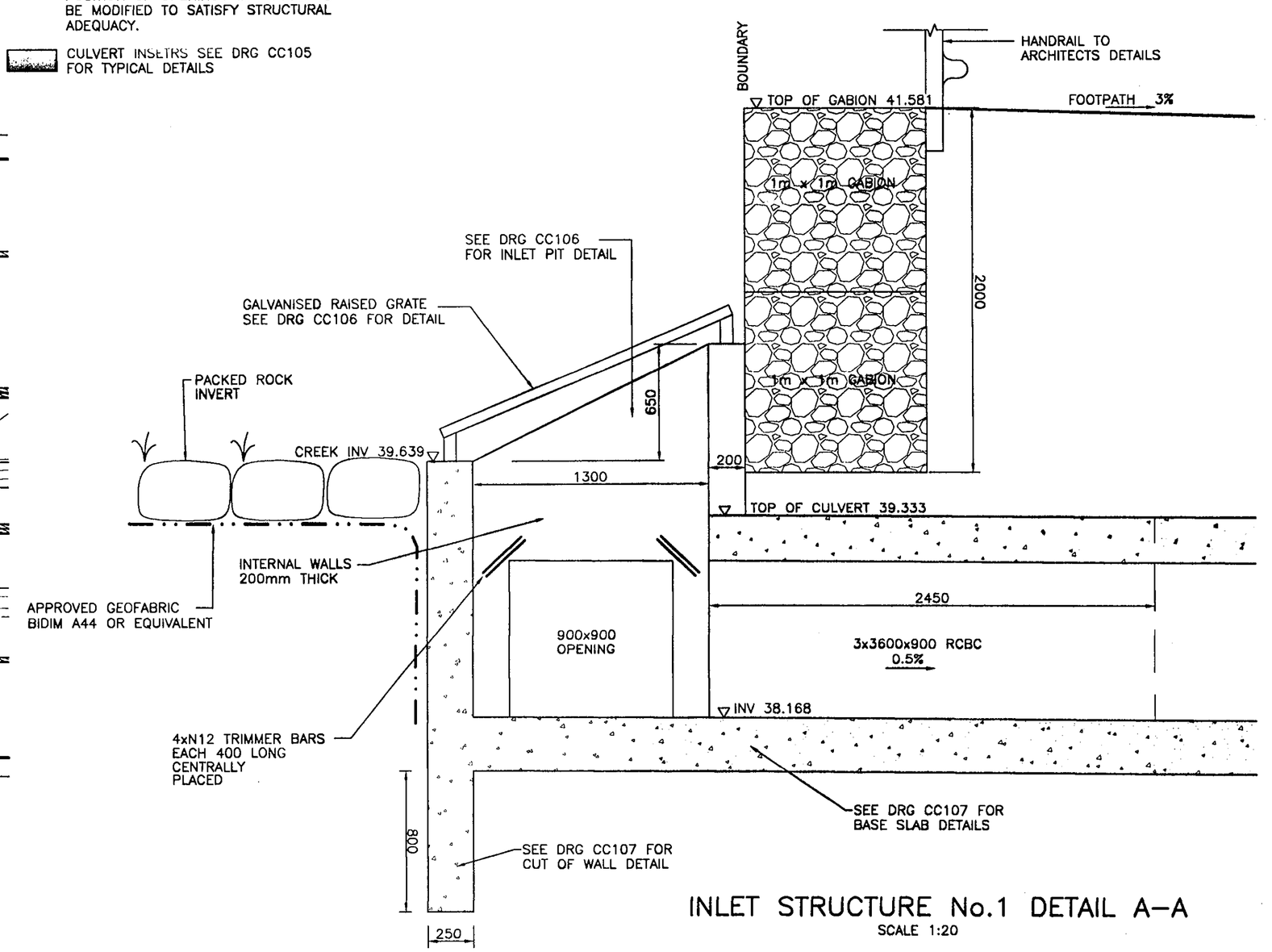
LEGEND:

39.295 =TOP OF CULVERT LEVEL

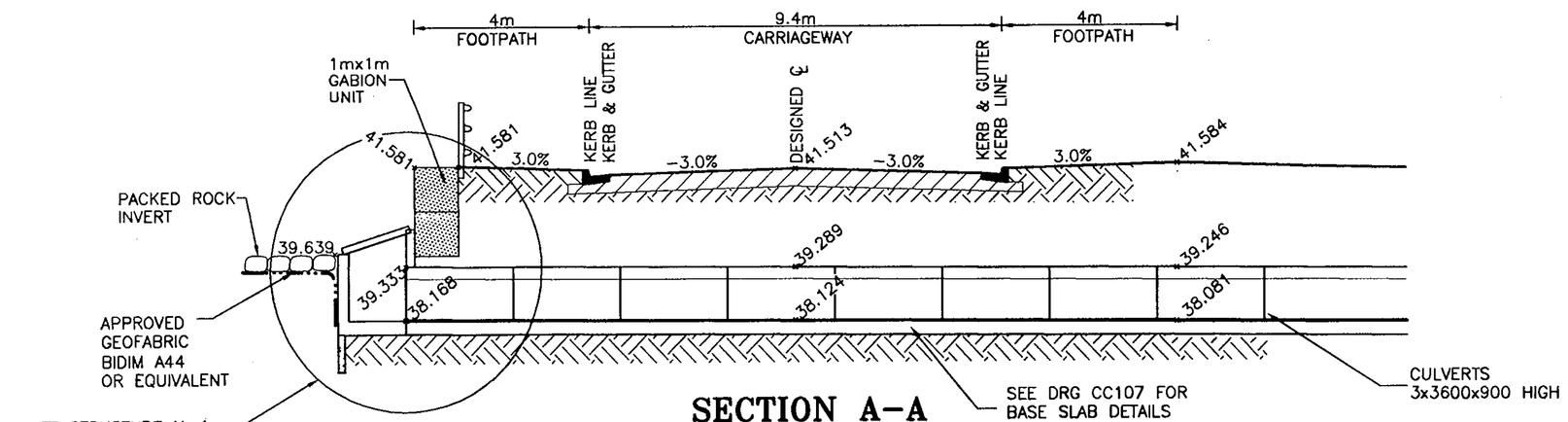
* BASE SLABS FOR SMALL INCOMING CULVERTS TO COUNCIL'S STANDARD DESIGN DETAILS

\# CONTRACTOR TO LIAISE WITH CULVERT MANUFACTURER FOR CERTIFIED DETAILS OF OPENINGS IN LEGS OF CULVERTS. POSITION OF OPENINGS MAY NEED TO BE MODIFIED TO SATISFY STRUCTURAL ADEQUACY.

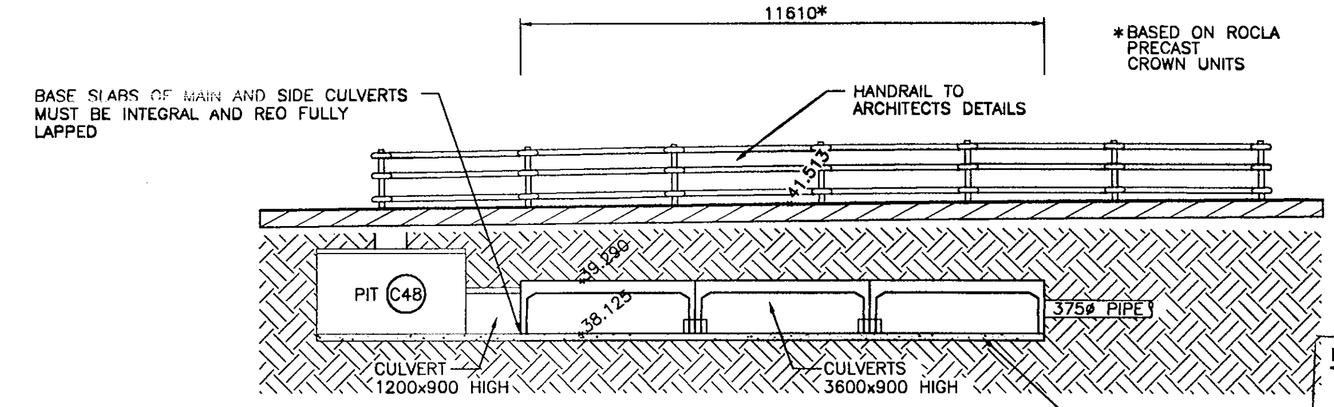
CULVERT INSERTS SEE DRG CC105 FOR TYPICAL DETAILS



