

Precinct 15 Altona North

Drainage Strategy

23rd March 2015



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1. INTRODUCTION

1.1. General

SMEC Australia has been engaged by Mirvac on behalf of the Precinct 15 landowners to establish a drainage strategy for the 67ha re-development area known as 'Precinct 15, Altona North' ("Precinct 15"). The Precinct is located 8 km west of the Melbourne Central Business District (CBD) in the suburb of Altona North and is approximately bounded by the following features:

- Westgate Freeway and Electricity sub-station Road in the North
- New Street in the East
- Blackshaws Road in the South
- Kyle Road in the West

The Melways Reference for the site is: 41 E12. A site locality plan is presented as Figure 1.1.

The majority of the precinct is currently zoned Industrial 1 (IN1Z) with small portions along the New Street interface and at Kyle Road zoned Industrial 3 (IN3Z). A map indicating current land zoning that applies to the Precinct is included as Appendix A.

Factories and warehouses currently exist throughout Precinct 15, however, some previously existing industrial buildings have since been demolished including the Gilbertsons Meat Processing Complex at 65 to 75 Kyle Road, Altona North. Parts of the Precinct have also formally been used as a quarry.

1.2. Project Background

The Hobsons Bay Industrial Land Management Strategy (ILMS) which was adopted by the Hobsons Bay City Council (HBCC) in 2008 indicates a desire to re-develop the land at Precinct 15 Altona North. It is understood that HBCC have proposed land at Precinct 15 to be re-zoned from 'Industrial' to 'Residential' with 'Mixed Use' components.

The Hobsons Bay ILMS defines the precinct as a strategic redevelopment area but land at 232 to 268 Blackshaws Road, Altona North is defined as a secondary industrial area. This secondary industrial area may also form part of the overall strategic redevelopment area if the land becomes redundant for the current industrial purposes as is the case with the vacated Dons Smallgoods site located on Kyle Road .

The drainage strategy is required to assist in the re-zoning of land at Precinct 15, and forms part of the planning permit application to subdivide land. Any proposed development for Precinct 15 Altona North would incorporate recommendations from this drainage strategy. The purpose of the drainage strategy is to outline the stormwater management infrastructure required for the site, in-line with objectives set-out in the Victorian Planning Provisions Clause 56-05-1 and Clause 56.07-4 'Urban Runoff Management Objectives'. The responsible Drainage Authority for the site is HBCC.

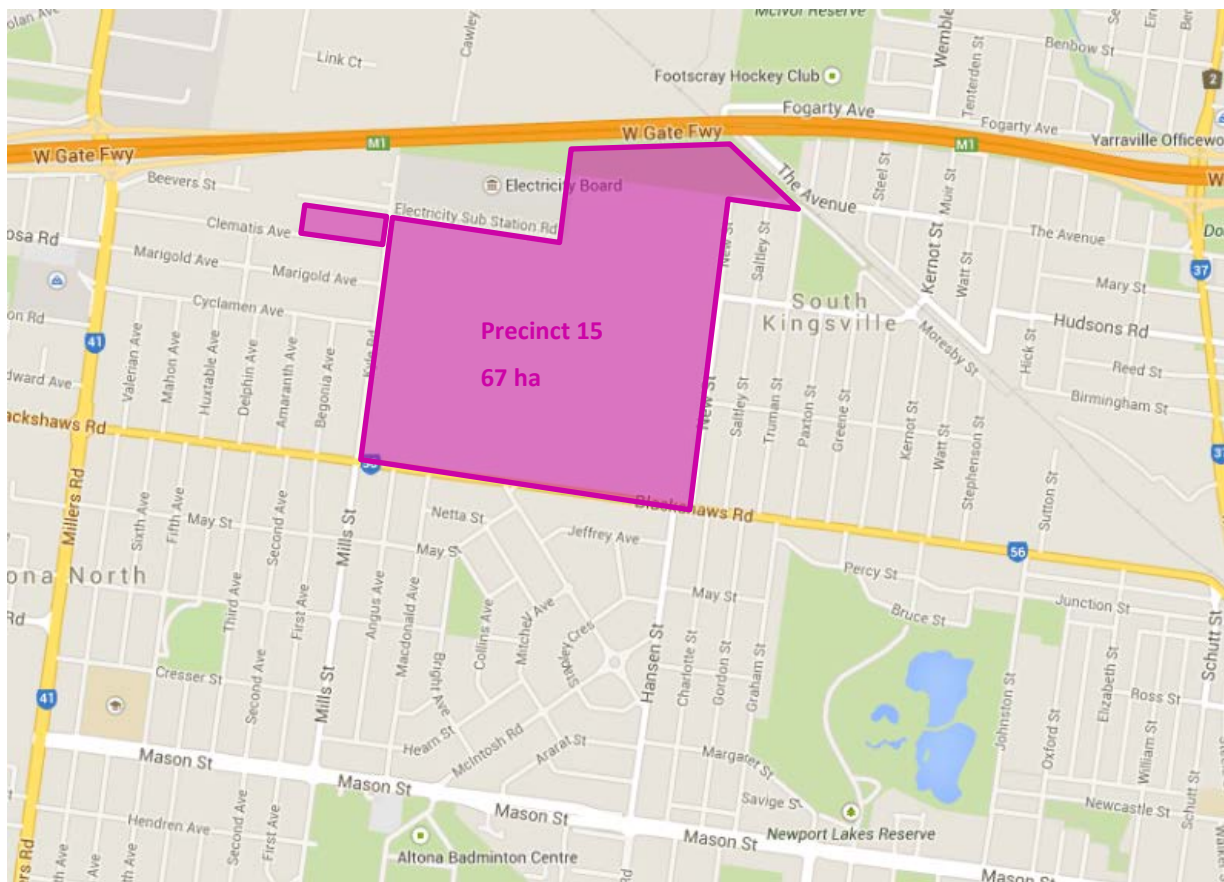


Figure 1.1: Site Locality Plan

The drainage strategy for Precinct 15 is dependent on a rationalised subdivisional layout which encompasses a fair and equitable financial scheme for all private land holders.

2. REVIEW OF PREVIOUS STUDIES

2.1. General

The existing services and future drainage infrastructure requirements for the subject development has been considered as part of an earlier investigation described in KLM Spatial (2012).

The relevant outcomes from KLM Spatial (2012) may be summarised as follows:

- The Precinct 15 site is split up into two primary catchments; these may be referred to as the 'northern catchment' and the 'southern catchment'.
- The southern catchment is identified as being within the MWC (4190) Paisley Drain Re-Development Drainage Scheme (RDS) and discharges to Paisley Drain in the south. The report assumed that stormwater management for the southern catchment would be catered for through a contribution to the RDS. The northern catchment of the site is not within a MWC Drainage Scheme and therefore management of stormwater is governed by HBCC stormwater management standards.
- The report provided historic photos showing the industrial development that previously existed in 'Property 2 North', 'Property 2 South', and 'Property 12' prior to recent demolition works. This information is useful in assessing the amount of stormwater runoff that was previously generated by these properties.
- The report has identified three (3) low points, and these include; one (1) outfall at Watsons Street near Edwards Reserve for the northern catchment, and two (2) outfalls along Blackshaws Road for the southern catchment.
- KLM Spatial (2012) proposes the use of existing quarries as stormwater management areas, to store and treat stormwater runoff in the northern catchment.

HBCC provided a response to KLM Spatial (2012) and they have indicated that the old quarry sites on Precinct 15 were subsequently used as landfills. Victorian Environmental Protection Authority (EPA) guidelines would prevent the use of landfills as water quality or retardation devices.

The assumption in KLM Spatial (2012) that the southern catchment does not require management infrastructure is now outdated. Melbourne Water no longer operates any RDS's and payment of a contribution to such a scheme is no longer an option.

3. AVAILABLE INFORMATION AND DATA

3.1. General

Data used to undertake the analysis and conceptual design for this Stormwater Management Strategy includes:

- Land Use Plan for Precinct 15 produced by Tract (20/3/2015) showing the Precinct boundary and the various land owner boundaries and land-use zoning within Precinct 15.
- Catchment maps from Melbourne Water Corporation (MWC) showing existing catchment boundaries, main drains and the extents of localised flooding in 1 in 100 AEP flood events.
- Information on the locations and alignment of existing services from KLM Spatial (2012) report
- Up to date survey information and 1m contour data provided by the Client
- Victorian Planning Scheme Maps for HBCC downloaded from:
<http://planningschemes.dpcd.vic.gov.au/schemes/hobsonsabay>
- 6 minute rainfall data obtained from Bureau of Meteorology (BoM)
- Monthly areal potential evapotranspiration data obtained from BoM
- Intensity Frequency Duration (IFD) rainfall data downloaded from:
<http://www.bom.gov.au/water/designRainfalls/ifd/index.shtml>

The above information was collected and reviewed as part of this Study. Site specific data, including; rainfall data, evapotranspiration data and contour data were utilised to estimate peak stormwater runoff rates and volumes. The Land Use Plan in combination with known existing surface elevations were utilised to create a concept layout showing the alignment of the stormwater pipes (main drains only) locations of outfalls and locations for stormwater treatment measures.

