# 1 HENRY STREET BELMONT

## STAGED MULTI-LOT SUBDIVISION

## SITE STORMWATER MANAGEMENT PLAN

REPORT

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## Project Details

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# EXECUTIVE SUMMARY

TGM Group Pty Ltd has been engaged by Belmont Projects Pty Ltd to provide a Site Stormwater Management Plan (SSMP) in support of a planning permit application for a multi-lot subdivision for land at 1 Henry Street, Belmont.

The subject area is a 6.21 hectare land parcel currently the site of the, now decommissioned, CSIRO Textile and Fibre Technology Laboratory. The subject land will represent an infill development that will be redeveloped from a *quasi*-light industrial site into a mixed density residential site.

The proposed subdivision will result in a decrease in impervious surfaces resulting in a decrease in stormwater runoff volumes and contaminant loading. However, City of Greater Geelong Council has seen this development as an opportunity to alleviate existing drainage issues present in the downstream catchment. This has resulted in the discharge objective for the site being set to reflect the capacity of the receiving drainage system.

The following site stormwater management plan (SSMP) provides guidance on the stormwater mitigation systems required to deliver design objectives an enable redevelopment of the site at 1 Henry Street, Belmont.

The objective of the stormwater management plan is to meet the conditions and requirements, set out by the City of Greater Geelong (COGG) Council in the planning application for stormwater management. Stormwater mitigation systems are designed to ensure that stormwater quality and quantity targets are met. The targets are:

1. Best Practice reductions for Water Quality

- 80% reduction in Suspended solids (SS)
- 45% reduction in total nitrogen (TN)
- 45% reduction in total phosphorus (TP)
- 70% reduction in gross pollutants (GP)

*Note: CoGG has allowed the option of a Surcharge Levy to be paid in lieu of water quality control measures to offset the impact of re-development and contribute to development of regional stormwater control measures.*

2. No-worsening stormwater peak discharges

- Up to and including the 1% AEP design storm event.

3. Achieve Permissible Site Discharge (PSD) targets[1]

- East Catchment PSD –
  - 1% AEP = 1.23 $m^3/s$
  - 20% AEP = 0.63 $m^3/s$
- West Catchment PSD –
  - 1% AEP = 0.05 $m^3/s$
  - 20% AEP = 0.01 $m^3/s$

[1] Set by City of Greater Geelong Council as a reflection of downstream drainage system capacity. [CoGG Letter dated 10 Nov. 2015]

Three scenarios have been considered to analyse the design stormwater objectives for the re-developed CSIRO site at 1 Henry Street, Belmont.

**Option 1**: *Existing Conditions*;

**Option 2**: Developed Conditions – On-Site Detention (OSD) and Water Quality Levy;

**Option 3**: Developed Conditions – On-Site detention and Stormwater Reuse. [For consideration only]

An integrated systems approach was used to create the stormwater management plan for the redevelopment of the Henry Street site, by analysing the performance of the stormwater and water cycle management design option. This type of analysis is dependent on detailed inputs including topography, climate, geology, hydrology, stormwater quality and sound urban design principles.

The assessment of stormwater runoff generated within the proposed redevelopment located at 1 Henry Street detailed in this report can be effectively managed to ensure all stormwater targets and objectives can be met.

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# 1 INTRODUCTION

TGM Group Pty Ltd has been engaged by Belmont Projects to submit a site stormwater management plan (SSMP) to support the planning permit applications for the redevelopment of land located at 1 Henry Street, Belmont, currently the site of the decommissioned CSIRO Textile and Fibre Technology Laboratory.

The planning permit will allow redevelopment of the existing *quasi*-industrial site into a mixed density residential subdivision with increased pervious surfaces, consistent with the Victorian governments '*Cleaner Environments – Smarter Urban Renewal*' reforms to redevelop existing brownfield sites into cleaner, more environmentally sustainable residential developments with the intent of enhancing the surrounding community.

The subject site is situated approximately 4.2 km south west of Geelong CBD, as depicted in Figure 1.1, below.


**Figure 1.1:** 1 Henry Street redevelopment site location

# 2 STUDY AREA

## 2.1 Site Description

The subject site is a 6.21 hectare land parcel previously the location of the CSIRO Textile and Fibre Laboratories. The CSIRO laboratory buildings still occupy the site, awaiting demolition, creating a highly impervious area with high runoff potential. The site can be seen in Figure 2.1, below.

**Figure 2.1:** 1 Henry Street development site (aerial view)

The site has three street frontages - Henry Street which runs the length of the northern boundary, High Street to the east and Reynolds Road to the west. The southern boundary backs onto established residential properties.

## 2.2 Catchment Characteristics

The subject site is located within the suburban area of Belmont. The majority of the site is situated at the top of a catchment feeding a tributary of the Waurn Ponds Creek, however, stormwater flows within the catchment are primarily conveyed within the urban drainage system. The characteristics of the catchment can be seen in Figure 2.2.

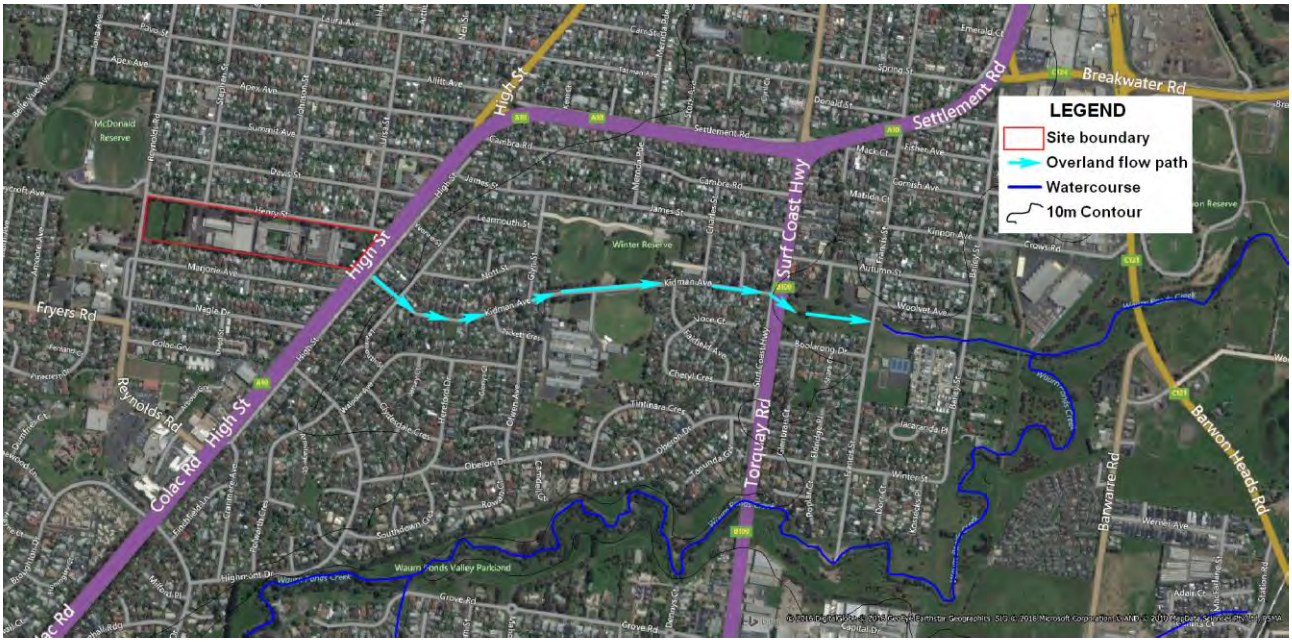



**Figure 2.2:** Catchment Characteristics

The surrounding catchment is a majority of urban residential in the form of General Residential – Zone 2 (GRZ2) with nearby Recreation Zones (PPRZ). As mentioned, the site is located at the top of an existing stormwater catchment and has no associated external catchments.

## 2.3 Internal Stormwater Catchments

### 2.3.1 Existing Site

The overall existing site can be broken up into 2 catchments, east and west, according to topography and point of discharge. The internal catchments are shown in Figure 2.3 and detailed in Table 2.1.

