ATTACHMENT 3

STORMWATER MANAGEMENT STRATEGY (AFFLUX CONSULTING)

mesh

McIvors Road, Kilmore

Stormwater Management Strategy




December 2019

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STORMWATER MANAGEMENT SOLUTIONS

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Climate Change Statement

A wide range of sources, including but not limited to the IPCC, CSIRO and BoM, unanimously agree that the global climate is changing. Unless otherwise stated, the information provided in this report does not take into consideration the varying nature of climate change and its consequences on our current engineering practices. The results presented may be significantly underestimated; flood characteristics shown (e.g flood depths, extents and hazards) are may be different once climate change is taken into account.

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1. Introduction

Afflux Consulting were engaged by Mesh Planning to investigate the surface water implications for the proposed development of a series of parcels around McIvors Road, Kilmore.

The site is within Mitchell Shire Council, the responsible agency for planning and building approvals in the area and the Goulburn Broken Catchment Management Authority (GBCMA) which is the authority responsible for flooding, drainage and waterway advice in the region.

Background information about the site and drainage requirements in the area have been obtained from both of these sources where possible, however much of the outcomes for this report have been guided by the Infrastructure Design Manual (IDM, 2019), Melbourne Water drainage scheme principals for large development areas, and the authors experience.

This report will outline investigations that have been undertaken to determine:

- Site hydrology and localised flood extents and levels
- Flood safety in channels and storages
- Outfall requirements and limitations including potential outfall upgrades
- Water quality requirements as per best practice environmental management guidelines

1. Background

The site is bounded by Tootle St to the north, Quinns Rd to the east, Northern Hwy to the west and Wandong Rd to the south Figure 1-1). The area slightly grades to the north (between 1% and 2%). A number of existing waterways and flow paths existing through the property, most significantly Kilmore Creek through the north west corner, but also tributaries of the creek coming from the east. Areas of existing storage and some farm drains are present across the site as will be discussed.

The proposed development is approximately 185 Ha of both Low Density and Standard Density Residential lots with internal roads, Open Space and Parkland as well as a future school site central to the development (Figure 1-2).

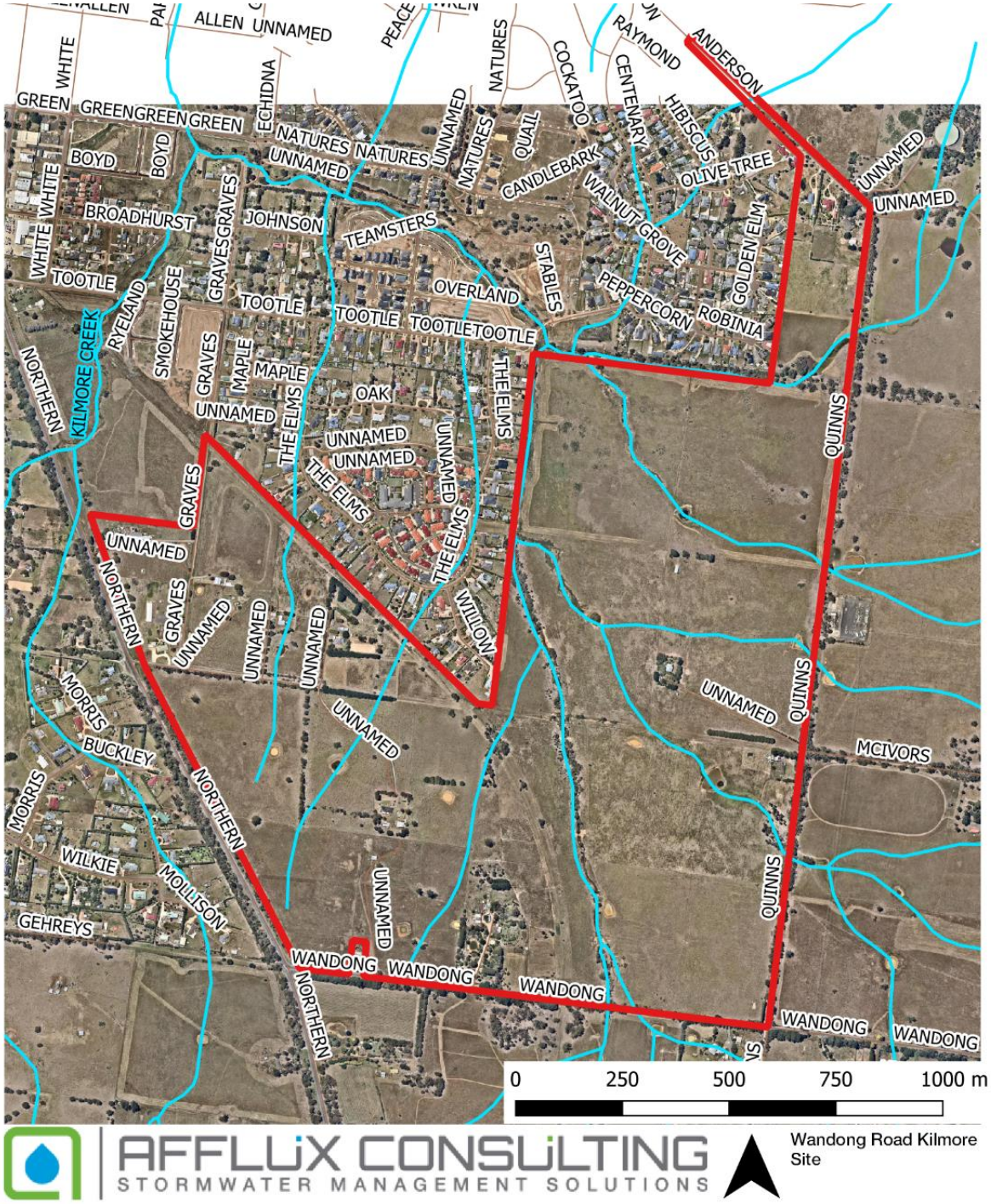


Figure 1-1 Site Location

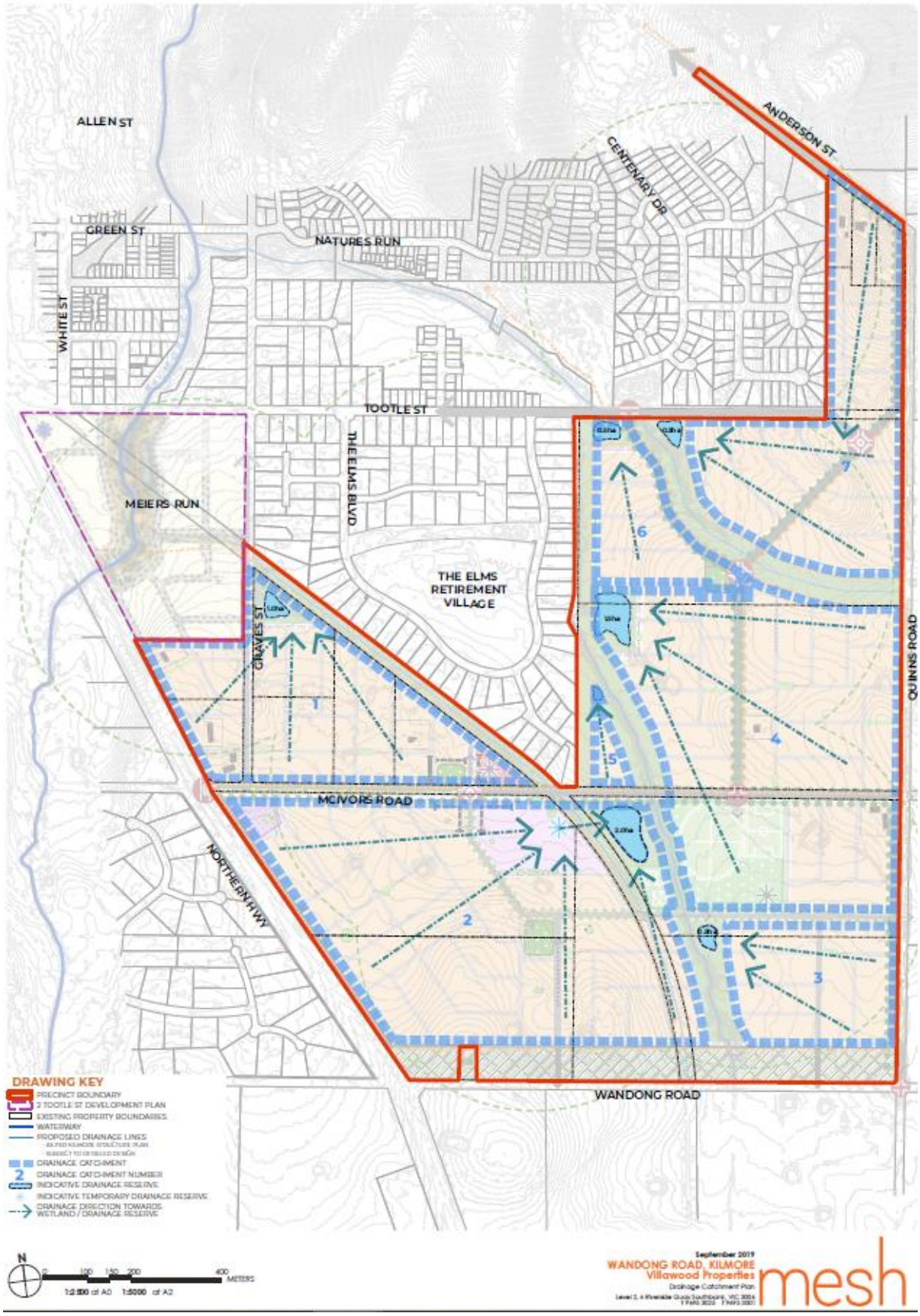


Figure 1-2 Proposed Development/Drainage Strategy

Information Sources

A number of information sources have been used in the formation of this report, these include:

- DEPI planning scheme and cadastral information as accessed online November 2019
- Discussions with Mitchell Shire Council
- Discussions and information as provided by GBCMA
- Lidar Data sourced Commercially.

Site Visit

A site visit was conducted on the 7th of November 2019. Key drainage features are shown below.

Existing Access Track

Relatively Undulating Site

"Tootle St East" Temporary Crossing

Vegetated Existing Drainage South of Tootle St

Figure 1-3 Site visit

Site Controls

As per the development plan, site flows are to exit to the north west through an existing culvert (2x900mm diameter culverts) and the north east under an as yet unconstructed culvert. The north west culvert will act as a significant site control and is discussed later in hydrology assessments. The north east crossing of the proposed Tootle St extension is limited by downstream channel capacity. All flows leaving the site will need to meet council requirements of flow attenuation to meet existing conditions.

2. Catchment Design Objectives

All development has the potential to adversely affect downstream environments through the effects of stormwater runoff. Increased impervious areas resulting in increased volumetric and peak flows have been extensively researched and linked to downstream environmental degradation. Contaminants contained in the runoff have also been linked with adverse changes to both water quality and stream ecology. Finally, the contribution of increased runoff can be linked to downstream flooding and capacity constraints.

To combat these affects a range hydrological and water quality mitigation measures have been researched and legislated in Victorian planning schemes. The design objectives for this catchment are considered below.