Property numbers referred to throughout this report represent the parcel numbers on the TRACT Land Use Plan included as Appendix B.

4. SITE DESCRIPTION

4.1. General

The Precinct 15 site comprises multiple private landholder properties and road reserves. A total of 16 private landholder properties exist within Precinct 15, 11 of which predominately occur within the southern portion of the site, and 5 of which predominately occur within the northern portion of the site. The properties are labelled 'Property 1' to 'Property 16'. The plan included as Appendix B indicates the land owner properties, respective boundaries numbers.

The land is relatively flat exhibiting average grades of 0.5 % throughout the site. Notwithstanding there has been some recent clearing works over Precinct 15, the land has predominantly been occupied by industrial development resulting in a high existing impervious area. Information on existing drainage infrastructure throughout the precinct is lacking, and it is presumed that the various existing properties discharge directly to a legal point of discharge on the closest street frontage.

4.2. Existing Catchment

There is an existing catchment divide traversing the Precinct east – west, between 'Property 1' in the north-west and 'Property 15' in the east. Correspondingly, two primary catchments exist within the Precinct, and these are referred to as the 'Northern Catchment' and the 'Southern Catchment'. Property 2 is split in two by the catchment divide and the separated portions of land are therefore referred to as 'Property 2 North'; and 'Property 2 South'.

A catchment Map was obtained from Melbourne Water Corporation (MWC), which confirms the alignment of the east-west catchment divide. A copy of the catchment map supplied by MWC is included as Appendix C.

4.2.1. The Northern Catchment

The Northern Catchment area encompasses 30.2 Ha of land representing 45% of the developable area within Precinct 15. Runoff in the Northern Catchment is generally moving in the north-east direction towards the outfall located on Watsons Street near Edwards Reserve. The catchment is estimated to have an existing fraction impervious of 73% when previous industrial developments over the site are considered.

Features of the Northern Catchment, are summarised as follows:

- The land throughout the Northern Catchment is generally draining towards the north east corner of the site, and will ultimately discharge into the MWC Stoney Creek Catchment.
- The catchment outfall or low point is located at Watsons Street near Edwards Reserve.
- 'Property 16' within Precinct 15 is used as a drainage reserve to service the GPU Power Net Pty Ltd land parcel to the north of Precinct 15. The reserve is understood to contain a water main and several abandoned sewer mains.
- The existing Brooklyn Trunk Sewer Main (2800 mm diameter) passes through 'Property 2' and 'Property 12'. The depth between the existing surface and the top of the sewer is approximately 30 m.
- It is understood that there are three (3) abandoned sewer mains (2 x 1800 mm diameter and 1 x 1200 mm diameter) located within 'Property 13'. The depth and exact location of these abandoned sewer mains is unknown.

- An Electrical Terminal Substation site is located to the north of Precinct 15 and it shares a boundary with Property No.2. The surface contours indicate that the site drains towards the north east and towards the general vicinity of the GPU Power Net service reserve and easement. It has been confirmed that the reserve is used as a drainage easement for the substation site.

It is understood that the sale of the reserve could potentially be negotiated if the drainage for the substation can be incorporated into the overall drainage scheme.

4.2.2. The Southern Catchment

The Southern Catchment encompasses 36.8 Ha of land, representing 55% of the developable areas within Precinct15. Runoff in the Southern Catchment is generally moving in the southern direction towards two separate outfalls along Blackshaws Road. The catchment is estimated to have an existing fraction impervious of 88%. The impervious fraction estimate includes the portion of Property No. 2 that was previously developed as an industrial enterprise.

Features of the Southern Catchment, are summarised as follows:

- The land throughout the Southern Catchment is generally draining towards the south, and will ultimately discharge into the MWC Paisley Drain Catchment.
- There are two (2) catchment outfalls or low points which are located along Blackshaws Road.
- HBCC have reported that there are no known flooding problems associated with this catchment.

4.3. Future Catchment

The HBCC ILMS considers that the 'most suitable use for the majority of the precinct is residential' and that the expected outcome would be 'residential with mixed use components'. The Land Use Plan proposed by Tract is in-line with HBCC ILMS recommendations, and has assigned preliminary land-use areas to developable land. The various land-uses and areas are summarised in Table 4.1.

Table 4.1 Land-Use Areas

Land-Use Type	Land-Use Area (ha)	Proportion of Total Developable Area
Residential	55	82%
Non Residential -Mixed Use Zone -Community Facilities -Connector Road	5	7.5%
Open Space	5	7.5%
Encumbered Land	2	3%
Total	67	100

There is an existing catchment divide traversing the Precinct east – west, between 'Property 1' in the north-west and 'Property 15' in the east.

Given that the Precinct 15 site comprises multiple private landholder properties and road reserves (a total of 16 private landholder properties), it is particularly important to consider property boundaries in relation to existing overland flow paths and the alignment of the underground pipe network. The Stormwater Management Strategy for Precinct 15 is dependent on a rationalised subdivisional layout which encompasses a fair and equitable financial scheme for all private land holders. Thus, investment in required stormwater management infrastructure should also be spread evenly between landholders.

It is envisaged that property development across Precinct 15 would occur sporadically. In addition, the property is relatively flat without any natural features to concentrate rainfall runoff. These two factors in combination mean that there is scope for water quality and retardation infrastructure to be constructed for individual properties within Precinct 15. For the purposes of developing this strategy, it is assumed that retardation and water quality requirements will be achieved through the use of distributed rather than concentrated infrastructure elements.

4.3.1. The Northern Catchment

The Northern Catchment comprises the following properties:

- 67% of Property 2
- 12% of Property 11
- 100% of Property 12
- 100% of Property 13
- 33% of Property 14
- 50% of Property 15
- 100% of Property 16 (GPU Power Net)

The development includes two encumbered land properties being an existing road reserve and a reserve understood to be used for drainage by GPU Power Net. The current development layout does not make use of the road reserve and it has been assumed for the purposes of this strategy that the reserve lands would be made available for sale by HBCC and ultimately would form part of the residential development. It is unclear at this stage whether the GPU Power Net drainage reserve will be sold and re-developed. It has been assumed for the purposes of this analysis that the reserve would remain unaltered in its current configuration.

Each of the above properties forms a sub-catchment of the Northern Catchment, and discharges to a proposed outfall at Watsons Street near Edwards Reserve. Stormwater from this catchment will ultimately be discharged to Stony Creek. The downstream drainage path incorporates a culvert crossing of the railway line at Brunel Street some 550 m distant from Precinct 15. Melbourne Water report that this culvert crossing floods in a 1 in 100 AEP event and they require that flows be appropriately retarded to ensure that the flood levels are not increased by the development works.

4.3.2. The Southern Catchment

The Southern Catchment comprises the following properties:

- 100% of Property 1
- 33% of Property 2
- 100% of Property 3 & 4
- 100% of Property 5
- 100% of Property 6 & 7
- 100% of Property 8
- 100% of Property 9
- 100% of Property 10
- 88% of Property 11
- 67% of Property 14

- 50% of Property 15

Each of the above properties is a sub-catchment within the Southern Catchment, and ultimately discharges to existing drainage infrastructure along Blackshaws Road. Stormwater ultimately discharges to Paisley Drain in the south.

Each property was considered as an individual sub-catchment within the Precinct as detailed in Figure 4.1.