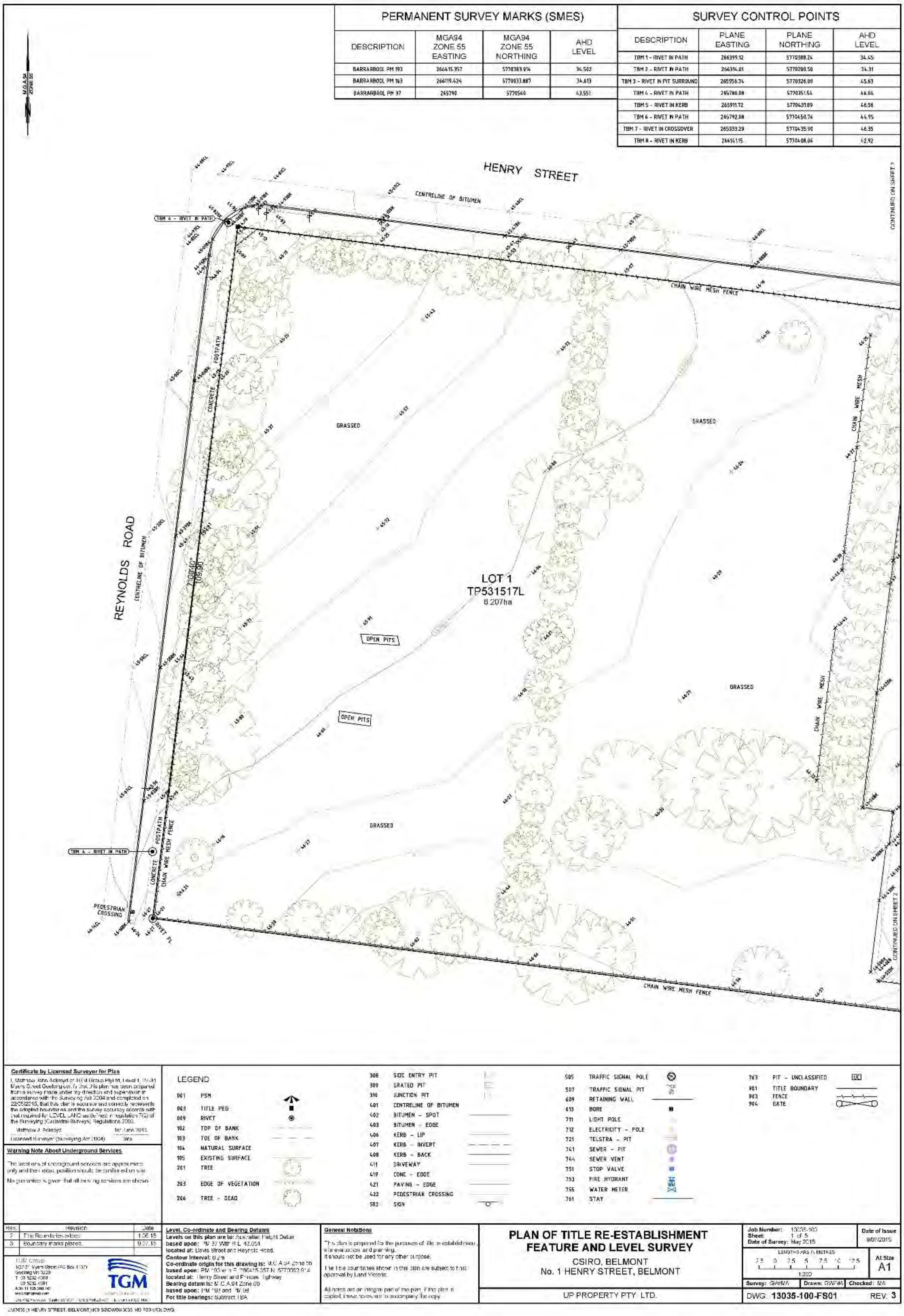

**Figure 2.3:** Internal sub-catchments and discharge locations

**Table 2.1:** Internal catchment details

| Catchment | Area (ha) | Point of Discharge |
|---|---|---|
| **East** | 4.85 | High Street |
| **West** | 1.36 | Reynolds Road |

TGM Group has undertaken detailed survey of the site and the internal catchment areas are confirmed. The feature survey is depicted in Figure 2.4 to Figure 2.8.

The majority of the CSIRO building structures are situated within the larger ‘east’ catchment currently resulting in 84% impervious surfaces. The existing ‘west’ catchment contains a few hard stands but no major building structures and resulting in much fewer impervious surfaces at roughly 21% of the area.




PERMANENT SURVEY MARKS (SMES)

| DESCRIPTION | MGA94 ZONE 55 EASTING | MGA94 ZONE 55 NORTHING | AHD LEVEL |
|---|---|---|---|
| BARRARBOOL PM 193 | 266415.357 | 5770383.914 | 34.502 |
| BARRARBOOL PM 163 | 266119.424 | 5770033.887 | 34.613 |
| BARRARBOOL PM 37 | 265790 | 5770560 | 43.551 |

SURVEY CONTROL POINTS

| DESCRIPTION | PLANE EASTING | PLANE NORTHING | AHD LEVEL |
|---|---|---|---|
| TBM 1 - RIVET IN PATH | 266399.12 | 5770388.24 | 34.45 |
| TBM 2 - RIVET IN PATH | 266314.01 | 5770280.50 | 34.31 |
| TBM 3 - RIVET IN PIT SURROUND | 265956.74 | 5770326.00 | 45.63 |
| TBM 4 - RIVET IN PATH | 265780.08 | 5770351.54 | 46.04 |
| TBM 5 - RIVET IN KERB | 265911.72 | 5770431.89 | 46.56 |
| TBM 6 - RIVET IN PATH | 265792.08 | 5770450.76 | 44.95 |
| TBM 7 - RIVET IN CROSSOVER | 265933.29 | 5770435.90 | 46.35 |
| TBM 8 - RIVET IN KERB | 266141.15 | 5770408.06 | 42.92 |