General Considerations

The Victorian State Planning Policy Framework includes provisions incorporating the provisions for stormwater management in its integrated water management clauses.

Water Quality Requirements

Current water quality requirements as listed by the Victorian EPA Best Practice Environmental Management (BPEM) Guidelines are:

- 80% Total Suspended Solids (TSS) reduction
- 45% Total Nitrogen reduction
- 45% Total Phosphorus reduction
- 70% Gross Pollutant capture

Flood Storage Requirements

The site shall be designed to ensure that flows are not to increase above the pre-development levels. Generally, this would be applied to the 100-year Average Recurrence Interval (ARI) storm only and checked at each of the site discharge points. This site currently conveys flows from a large catchment with some existing onsite storage evident. A number of existing storage locations are to be upgraded to provide required storage for the larger development flows. Discharge limits and storage requirements are analysed in this report.

Flood Protection Requirements

All lots within the development will be provided at least 300mm freeboard above any predicted 100-year ARI flood level. All retarding basins will be designed to be cut into the natural surface avoiding any potential dam wall construction issues.

Ecological Objectives

Kilmore Creek is the downstream receiving water and contains a number of high ecological values. The protection of these downstream environs through the provision of water quality and quantity control devices is an important aspect of this sites development. Additionally, by providing wetlands as the primary water quality

improvement strategy, some ecological values will be both provided and enhanced on the site. In addition to this the following points are noted:

- Changes to ground water drainage patterns or stream channels which affect the water table (e.g. dam construction, stream diversion).
- Clearing of riparian vegetation, changing hydrology and causing drying out of sites;
- General road and drainage activities impacting on seepage, wetland and stream bank habitat and any activities that may degrade stream bank integrity, increase siltation and enhance erosion;
- Soil disturbance and compaction due to vehicles, stock trampling and inhibit burrow formation. Compaction also impairs soil permeability and water holding capacity;
- Water contamination, especially through application of chemical sprays, pesticides, excess nutrients or toxic leaching;

In order to best protect this habitat, drainage activities should be located outside of these zones where possible.

Specific Challenges

A number of catchment specific challenges have presented themselves in the review of the site. These include:

- Existing waterways and flood paths need to be dealt with appropriately considering flow magnitudes and council and CMA requirements. These should be checked against any existing flood knowledge of the area
- Avoidance of protected species habitat area, limiting hydrological changes, and works extents
- The existing culvert crossing for Kilmore Creek at Tootle St is small considering the size of the contributing catchment
- The staging of the development is subject to planning zone changes, and as such any proposed water quality/quantity treatment needs to balance the long term objectives against any planning timing issues
- The changes in hydrology will provide pressure on the existing channel form. The existing environmental values need to be balanced against the geomorphological realities. Sites of high value should be maintained and enhanced.

3.Hydrology

RORB Model

The primary model for flow evaluations for the site is Monash Universities RORB model. RORB was produced by Laurenson and Mein as a runoff routing model for the production of flood hydrographs. It is considered the industry standard model for Victorian Flood studies.

The RORB model from the Kilmore Creek Flood Study has been provided by Council and GBCMA's consultants for the purposes of this investigation. The model has been analysed for the regions relevant to this site, but no greater review has been undertaken. All results from this model are assumed to be approved and accurate representations of the area. The RORB model as supplied can be seen in Figure 3-1 below.

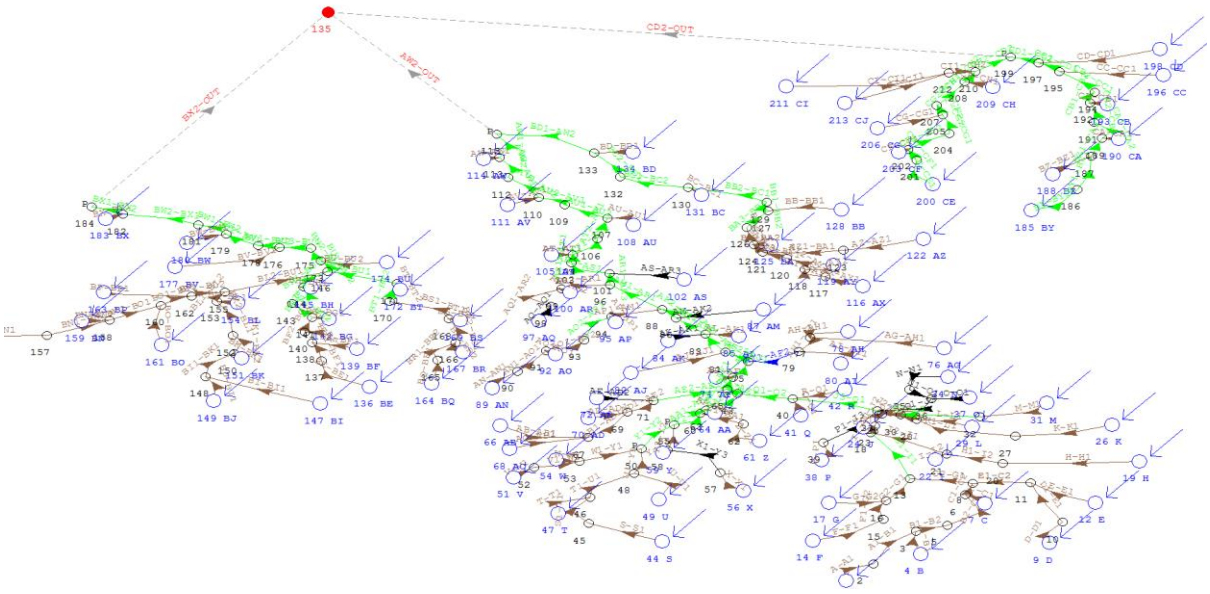


Figure 3-1 As Supplied RORB Model

Developed Conditions

To produce development flows for the catchment, both an increase in the fraction impervious and some minor rearrangement of the catchments was required. The Initial FI values and catchments were derived as part of the Kilmore Flood Study and are designed for critical input areas. The catchments have been rearranged to better reflect the site and its outfalls. The reach for catchment P has been shortened and directed to I2 as shown in the development plan. The reaches AA, Ia, Ib and P have been upgraded to a Type 3 reach (lined channel) to reflect their urbanised nature. Reach G1-I1 has been upgraded to Type 2 from Type 1 considering the expected upgrading of this reach. No other changes have been made to the model (though it could be argued that Catchment Z should be diverted further down the catchment past the development site).

Existing RORB subcatchment assumptions are shown in Figure 3-2 and the final catchment parameters can be seen in Table 3-1 and Figure 3-3. As can be seen all of the developed catchments have been given an FI of 60%.

Table 3-1 Catchment Revisions

Catchment	Area Exist	Area Dev	FI Exist	FI Dev
AA	0.12	0.12	0.210	0.600
H	1.04	0.74	0.037	0.037
I (Ia, Ib)	0.87	(0.20, 0.44)	0.053	(0.410, 0.440)
J	0.35	0.35	0.205	0.600
K	0.81	1.35	0.043	0.032
L	0.29	0.29	0.042	0.500
P	0.44	0.44	0.076	0.600
Y	0.71	0.71	0.252	0.252
Z	0.33	0.33	0.126	0.600
Site	0.23	0.23	0.217	0.600