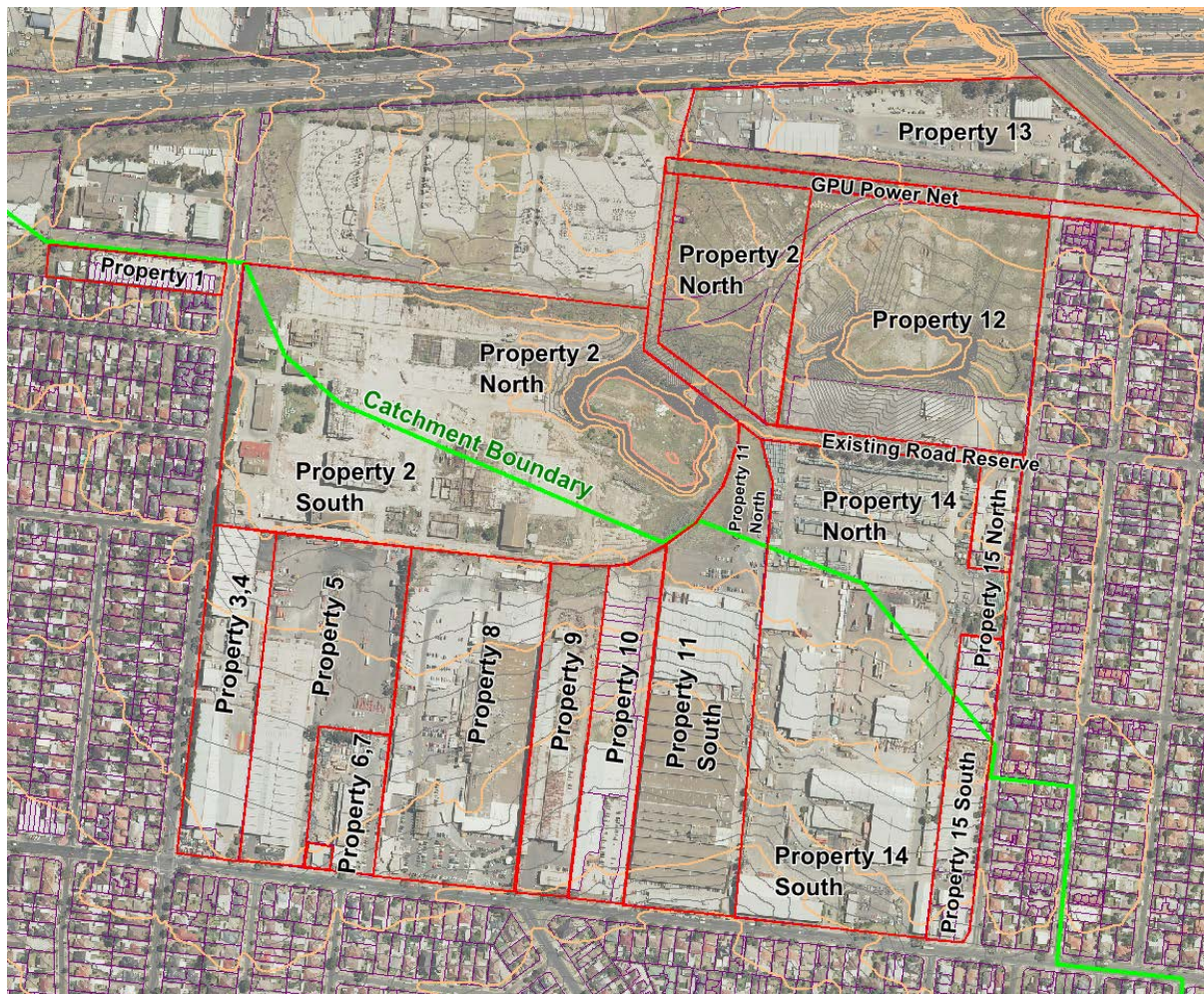


Figure 4.1 North South Catchment Boundary

5. STORMWATER QUANTITY INFRASTRUCTURE

5.1. General

Stormwater quantity infrastructure is required to ensure that the development does not unduly impact upon the existing stormwater infrastructure. HBCC requirements in this respect are that 1 in 5 AEP stormwater peak runoff rates following the development works should be no greater than at present.

Consideration should also be given to any potential impacts on 1 in 100 AEP flooding further downstream for which Melbourne Water is responsible.

5.2. Conceptual Layout

HBCC has advised that they have a stormwater harvesting and treatment facility which in part is fed by runoff draining to the south from Precinct 15 (refer email correspondence included as Appendix D). They have further advised that they would be happy to accept any additional runoff into this system. As a result, HBCC will not require any stormwater quality treatment of stormwater which is drained to the south from Precinct 15.

HBCC has advised that they require retardation for 1 in 5 AEP flows only and excess 1 in 100 AEP flows are carried on the street network. While there may be little change in effective impervious area for many of the Precinct 15 properties, it is recognised by HBCC, that the impervious areas over much of the existing development is not directly connected to the existing drainage network. It has been assumed that there will be increased flows into the existing stormwater drainage network and therefore retardation will be required for the 1 in 5 AEP event.

MWC have provided a catchment map which details stormwater flooding extents in a 1 in 100 AEP event and this map is included as Appendix C. The map indicates that there is property flooding at the outlet for the northern catchment in the existing 1 in 100 AEP flow event.

It is assumed that if there is no effective change in the proportion of impervious area, that there would be little change in the 1 in 100 AEP flows and no retardation is proposed in such circumstances. This is the case for the catchment areas which drain to the south, and no additional retardation is proposed for the southern draining catchments. The catchments which drain to the north include some areas which have never been substantially developed and it is proposed that retardation for 1 in 100 AEP events will be required for catchments draining to the north.

5.3. Rainfall Runoff and Attenuation Modelling

5.3.1. General

Rainfall runoff modelling has been undertaken for several purposes, namely:

- To estimate the stormwater runoff generated for existing catchment conditions
- To estimate the stormwater runoff generated for the future (re-developed) catchment conditions.
- To determine the requirements for stormwater retardation

Stormwater runoff was calculated for the existing and future catchment scenarios by applying the Rational Method approach. Stormwater retardation requirements were estimated using the Boyds Method.

5.3.2. Peak Flow Modelling

General

The rational method was used to estimate peak design flows at various locations throughout the Precinct. The Rational Method expresses a relationship between rainfall intensity and catchment area as independent variables and the peak flood discharge resulting from the rainfall as the dependent variable. The Rational Method Equation is as follows:

$$Q = (C I A) / 360$$

Where:

Q = Design discharge (m³/s)

C = Runoff Coefficient

I = Rainfall Intensity (mm/hour)

A = Catchment Area (Ha)

Runoff Coefficient

The runoff coefficient has been computed using a standard procedure for urban conditions described in IEAust (1987). The relationship is a function of rainfall intensity and catchment proportion imperviousness.

The catchment proportion impervious for existing conditions has been estimated based upon the maximum degree of development which has historically occurred on any part of the catchment. Historic aerial imagery has been used to assist in this regard.

Future catchment imperviousness has been estimated based upon the Land Use Plan which indicates that average lot sizes will be under 300m². Residential developments in this category are typically assumed to be 80% impervious.

Time of Concentration (Critical Rainfall Intensity)

As discussed above, it is to be expected that there will be additional stormwater runoff following the development due to the nature of the amount of direct connected impervious area in the existing and future developed conditions.

The difference in flow rate has been quantified as a difference in the time of concentration. Time of concentration is the time it takes for runoff to get from the top of a catchment to the bottom of the catchment (or catchment outlet).

For the existing scenario, it was assumed that there is no direct pipe connection to the receiving stormwater network and runoff can only be conveyed by overland flow. The time of concentration for the existing scenario was calculated using the Mannings equation, where the entire width of the property or catchment acted as a channel conveying overland flow.

For the future scenario, flows will be conveyed to the existing stormwater network via a piped drainage system. Therefore, the time of concentration was calculated using the pipe flow form of the Mannings equation.

The Mannings Equation is as follows:

$$V = Q/A = [1/n (A R^{2/3} S^{1/2})] \div A$$

Where:

Q = Channel or Pipe Discharge (m³/s)

n = Manning's n value for (0.035 for channels and 0.011 for pipes)

A = cross-sectional area of channel or cross-sectional area of pipe

R = hydraulic radius

S = longitudinal slope of channel or pipe

NB: Time of concentration is calculated by multiplying the velocity (V) by the flow path length.

In addition to the above, an initial minimum time has been added to all areas to represent the time taken to convey stormwater to the pipe or overland flow conveyance feature. A runoff initiation time of 7 minutes was applied to the existing scenario, and a runoff time of 5 minutes was applied to the future scenario. Time of concentration values calculated for the various properties is presented graphically as Figure 5.1.