INLET STRUCTURE No.1 DETAIL A-A
SCALE 1:20



SECTION A-A
SCALE 1:100



SECTION B-B
SCALE 1:100

1:20 (AT A1) 400 200 0 400 800 1200 1600 2000 MILLIMETRES

1:100 (AT A1) 2 1 0 1 2 3 4 5 6 7 8 9 10 METRES

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K. Jeffs
ENGINEER
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DATUM: A.H.D.
ORIGIN:

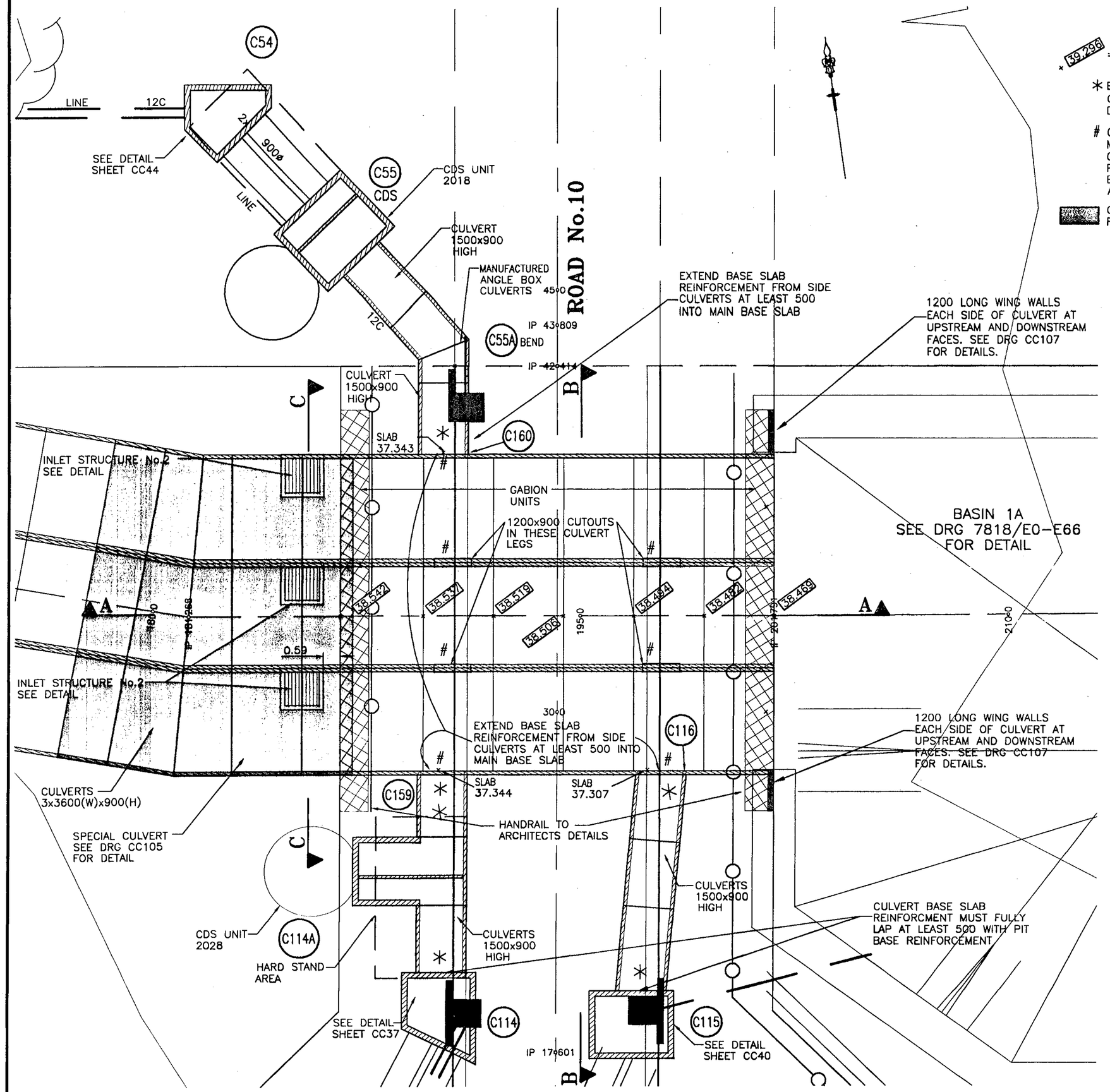
SCALES: 1:100

CLIENT: STATELAND DEVELOPMENTS

MIDDLETON GRANGE – PRECINCT 2
TOWN CENTRE

INLET STRUCTURE No.1 PLAN AND DETAILS

PLAN No. 7887CC103 B
FILE No. 7887CC103-104
SHEET 3 OF 7 SHEETS



INLET STRUCTURE No.2 AND OUTLET STRUCSTURE PLAN
SCALE 1:100

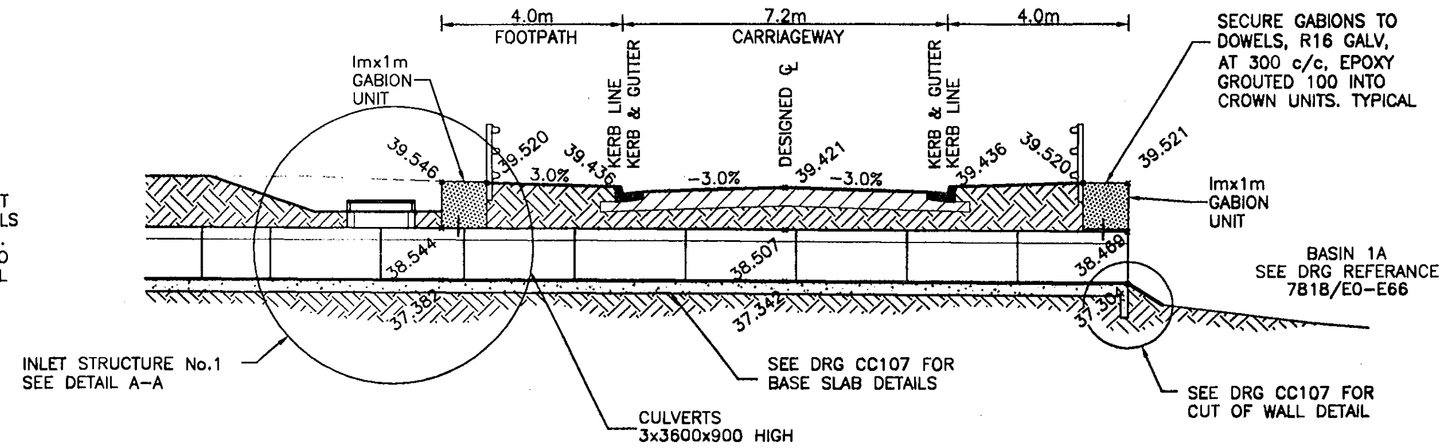
LEGEND:

59.298 =TOP OF CULVERT LEVEL

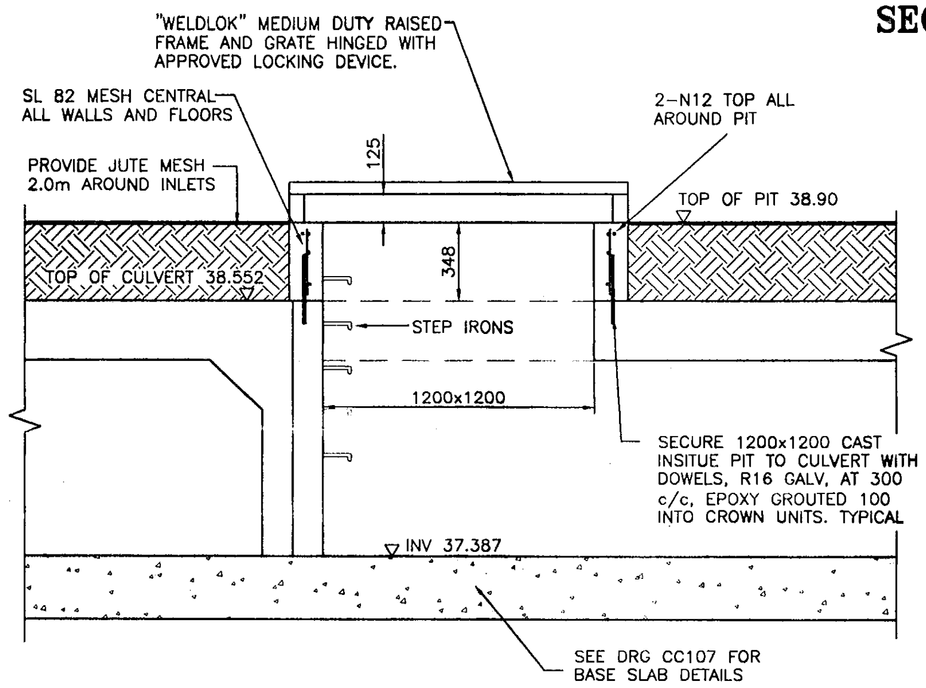
* BASE SLABS FOR SMALL INCOMING CULVERTS TO COUNCIL'S STANDARD DESIGN DETAILS

\# CONTRACTOR TO LIAISE WITH CULVERT MANUFACTURER FOR CERTIFIED DETAILS OF OPENINGS IN LEGS OF CULVERTS. POSITION OF OPENINGS MAY NEED TO BE MODIFIED TO SATISFY STRUCTURAL ADEQUACY.

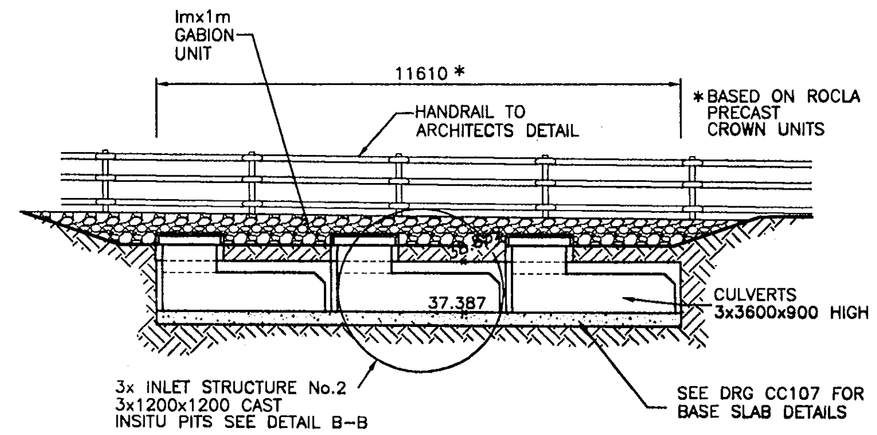
CULVERT INSERTS SEE DRG CC105 FOR TYPICAL DETAILS



SECTION A-A
SCALE 1:100



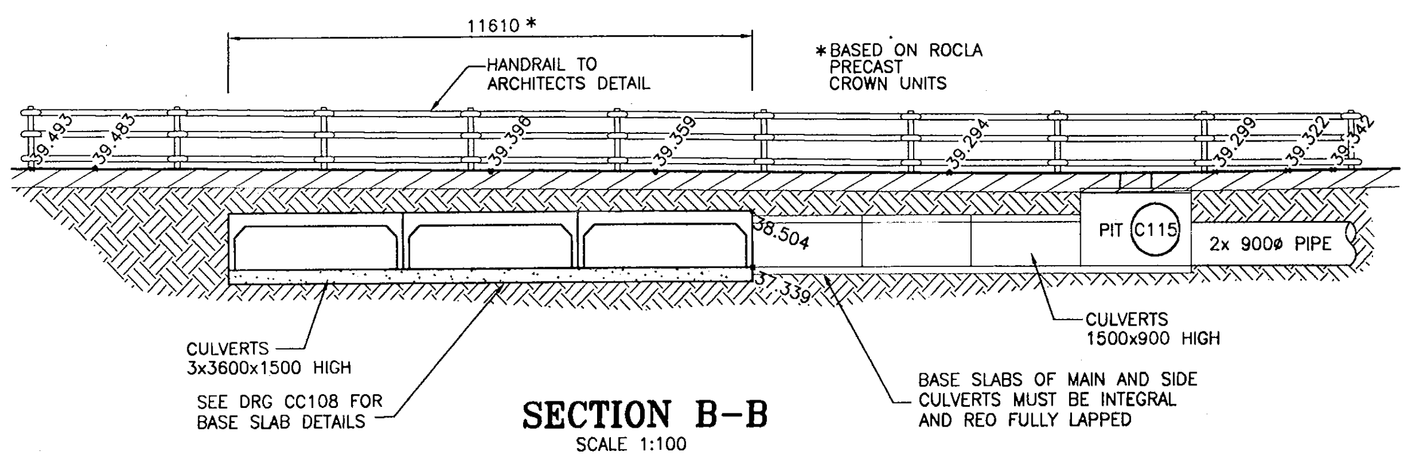
TYPICAL INLET STRUCTURE No.2 DETAIL B-B
SCALE 1:20



SECTION C-C
SCALE 1:100

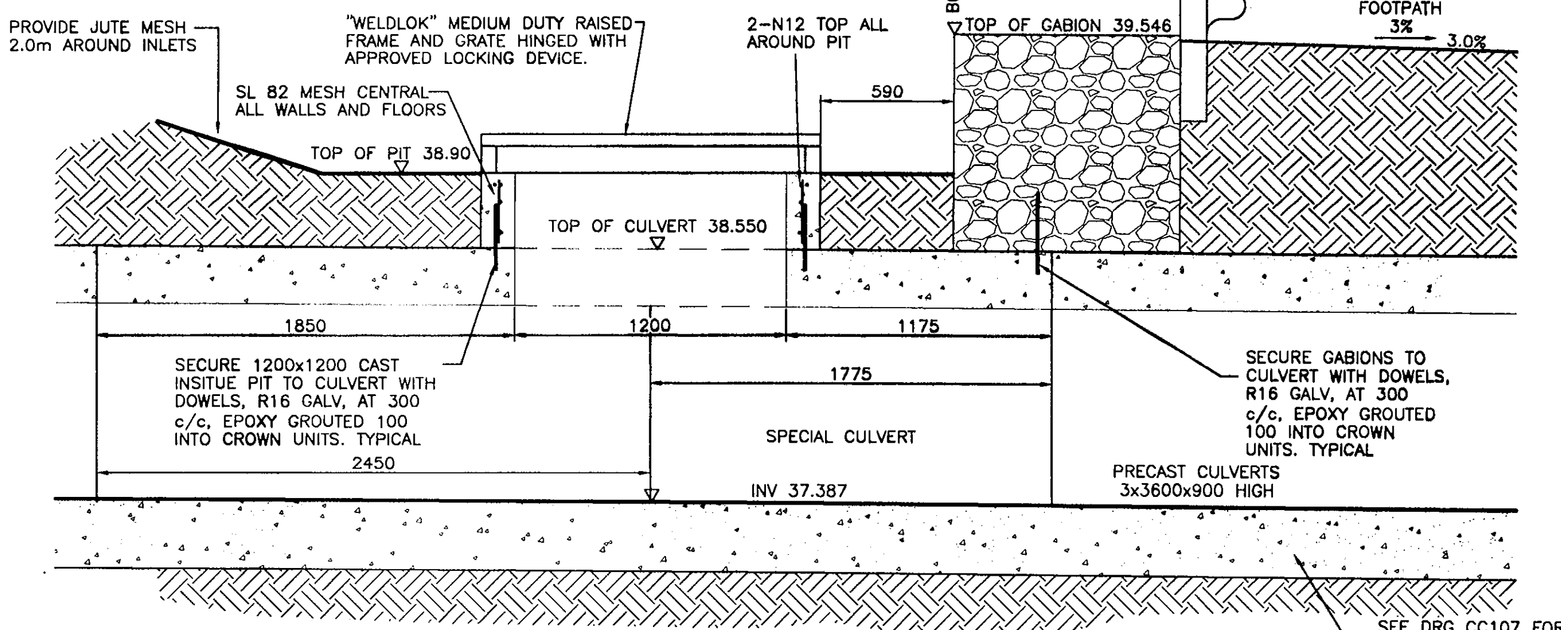
I HEREBY CERTIFY THAT I HAVE CHECKED AND APPROVED THE STRUCTURAL ADEQUACY OF THIS DRAINAGE STRUCTURE.