**Figure 2.4:** Site Feature and Level Survey (Sheet 1)

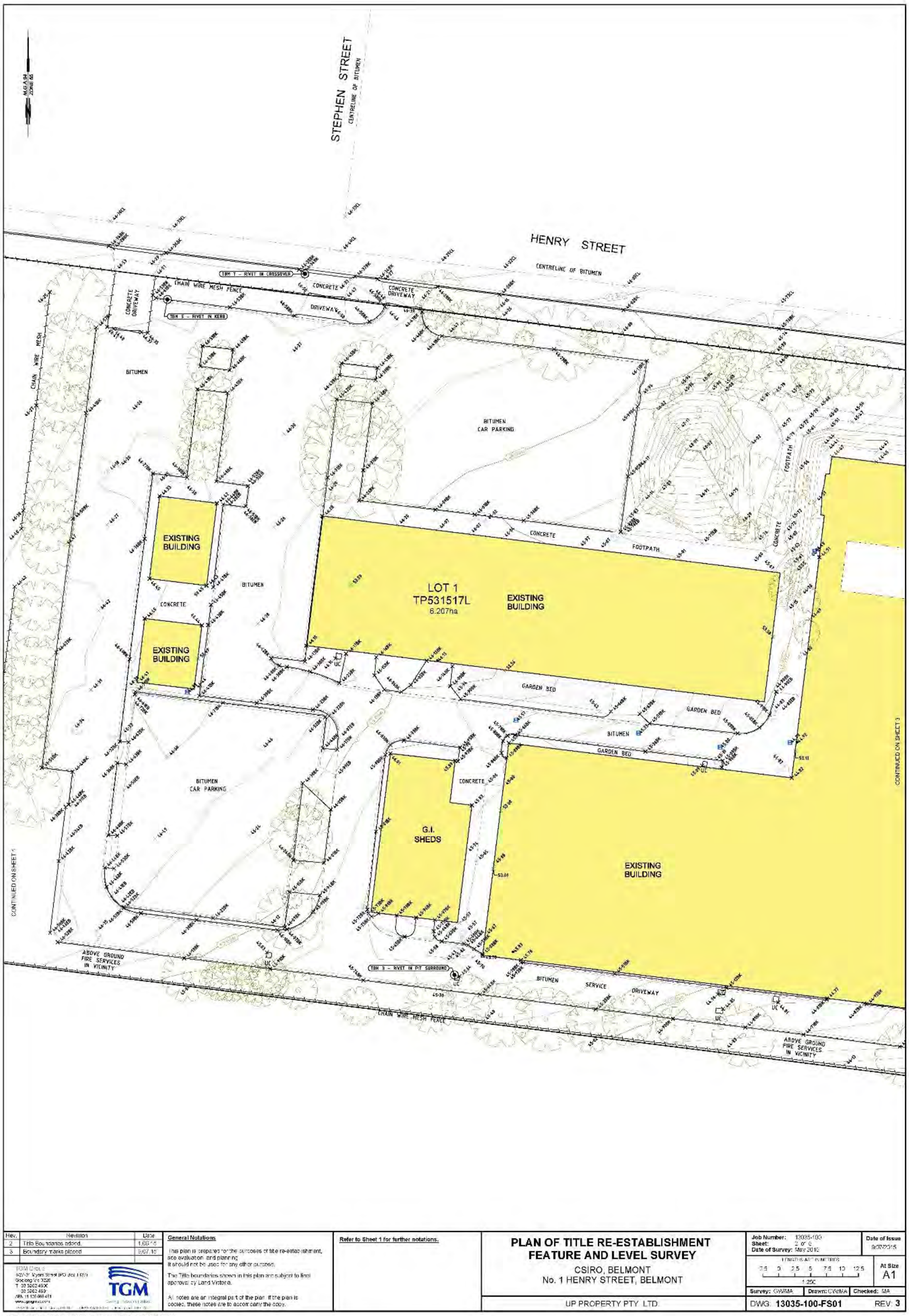



**Figure 2.5:** Site Feature and Level Survey (Sheet 2)


**Figure 2.6:** Site Feature and Level Survey (Sheet 3)


**Figure 2.7:** Site Feature and Level Survey (Sheet 4)

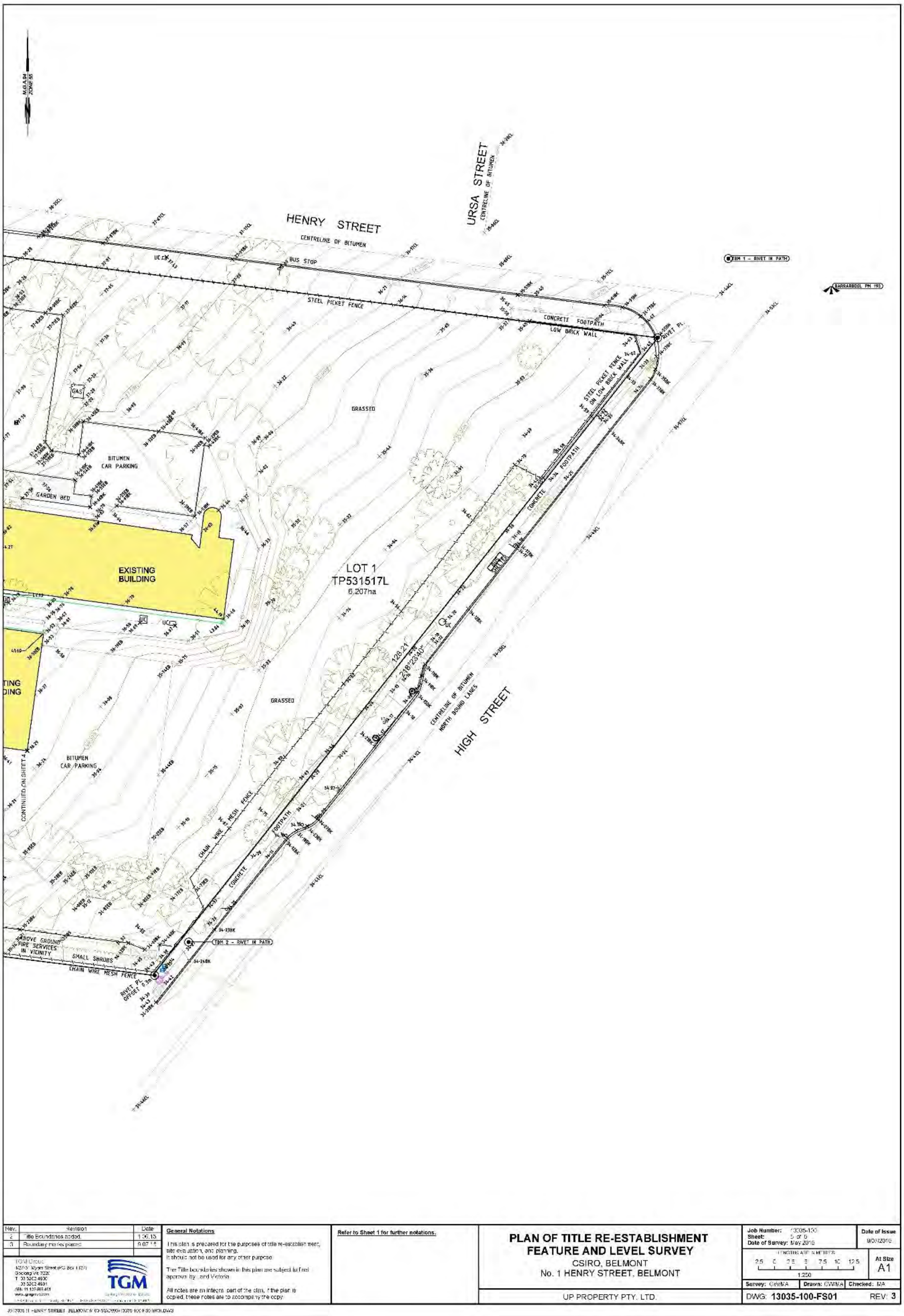



**Figure 2.8:** Site Feature and Level Survey (Sheet 5)

## 2.3.2 Staging Catchments

It is proposed to re-align the existing 'ridgeline' delineating the East and West catchments to enable separation of the urban drainage systems connected to each legal point of discharge (LPOD), reflecting the proposed staging of the re-development, resulting in approximately 80% of the site falling towards the east LPOD and 20% falling to the west.

The staging catchment delineation is depicted in Figure 2.9.

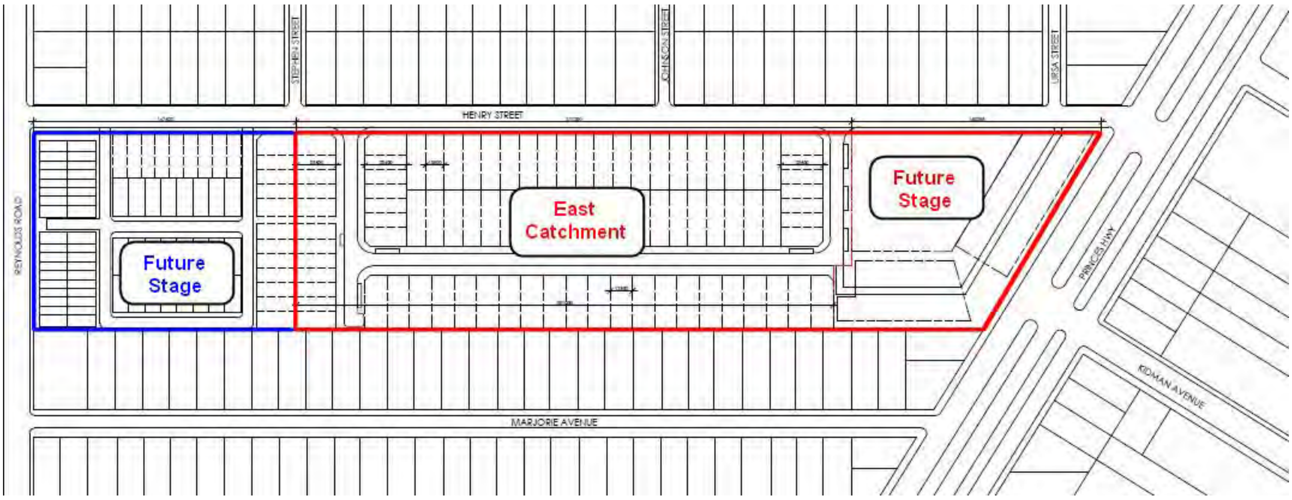



**Figure 2.9:** Re-development staging catchment plan

The east catchment, including the 'Future Stage' fronting High Street, will be analysed as part of this study. Analysis of the 'Future Stage' to the west will be undertaken at a later date.

### 2.3.3 Developed Site

Buildings will be removed from the site and the site levelled prior to development. The sub-catchments analysed will reflect the mixed density building clusters, separated by the road reserve. The re-developed layout and sub-catchment delineation is depicted in Figure 2.10.


**Figure 2.10:** Developed site layout plan

**Table 2.2:** Developed East Catchment - Subcatchments

| Catchment | Area (ha) | Percentage Impervious (%) |
|---|---|---|
| Larger Lots 400 | 0.81 | 80 |
| Larger Lots 315 | 1.32 | 80 |
| Semi Detached 1 | 0.103 | 90 |
| Semi Detached 2 | 0.134 | 90 |
| Semi Detached 3 | 0.147 | 90 |
| Semi Detached 4 | 0.147 | 90 |
| Townhouse Area 1 | 0.218 | 95 |
| Townhouse Area 2 | 0.283 | 95 |
| Park | 0.5 | 5 |
| Road | 0.73 | 95 |
| Other | 0.21 | 50 |

The proposed subdivision will decrease the amount of impervious surfaces within the 4.60 ha hectare east catchment from approximately 84% to 76%. The total impervious area will be approximately 3.48 hectares compared to the existing 3.86 hectares.

The decrease in impervious surfaces results in an increase in stormwater infiltration; this creates a decrease in the stormwater runoff volumes, velocities and pollutant loads being generated within the site.

Stormwater mitigation measures will be required to counteract the impact of the proposed development upon the downstream catchments and receiving environment and achieve best practice objectives as defined in the Best Practice Environmental Management Guidelines.

# 3 STORMWATER OBJECTIVES

The objective of the stormwater management plan is to meet the conditions and requirements set in the planning application for stormwater management. These requirements ensure that appropriate design and stormwater mitigation is applied to ensure that stormwater quality and quantity targets are achieved and maintained.