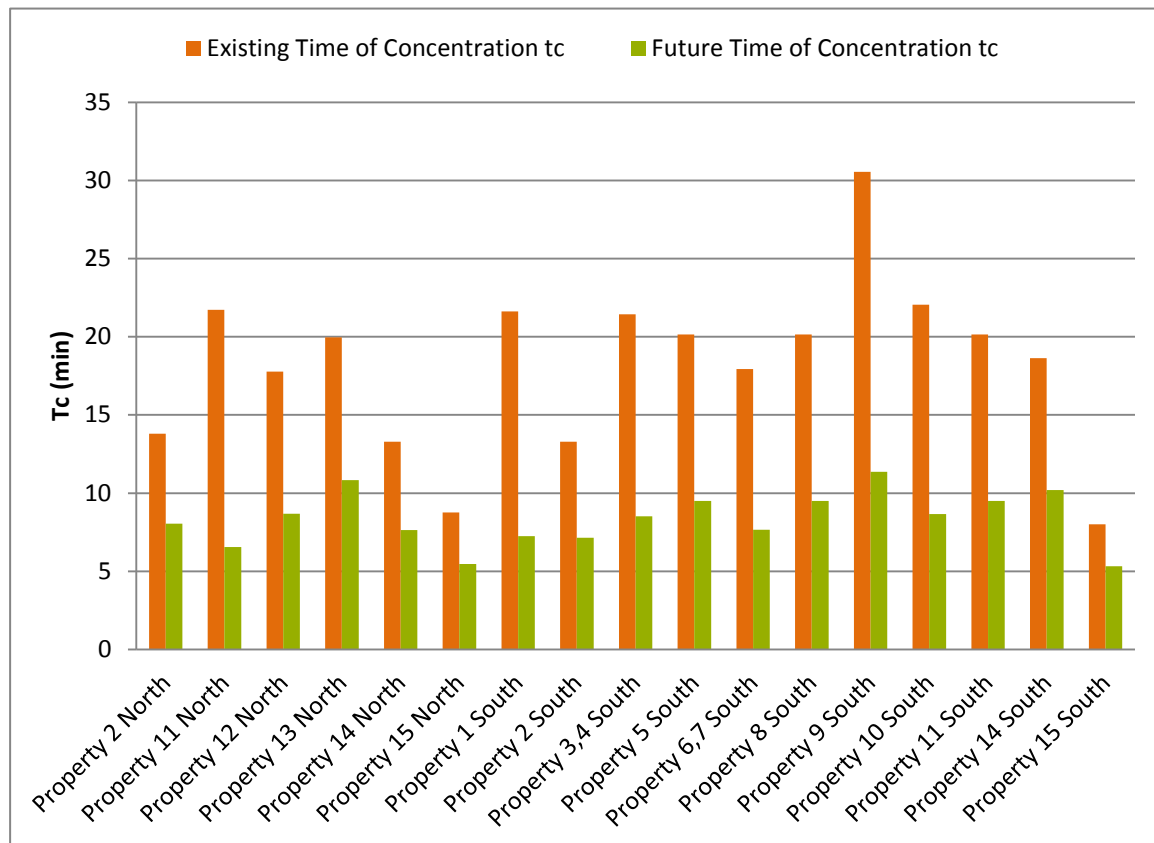


Figure 5.1 Existing and Future (re-development) Scenario Catchment Time of Concentrations
Catchment Area

The catchment area for the various properties has been measured off the Land Use Plan.

Peak Flow Modelling Outcomes

The Rational Method has been used to estimate peak runoff volumes for the various properties within the Precinct. The Rational Method results for the 1 in 5 AEP and 1 in 100 AEP rainfall events are shown graphically in Figures 5.2 and 5.3. 1 in 100 AEP events have only been shown for sub areas where the proportion of impervious area has increased.

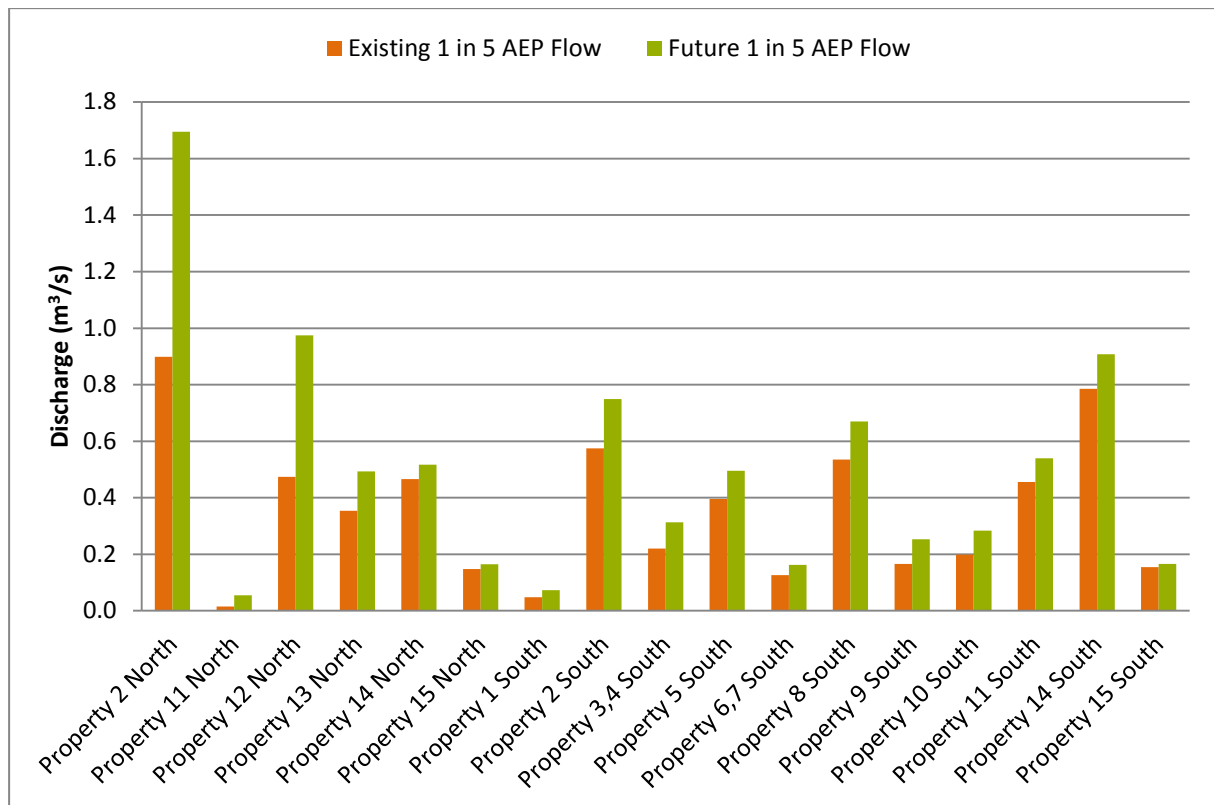


Figure 5.2 1 in 5 AEP peak flow rates

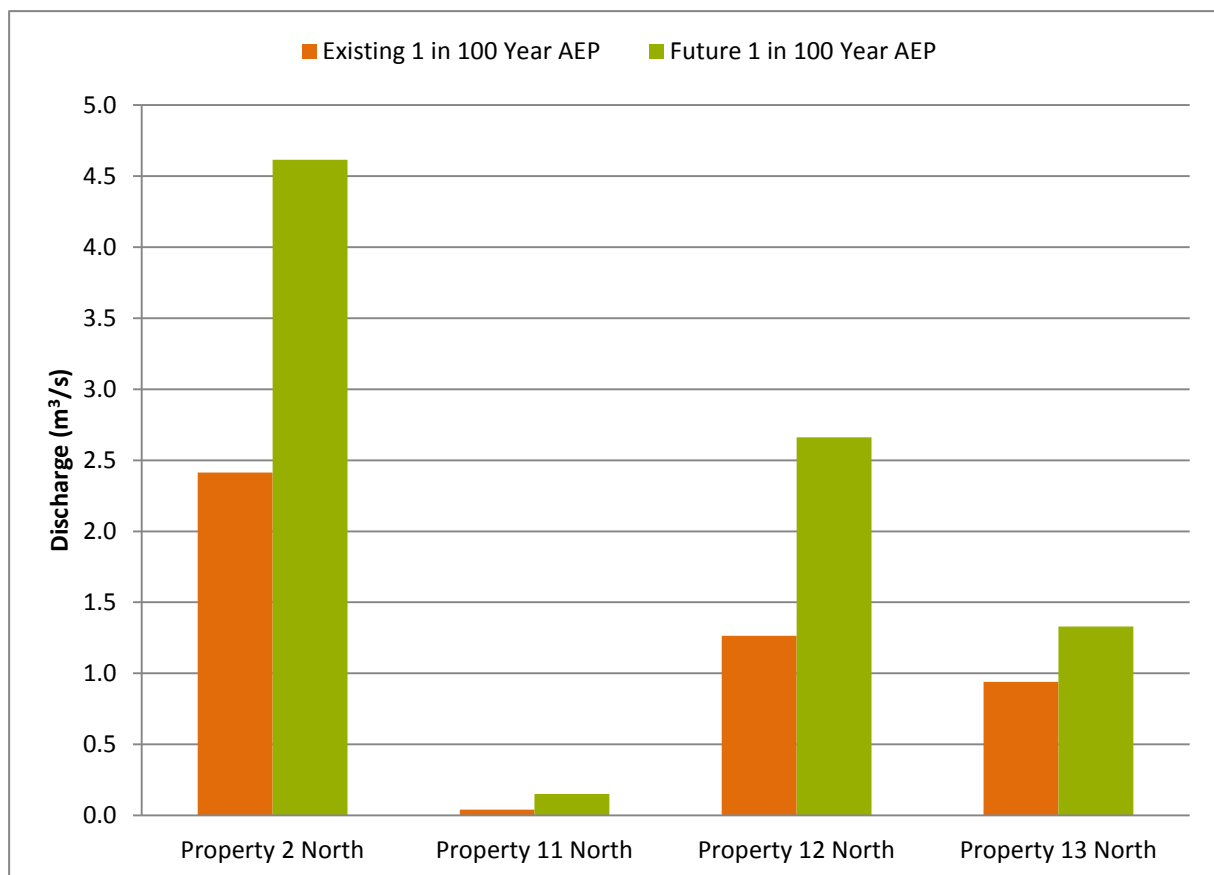


Figure 5.3 1 in 100 AEP peak flow rates

It may be noted from the above graph that the greatest increase in runoff rate is for the Properties 2 and 12 to the north. This corresponds to catchments with significant changes to the proportional impervious area.