[ROGER E. DOHNT]
BE, MIE Aust, NPER 61807
for INHOUSE CONSULTING ENGINEERS PTY. LTD.
REF. No. 14384 DATE: 11.2.2008



SECTION B-B
SCALE 1:100

LIVERPOOL CITY COUNCIL
CERTIFIED APPROVED COPY
ENGINEER
11 JUL 2008
DATE



INLET STRUCTURE No.2 DETAIL A-A
SCALE 1:20

1:20 (AT A1) 400 200 0 400 800 1200 1600 2000 MILLIMETRES

1:100 (AT A1) 2 1 0 1 2 3 4 5 6 7 8 9 10 METRES

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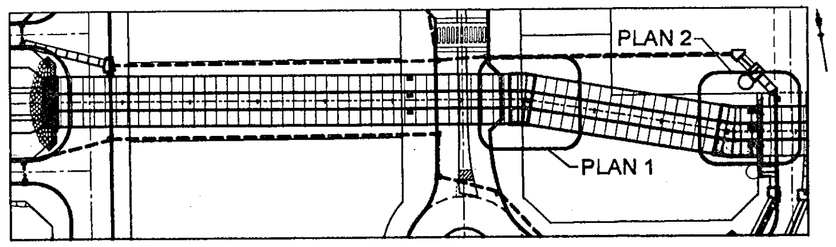
APPROVED ____ DATE ____
DATUM: A.H.D.
ORIGIN:
SCALES: 1:100
CLIENT: STATELAND DEVELOPMENTS

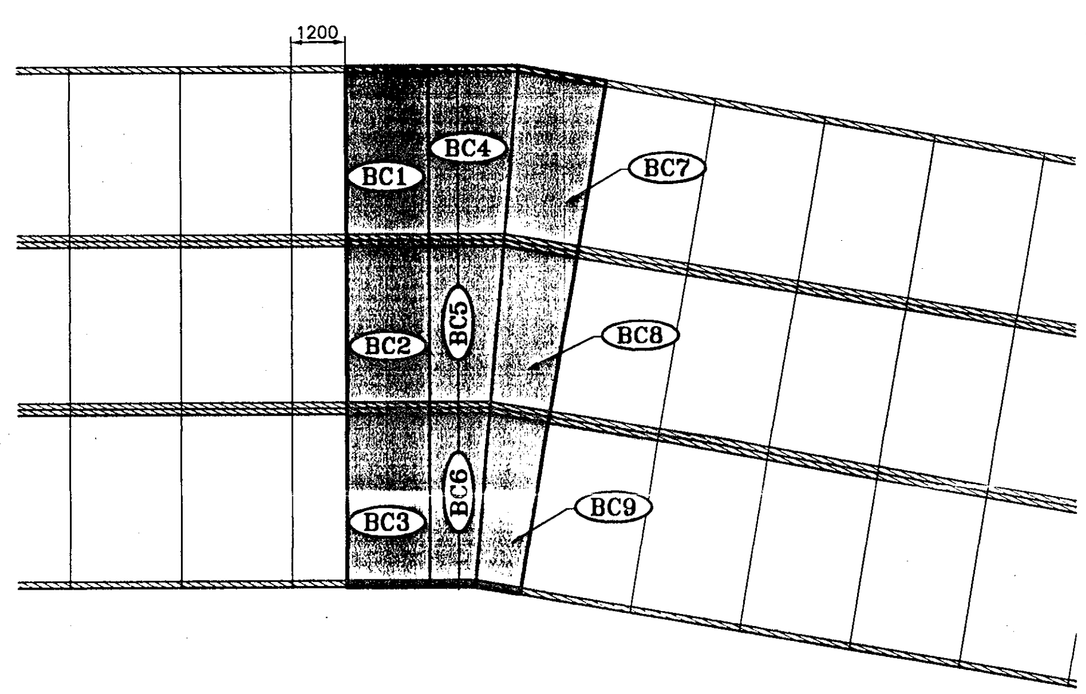
MIDDLETON GRANGE EAST

INLET STRUCTURE No.2 AND OUTLET STRUCTURE PLAN AND DETAILS

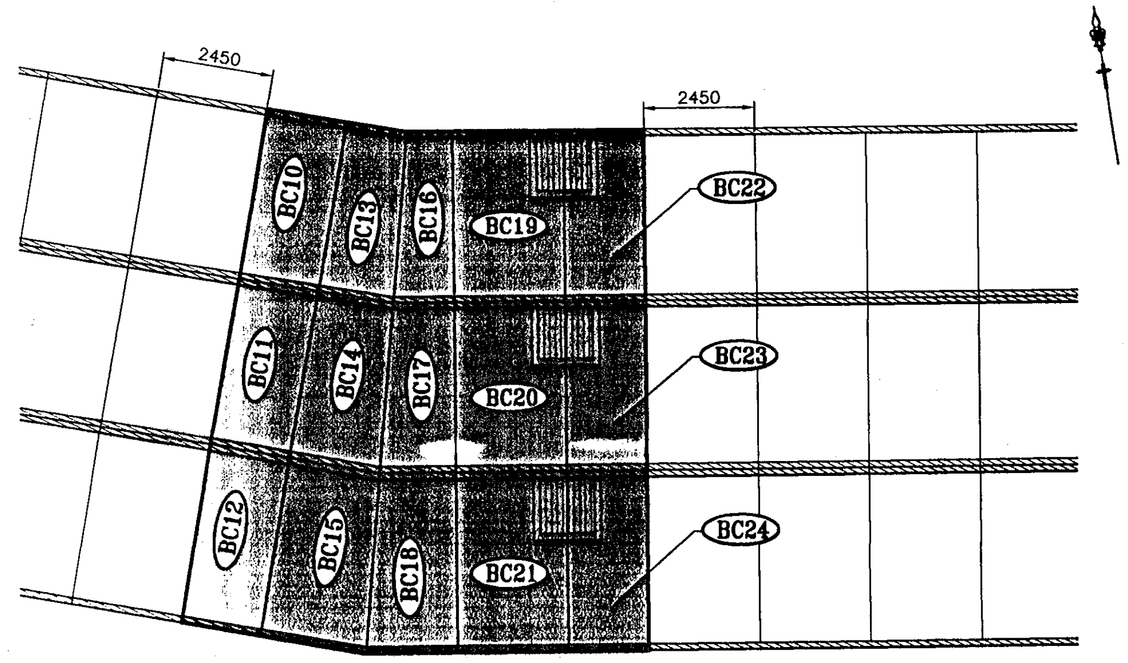
PLAN No. 7887CC104 B
FILE No. 7887CC104
SHEET 4 OF 7 SHEETS