## 3.1 Site Stormwater Objectives

1. Best Practice reductions for Water Quality
   i. 80% reduction in Suspended solids (SS)
   ii. 45% reduction in total nitrogen (TN)
   iii. 45% reduction in total phosphorus (TP)
   iv. 70% reduction in gross pollutants (GP)
2. Ensure stormwater peak discharges do not exceed existing conditions
   a. Up to and including the 1% AEP critical storm event.
3. Reduction in site stormwater discharges
   i. East catchment permissible site discharge (PSD)
      a. 1% AEP = 1.23 $m^3/s$
      b. 20% AEP = 0.63 $m^3/s$
   ii. West catchment PSD
      a. 1% AEP = 0.05 $m^3/s$
      b. 20% AEP = 0.01 $m^3/s$

*Note:* Re-development staging has focussed solely on the eastern catchment area at this point. The following SSMP provides stormwater designs to achieve objectives related to the East LPOD only. The west catchment will be assessed at a later stage.

# 4 MITIGATION OPTIONS

Three design options will be assessed to understand how the developed site can achieve best practice reductions and stormwater objectives identified in Section 3.

## 4.1 Option 1 – Existing Conditions

The stormwater runoff characteristics from the development site and contributing catchments in its existing state will be evaluated for the 1% and 20% AEP critical duration storm events. These values will form the basis for comparison to ensure that the redeveloped site fulfils objectives required under the state development act[2].

Should the existing conditions discharge be lower than the PSD nominated by COGG (representing the capacity of the downstream drainage system), then it will be used to set design objectives.

## 4.2 Option 2 – Developed Conditions [OSD + Water Quality Levy]

Stormwater runoff generated within the east catchment during the 1% and 20% AEP events will be captured in on-site detention (OSD) facilities connected to effective roof areas and hard surfaces throughout the development. The OSD facilities will operate as source control measures rather than end-of-line due to the development layout and the terrain and infrastructure constraints.

Rainwater tanks (RWT) will be used as OSD facilities to enable integration throughout the development. Larger underground OSD's may be adopted for the high density apartment blocks and common property (body corporates) and to allow connection to surface runoff where required. The RWT will act as OSD using an operational setup similar to that depicted in Figure 4.1.

[2] EPA (2006). Stormwater and Clause 56 of the Victorian Planning Provisions. *Residential Subdivision.*

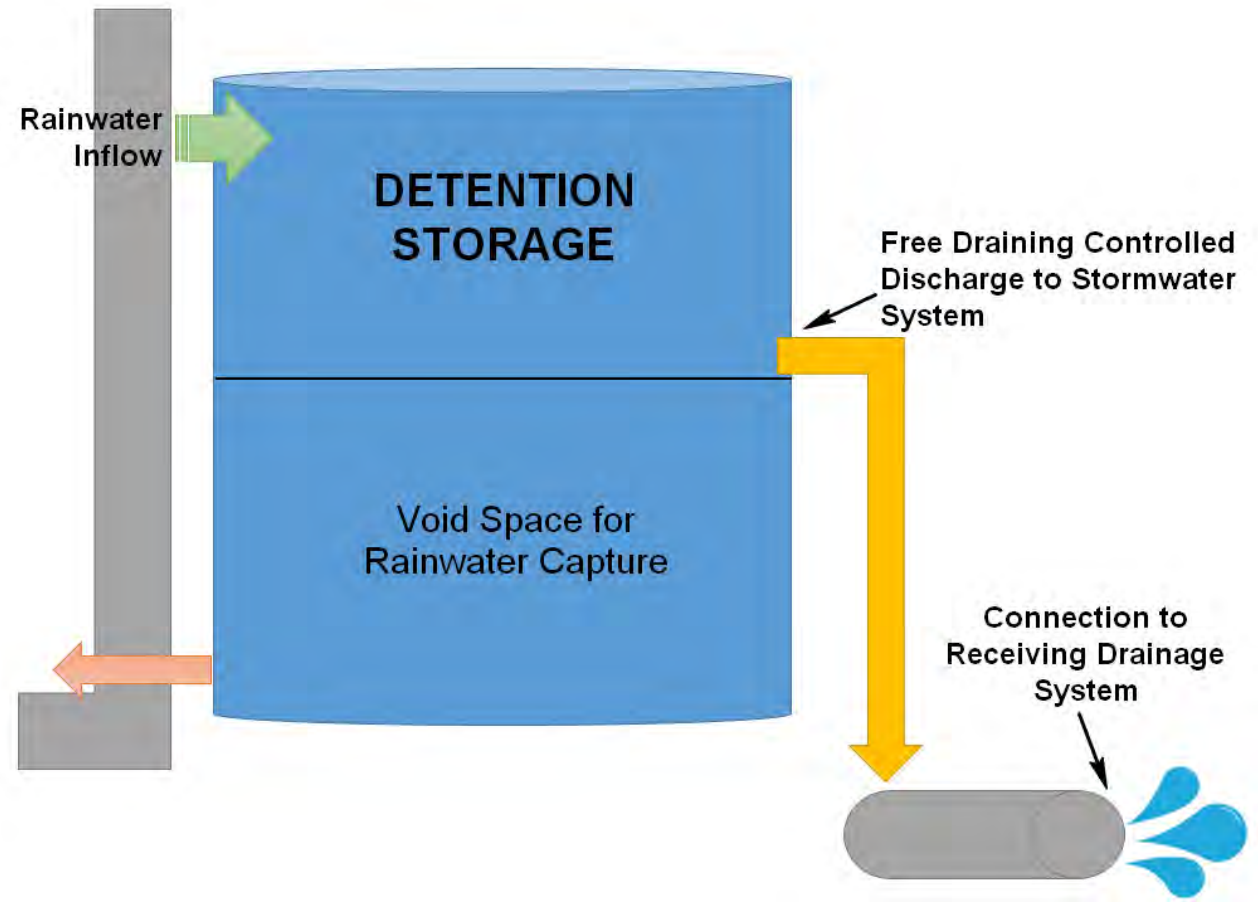



**Figure 4.1:** Rainwater tank configuration for On-site detention

End-of-line facilities will not be adopted for stormwater mitigation in the re-development of the CSIRO site would require significant excavation and a large footprint as the basin design would be dictated by the invert levels of the receiving downstream drainage infrastructure. This is a common constraint associated with brownfield developments.

Water quality objectives (WSUD) will be offset by paying a levy to City of Greater Geelong (CoGG) as accepted by Senior Development Engineer Bojan Ritonja via email dated 17/12/2015, to be paid on a stage by stage basis.

These payments would form a contribution towards external Water Quality projects that council would implement downstream of the site as part of the greater catchment

## 4.3 Option 3 – Developed Conditions [OSD + Stormwater Reuse]

This option will adopt the detention measures nominated in Option2, however, instead of paying a levy to CoGG to offset water quality, rainfall runoff will be harvested for internal and external reuse applications supplementing the potable water supply and discharged via the wastewater system.

The RWT configuration incorporating a reuse application can be seen in Figure 4.2.

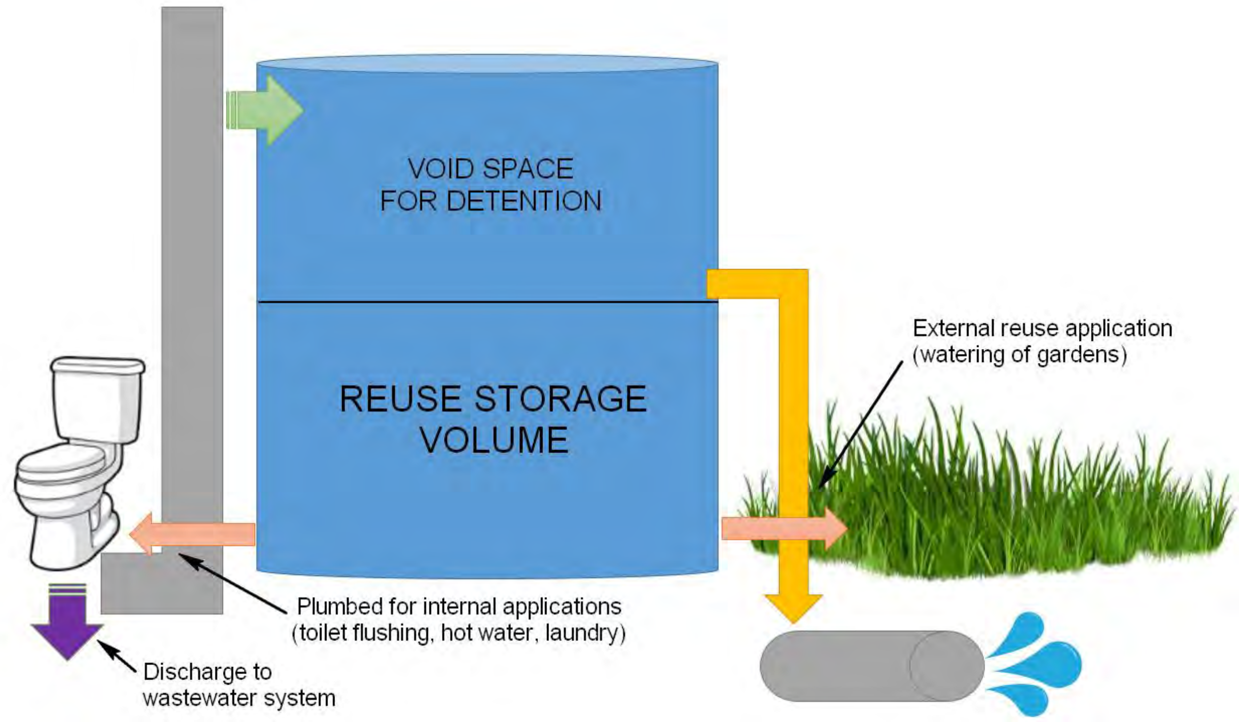



**Figure 4.2:** Rainwater tank configuration for On-site detention and Reuse

The RWT capacity for reuse applications will be determined by demand. Rainwater will supplement the potable water supply when available. During dry periods or periods of low rainfall, the potable water supply will top up the RWT to meet demands.