5.3.3. Stormwater Attenuation Modelling

General

As part of the development of Precinct 15 attenuation of flows is required to ensure that the existing conditions in receiving drainage networks downstream are not adversely impacted. As discussed in Section 5.2, despite an insignificant change in catchment impervious area, the implementation of an underground piped drainage network at Precinct 15 is likely to increase peak flow rate discharging to outfalls.

In determining the locations and form of retardation infrastructure, the following factors were considered:

- There are no natural features on site to concentrate flow paths
- There are a large number of property owners that are likely to have significantly different development timeframes
- Drainage outfalls invert levels are fixed by the existing drainage system pipe infrastructure
- Development intensity is high and reductions in developable space may impact upon the financial viability of developments
- Many properties require retardation for 1 in 5 AEP flows only.

Given the above considerations, it is suggested that retardation may be best achieved predominately through the use of oversize stormwater pipe infrastructure. Use of these infrastructure elements will suit the likely piecemeal development across Precinct 15. In the case of Properties 2, 12 and 13, it may be more cost effective to use small retardation basins to achieve the required outcomes or a combination of oversized pipes and retarding basins.

Boyds Method

The Boyds Method was applied in order to determine the volume of stormwater to be attenuated at each property. The Boyds Method utilises an inflow hydrograph and an outflow hydrograph as inputs, and estimates the difference in volume between the two hydrographs at any point in time during a storm event. The Boyds Method Equation is as follows:

$$S_{\max} = V_1 \times (1 - (Q_p \div I_p))$$

Where:

$S_{\max}$ = Maximum volume of temporary storage (m^3)

V_1 = Volume of inflow flood (m^3)

Q_p = Peak discharge of inflow hydrograph (m^3/s)

I_p = Peak discharge of outflow hydrograph (m^3)

1 in 5 AEP Flows Attenuation Requirements

Attenuation of 1 in 5 AEP flows is required for all properties within the precinct except for Property 16 North. It has been assumed that Property 16 North is not to be developed and will remain as a drainage reserve GPU Power Net.

Attenuation of 1 in 100 AEP flows

Retardation for 1 in 100 AEP flows is required to ensure that existing flooding conditions downstream of the Precinct 15 development are not exacerbated. Existing flooding conditions for 1 in 100 AEP flows are shown diagrammatically on the MWC supplied map included as Appendix C.

Attenuation of 1 in 100 AEP flows is required for properties draining to the north. This is due to the increase in the proportion of impervious area.

The properties requiring attenuation for 1 in 100 AEP flows are listed below:

- Property 2 North
- Property 11 North
- Property 12 North
- Property 13 North

Stormwater Attenuation Infrastructure

The outcomes from the Boyds Method analysis are presented graphically as Figure 5.4.

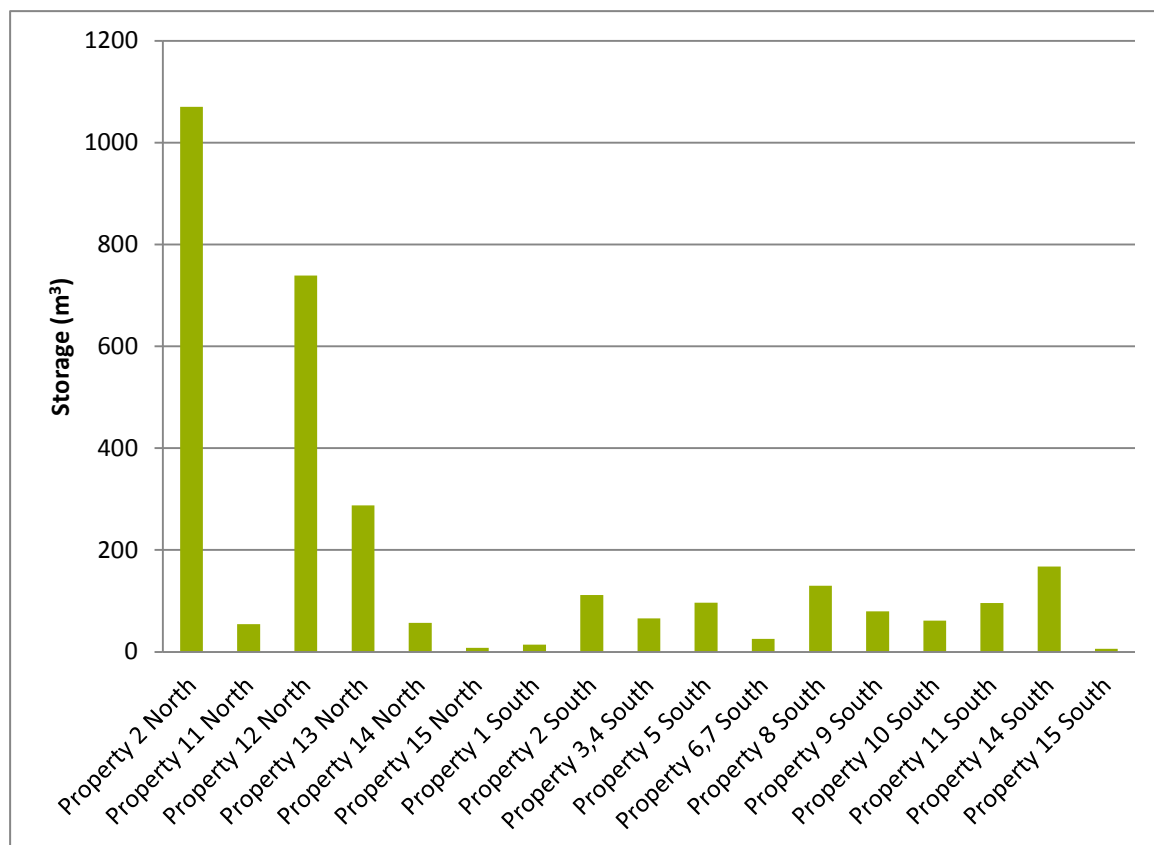


Figure 5.4 Retardation Storage Volumes for various properties

It may be noted that Property Nos 2, 11, 12 and 13 north are required to provide for 1 in 100 AEP storm retardation, while the remainder of the catchments are required to retard 1 in 5 AEP flows only.

Some computational details of the above analyses are included as Appendix E.

6. STORMWATER QUALITY INFRASTRUCTURE

6.1. General

The revised Victorian Planning Laws Clause 56.074 states that the water management in residential subdivisions must minimise increases in stormwater runoff and protect the environmental values of receiving waters. Drainage for new developments should meet current best practice objectives, as defined by the Victorian Stormwater Committee (1999). The target reductions which should be achieved for developments are as follows:

- Total Suspended Solids – 80%
- Total Phosphorous – 45%
- Total Nitrogen – 45%
- Gross Pollutants – 70%

As discussed previously, HBCC has advised that stormwater runoff which is directed to the southern catchment does not require water quality infrastructure to be included for the development (see Appendix D).

Treatment of flows applies to all areas of properties that are north of the existing catchment divide as follows.

- Property 2 North
- Property 11 North
- Property 12 North
- Property 13 North
- Property 14 North
- Property 15 North

6.2. Stormwater Quality Infrastructure

A variety of measures may be used in isolation or combination to achieve the water quality objectives as follows:

Wetlands – These devices are best suited to centralised treatment strategies for larger development areas. While they can be cheaper to maintain than other devices, they require specialist knowledge to ensure proper operation. HBCC have advised that they do not support the construction of wetlands in Precinct 15.

Bioretention Basins/Raingardens – These elements are suited to smaller development areas. They require less specialist maintenance knowledge than wetlands, but annual maintenance costs can be comparatively and prohibitively high.

Vegetated Swales – Vegetated swales perform in a similar manner to bioretention/raingarden systems. Swales are not well suited to the urban context as the designs invariably require multiple culverts at cross overs and other connection points with high blockage potential. Maintenance costs are similar as a percentage of construction cost to bioretention basin/raingarden systems.

Proprietary systems – A range of proprietary systems are available on the market to achieve treatment outcomes. They typically offer the advantage of a relatively small construction footprint. These systems do, however, tend to be relatively expensive to both install and maintain. Replaceable and proprietary cartridges or filters are typically required to ensure proper operation of

the system. In addition to the annual maintenance costs for the above options, lifecycle costs should also be considered as they can deteriorate over time and will eventually require full reconstruction.