LOCALITY



PLAN 1
SCALE 1:100



PLAN 2
SCALE 1:100

LIVERPOOL CITY COUNCIL
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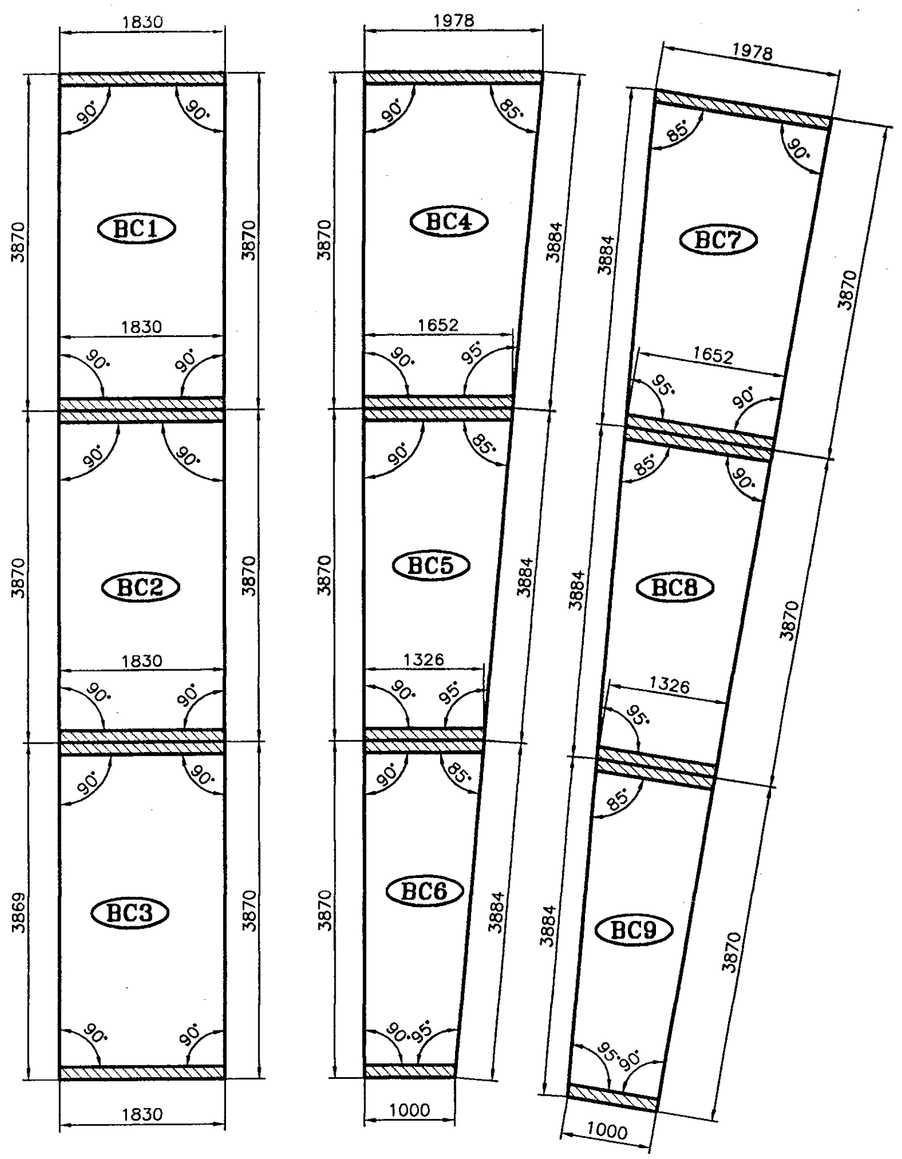
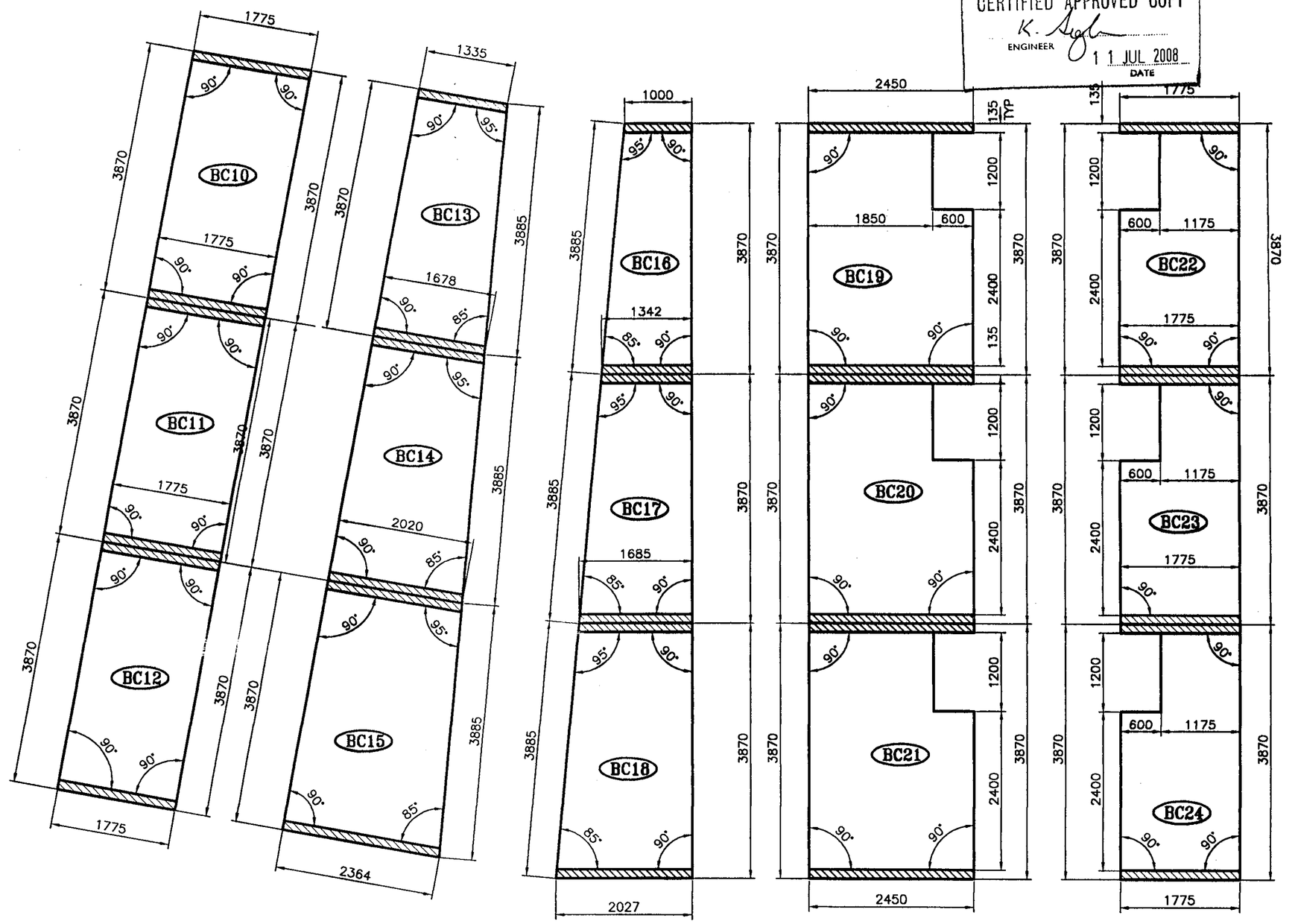
K. Taylor
ENGINEER
11 JUL 2008
DATE



PLAN 1
DETAILS
SCALE 1:50



PLAN 2
DETAILS
SCALE 1:50

1:50 (AT A1) 100 0 100 200 300 400 500 MILLIMETRES

1:100 (AT A1) 2 1 0 1 2 3 4 5 6 7 8 9 10 METRES

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SIGNED S. Arduca DATE 17/7/08