The RWT will feature a first flush device of some description to avoid unnecessary contamination of the water supply. These will be discussed at a later stage, when Option 3 is fully investigated.

Preliminary investigations into Option 3 suggest that reusing rainfall runoff collected within RWT's will not completely meet discharge requirements. It is anticipated that water quality measures such as gross pollutant traps (GPT's) will be included into the treatment train to achieve best practice reduction in contaminant loads. However, should this option be adopted, the required treatment train will be detailed at a later stage.

# 5 METHODOLOGY

The analysis underpinning the assessment detailed in this stormwater management plan employed an integrated systems approach to analyse the performance of a range of stormwater and water cycle management options. A more detailed assessment of water cycle management options will be detailed in the Integrated Water Cycle Strategy that will be developed to accompany the assessment of Option 3, should it be pursued further.

This type of analysis is dependent on detailed inputs including topography, climate, geology, hydrology, stormwater quality and sound urban design principles. The inputs relevant to the SSMP are discussed below.

## 5.1 Topography and existing infrastructure

The topography of the existing site was defined with detailed TGM ground and feature survey data undertaken May 2015 (refer Figure 2.4 to Figure 2.8).

As the re-development site is a brownfield site, many existing CSIRO building structures and hardstands are present. The existing site is largely devoid of any stormwater infrastructure. Rainfall runoff generated within the existing site is conveyed via the internal road network as overland flow to the receiving drainage system in the downstream catchments.

## 5.2 Hydrology

It is an objective for this study that the proposed development should achieve stormwater runoff discharges suitable at being conveyed effectively within the downstream (receiving) drainage systems. The assessment of the stormwater runoff characteristics of the site under existing, developed and design conditions was undertaken using the XP-RAFTS runoff-routing hydrology model.

### 5.2.1 Intensity-Frequency-Discharge (IFD) Data [ARR 87]

The intensity frequency duration (IFD) data used in the hydrology model to simulate the performance is shown in Table 5.1.

**Table 5.1:** IFD data for the Site (1 Henry Street)

| ARI (years) | Rainfall intensity (mm/hour) for a given duration (hours) | | |
|---|---|---|---|
| | $I_1$ | $I_{12}$ | $I_{72}$ |
| 2 | 17.99 | 3.25 | 0.89 |
| 50 | 34.44 | 6.06 | 1.8 |

The resulting IFD table is shown in Figure 5.1, below:

**Intensity-Frequency-Duration Table**

Location: 38.175S 144.325E NEAR.. 1 Henry St, Belmont Issued: 18/2/2016

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

| | Average Recurrence Interval | | | | | | |
|---|---|---|---|---|---|---|---|
| Duration | 1 YEAR | 2 YEARS | 5 YEARS | 10 YEARS | 20 YEARS | 50 YEARS | 100 YEARS |
| 5Mins | 45.0 | 59.9 | 81.8 | 97.0 | 117 | 147 | 172 |
| 6Mins | 41.9 | 55.9 | 76.1 | 90.2 | 109 | 136 | 160 |
| 10Mins | 34.1 | 45.3 | 61.1 | 72.0 | 86.7 | 108 | 126 |
| 20Mins | 24.8 | 32.7 | 43.4 | 50.6 | 60.4 | 74.4 | 86.0 |
| 30Mins | 20.0 | 26.3 | 34.6 | 40.2 | 47.7 | 58.5 | 67.3 |
| 1Hr | 13.3 | 17.4 | 22.6 | 26.0 | 30.8 | 37.4 | 43.0 |
| 2Hrs | 8.43 | 11.0 | 14.2 | 16.3 | 19.2 | 23.2 | 26.6 |
| 3Hrs | 6.38 | 8.31 | 10.7 | 12.2 | 14.4 | 17.4 | 19.9 |
| 6Hrs | 3.94 | 5.12 | 6.56 | 7.51 | 8.80 | 10.6 | 12.1 |
| 12Hrs | 2.43 | 3.17 | 4.07 | 4.66 | 5.47 | 6.61 | 7.53 |
| 24Hrs | 1.51 | 1.97 | 2.55 | 2.94 | 3.46 | 4.20 | 4.81 |
| 48Hrs | .912 | 1.20 | 1.57 | 1.83 | 2.18 | 2.66 | 3.07 |
| 72Hrs | .659 | .869 | 1.15 | 1.34 | 1.60 | 1.97 | 2.27 |

(Raw data: 17.99, 3.25, 0.89, 34.44, 6.06, 1.8, skew=0.42, F2=4.29, F50=14.84) © Australian Government, Bureau of Meteorology

**Figure 5.1:** IFD Table – 1 Henry Street site (Bureau of Meteorology)

### 5.2.2 Validation of hydrology model

The existing hydrology model was validated using the Probabilistic Rational Method (PRM). PRM is suitable for non-development rural catchments; therefore, the validation model assumes all catchments are undeveloped to determine model input parameters. Once the RAFTS model has been validated, the model is amended to reflect existing conditions. The rational method parameters are detailed in Table 5.2.

**Table 5.2:** Rational Method parameters for development site

| Parameter | Value | Notes |
|---|---|---|
| Area of east catchment | 4.60 ha | 1 Henry Street |
| $C_{10}$ | 0.09 | Runoff coefficient |
| $T_c$ | 14.15 minutes | Time of concentration |
| F2 | 4.29 | Geographical factor for a 6 minute, 2 year ARI |
| F50 | 14.84 | Geographical factor for a 6 minute, 50 year ARI |

Design storms were generated for all storm durations using a skew (G) of **0.42** and temporal pattern region **1** as defined from Australian Rainfall and Runoff.

The Rational method produced a 1% AEP ($Q_{100}$) peak discharge which was used to validate the RAFTS validation process. The east LPOD sub-catchment (reflecting proposed re-development delineation) were validated and updated to peak discharges to define existing discharges. These are depicted in Table 5.3.

**Table 5.3:** Validated Peak Discharges

| Catchment | Area (ha) | Rational Method Q (m³/s) | Rational Method +30% (CoGG) Q (m³/s) | RAFTS Validation Q (m³/s) | RAFTS Exist Q (m³/s) |
|---|---|---|---|---|---|
| Larger Lots 400 | 0.81 | 0.039 | 0.051 | 0.044 | 0.323 |
| Larger Lots 315 | 1.32 | 0.058 | 0.076 | 0.066 | 0.477 |
| Semi Detached 1 | 0.103 | 0.006 | 0.008 | 0.009 | 0.04 |
| Semi Detached 2 | 0.134 | 0.008 | 0.011 | 0.012 | 0.054 |
| Semi Detached 3 | 0.147 | 0.009 | 0.012 | 0.013 | 0.06 |
| Semi Detached 4 | 0.147 | 0.009 | 0.012 | 0.013 | 0.06 |
| Townhouse Area 1 | 0.218 | 0.013 | 0.016 | 0.017 | 0.018 |
| Townhouse Area 2 | 0.283 | 0.016 | 0.021 | 0.02 | 0.07 |
| Park | 0.5 | 0.026 | 0.034 | 0.031 | 0.122 |
| Road | 0.73 | 0.036 | 0.047 | 0.04 | 0.265 |
| Other | 0.21 | 0.012 | 0.016 | 0.016 | 0.076 |

The RAFTS layout schematic is shown in Figure 5.2.


**Figure 5.2:** RAFTS model conceptual schematic layout (Existing Conditions)

### 5.2.3 Developed Hydrology Model

The developed model will identify the degree of stormwater mitigation required and allow design detention facilities, using the OSD feature of RAFTS, to manage peak discharges up to and including the 1% AEP critical storm event to achieve PSD objectives.