Offset payment - The water quality offset scheme involves the payment of water quality contributions to Melbourne Water which are in turn used to fund the construction of water quality infrastructure at an alternative location. The end result is a stormwater treatment element at some location which will reduce the quantum of pollutants discharging to Port Phillip Bay.

Of the above measures, raingarden and the offset payment have been considered for the Precinct 15 development.

Raingardens

Precinct 15 presents challenges to the application of bioretention systems at the site. Bioretention devices are gravity driven systems which require an elevation differential of around 1 metre between inflows and the outlet. The flat grades over Precinct 15 in conjunction with the fixed invert levels of the receiving stormwater network mean that the bioretention basins would need to be constructed relatively deep. The presence of rock at shallow depths would introduce significant construction complexity depending upon the depth and hardness of the materials.

The fractured ownership of Precinct 15 is likely to have an impact upon the timing of development. Some number of the developments will occur well ahead of others and as a result, individual property owners would most likely be required to construct their own separate water treatment infrastructure. Assuming that some consolidation of assets is achievable, a minimum, three separate raingardens are likely to be required on each of property nos 2, 13 and 12.

In order to estimate the raingarden area that may be required to achieve design stormwater treatment targets for the northern catchment, a MUSIC model was created. MUSIC is a conceptual design tool that utilises catchment characteristics, rainfall data and evapotranspiration data, to assess the effectiveness of a stormwater treatment measure in removing large pollutants from urban runoff. The model indicated that the 30.2 ha which comprise the northern catchment would require a raingarden with a planted surface area of 3,200 m². An estimate has been prepared of the likely maintenance cost to HBCC of the asset.

Annual Maintenance Cost Estimate Lower: 3,200 x \$8.76 = \$28,032

Upper: 3,200 x \$13.25 = \$42,400

Maintenance cost rates have been obtained from Melbourne Water (2010), an extract of which is included as Appendix F. The annual maintenance costs estimates for three separate raingardens would be a higher overall figure and additional costs would be incurred when reconstruction is eventually required.

Offset Payment

The offset payment is often an appropriate alternative to construction of water quality infrastructure, especially in cases where it is difficult or occasionally impractical to construct the infrastructure. In considering whether an offset payment is appropriate, the following issues have been considered:

- Due to the relatively flat terrain the raingarden surface would need to be set well down below the natural surface level, significantly increasing the surface area required and potentially the aesthetic appeal.
- The likely presence of hard rock close to the surface would increase the complexity of design and construction.
- The potential for contaminated soils on the site may limit choice of sites or otherwise may increase the design and construction complexity.

- Maintenance costs and HBCC's relative lack of experience in managing water quality assets. It may be noted that three separate raingarden assets would be required for the development in order to suit the likely construction sequencing.
- Melbourne Water have advised that they are supportive of an offset payment for Precinct 15.

In considering the above listed issues, it is considered preferable at this site to make use of the Melbourne Water offset scheme for the purposes of meeting water treatment objectives.

6.3. Additional Considerations

There are two old quarry sites on Properties 2 and 12 which HBCC have advised were subsequently used as landfills. It is understood that these landfill sites have not yet been fully investigated and it is unclear what controls may exist with respect to these sites.

Regardless of the investigation outcomes, it is expected that the EPA are unlikely to allow construction of any water quality or retardation facilities on either of these two sites. In addition, HBCC have indicated that they would strongly object to any proposal which includes water quality or retardation infrastructure on either of these two old landfill sites.

HBCC has indicated that as a minimum they would prefer to have GPT units installed in any commercial districts included as part of the development.

While HBCC have indicated that they do not require water quality infrastructure to be included in the proposed development for catchments that drain to the south, they do nevertheless encourage inclusion of WSUD elements into urban design.

HBCC have indicated that they strongly encourage the use of rainwater collection tanks on individual properties. It is not clear at the time of writing whether HBCC propose to mandate their use. Until the HBCC position is clear, it is assumed that rainwater tank usage will be at the discretion of individual lot owners. It is anticipated that some lot owners may elect to incorporate stormwater tanks into developments in order to meet the required green star rating criteria.

7. CONCLUSIONS AND RECOMMENDATIONS

This Stormwater Management Strategy provides a basis for the design and implementation of primary stormwater management infrastructure necessary to service the Precinct 15 Altona North re-development site.

The following recommendations apply to management of stormwater at Precinct 15 Altona North:

Infrastructure Layout

- It is recommended that stormwater retardation and treatment infrastructure be constructed on individual properties as distributed rather than as centralised systems. The preference for a distributed system is due to the likely intermittent development staging and the flat terrain within the catchment.

Northern Catchment

- Minor storm event (1 in 5 AEP) runoff should be managed via an underground pipe drainage network, with oversized pipes to ensure temporary attenuation flow back to the existing 1 in 5 AEP runoff rate.
- Major storm event (1 in 100 AEP) runoff from the Northern Catchment can be managed via above ground basins or a combination of basin and oversized stormwater pipes to ensure attenuation of flows back to the existing 1 in 100 AEP runoff rates.
- It is recommended that water quality objectives for the north draining catchment be met through provision of a contribution to the Melbourne Water offset scheme.

Southern Catchment

- Minor storm event (1 in 5 AEP) runoff should be managed via an underground pipe drainage network, with oversized pipes to ensure attenuation of flows back to the existing 1 in 5 AEP runoff rate.
- There would be no requirement to retard 1 in 100 AEP runoff from the Southern Catchment as there will be no overall increase in the proportion of impervious area.
- Stormwater runoff from the Southern Catchment does not need to be treated on-site, and can discharge to the receiving drainage network un-treated. HBCC have confirmed that the stormwater runoff from the Southern Catchment will be treated downstream via the existing Paisley Drain stormwater management network.

8. REFERENCES

KLM Spatial (2012) Services Appraisal, Blackshaws Road Altona – Version 6, Report to Precinct 15 Landowners and Hobsons Bay City Council, October 2012.

Melbourne Water (2010) Generic WSUD Guidelines, Applying the Model WSUD Guidelines.

Victorian Stormwater Committee (1999), *Best Practice Environmental Management Guidelines for Urban Stormwater*, CSIRO Publishing, Melbourne

DOCUMENT/REPORT CONTROL FORM

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Project Name:	Precinct 15 Altona North Drainage Strategy
Project Number:	30048005F
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Revision History

Revision #	Date	Prepared by	Reviewed by	Approved for Issue by
Draft	26-11-2014	Siobhan Maxwell	Tim Rhodes, Stephen Watters	Stephen Watters
Final	19-01-2015	Tim Rhodes	Stephen Watters	Stephen Watters
Final	23-03-2015	Tim Rhodes	Stephen Watters	Stephen Watters

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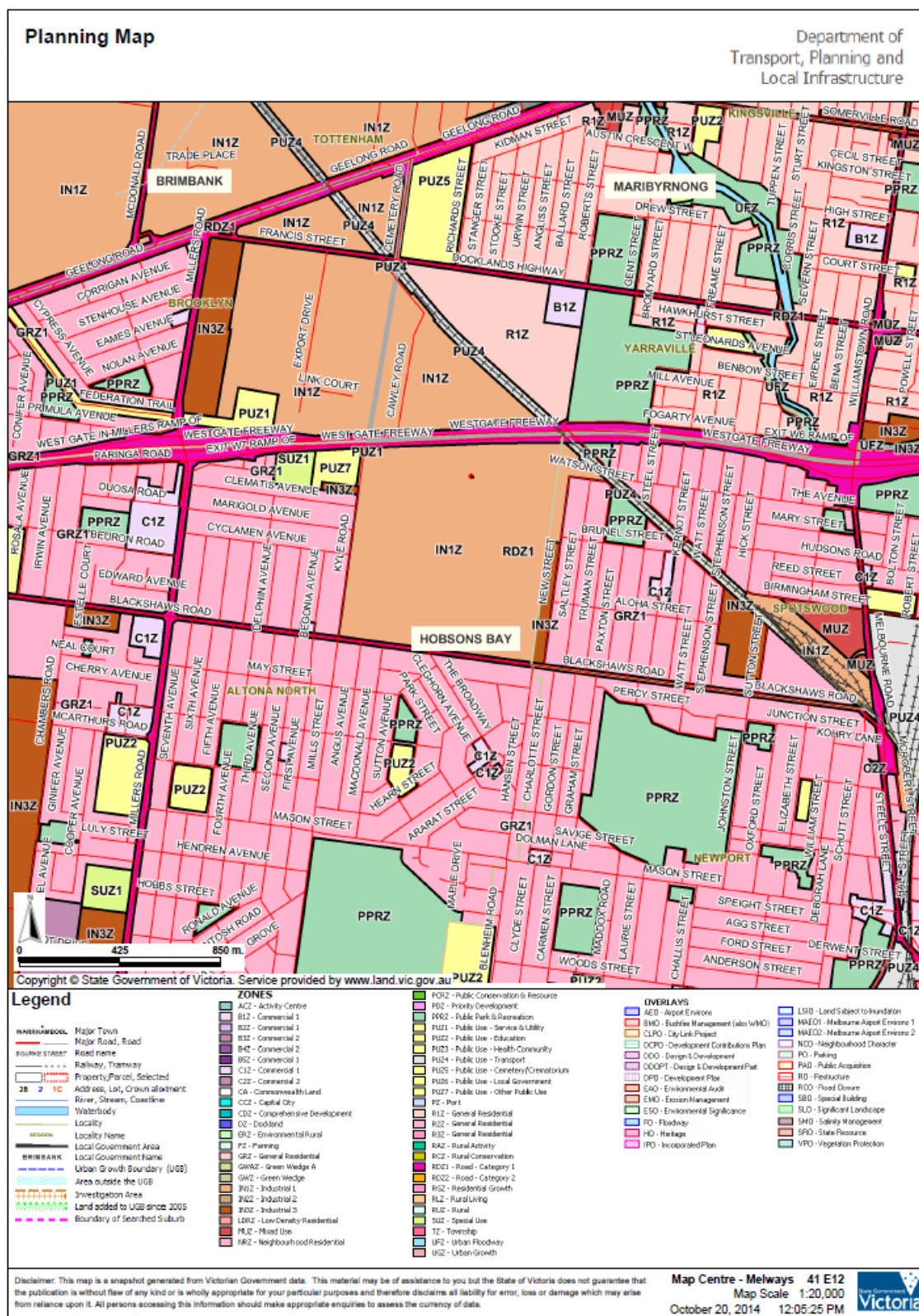
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APPENDIX A – PLANNING ZONES MAP