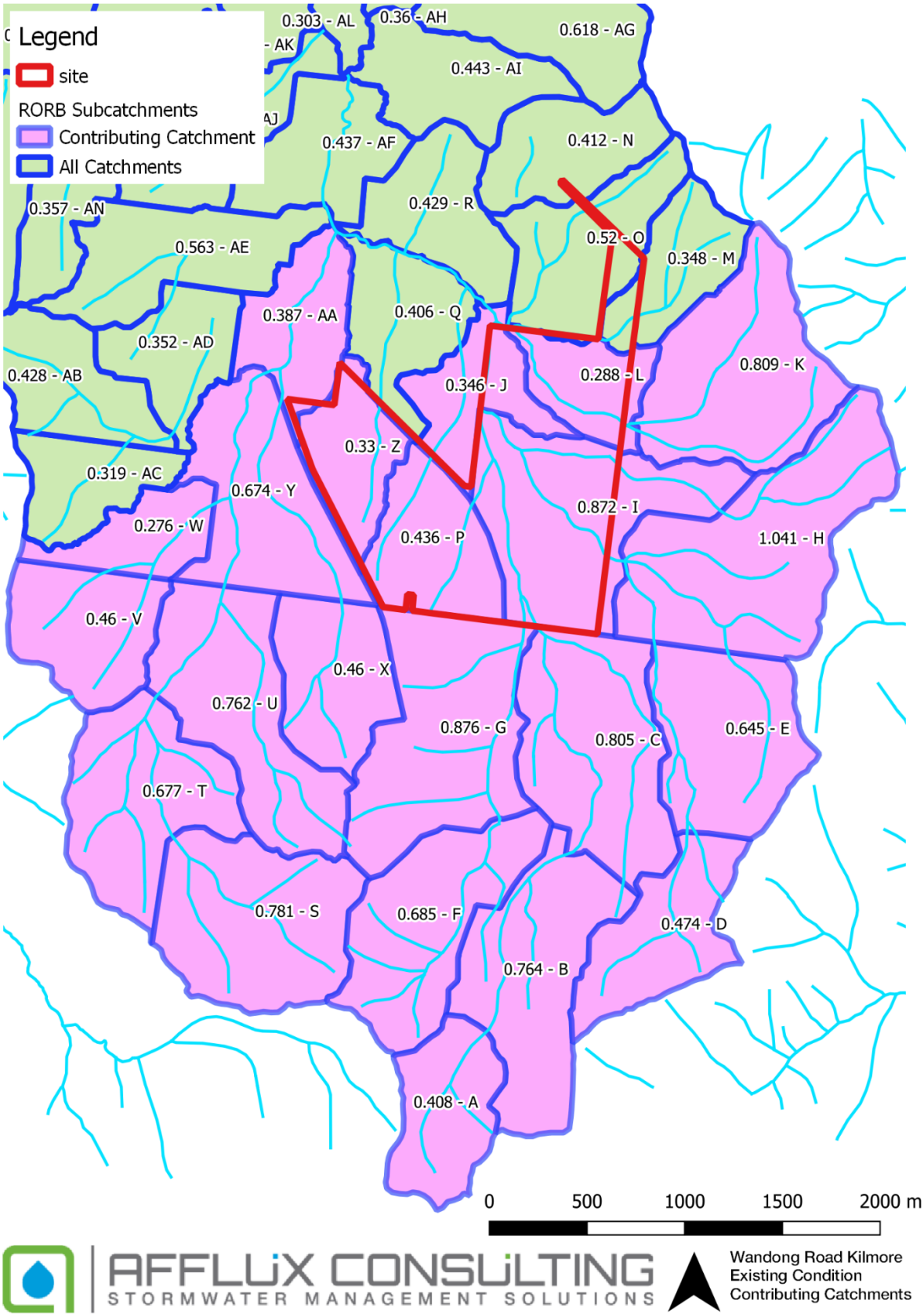


Figure 3-2 Existing Condition RORB Subcatchments

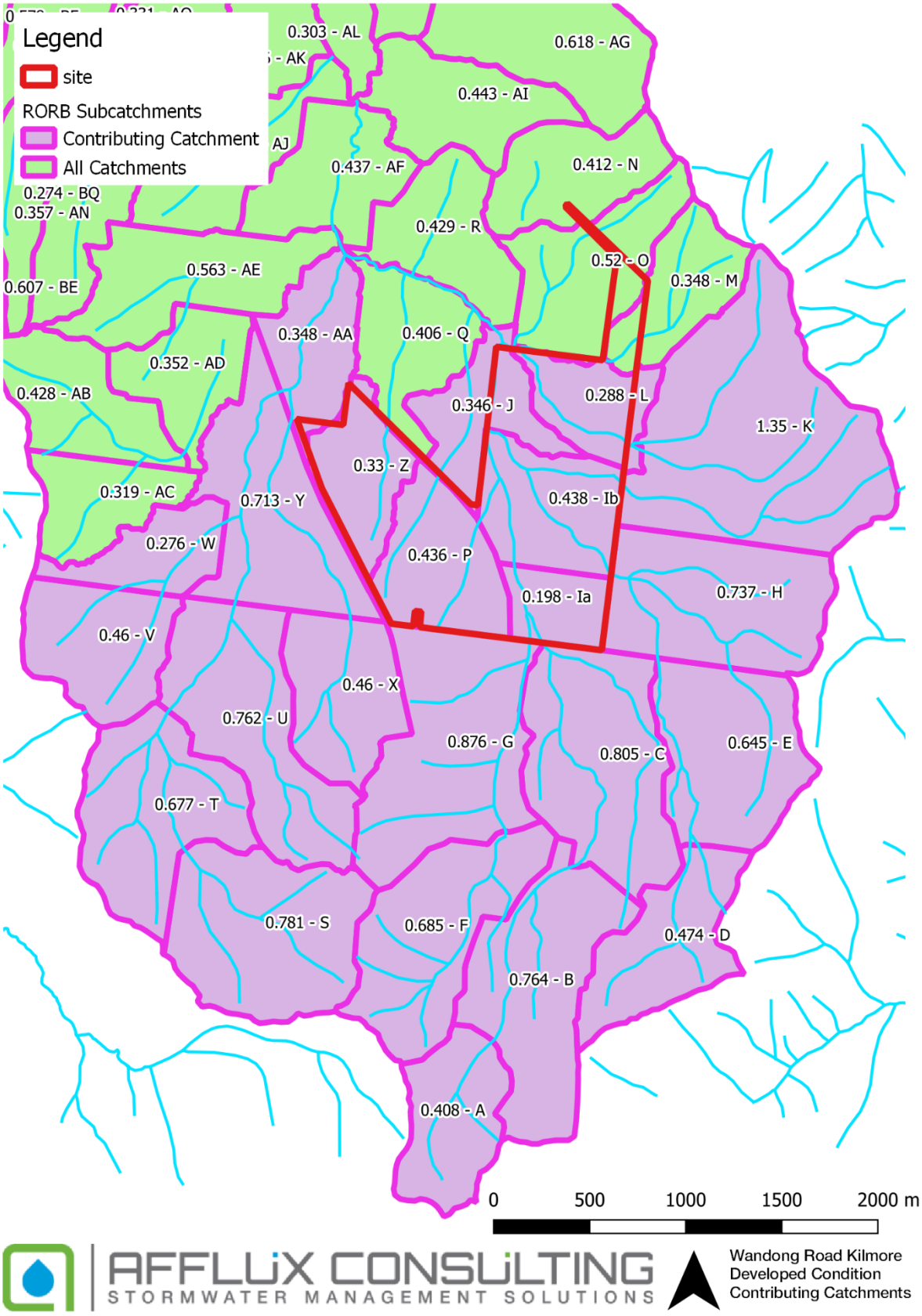


Figure 3-3 Developed Condition RORB Subcatchments

4. Development Assessment

As part of the development strategy, six drainage reserves have been considered, five within the site for this document and one relevant reserve as part of the adjoining "Meiers Run" site to the north west. These reserves have been modelled as storages in RORB to attenuate flows to existing flow rates.

Stormwater Detention

The recommended storage characteristics as modelled in the RORB are outlined in Table 4-1. Storage locations are shown in Figure 4-1. The storage to the north west, known in this report as Tootle West, has been designed as part of previous work by Afflux (J275_TootleSt_SWMP_R02, 2017). Refer to this report for details on water balance and water quality at this site.

Table 4-1 Retarding Basin Characteristics

Storage	Area (ha)	Peak Storage (m^3)	Peak Depth (m)	Weir Height (m)	Weir Length (m)	Outlet Requirement
GravesSt	1	7560	1.76	1.8	10	1x600mm RCP Culvert
TootleSt East	2.5	13,900	1.67	1.7	100	9x2400mm RCP Culvert
McIvorsRd	2	10,000	1.5	1.5	20	1x900mm RCP Culvert
Catch I	1.5	7460	1.49	1.6	25	1x1080mm RCP Culvert
WandongRd	0.5	1820	1.1	1.4	5	1x1050mm RCP Culvert

Upgrades at Tootle Street

The modelled waterways as shown in this report suggest culvert sizings for the two (eastern and western) crossings of Tootle Street. These culverts have been sized using 900mm RCP's as a set assumption, and as can be seen will require significant upgrades. Given the flows at these two locations this is unsurprising, but should be noted as a significant cost. Realistically, an open box culvert section at both of these crossings will be the installed final outcome with a similar waterway area to the shown 900mm pipes.

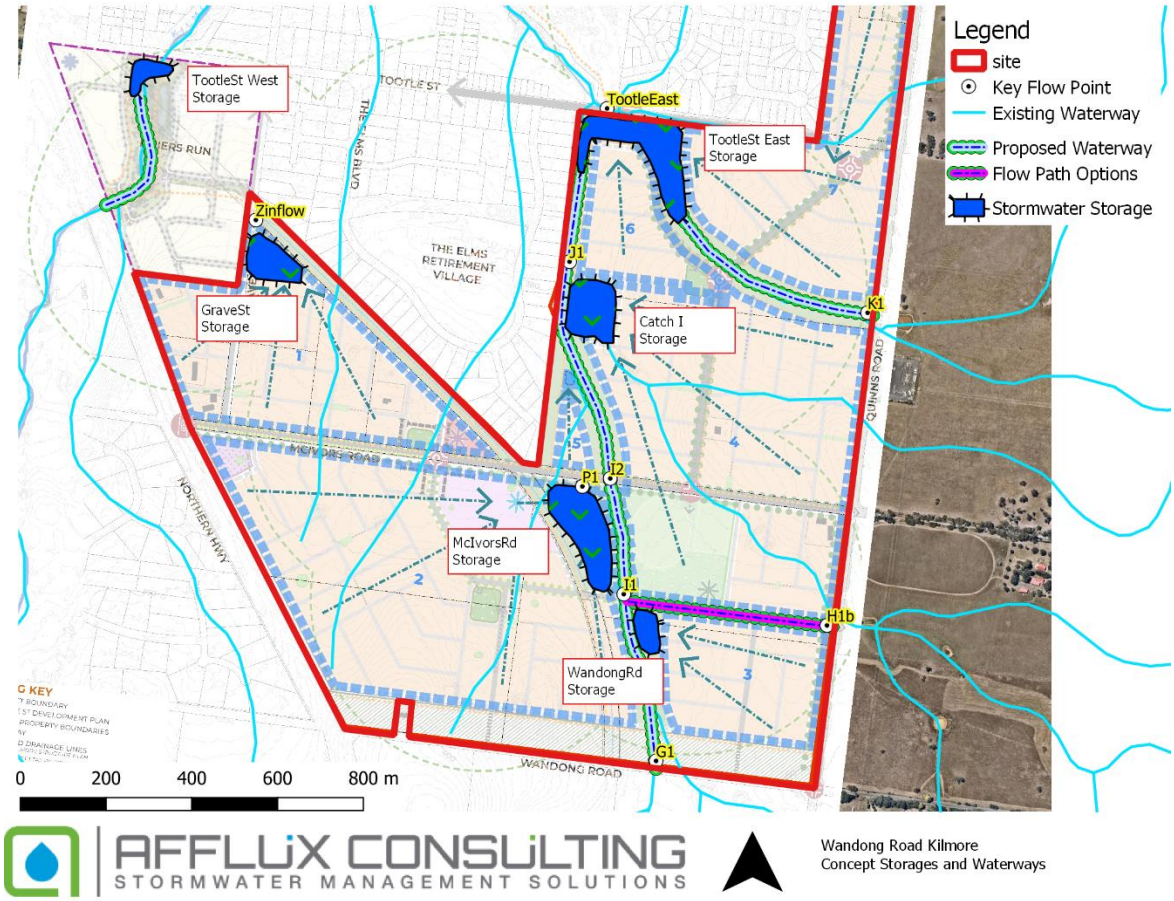


Figure 4-1 Storage and Flow Modelling Locations

Results

Based on the RORB model, the key point flows have been derived (highlighted in Figure 4-1 above), these have been tabulated below (Table 4-2). For minor flow sensitivity, the 5yr peaks have also been shown in Table 4-3.

Table 4-2 Flow Locations and Peaks for 100yr event

Flow Location	Existing Peak Flow (m^3/s)	Developed Peak Flow (m^3/s)	Notes
G1	22.30 (9h)	22.30 (9h)	
H1b	13.27 (9h)	11.44 (9h)	Catchment H reduced in size and partially diverted north
I1	18.00 (9h)	12.57 (9h)	Catchment I divided in half, Ib enters network at J1
I2	34.15 (9h)	34.50 (9h)	

J1	35.63 (9h)	38.45 (9h)	
K1	4.84 (9h)	8.03 (9h)	Catchment K taking flows from Catchment H
P1	2.83 (1h)	1.86 (9h)	McIvorSt Storage attenuates peak to 9h storm
TootleStEast US	44.70 (9h)	44.31 (9h)	U/S of proposed Tootle St Crossing
TootleStEast DS	52.50 (9h)	52.11 (9h)	D/S of crossing, Catchments M and O contributing
Z Inflow	2.35 (1h)	1.06 (9h)	GraveSt Storage attenuates peak to 9h storm

Table 4-3 Flow Locations and Peaks for 5yr event

Flow Location	Existing Peak Flow (m^3/s)	Developed Peak Flow (m^3/s)
G1	5.81 (9h)	5.81 (9h)
H1b	2.77 (12h)	2.36 (12h)
I1	3.51 (12h)	2.62 (12h)
I2	7.03 (12h)	7.73 (9h)
J1	7.21 (12h)	8.84 (9h)
K1	1.19 (9h)	2.06 (9h)
P1	0.86 (9h)	0.73 (9h)
TootleStEast US	9.51 (12h)	10.46 (9h)
TootleStEast DS	11.24 (12h)	11.79 (9h)
Z Inflow	0.79 (9h)	0.73 (2h)

Waterway Requirements

The creek offsets and protection zones are a primary concern of GBCMA and Council in the development of this parcel. This section describes the proposed offsets.

Offsets and Zones

Although in a GBCMA area, the Melbourne Water guidelines have been used to define the required offsets using the Waterway Corridors Guidelines. The proposed offsets and zones have primarily been based on a Strahler stream order, and other identified site features. Setback requirements and zoning can be seen in Figure 4-2 for each reach of proposed waterway.