### 5.2.4 On-site Detention

In order to lower peak discharges, on-site detention (OSD) was integrated throughout the site. The OSD requirements for the site were calculated using the RAFTS On-site Detention tool. The parameter inputs applied in the OSD tool are shown in Figure 5.3.

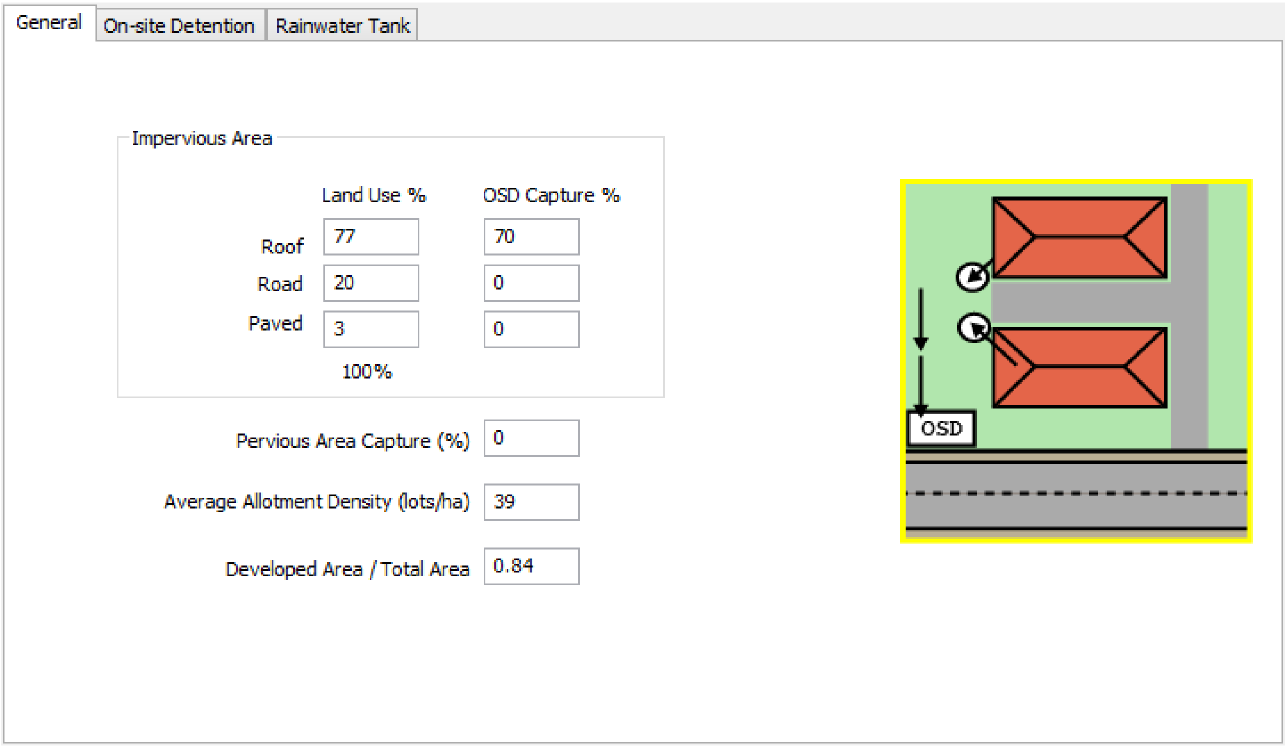



**Figure 5.3:** RAFTS on-site detention tool

The data input into the OSD calculations are detailed in Table 5.4.

**Table 5.4:** OSD calculation parameters

| Catchment | Impervious Area (ha) | Roof Coverage (%) | Roof Area (ha) | Roof Capture (%) | Effective Roof Draining Area |
|---|---|---|---|---|---|
| Larger Lots 400 | 0.65 | 60 | 0.486 | 50 | 0.24 |
| Larger Lots 315 | 1.06 | 70 | 0.924 | 50 | 0.46 |
| Semi Detached 1 | 0.09 | 85 | 0.088 | 100 | 0.09 |
| Semi Detached 2 | 0.12 | 85 | 0.114 | 100 | 0.11 |
| Semi Detached 3 | 0.13 | 85 | 0.125 | 100 | 0.12 |
| Semi Detached 4 | 0.13 | 85 | 0.125 | 100 | 0.12 |
| Townhouse Area 1 | 0.21 | 95 | 0.207 | 100 | 0.21 |
| Townhouse Area 2 | 0.27 | 95 | 0.269 | 100 | 0.27 |
| Road | 0.69 | 0 | 0 | 0 | 0.00 |
| Other | 0.11 | 0 | 0 | 0 | 0.00 |

Semi-detached dwellings and townhouses were assumed to achieve 100% roof capture based off the roof profile depicted in architectural designs provided by Genton Architecture. Larger lots will be individually designed by residents therefore a conservative estimate of 50% roof capture was adopted.

The park has not been considered in our OSD calculations and its runoff will be unmitigated. However, due to higher permeability its discharge will be lower.

# 6 RESULTS

The results of the analysis undertaken for the SSMP are shown in this section.

Design storm events were used to evaluate the stormwater peak discharges generated by the contributing catchment area. The critical storm duration was identified by simulating a range of event duration between 10 minutes to 12 hours.

Two (2) design storm events were used to assess the impact across the catchment. The percentage impervious resulted in critical events durations of 15 and 20 minutes.

The peak discharges from the site for Option 1 (existing), Option 2 (onsite detention) and Option 3 (onsite detention and re-use) are discussed in the following section.

## 6.1 Option 1 – Existing Conditions

The existing conditions create a peak discharge of **0.810m³/s** and **1.547m³/s** for the 5 and 100 year ARI storm events respectively.

The existing conditions hydrographs are shown in Figure 6.1 and Figure 6.2.