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DATUM: A.H.D.
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SCALES: 1:100

CLIENT: STATELAND DEVELOPMENTS

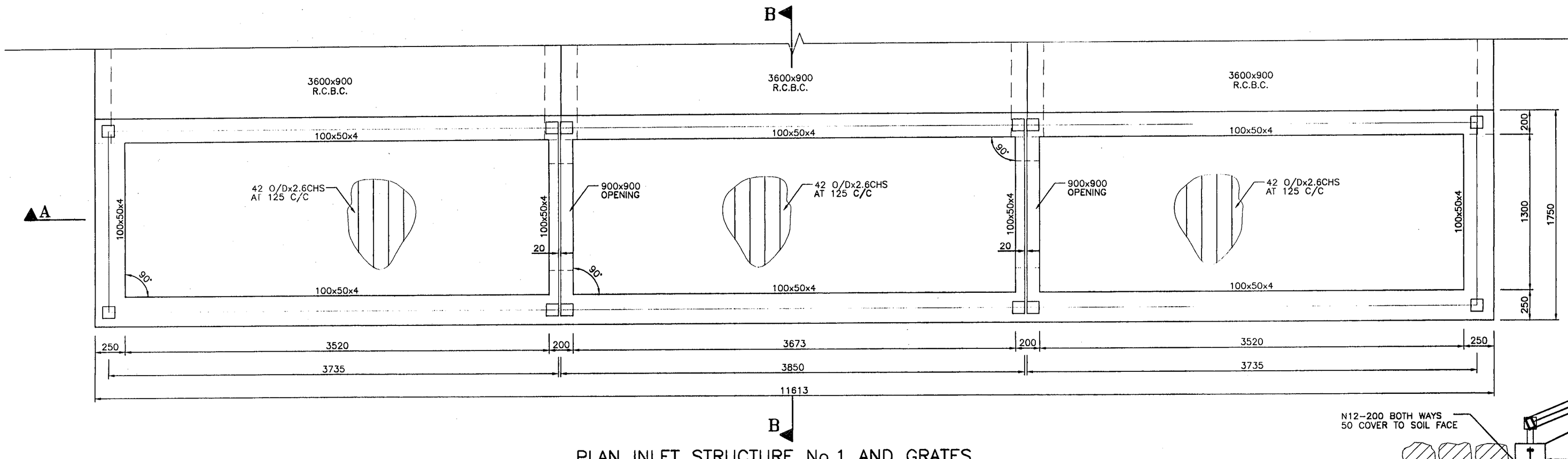
MIDDLETON GRANGE EAST

SPECIAL CULVERT DETAILS

PLAN No. 7887CC105 B
FILE No. 7887CC105
SHEET 5 OF 7 SHEETS

I HEREBY CERTIFY THAT I HAVE CHECKED AND APPROVED THE STRUCTURAL ADEQUACY OF THIS DRAINAGE STRUCTURE.

[ROGER E. DOHNT]
BE, MIE Aust, NPER 61807
for INHOUSE CONSULTING ENGINEERS PTY. LTD.
REF. No. 14384 DATE: 11.2.2008



PLAN INLET STRUCTURE No.1 AND GRATES

SCALE 1:50

STRUCTURAL NOTES

GENERAL

1.1 ALL WORKMANSHIP AND MATERIALS SHALL BE IN ACCORDANCE WITH AUSTRALIAN STANDARD AS 3600 AND OTHER RELEVANT CODES.
1.2 ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

CONCRETE

2.1 CONCRETE QUALITY

ELEMENT	CONCRETE STRENGTH F'c	MAX. AGGREGATE SIZE	MAX. SLUMP	CEMENT TYPE
SLABS	40MPa	20mm	75mm	GB
WALLS	40MPa	20mm	75mm	GB
BLINDING SLABS	5MPa	20mm	75mm	GB

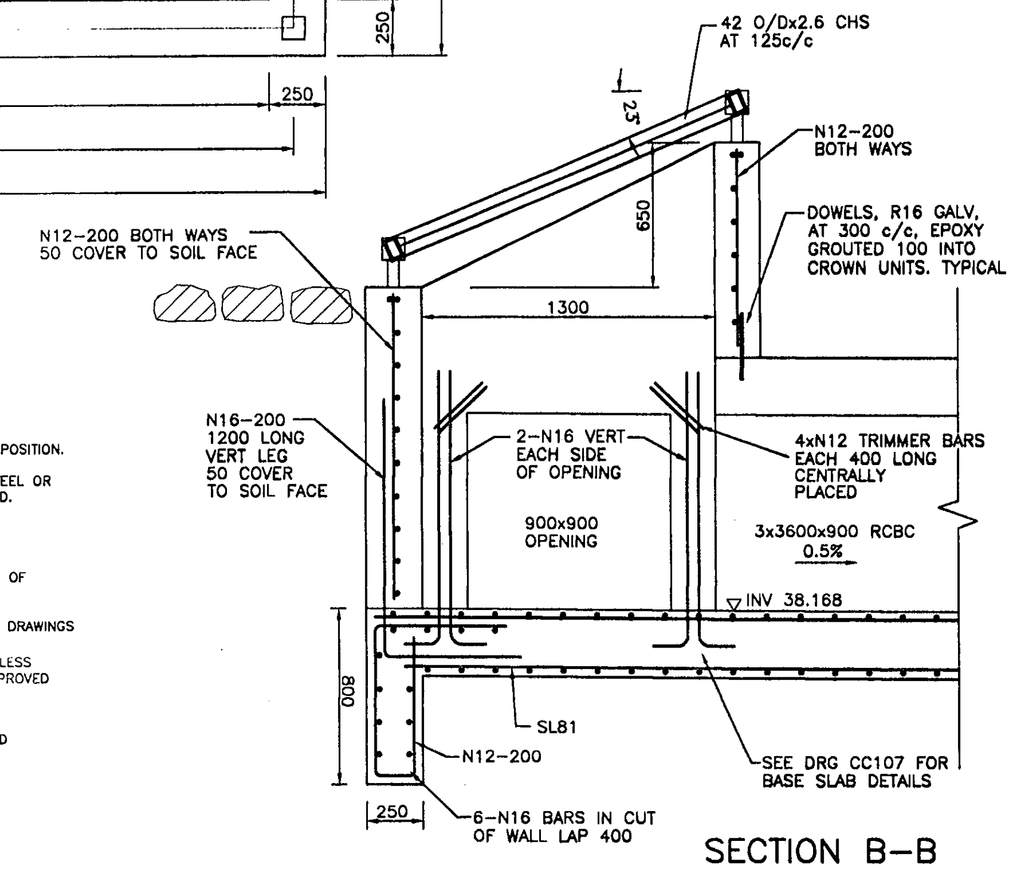
2.2 NO ADMIXTURES SHALL BE USED IN CONCRETE UNLESS APPROVED IN WRITING BY COUNCIL'S ENGINEER.
2.3 CLEAR CONCRETE COVER TO REINFORCEMENT SHALL BE 40mm TO ALL SURFACES UNLESS NOTED OTHERWISE.
2.4 CONSTRUCTION JOINTS NOT INDICATED SHALL BE LOCATED AND FORMED TO THE APPROVAL OF COUNCIL'S ENGINEER.
2.5 A BOND BREAKING MATERIAL IS TO BE PLACED BETWEEN CONTACTING SURFACES AT CONSTRUCTION JOINTS.
2.6 NO PENETRATIONS, RECESSES OR CHASES OTHER THAN THOSE INDICATED ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS UNLESS APPROVED IN WRITING BY COUNCIL'S ENGINEER.
2.7 UNLESS SHOWN OTHERWISE ALL EXTERNAL AND RE-ENTRANT CORNERS SHALL BE CHAMFERED 25mm.
2.8 SLABS TO BE CURED AND KEPT MOIST FOR 7 DAYS MINIMUM.
2.9 NO CONCRETE TO BE POURED WHEN SITE TEMPERATURE EXCEEDS 35 DEGREES CELSIUS OR FALLS BELOW 5 DEGREES CELSIUS.