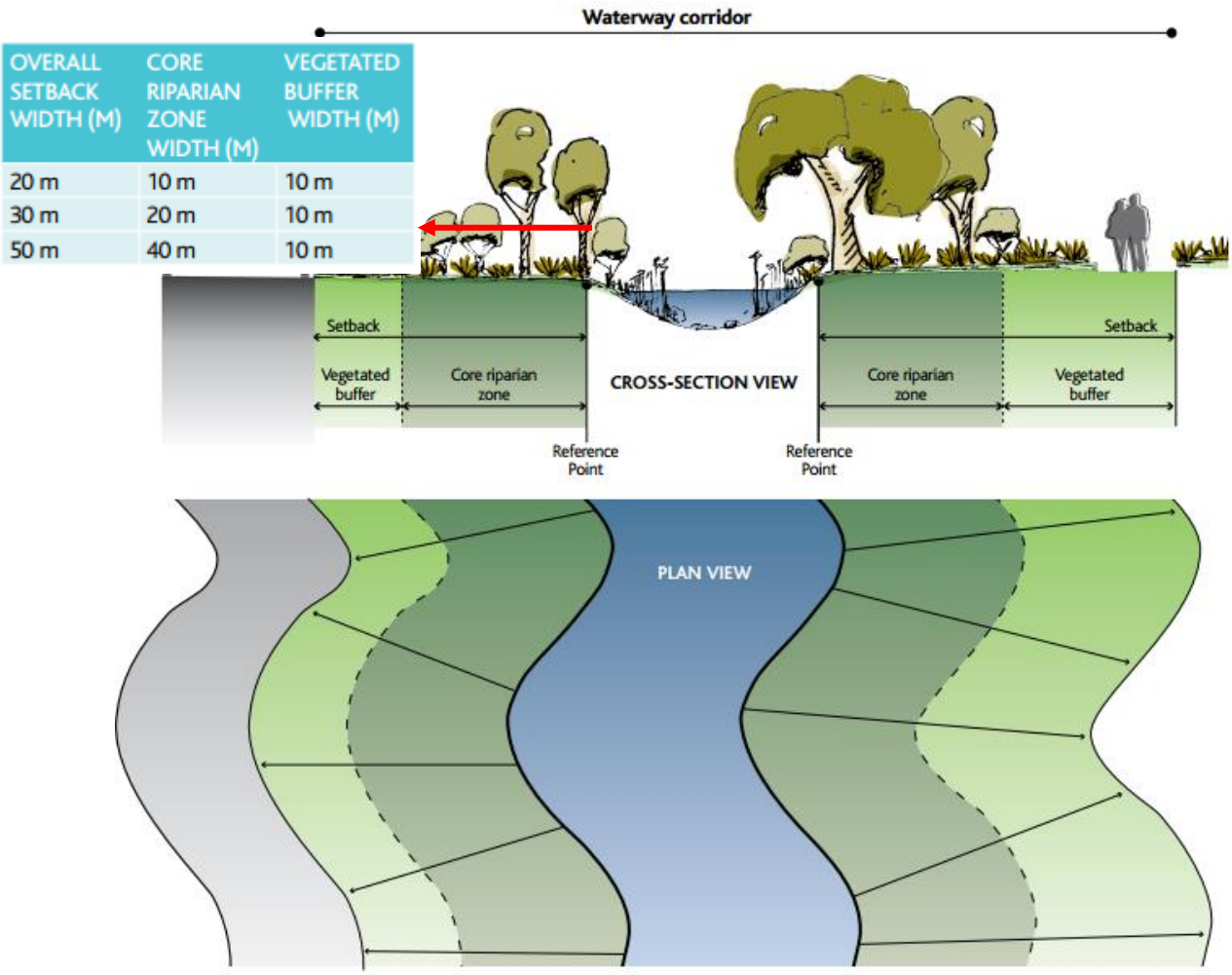


Figure 4-2 Waterway Offset Requirements (Waterway Corridor Guidelines)

Waterway Sizes

Given the reported developed flows across the site, specific waterway zones widths have been recommended for the waterway reserves outlined in the development strategy. Table 4-4 gives recommended waterway corridor widths given the expected flow requirements. Figure 4-3 shows the location of each waterway with the advised 60m

waterway corridor from GBCMA. A 5th overland flow path has been considered from point H1b in Figure 4-3. Options for this reach are presented in the next section.

Table 4-4 Waterway Corridor Requirements

Reach	Developed Flow (m^3/s)	Minimum Waterway Corridor Requirement (m)
1	22.3	40
2	34.5	50
3	38.5	50
4	8.0	30

*Note: Minimum waterway corridor requirement estimated from Melbourne Water Guideline, *Waterway Corridors (2013)*

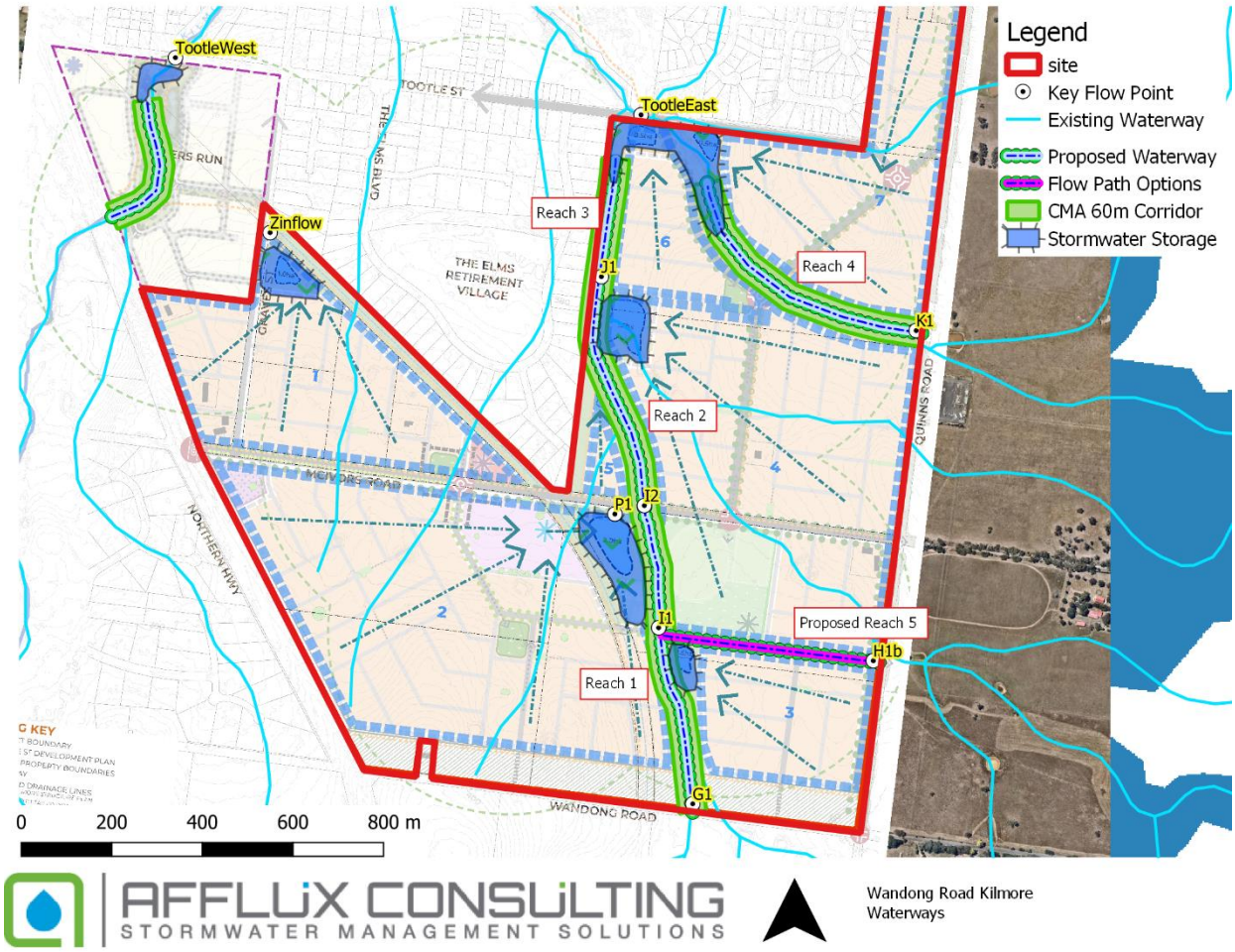


Figure 4-3 Waterway Locations with CMA Recommended Buffer Zones

Overland Flow Path Options Analysis

The existing flow path coming from point H1b in Figure 4-3 above appears to consist of sheet flows consolidated by two separate farm dams. Strategies for the existing flow path have been explored to avoid a formalised waterway, increasing yield and amenity

for the parcel immediately south of McIvors Rd. The modelled 1% AEP flow at this point has been taken to be **11.5m³/s** from the RORB model. These two options have been explored in discussions with land holders, planners and council. The options are outlined below:

<u>Pipe Option</u>

Flows to be piped directly to the design waterway beneath the proposed roadway. Given flow magnitude and existing grade (1 in 200), a 1950mm RCP or equivalent would be required.

<u>Green Road Option</u>

The preferred option is a "Green Link" or "Green Road" with widened tree corridors to effectively manage gap flows, reducing required pipe sizes. Based on the standard "Green Link" cross-section (Figure 4-4) and minimum fall, a flow of around 4-6 m³/s can be safely conveyed through the corridor. A low flow pipe of around 1200-1350mm RCP would be installed to carry up to 5-6 m³/s safely beneath the roadway.