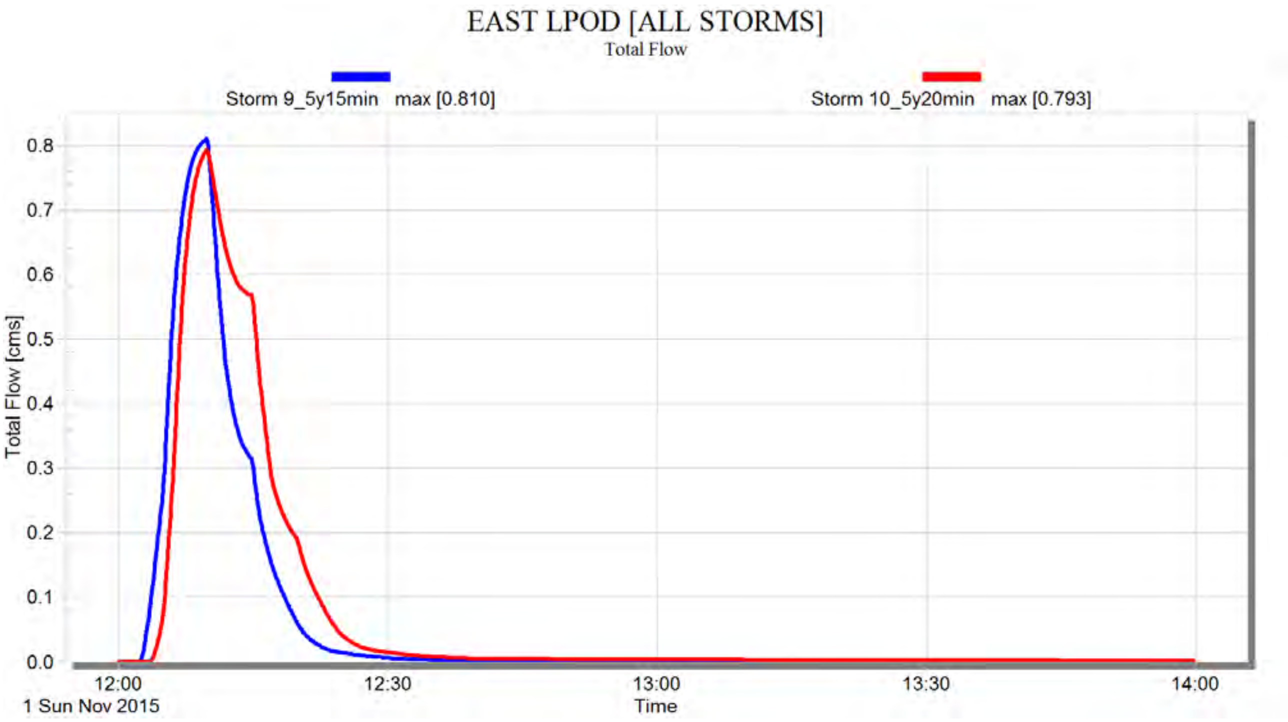



**Figure 6.1:** Option 1 – 20% AEP Existing conditions discharge hydrograph

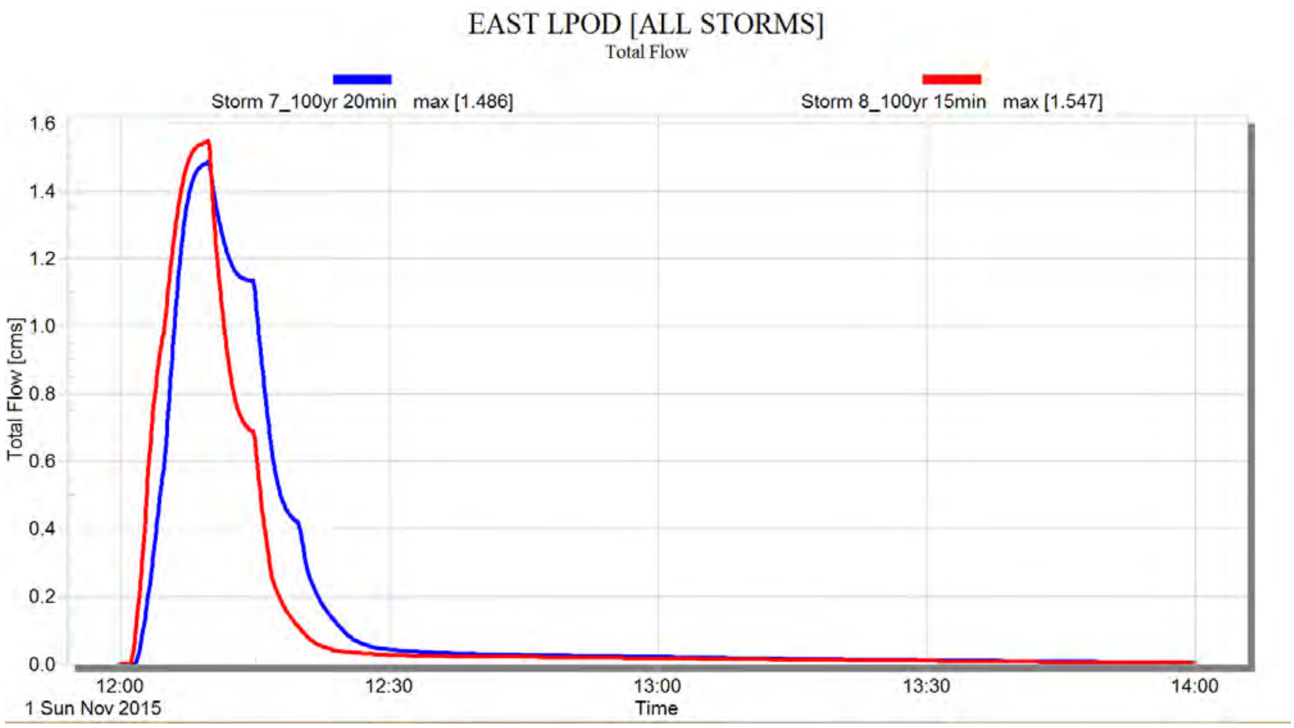



**Figure 6.2:** Option 1 – 1% AEP Existing conditions discharge hydrograph

### 6.1.1 Re-developed Conditions

Re-development of the site will result in an increase in permeable surfaces. This will inherently result in a decrease in peak discharges to **0.721m³/s** and **1.402m³/s** for 20% and 1% AEP, events respectively. The impact of the developed site can be observed in the hydrographs shown in Figure 6.3 and Figure 6.4.

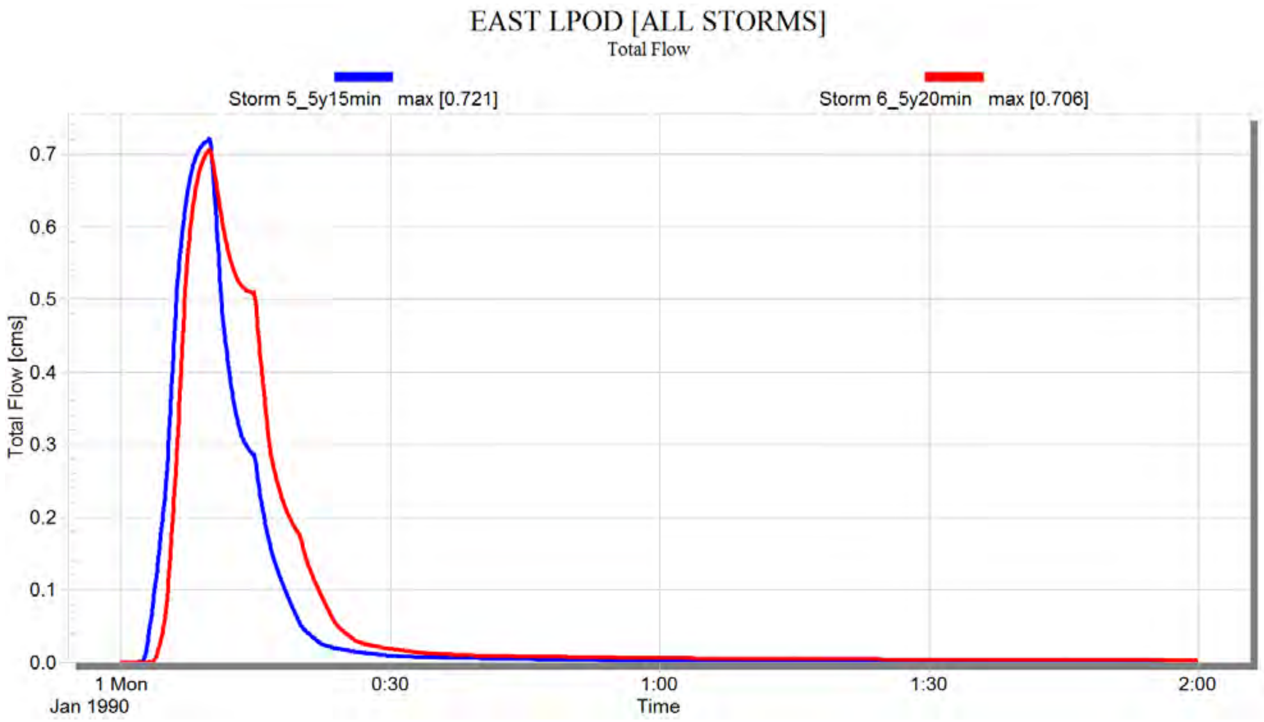



**Figure 6.3:** 20% AEP Re-developed conditions discharge hydrograph

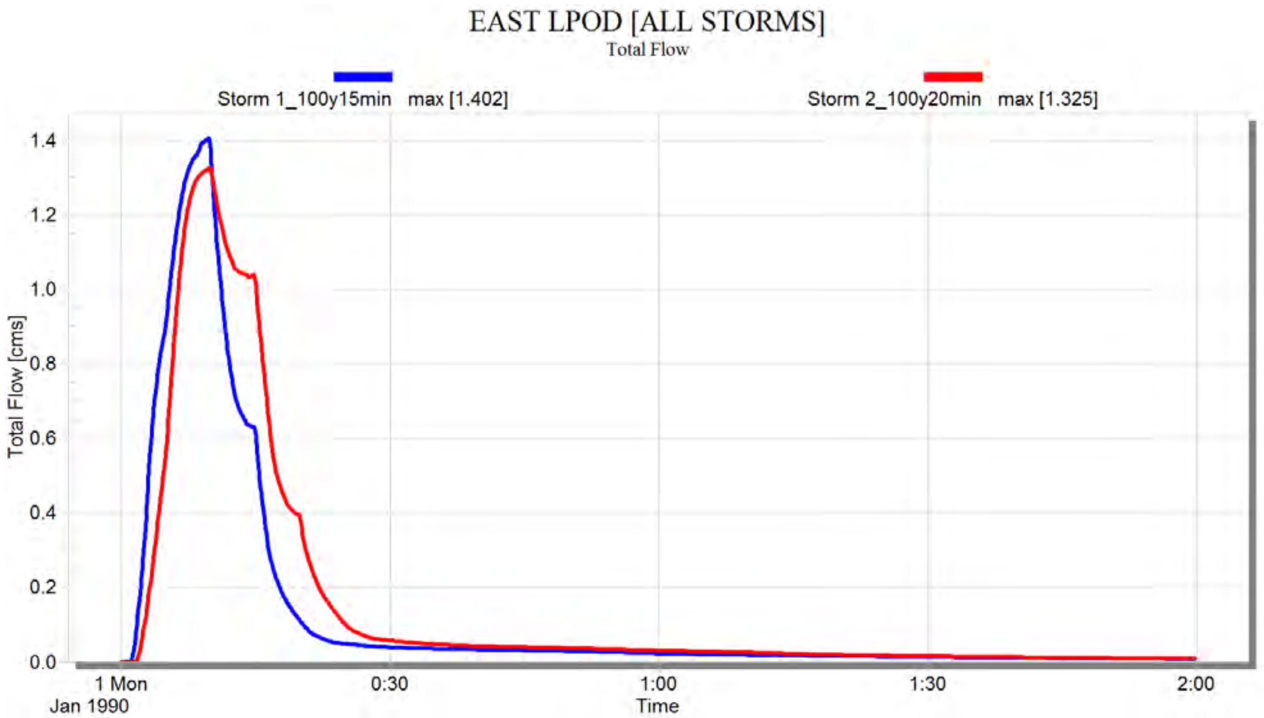



**Figure 6.4:** 1% AEP Re-developed conditions discharge hydrograph

While this satisfies the normal requirements of producing a 'no worsening' effect on catchment discharge, it does not meet the permissible site discharge (PSD) of 1.23m³/s, as stipulated by CoGG[3].