REINFORCEMENT

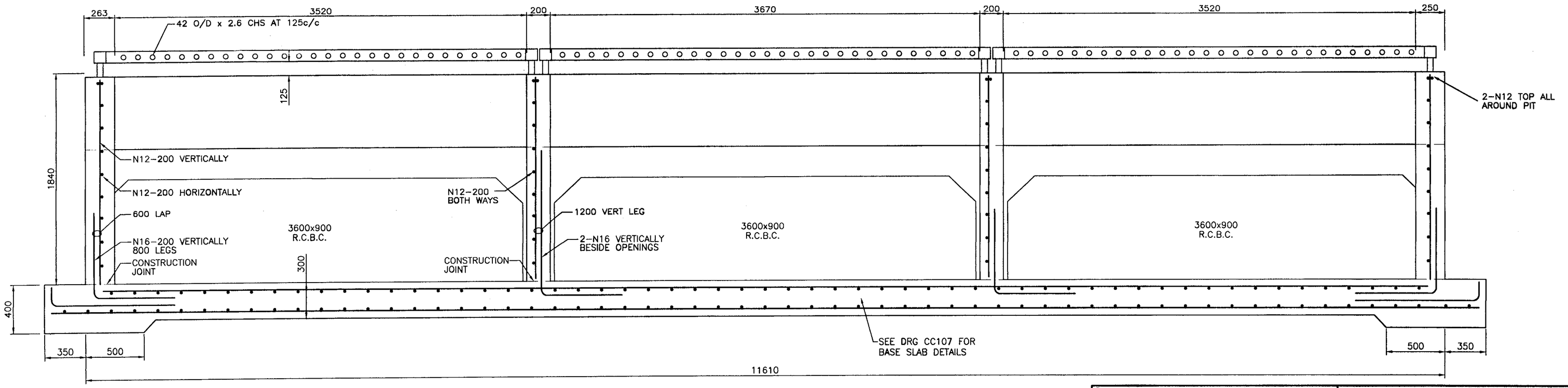
3.1 REINFORCEMENT STEEL QUALITY:

REINFORCEMENT TYPE	GRADE	SAA CODE	SYMBOL
WELDING GRADE DEFORMED	500	AS 4671	N
PLAIN ROUND	230	AS 1302	R
FABRIC	500	AS 4671	SL, RL, L

3.2 REINFORCEMENT IS REPRESENTED DIAGRAMMATICALLY. IT IS NOT NECESSARILY SHOWN IN TRUE POSITION.
3.3 ALL REINFORCEMENT SHALL BE SECURELY TIED AND POSITIONED ACCURATELY BY MEANS OF STEEL OR PLASTIC CHAIRS OR OTHER APPROVED ACCESSORIES. MASONRY BLOCKS WILL NOT BE PERMITTED.
3.4 PROVIDE COUNCIL'S ENGINEER WITH 24 HOURS NOTICE OF REINFORCEMENT BEING READY FOR INSPECTION. NO CONCRETE IS TO BE POURED WITHOUT APPROVAL OF COUNCIL'S ENGINEER.
3.5 SPLICES IN REINFORCEMENT SHALL BE MADE ONLY IN THE POSITION INDICATED. THE APPROVAL OF COUNCIL'S ENGINEER SHALL BE OBTAINED FOR ANY OTHER SPLICE.
3.6 WELDING OF REINFORCEMENT WILL NOT BE PERMITTED UNLESS INDICATED ON THE STRUCTURAL DRAWINGS OR WITH WRITTEN APPROVAL OF COUNCIL'S ENGINEER.
3.7 MINIMUM LAP OF REINFORCEMENT SHALL BE AS SHOWN IN TABLE 13.1.2.2(A) OF AS 3600 UNLESS SHOWN OTHERWISE. LAPS FOR MESH SHALL BE 1.5 TIMES THE NOMINAL WIRE SPACING OR APPROVED EQUIVALENT.
3.8 REINFORCEMENT MUST NOT BE CONTINUOUS THROUGH CONTRACTION JOINTS. OTHERWISE.
3.9 MINIMUM RADIUS FOR BENDS IN REINFORCEMENT TO BE 4 BAR DIAMETERS (DB) UNLESS NOTED



SECTION B–B
SCALE 1:20



SECTION A–A
SCALE 1:20

LIVERPOOL CITY COUNCIL
CERTIFIED APPROVED COPY
K. Agan
ENGINEER
11 JUL 2008
DATE

ISSUED FOR CONSTRUCTION APPROVAL
SIGNED S. Andrews DATE 12/2/08

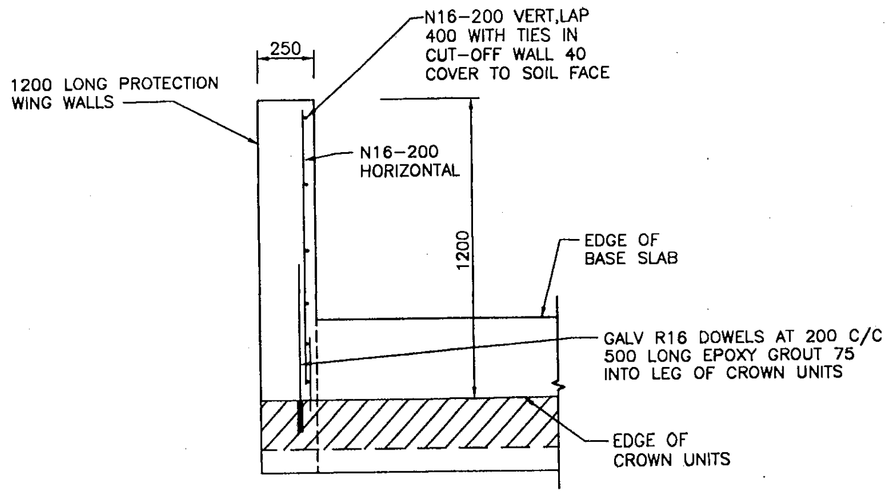
No.	AMENDMENT	DATE
F		
E		
D		
C		
B	WIDENING OF RAOD 20 & ALL MEDIANS; ROAD 23 REMOVED	JAN 08
A	FIRST ISSUE	SEPT 2007

J. Wyndham Prince Pty. Ltd.
CONSULTING CIVIL ENGINEERS & PROJECT MANAGERS
A.B.N. 67002 318 621
P.O. BOX 4366 PENRITH PLAZA. 2750
DX 8032 PENRITH
EMAIL: jwp@wprince.com.au
PH: (02) 4732 3366
FAX: (02) 4721 7638

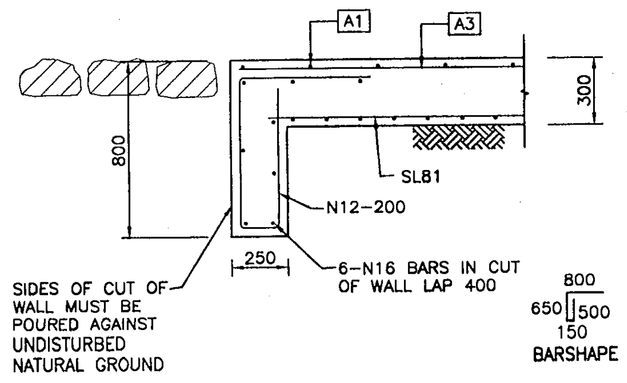
DESIGNED KM
DRAWN NM
CHECKED K.N./M.S.
APPROVED _____ DATE _____
DATUM: A.H.D.
ORIGIN:
SCALES: 1:100
CLIENT: STATELAND DEVELOPMENTS