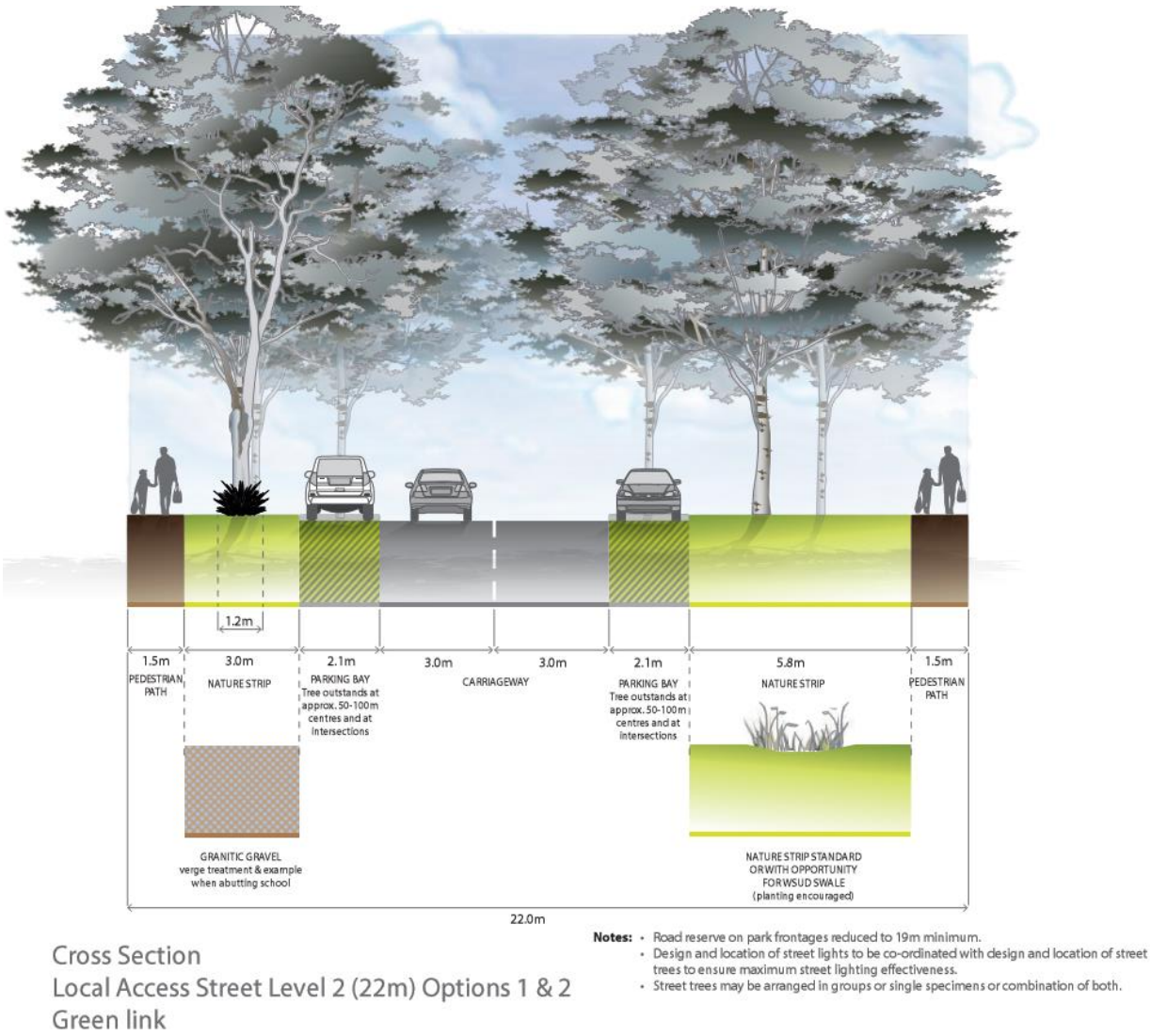


Figure 4-4 Green Link Road Typical Cross-Section

5. Water Quality

In order to achieve water quality objectives (BPEM, Clause 56-7.04), a number of treatment elements will be required.

The MUSIC software program has been used to develop and evaluate a treatment train comprising of:

- A Gross Pollutant Trap (GPT) is recommended for the outlet from the school zone (Part of Subcatchment P) to capture sediment and other major gross pollutants from this high traffic area. A recommended unit is the Rocla CDS P1009, suitable for catchments of this size (3.7Ha)
- Sediment ponds of minimum 500m² area for every catchment
- Minimum site wetland area of 2.7 ha (can be distributed). Design staging to decide distribution options. For the purposes of this report, it has been assumed that each of the drainage reserves have water quality infrastructure associated with them.

MUSIC Modelling

MUSIC modelling is an industry standard approach to determine water quality treatment and sequencing.

Guidance for model inputs was sourced from the IDM as well as Melbourne Water's MUSIC guidelines. In the absence of dedicated MUSIC input data for the region, the Melbourne City data (yearly average rainfall 650-750mm) was taken given yearly average rainfall for the Kilmore area is estimated at between 650 and 850mm by the Bureau of Meteorology. MUSIC input data will need to be created to assess system water balance and wetland health characteristics.

Treatment elements used in the model are discussed below.

Sediment Control

Control of sediment from a developed area is an important consideration for both the hydraulic function of drainage and water quality assets.

Build-up of sediment can lead to the failure of pipe networks (through blockage) and biological systems (through blockage and bypass).

Given the scale of the residential development, sediment ponds are recommended as a suitable intervention. The target particle removal size is 125µm. It is recommended that all local pipe network outlets end in a sediment pond of this size before discharge to the waterway. Calculated minimum sediment basin sizes and locations are outlined in

Table 5-1 and Figure 5-1 respectively. Typical MUSIC node setup is shown in Figure 5-2.

Table 5-1 Concept Sediment Basin Characteristics

Sediment Pond Number	Catchment Area (ha)	1yr Flow Rate (m^3/s)	Sed Pond Size (m^2)	Fraction Removal	Cleanout Rate (50% full)
SB 1	19.8	1.22	1200	95%	20yrs
SB 2	43.6	3.47	3500	95%	30yrs
SB 3	43.8	2.57	2800	95%	25yrs
SB 4	63.4	6.15	5800	95%	35yrs
SB 5	33	1.63	1600	95%	20yrs

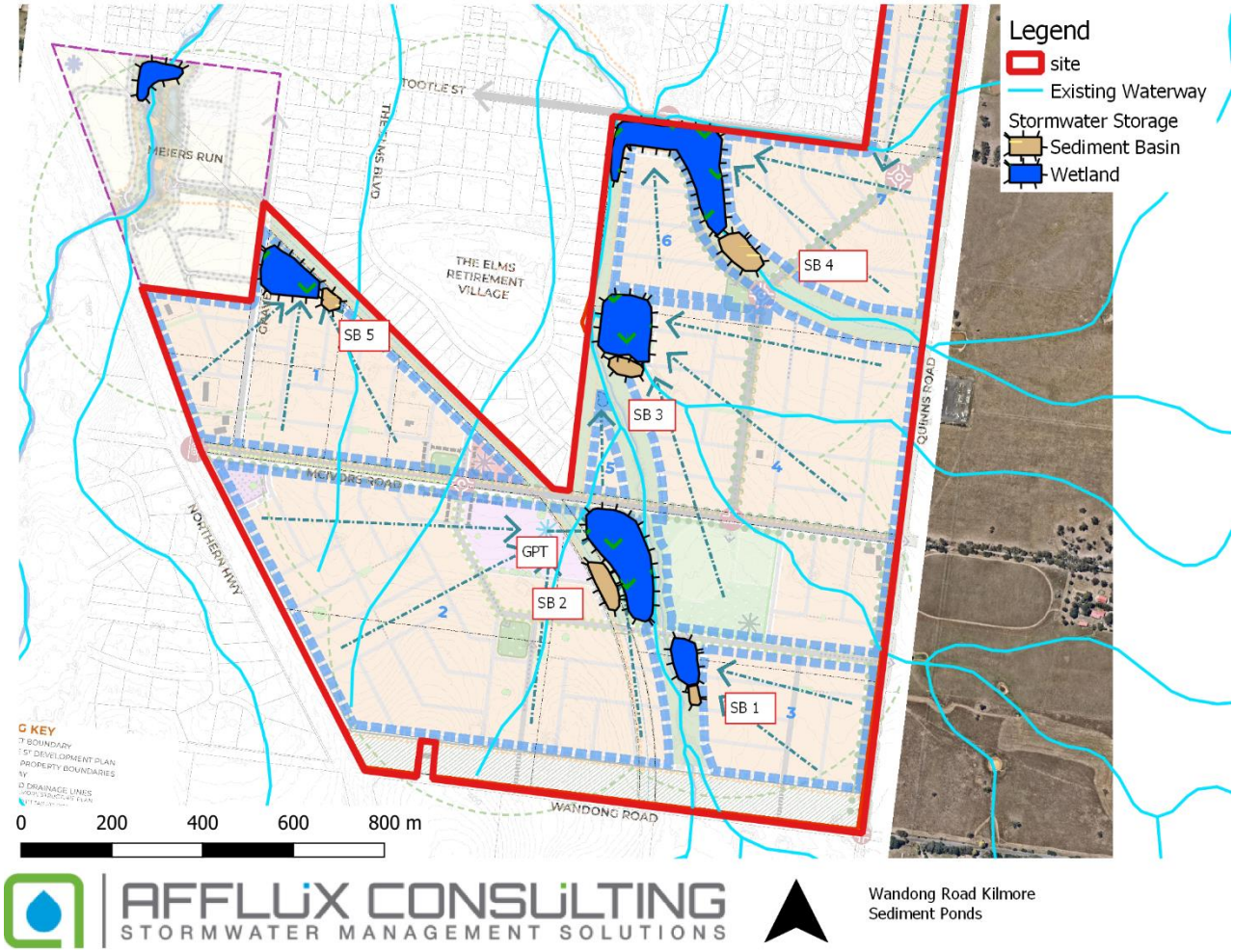


Figure 5-1 Sediment Basin Locations

In addition to sediment ponds, it is recommended that the school zone is fitted with GPTs to screen out higher loads of gross pollutant and sediment.

For modelling purposes, a CDS style unit (CDS 1009) has been recommended for inclusion in the treatment train.

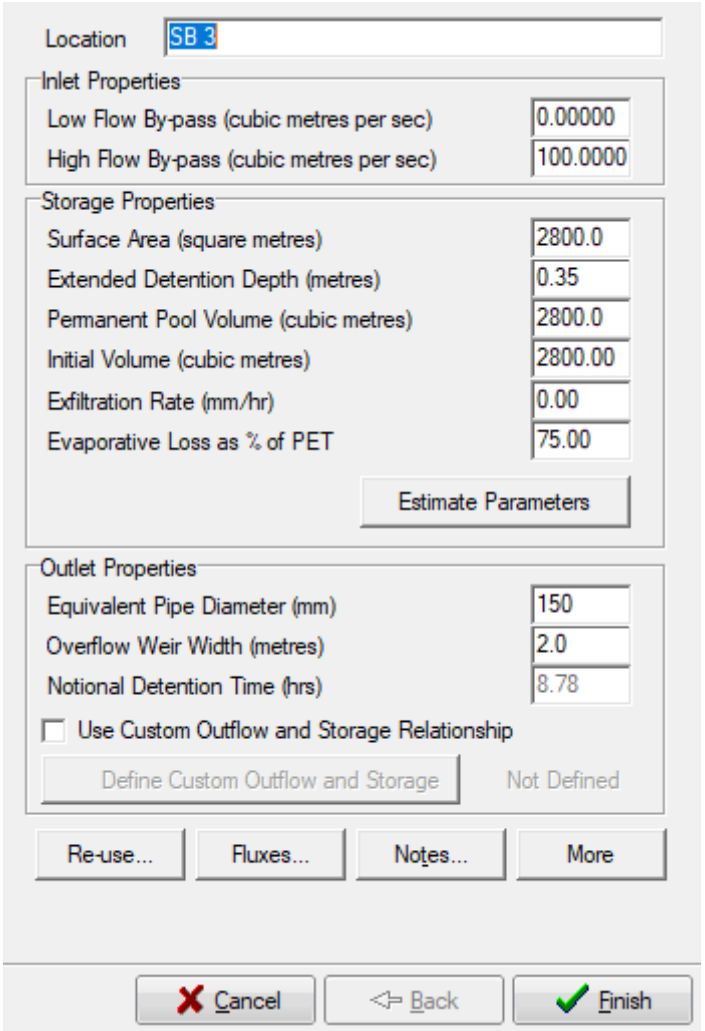


Figure 5-2 MUSIC Sediment Basin Design Inputs

Wetland Treatment

Biological treatment of stormwater reduces the loads of nutrients entering receiving waters, an important aspect of best practice guidelines. Wetland surface area dictates the potential effectiveness of these treatments, with plant selection and density being limited by available treatment area. For the purposes of this assessment, 2.7Ha of wetland was found to achieve targets, distributed as per Table 5-2. Given the drainage reserve areas and retardation requirements, these wetlands will likely need to be contained in the bottom of detention basins. The volume below the NWL cannot contribute to retardation volumes. Typical MUSIC node setup is shown in Figure 5-3

Detailed design of these systems will require careful consideration of local factors. A detailed water balance of the sites and site soil types will be required.