APPENDIX B – LAND USE PLAN



- P15 Boundary
- Property Boundary
- Mixed Use Area
- Residential
- Residential (Existing Road Reserve - Council Land Swap Opportunity)
- Community Facility
- Open Space**
- Encumbered Open Space
- Landscape Link / Laneway Access
- Railway
- Connector Street
- Access 2 Street *
- Signalised Intersection
- Roundabout
- Existing Signalised Intersection
- Off Road Bicycle Path
- External Pedestrian and Bicycle Link
- Existing Large Scale Power Lines & Towers

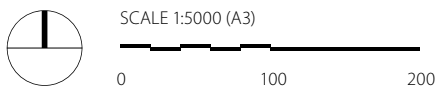
NOTE:

* Access 2 Streets nominated on the plan are indicative only, subject to future conceptual design investigations and traffic engineering assessment.

** Shape and locations of parks are indicative, subject to detailed concept design development, however they are to be generally in accordance with the requirements of this development plan.

DISCLAIMER:

The Land Use Plan is based on Brown Consulting Feature Level Survey, Reference M140666 Version C, Dated 2/12/14. As per this feature level survey, we note that the position of boundaries and easements shown are only approximate and have been derived from VICMAP digital property data (They have not been verified by this survey). As such, any area calculations are approximate only.



Land Use Plan
Precinct 15, Altona North

APPENDIX C – MW SUPPLIED CATCHMENT MAP



APPENDIX D – MW AND HBCC CORRESPONDANCE

From: Con Gantonas [mailto:Con.Gantonas@melbournewater.com.au]
Sent: Thursday, 8 January 2015 9:17 AM
To: Watters, Stephen
Cc: Keith Boniface; Rhodes, Tim; Hollow, Nathan
Subject: RE: Precinct 15 Drainage Strategy

Hi Stephen,

Thank you for your email. Melbourne Water has reviewed the submitted draft Land Use Plan and can provide the following comments and advice for your consideration.

Hydraulics

Information available at Melbourne Water indicates that the property is not subject to flooding from Melbourne Water's drainage system, based on a storm event with a 1% chance of occurrence in any one year.

The proposed works are substantial and located within four Melbourne Water catchments, Francis St M.D (4213), Schutts Estate M.D. (4212), Blenheim Rd Drain (4191) and Paisley Drain (4190). As indicated in previous discussions between Aijaz Memon and Tim Rhodes (email dated 18/12/14) Melbourne Water will accept Hobson Bay City Council (HBCC) requirements for hydraulics provided that the proposed works do not worsen the flood levels or flows for the north draining catchments, Schutts Estate M.D. (4212) and Francis St M.D. (4213). It is expected that by meeting the HBCC requirements for the south draining catchments, Blenheim Rd (4191) and Paisley Drain (4190), that the flood levels and flows in these catchments for Melbourne Water's responsible area will not increase for the 1% AEP.

Melbourne Water requires a detailed Drainage and Stormwater Management Plan to be submitted for approval which demonstrates that the above requirements will be achieved.

Stormwater Quality

Melbourne Water has no objection to the treatment and offset requirements stipulated by Council, as outlined in your email.

Asset Protection

Melbourne Water owns the abandoned Melbourne Outfall Sewer main at this location. It consists of multiple conduits (2 X 1800mm unreinforced concrete and 1 x 1200mm wrought iron circular rising mains).

It appears as though it is owned by the power station. If Melbourne Water is accountable for this asset, we will need to ensure that the construction does not impact on the asset in its current condition or pose any ongoing risk. At present, the abandoned main does not appear to be filled at these locations and was unable to be accessed for CCTV in 2001.

The live asset at this location is the Brooklyn Trunk Sewer which is a deep sewer. Impact on the conduit would be considered to be negligible unless deep foundations are required.

Melbourne Water has no objection to the proposed works from an asset protection perspective, subject to the following:

1. Any construction that may have an impact on the sewer will be required to be submitted to Melbourne Water for approval.
2. Access to manholes will be required at all times.
3. Land currently associated with manholes will be required in the future and should be allocated as such.

Regards,

Con Gantonas | Developer Services Planner, Land Development | Waterways and Land
| Service Delivery Group | **Melbourne Water**

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VIC 3001 | [melbournewater.com.au](mailto:con.gantonas@melbournewater.com.au)

Enhancing Life and Liveability

From: Watters, Stephen [<mailto:Stephen.Watters@smec.com>]
Sent: Thursday, 18 December 2014 5:39 PM
To: Kerrie Homan
Cc: Keith Boniface; Rhodes, Tim; Hollow, Nathan
Subject: RE: Precinct 15 Drainage Strategy

Hi Kerrie,

We have been dealing with Aijaz Memon from your office, in relation to the drainage strategy for the above Precinct (refer to the attached draft structure plan for your information).

Aijaz has confirmed a number of issues for us mainly relating to retardation of the site (refer below), but suggested that we should be speaking to you in relation to obtaining one consolidated response from Melbourne Water in relation to the drainage strategy for the site.

We are also currently in discussions with the Hobsons Bay City Council (HBCC) in relation to the approach that they would like to take in relation to water quality for the site.

The remaining queries that we have for Melbourne Water are summarised below:

Water Quality

- With respect to water quality, HBCC has indicated that catchments draining to the south will be connected to an existing stormwater treatment and harvesting scheme and that additional water quality infrastructure is not required for drainage directed towards the south.
- HBCC have indicated that full treatment is required for stormwater runoff draining towards the north. HBCC are not well equipped to manage wetlands, however, and do not wish to have such infrastructure elements included in designs. In addition, the site is quite flat and rock is close to the surface. This makes construction of bio-retention systems problematic and furthermore, HBCC has had little success in establishing and maintaining such systems. It would appear that HBCC have a preference for a contribution being made to the water quality offset service in the case of Precinct 15. We propose that the catchment to the north would be offset as HBCC have advised that the catchment to the south does not need treatment. Would you have any reason to object to such a proposal?

Also we have had verbal discussions with members of your assets team in relation to two deep sewers that cross the precinct, and we would appreciate your confirmation in relation to any restrictions to development that may apply in the vicinity of the sewers.

We would also be happy to meet with you to discuss the above.

Thanks,

Steve.

Stephen Watters | Manager Urban Engineering - Melbourne
SMEC – Australia & New Zealand Division
T +61 3 9869 0896 | M +61 427 948 186

From: Aijaz Memon [<mailto:aijaz.memon@melbournewater.com.au>]
Sent: Thursday, 18 December 2014 4:21 PM
To: Rhodes, Tim
Cc: Watters, Stephen; Keith Boniface
Subject: RE: Precinct 15 Drainage Strategy

Hi Tim,

Thank you for visiting us seeking some clarification about our previous memo.

I confirm that following discussions were made in our last meeting and I am happy with this.

Regards

Aijaz Memon

From: Rhodes, Tim [<mailto:Tim.Rhodes@smec.com>]

Sent: Thursday, 18 December 2014 12:20 PM

To: Aijaz Memon

Cc: Watters, Stephen

Subject: Precinct 15 Drainage Strategy

Aijaz

Reference is made to the precinct 15 Altona north development and our meeting yesterday.