MIDDLETON GRANGE – PRECINCT 2 TOWN CENTRE
INLET STRUCTURE No.1 PLAN AND DETAILS

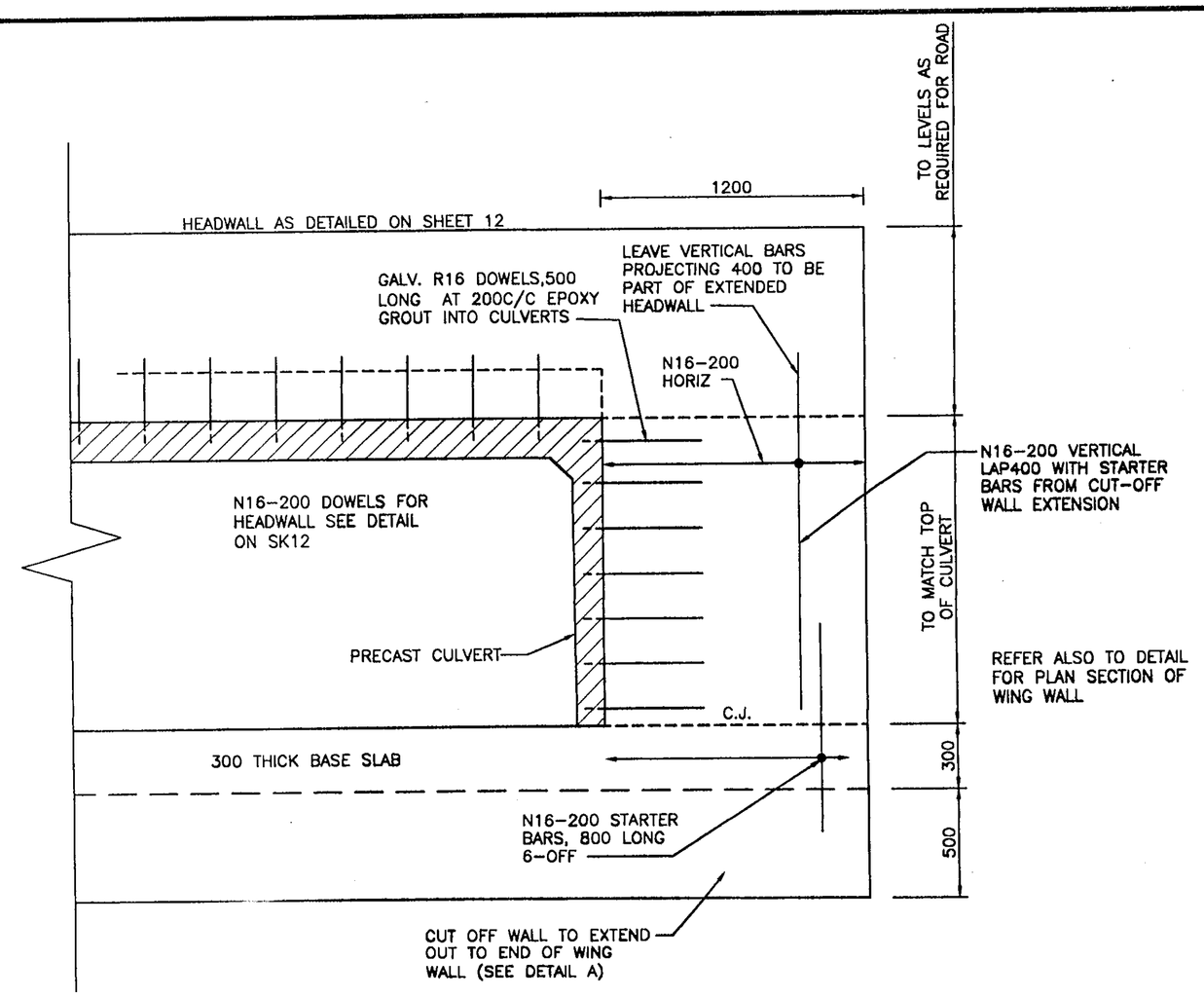
PLAN No. 7887CC106 B
FILE No. 7887CC106
SHEET 6 OF 7 SHEETS



PLAN – WEIR TO WING WALL JUNCTION
SCALE 1:20



DETAIL 1:CUT OF WALLS
(PROVIDE CUT–OFF WALL AT BOTH ENDS OF ALL CULVERTS)
SCALE 1:20



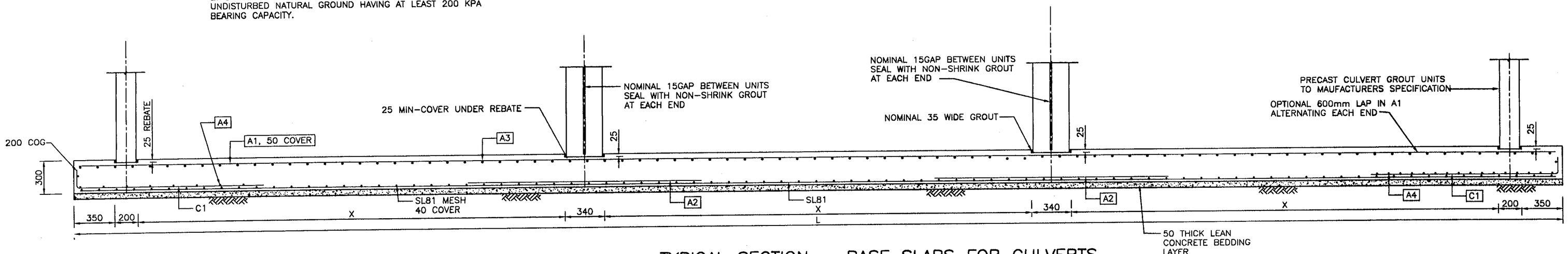
ELEVATION – WING WALLS
SCALE 1:20

* CULVERT SIZES ARE BASED ON 'ROCLA' PRECAST CROWN UNITS

NOTE

* DIMENSIONS BASED IN STANDARD BOX CULVERTS WITH STRAIGHT LEGS, HUMES/ROCLA OR EQUIVALENT TO AS1597.2 (NON RTA SPECIFIED PROJECTS)

1. CONCRETE TO BE N32 MPa FOR EXPOSURE CLASSIFICATION B1
2. SUBBASE OF CULVERT TO BE TRIMMED TO EXPOSE UNDISTURBED NATURAL GROUND HAVING AT LEAST 200 KPA BEARING CAPACITY.



TYPICAL SECTION – BASE SLABS FOR CULVERTS

DIMENSION SCHEDULE			REINFORCEMENT SCHEDULE				
CULVERT	DIM 'X'	DIM 'L'	A1	A2	A3	A4	C1
3x3600x900	3660	12760	N20–150	N24–150, 2000 LONG	N16–200, LAP 400	6–N12–150, LAP 300	N16–100, 1600 O/A LONG

LIVERPOOL CITY COUNCIL
CERTIFIED APPROVED COPY
ENGINEER
11 JUL 2008
DATE

I HEREBY CERTIFY THAT I HAVE CHECKED AND APPROVED THE STRUCTURAL ADEQUACY OF THIS DRAINAGE STRUCTURE.
[ROGER E. DOHNT]
BE, MIE Aust, NPER 81807
for INHOUSE CONSULTING ENGINEERS PTY. LTD.
REF. No. 14384 DATE: 11.7.2008

1:20 (AT A1) 400 200 0 400 800 1200 1600 2000 MILLIMETRES

ISSUED FOR CONSTRUCTION APPROVAL
SIGNED S. Anderton DATE 12/2/08

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DESIGNED KM
DRAWN NM
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DATUM: A.H.D.
ORIGIN:
SCALES: 1:100
CLIENT: STATELAND DEVELOPMENTS

MIDDLETON GRANGE EAST
OUTLET STRUCTURE DETAILS

PLAN No. 7887CC107 B
FILE No. 7887CC107
SHEET 7 OF 7 SHEETS