Table 5-2 Concept Wetland Characteristics

Wetland	Catchment Area (ha)	WL Area (m^2)	Estimated NWL (m AHD)	Modelled Detention Time (hrs)
WandongRd WL	19.8	2000	384.0	88.2
McIvorRd WL	43.6	7000	382.5	77.1
Catch I WL	43.8	5000	379.5	72
TootleSt E WL	63.4	8000	375.0	69.7
GraveSt WL	33	5000	382.5	72

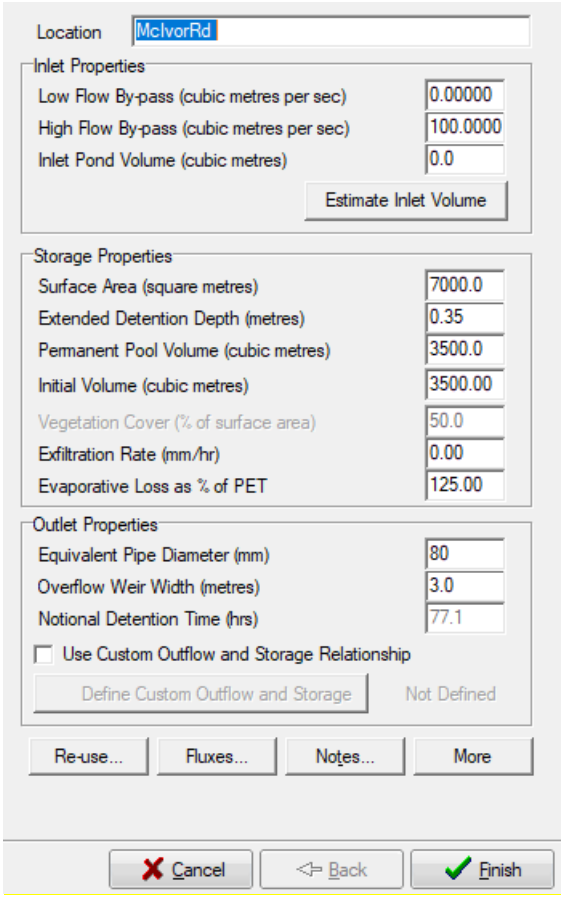


Figure 5-3 MUSIC Wetland Design Inputs

MUSIC Model Setup

Figure 5-4 shows the general layout of the nodes in the model. Sub catchments have been modelled on the basis of the original Kilmore Flood Study with developed areas assumed to have an FI of 60%.

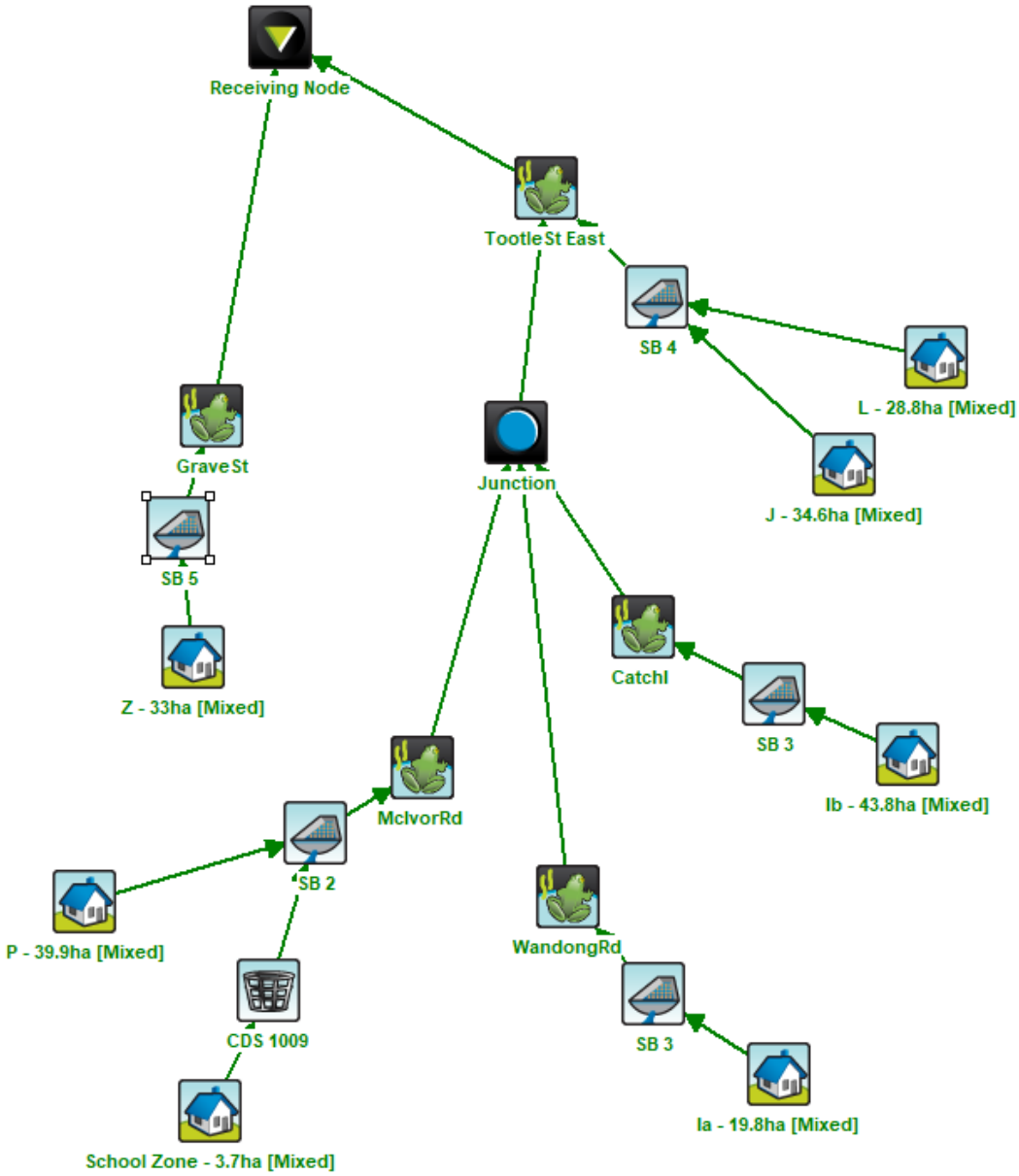


Figure 5-4 MUSIC Model Network Setup

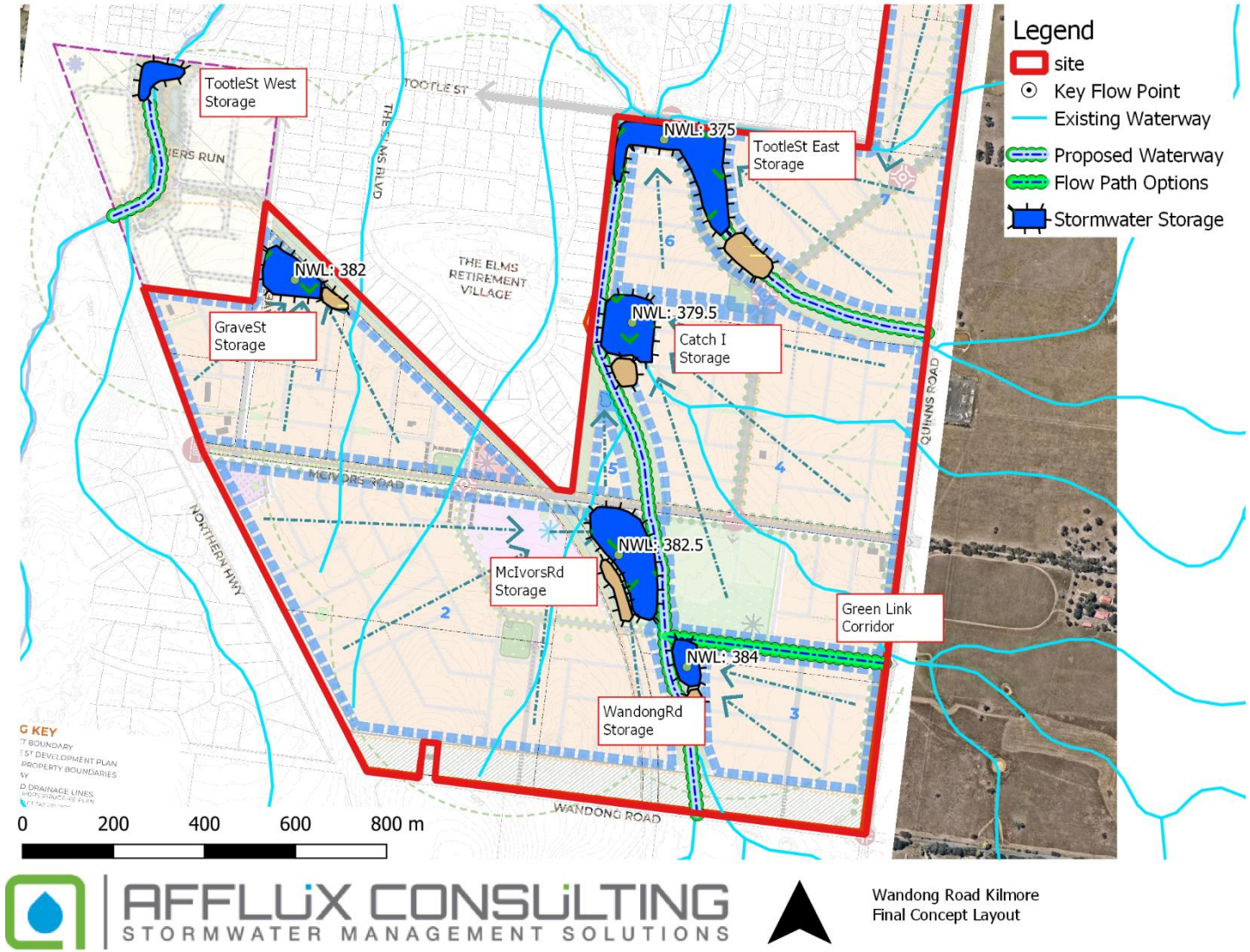
The results of the MUSIC modelling are shown in Figure 5-5 and indicate that best practice objectives are met or exceeded in all categories.

	Sources	Residual Load	% Reduction
Flow (ML/yr)	757	713	5.7
Total Suspended Solids (kg/yr)	134000	17400	87
Total Phosphorus (kg/yr)	286	82.2	71.3
Total Nitrogen (kg/yr)	2100	1150	45.3
Gross Pollutants (kg/yr)	28200	0	100

Figure 5-5 Model results for proposed treatment train

6. Final Concept

The final concept consolidates the findings of this report with estimated locations and sizes of drainage infrastructure recommended for this strategy. Figure 6-1 shows the final drainage concept. A summary of the storage requirements and water quality assets can be seen in Table 6-1 and Table 6-2 respectively. A typical waterway cross-section can be seen in Figure 6-2 below. Waterways are to be taken as 60m corridors unless advised by GBCMA.