During the course of our meeting, we discussed various aspects of the drainage strategy. Our discussions were largely confined to the retardation requirements for the development. The outcomes of our discussion were as follows:

- Precinct 15 incorporates a ridge line with part of the catchment draining to the north and the remainder draining towards the south
- We reported that Hobsons Bay City Council (HBCC) are encouraging of directing additional stormwater runoff from the north of the catchment to the south of the catchment. At this stage, however, there are no plans to redirect any stormwater runoff due to the additional expense and potential impacts on retardation requirements.
- We reported that the HBCC standard with respect to retardation is the 1 in 10 Annual Exceedance Probability (AEP) event. It is proposed that all catchments draining to the south will be designed to this standard. You indicated that Melbourne Water have no objection to this approach. You further indicated that if the strategy for south draining catchments meets HBCC requirements, Melbourne Water would have no additional comment to make with respect to retardation.
- We discussed the extent of development over the site and we highlighted the fact that the north draining catchment has been cleared relatively recently and that the proportion impervious for that catchment has historically been higher than at present. For the purposes of undertaking retardation computations, we suggested using the highest historic development circumstance to determine the 'existing' conditions. You indicated that Melbourne Water would not object to this approach.
- It was noted that the northern draining catchment eventually drains to Schutts Estate Drain under the railway line and that at present there are properties which are flooded at this location in a 1 in 100 AEP event. While Melbourne Water are accepting of HBCC drainage requirements with respect to the Precinct 15 development, the outcomes will be reviewed to ensure that the degree of flooding at the railway line is not made any worse in a 1 in 100 AEP event. To this end, it is intended that north draining catchments will be designed to ensure that 1 in 100 AEP flows from the northern portion of the catchment are not increased.
- We discussed the method by which retardation volumes are to be computed. You advised that you have not undertaken a detailed assessment of the storage volume required, but pending a review, you would accept the reported outcomes developed from an appropriate methodology such as the Boyds method.

Could you please confirm by reply email whether you consider that the above is an accurate summary of our discussions.

Regards

Tim Rhodes | Technical Principal Water Resources - VIC

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From: Karmen Markis [mailto:kmarkis@hobsonsabay.vic.gov.au]
Sent: Monday, 29 December 2014 10:53 AM
To: Rhodes, Tim
Cc: Watters, Stephen; Allan Breasley; Ben Hynes
Subject: RE: Precinct 15 Altona North

Hi Tim,

Thanks for being so patient with this. Yes I can confirm that your summary below is correct.

If you have any comments/ questions, please contact me on 9932 1088.

Kind regards,

Karmen Markis
Strategic Planner
Strategy and Advocacy
Hobsons Bay City Council
T: 9932 1088 | F: 9932 1340
W: www.hobsonsabay.vic.gov.au

From: Rhodes, Tim [mailto:Tim.Rhodes@smec.com]
Sent: Friday, 5 December 2014 4:31 PM
To: Karmen Markis
Cc: Watters, Stephen
Subject: Precinct 15 Altona North

Karmen

Reference is made to the Precinct 15 Structure Plan and our meeting relating to drainage on 3/10/14.

During the course of our meeting, Allan Breasley indicated that south draining properties within Precinct 15 ultimately direct stormwater runoff to the Paisley Park Stormwater Harvesting Scheme. The scheme is understood to incorporate a wetland which provides water quality treatment for stormwater runoff.

He indicated that the stormwater harvesting scheme provides treatment for stormwater runoff from Precinct 15 and that as a result there is no need to provide stormwater quality treatment infrastructure for properties that currently drain towards the south. He further indicated that if we can direct any additional catchment area towards the south that there would be no requirement to provide stormwater quality treatment infrastructure for those additional catchment areas either.

Notwithstanding the above, it is understood that GPT devices would be required for commercial areas. It is further understood that catchments draining towards the north would be required to comply with water quality treatment requirements.

We appreciate the opportunity that you are providing to the development. Would you be able to provide confirmation via email or other means that our understanding as stated above is correct?

Regards

Tim Rhodes | Technical Principal Water Resources - VIC

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From: Karmen Markis [mailto:kmarkis@hobsonsabay.vic.gov.au]
Sent: Thursday, 6 November 2014 10:09 AM
To: Rhodes, Tim
Cc: Allan Breasley
Subject: P15 question

Hi Tim,

Further to our conversation yesterday, I can confirm that both systems to the south of the precinct connect to the water recycling facility.

If you have any more comments/ questions, please contact me on 9932 1088.

Kind regards,

Karmen Markis
Strategic Planner
Strategy and Advocacy
Hobsons Bay City Council
T: 9932 1088 | F: 9932 1340
W: www.hobsonsabay.vic.gov.au

APPENDIX E – STORMWATER MODELLING DETAILS

Pollutant	Northern Property Nos						Southern Property Nos											
	2	11	12	13	14	15	1	2	3,4	5	6,7	8	9	10	11	14	15	
Catchment Area (ha)	12.1	0.6	7.6	4.0	3.8	1.0	0.5	6.0	2.3	4.0	1.2	5.4	2.1	2.1	4.6	7.6	1.0	
Existing Time of Concentration (min)	13.8	21.7	17.8	20.0	13.3	8.8	21.6	13.3	21.4	20.2	17.9	20.2	30.6	22.1	20.2	18.6	8.0	
Future Time of Concentration (min)	8.0	6.5	8.7	10.8	7.6	5.5	7.2	7.1	8.5	9.5	7.7	9.5	11.4	8.7	9.5	10.2	5.3	
Existing 1 in 5 AEP Flow (m³/s)					0.47	0.15	0.05	0.58	0.22	0.40	0.13	0.54	0.17	0.20	0.46	0.79	0.15	
Future 1 in 5 AEP Flow (m³/s)					0.52	0.16	0.07	0.75	0.31	0.50	0.16	0.67	0.25	0.28	0.54	0.91	0.17	
Existing 1 in 100 AEP Flow (m³/s)	2.4	0.0	1.3	0.9														
Future 1 in 100 AEP Flow (m³/s)	4.6	0.2	2.7	1.3														
Retardation Storage Volume (m³)	1070	55	739	288	54	9	13	101	58	86	23	116	70	54	85	152	7	
Retardation Storage Volume (m³/ha)	88	91	97	72	14	9	26	17	25	21	19	21	33	26	19	20	7	

APPENDIX F – MELBOURNE WATER (2010) EXTRACT

Model WSUD Guidelines Part 2 – Getting WSUD On The Ground

Appendix 1 – Maintenance costs for rain gardens and other treatment devices

Rain garden street-scale works to date have shown that maintenance costs average between \$3.80 and \$20 per square metre of landscape per annum³². The range of costs reflects the profile of the site to be maintained, with higher profile sites requiring greater maintenance intervention.

Table 14 shows a typical maintenance regime. Two maintenance regimes were developed and costed, reflecting the profile of various sites. Annual costs are:

- \$8.76/m² for low maintenance levels
- \$13.25/m² for high maintenance levels.

Annual inspections and litter pick up take up a large proportion of the maintenance costs. If you want to reduce maintenance inputs, make savings in these areas, rather than reducing weed control or replanting. Coordinate maintenance of rain gardens with adjacent landscapes to reduce the costs.

Table 14. Estimated annual maintenance costs per square meter of rain garden

Activities	Lower cost	Upper cost
Aesthetics	\$ 4.80	\$ 7.20
Vegetation	\$ 3.00	\$ 4.13
Damage	\$ 0.96	\$ 1.92
Total annual cost	\$ 8.76	\$ 13.25

Source: Somes and Crosby 2006

Table 15. Typical maintenance costs for various WSUD systems, EPA 2008

Treatment devices	Typical annual maintenance cost (TAM)	Correlation
Constructed wetlands	TAM (\$2004) = 6.831 x (A) 0.6435	R ² = 0.76; p< 0.01; n= 21
Vegetated swales	TAM (\$2004) = 48.87 x (TAC) 0.4407	R ² = 0.94; p= 0.03; n= 4
Buffer strips	TAM (\$2004) = 48.87 x (TAC) 0.4410	R ² = 0.94; p= 0.03; n= 4
Rain gardens	TAM (\$2004) = 48.87 x (TAC) 0.4410	R ² = 0.94; p= 0.03; n= 4
Ponds and sediment basins	TAM (\$2004) = 185.4 x (A) 0.4780	R ² = 0.92; p= 0.04; n= 4
Infiltration systems	TAM (\$2004) = 30.15 x (TAC) 0.4741	R ² = 0.80; p= 0.04; n= 5

Source: EPA, Maintaining water sensitive urban design elements, publication 1226

Notes

The size/cost relationships for TAM, TAC and RC are derived from a combined data set involving vegetated swales, buffer strips and rain gardens. There is insufficient data to analyse swales on their own.

A = surface area of treatment zone/ basin/ infiltration system in m².

TAC = total acquisition cost.

R² = explanation of variance

p = significance

n = number of samples p is derived from.

³² Somes and Crosby (2006) report