## 6.2 Option 2 – Onsite detention

To ensure the developed site can achieve PSD objectives, **271 m³** of detention is required.

The design outflow hydrographs produce discharged of **0.49m³/s** and **1.23m³/s** and are shown in Figure 6.5 to Figure 6.6, below.

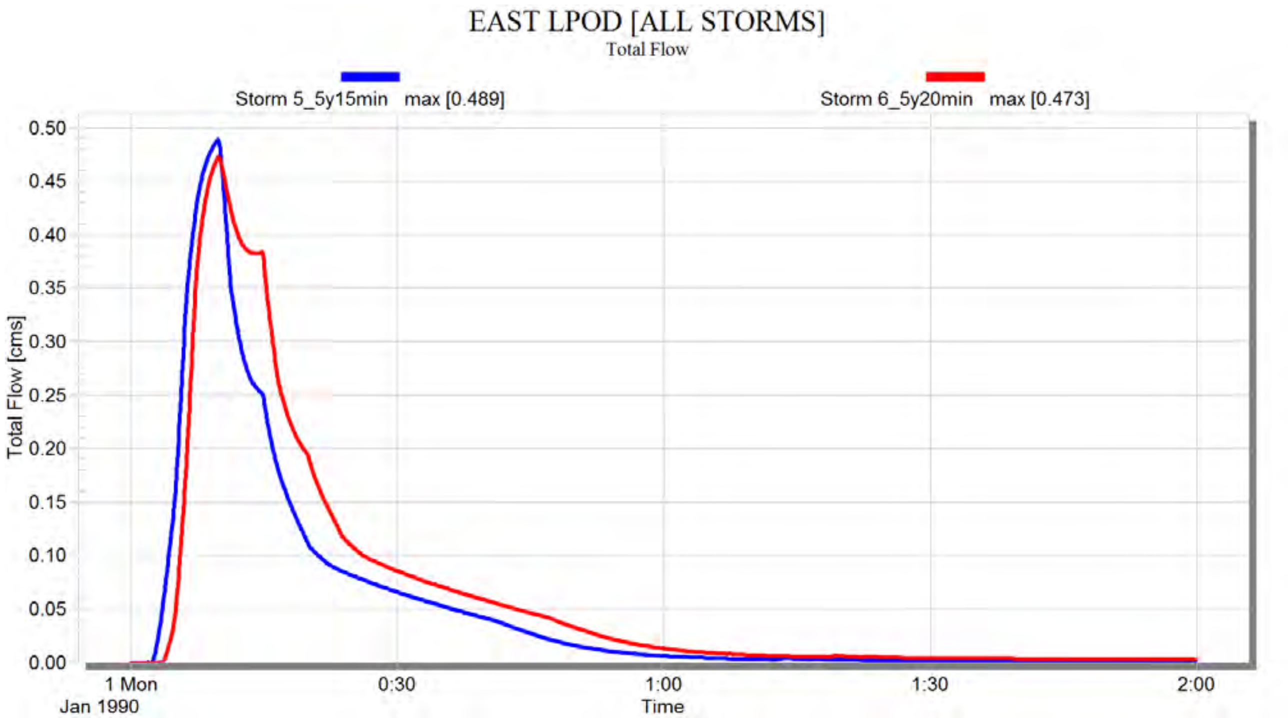



**Figure 6.5:** Option 2 – 20% AEP On-site Detention discharge hydrograph

[3] Smith,P. CoGG Letter. 10 November 2015. C251. Greater Geelong Planning Scheme Amendment C251 CSIRO Commonwealth Land, Belmont – Water Strategy.

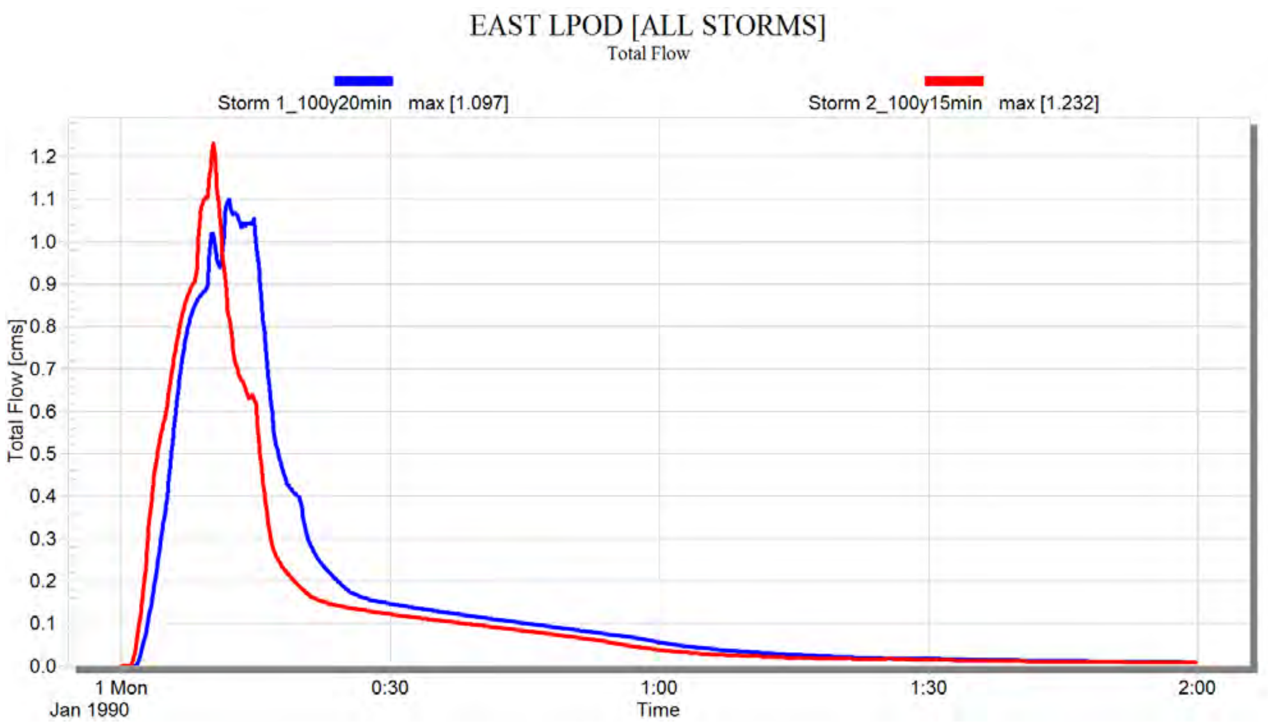



**Figure 6.6:** Option 2 – 1% AEP On-site Detention discharge hydrograph

## 6.3 Option 3 – OSD & Reuse

Option 3 will incorporate the same detention strategy applied in Option 2. An integrated water cycle solution will be required to achieve design objectives, incorporating rainfall harvesting in rainwater tanks connected to reuse applications as a large component of the treatment train. Results from this analysis will be documented in an Integrated Water Cycle Management (IWCM) report to be issued at a later date for application in detailed design considerations, should this option be pursued further.

# 7 CONCLUSION

Brownfield developments are often constrained by many existing factors related to all facets of development. Stormwater constraints can be legislative and physical. Stormwater objectives applied to development these days may not have been applied, or required, in surrounding development area.

This often results in aging and under-designed infrastructure within the receiving catchment, augmentation of which can be cost prohibitive. Limited space within the developable area to accommodate required mitigation facilities and the design levels can often be dictated by external influences.

The Henry Street site is no exception to these constraints and the stormwater management strategy detailed in this report has taken them into account.

The analysis detailed in this SSMP indicates that the east catchment of the existing CSIRO site can be re-developed and achieve stormwater objectives for the both water quality and quantity.

The water quality requirement can be offset with a levy contribution to the regional water quality scheme, whilst integration of rainwater tanks throughout the development, governed by Section 173 agreements and designed to provide on-site detention of rainfall runoff close to the source, enable mitigation of stormwater runoff flows to achieve a permissible site discharge set by CoGG, reflecting the capacity of the downstream drainage system.

Preliminary investigations indicate that an integrated water cycle solution can be effectively applied to this site. Incorporating a stormwater harvesting and reuse application can reduce site discharge volumes and demand on potable water supply, however, detailed discussion of this scenario will be provided if and when Option 3 is pursued further.