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Wandong Road Kilmore
Final Concept Layout

Figure 6-1 Final Drainage Concept Plan

Table 6-1 Site Storage Requirements

Storage	Area (ha)	Peak Storage (m^3)	Peak Depth (m)	Weir Height (m)	Weir Length (m)	Outlet Requirement
GravesSt	1	7560	1.76	1.8	10	1x600mm RCP Culvert
TootleSt East	2.5	13,900	1.67	1.7	100	9x2400mm RCP Culvert
McIvorsRd	2	10,000	1.5	1.5	20	1x900mm RCP Culvert
Catch I	1.5	7460	1.49	1.6	25	1x1080mm RCP Culvert
WandongRd	0.5	1820	1.1	1.4	5	1x1050mm RCP Culvert

Table 6-2 Site Water Quality Assets

Name	Catchment Area (ha)	Size (m^2)	Estimated NWL (m AHD)	Primary Catchments
WandongRd WL	19.8	2000	384.0	Ia
McIvorRd WL	43.6	7000	382.5	P
Catch I WL	43.8	5000	379.5	Ib
TootleSt E WL	63.4	8000	375.0	J and L
GraveSt WL	33.0	5000	382.5	Z
SB 1	19.8	1200	384.0	Ia
SB 2	43.6	3500	382.5	P
SB 3	43.8	2800	379.5	Ib
SB 4	63.4	5800	375.0	J and L
SB 5	33.0	1600	382.5	Z
GPT	3.7	CDS P1009		P (school zone)

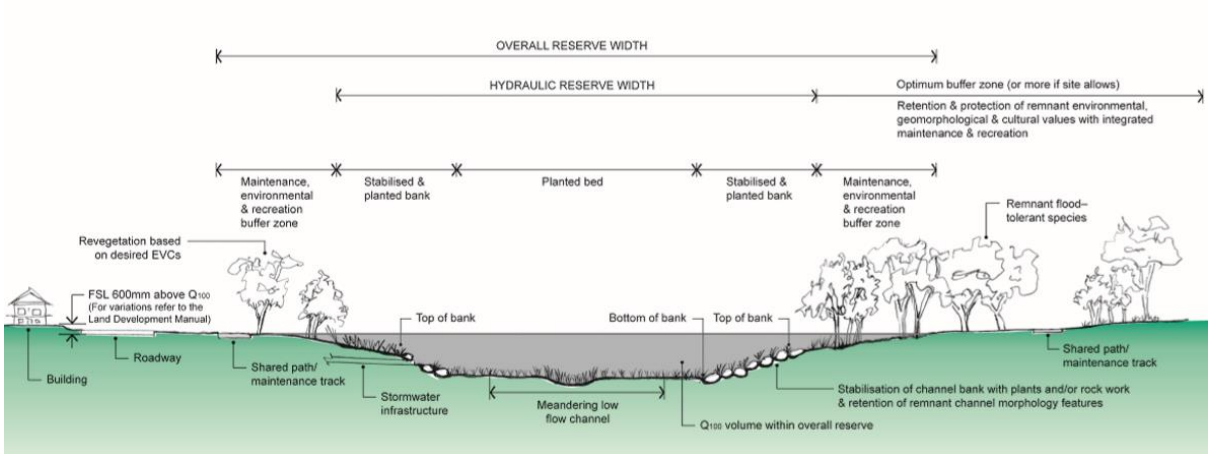

Figure 6-2 Contemporary constructed waterway typical sections

7. Conclusion

This stormwater strategy sets out the major requirements for the development of over 180ha of land in Kilmore. The macro drainage features (waterways and treatment storages) have been considered for the site, and reasonable design constraints given. The water quality treatment has also been considered. In summary the following elements are required for this site to meet contemporary drainage outcomes:

- A series of 60-meter constructed waterways to link the development areas
- At least 2.7ha of water quality treatment wetlands.
- Significant onsite storage is required across the site to retain existing waterway flow rates and maintain ecological benefit as recommended.
- A minimum site floor level subject to detailed design and localised to individual parcels.

ATTACHMENT 4

GOULBURN BROKEN CATCHMENT MANAGEMENT AUTHORITY (GBCMA) LETTER

Our Ref: PLN/Mitchell General

GOULBURN BROKEN
CATCHMENT MANAGEMENT AUTHORITY

5 February 2020

Chris Beardshaw
Director
Afflux Consulting Pty Ltd
PO Box 457
Emerald VIC 3782

Dear Mr Beardshaw

Stormwater Management Strategy – McIvors Road Kilmore (Dec 2019)
(South-East Precinct of the Kilmore Structure Plan)

I refer to the abovementioned document seeking comments and support from the Goulburn Broken CMA.

I also refer to meeting held at the Goulburn Broken CMA's Office of 21 January to discuss the strategy, particularly in relation to waterway management and flooding matters.

The Goulburn Broken CMA understands that this strategy is a requirement of Mitchell Shire Council's Kilmore Structure Plan – Guiding the Growth of Kilmore (August 2016 as revised including Planning Scheme Amendment C123 Gazettal 28 March 2019). The McIvors Road relates to the South-East Precinct of the Structure Plan.

The Goulburn Broken CMA in 2016 wrote to the Council expressing concerns with the approach to significantly alter waterways.

The adopted Kilmore Structure Plan has however recognised guiding principles for drainage, and biodiversity and Environment (page 19). Further, at pages 31, 64 and 66, the Plan recognises the values of natural features including waterways. It would appear that Figure 44 (page 87) is somewhat counter to the narrative of Kilmore Structure Plan.

From our meeting, you highlighted explained that your submitted Stormwater Strategy has somewhat departed from Figure 44, and is more aligned with the narrative of the Kilmore Structure Plan.

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From our discussions, the Goulburn Broken CMA wishes to make the following observations in relation to the Stormwater Strategy – McIvors Street:

1. The Kilmore Structure Plan requires:
    a. A holistic approach for water sensitive urban design approaches to stormwater treatment and management.
    b. The preparation of a fully costed sub-catchment wide drainage schemes as a ***precondition of any further rezoning or development within Kilmore growth precincts*** as identified in Chapter 4 and Chapter 5 (of the Kilmore Structure Plan). It is understood that the Stormwater Strategy informs this requirement at a strategic conceptual level prior to investing in this detailed work, but would appear that the detailed work is required for the precinct holistically rather on a stage by stage approach.
2. From our discussions, it was explained that your Stormwater Strategy has somewhat departed from Figure 44 and is more aligned with the narrative of the Structure Plan, and:
    a. Predominant waterways are aligned along its natural alignments within a 60 metre wide corridor. This is more acceptable to the Goulburn Broken CMA. The exceptions are small sized catchments (east of the site) that are to be re-aligned with a combination of a low-flow pipe and swale known as the "green-link", and minor drainage lines further west.
    b. The smaller eastern catchments are generally ill defined in terms of "bed and banks" that provide particular constraints for stormwater management options that led to the "green-link" strategy.
    c. Stormwater water treatments and retardation basins are off-line.
    d. Wetlands (flood storages) are provided at the downstream end of the development (Tootle Street East and West) to assist with treating flood impacts. This includes the Kilmore Creek that already has a drainage plan. The flood storage is to assist with managing flood impacts.
    e. There are concerns about the sustainability around wetlands in terms of required water volumes to support wetlands, and water quality or lack thereof (such as blue-green algae), which has been problematic with other man-made wetlands.
    f. It is recognised that the waterways are likely to see changes in hydrology due to the ultimate development conditions, and there are likely to be unintended consequences in terms of geomorphic impacts (i.e. bed deepening and widening which may impact on surrounding infrastructure) if not well designed and managed.
    g. To manage hydrologic changes, some waterways will need to be enhanced to ensure, amongst other things, intrinsic stability. It is noted that a straightened waterway-reach to Tootle Street West will need to be reinstated within a proposed 60 metre wide corridor – this is considered a positive way forward.
    h. It is noted that the hydrologic analysis has only been carried out to date and it is acknowledged that there is a need for hydraulic review. Such hydraulic modelling would greatly inform third-party flood impacts (if any), and to inform geomorphic design of the waterways, particularly in terms of (g) above. It would be beneficial to look at this holistically rather than wait for each specific drainage-plan for each stage (that is likely to be many years) so that developers are aware of the challenges required to be addressed when the time arrives. This should be presented in the Stormwater Strategy. This matter is further detailed below.

Having regards to the above on balance, the Goulburn Broken CMA in principle, supports the Stormwater Strategy (McIvors Road) subject to additional information to be documented within the strategy:

1) For the ultimate developed conditions, a hydraulic assessment (of the precinct, i.e. all stages) is to be included to establish/demonstrate holistically that the conceptual strategy:
   - Provides no "adverse" third-party impacts to downstream areas and the upstream areas of the proposed "green-link."
   - Provide hydraulic parameters (i.e. discharge, velocity) is assist with geomorphic response together with a list of possible detailed design matters to be considered in detailed design phase such as soil types, grade reducing structure, etc.
2) For the ultimate developed conditions, an assessment of the viability of the proposed wetlands to ensure that proposed measures are ecologically sustainable in terms of required water volumes to support wetland flora, and without impacts to water quality and waterway health (including blue-green algae).

Alternatively, the Goulburn Broken CMA would be prepared to see the above be carried out following rezoning as part of the required Development Plan as part of Planning Scheme Amendment C136. Therefore, the Section 7 of the Stormwater Strategy should include the narrative to sign-post the above requirements (including the Kilmore Structure Plan (see (1(b)) above) as part of the required Development Plan.

If you have any queries, please contact Tom O'Dwyer on **(03) 5822 7700**. Please note that all electronic correspondence should be directed to planning@gbcma.vic.gov.au.

Yours sincerely

Guy Tierney
Statutory Planning and Floodplain Manager

cc Sean Greer Mitchell Shire Council

Our Ref: GBCMA-F-2021-00111
GBCMA-F-2020-00047
Contact Officer: Joel Leister
Your Ref: 24055

Date: 1 March 2021

Mr Chris Beardshaw
Afflux Consulting
Po Box 457
Emerald Vic 3782 chris@afflux.com.au

Dear Mr Beardshaw

Floodplain Management Advice for
Tootle St (East), Kilmore – Hydraulic Assessment
Lot 1 TP80904, Parish Of Bylands
2 Tootle Street Kilmore Vic 3764

The Goulburn Broken CMA has previously provided Mitchell Shire Council with correspondence (Ref: GBCMA-F-2020-00047 and GBCMA-F-2020-00047-2) that provided in principle support for the Stormwater Management Plan associated with the development of the Kilmore South-East Precinct.

The additional information provided by Afflux Consulting on 1 February 2021 was aimed at confirming several items referenced in the Goulburn Broken CMA's previous responses, namely:

1. Ensure no worsening of flooding in the 1% AEP flood event as a result of the proposed development.
2. Ensure the proposed lot layout is flood free.
3. Ensure no worsening of flooding due to the proposed 'Green Link'; and
4. Provide hydraulic parameters (such as depth, velocity, levels) to assist with the geomorphic response for the waterway.

The report provided by Afflux Consulting (*Tootle St (East), Kilmore – Hydraulic Assessment*, Ref: 442_01 R01c, 17 December 2020) has addressed the following concerns:

- The mapping presented in Appendix C of the *Hydraulic Assessment* has demonstrated that the 1% AEP flood extent is confined to the waterway alignment and identified drainage alignment (flowpaths), i.e., it does not extend onto areas proposed for residential development (including proposed lots).
- The report demonstrates that the flows through Centenary Drive and downstream of the proposed development have decreased due to the measures proposed to manage runoff and flow from the proposed development.
  Note: Figure 20 does not appear to correctly present the modelled afflux downstream of the development, however, the information presented is

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sufficient for the Goulburn Broken CMA to be comfortable that there is no worsening of flooding during a 1% AEP event downstream of the development.

- The modelling of the 'Green Link' has demonstrated sufficient capacity to match the overland flowpath that, under existing conditions, flowed to the north west from Quinns Road.
- The report has provided flood depths, flood levels and depth x velocity product for proposed development which can be used to assess the geomorphic response of the waterway and which will enable consideration of these waterway characteristics in future design stages.

The Goulburn Broken CMA agree that the proposed retarding basin configuration and 'Green Link' design do not worsen the flood risk to the area, particularly downstream of the development.

Having regard to the above, the Goulburn Broken CMA **does not object** to the concepts and strategies for surface water management as outlined and proven by the hydraulic analysis of Afflux Consulting (2020), **subject to the following conditions:**

- The detailed design of the 'Green Link' and other associated drainage infrastructure must maintain (or better) the performance demonstrated in the hydraulic analysis (Afflux Consulting, 2020) in terms of flood attenuation.
- The Development Plan (DP) and subsequent Stormwater Management Plans for individual parcels of the proposed development are provided to the Goulburn Broken CMA for assessment.

If you have any queries, please contact Joel Leister on **(03) 5822 7700**. To assist in handling any enquiries please quote **GBCMA-F-2020-00047** in your correspondence. Please note that all electronic correspondence should be directed to planning@gbcma.vic.gov.au.

Yours sincerely

Guy Tierney
Statutory Planning and Floodplain Manager

Information contained in this correspondence is subject to the definitions and disclaimers below.

Definitions and Disclaimers

1. The area referred to in this letter as the 'proposed development location' is the land parcel(s) that, according to the Authority's assessment, represent(s) the location identified by the applicant. The identification of the 'proposed development location' on the Authority's GIS has been done in good faith and in accordance with the information given to the Authority by the applicant(s) and/or local government authority.
2. While every endeavour has been made by the Authority to identify the proposed development location on its GIS using VicMap Parcel and Address data, the Authority accepts no responsibility for or makes no warranty with regard to the accuracy or naming of this proposed development location according to its official land title description.
3. **AEP** as Annual Exceedance Probability – is the likelihood of occurrence of a flood of given size or larger occurring in any one year. AEP is expressed as a percentage (%) risk and may be expressed as the reciprocal of ARI (Average Recurrence Interval).
4. **ARI** as Average Recurrence Interval - is the likelihood of occurrence, expressed in terms of the long-term average number of years, between flood events as large as or larger than the design flood event. For example, floods with a discharge as large as or larger than the 100-year ARI flood will occur on average once every 100 years.

5. **AHD** as Australian Height Datum - is the adopted national height datum that generally relates to height above mean sea level. Elevation is in metres.

6. No warranty is made as to the accuracy or liability of any studies, estimates, calculations, opinions, conclusions, recommendations (which may change without notice) or other information contained in this letter and, to the maximum extent permitted by law, the Authority disclaims all liability and responsibility for any direct or indirect loss or damage which may be suffered by any recipient or other person through relying on anything contained in or omitted from this letter.

7. This letter has been prepared for a proposed **Drainage Scheme/Works** and is for the use only of the party to whom it is addressed and no responsibility is accepted to any third party for the whole or any part of its contents. Neither the whole nor any part of this letter or any reference thereto may be included in any document, circular or statement without the Authority's written approval of the form and context in which it will appear.

8. The flood information provided represents the best estimates based on currently available information. This information is subject to change as new information becomes available and as further studies are carried out.

9. ***The responsible authority may use this information within 90 days of this letter***.

ATTACHMENT 5

SERVICING REPORT (MILLER MERRIGAN)

Development Servicing Memorandum

Kilmore South East Growth Precinct

Date: 20 September 2021

Version 2

Reference: 24055

Author: Dennis Graf

1 INTRODUCTION & CONTEXT

This servicing memorandum details the investigated availability of drainage and servicing, and the anticipated requirements to provide services to the proposed development area.

The land is situated south east of the existing Kilmore township as depicted in Figure 1.

The site was recently zoned to facilitate residential development in line with the strategic direction of the Kilmore Structure Plan.

The proposed development plan seeks to provide for approximately 1800 new residential allotments with associated social and community infrastructure as detailed within the Kilmore Structure Plan.

Development of this order require high level servicing planning and appropriate early consultation with servicing authorities to ensure the best outcome can be planned for.

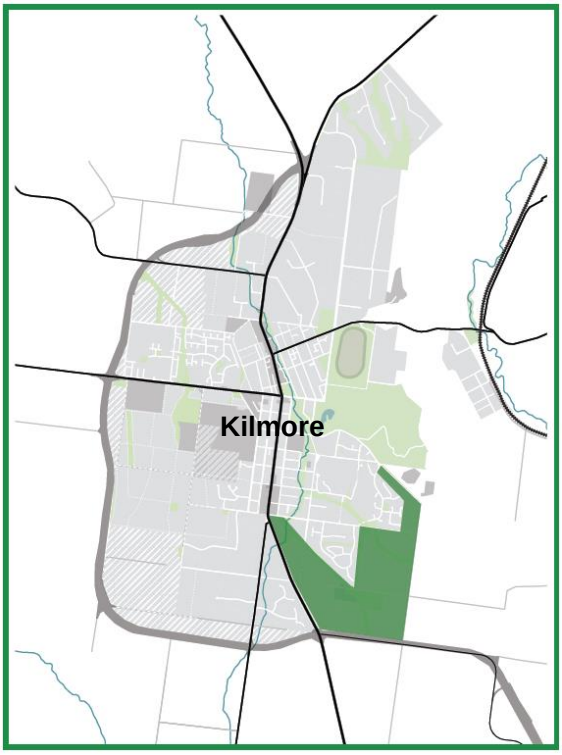

Figure 1 - Kilmore context plan

2 DRAINAGE & SERVICES

2.1 DRAINAGE STRATEGY

The responsible authority for local drainage is Mitchell Shire Council, the catchment management authority is the Goulburn Broken Catchment Management Authority (GBCMA).

The pre-application contacts within these organisations are:

- Cameron Baird from Mitchell Shire Council cameron.baird@,itchellshire.vic.gov.au
- Joel Leister from GBCMA joell@gbcma.vic.gov.au

As part of the planning scheme amendment process, a Stormwater Management Strategy (SWMS) was prepared for and reviewed by the GBCMA. The SWMS reviewed the intent of the Kilmore Structure Plan, recent flood modelling commissioned by the CMA and Council and provided detailed management strategies to guide future development applications to ensure appropriate stormwater facilities are incorporated within the development plan area.

During the design, Millar Merrigan and Afflux Consulting collaborated with GBCMA to form the SWMS, the general outcome indicated below in Figure 2 - Drainage Concept (Afflux).

The control point for the system are the existing drainage and watercourses at the downstream side of the proposed storage assets nominated below as Graves St Storage and Tootle Street Est Storage.

Upstream waterways contributing to the development area have been addressed to ensure all surface runoff is appropriately considered and incorporated into the Development Plan area in an efficient manner that provides the great community use and benefit.

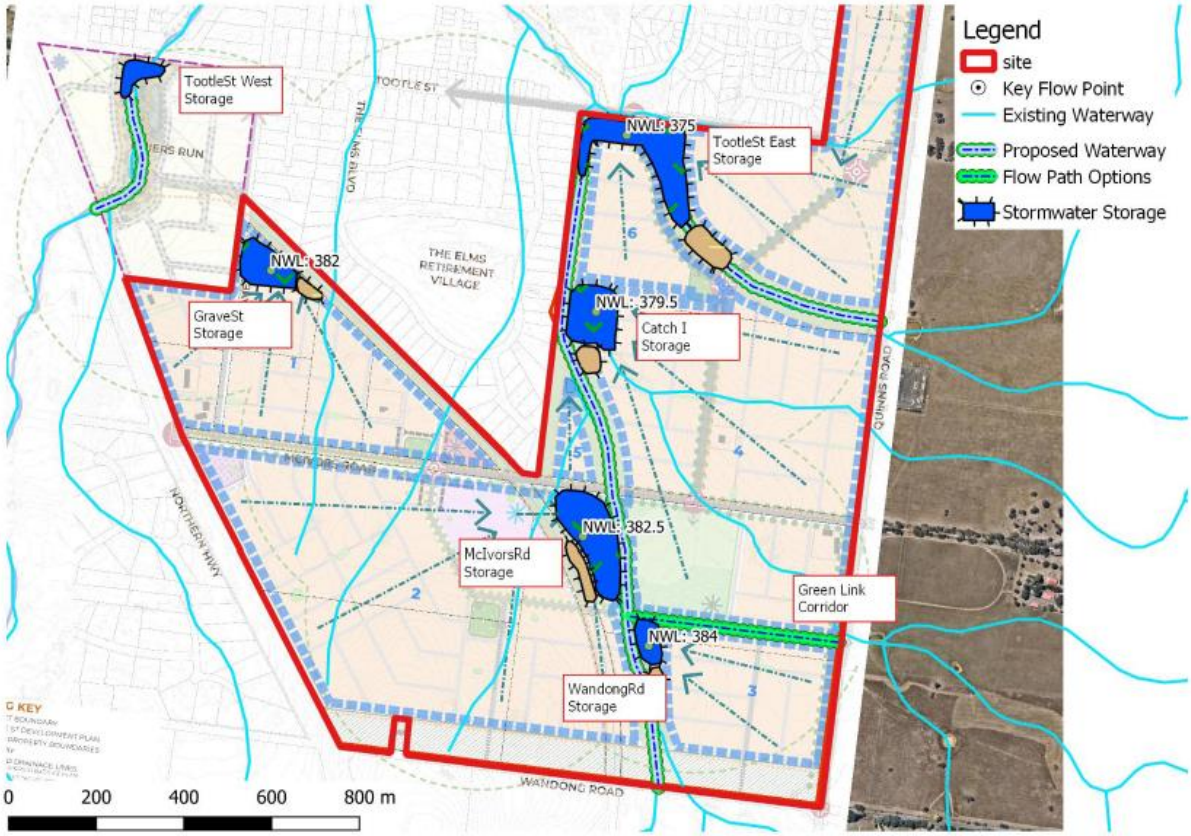

Figure 2 - Drainage Concept (Afflux)

The SWMS is the backbone of future individual Stormwater Management Plans for each development, functional and detailed design of drainage infrastructure.

2.2 SEWER & WATER

The responsible authority for sewerage and water services is Goulburn Valley Water (GVW). The network growth to service this precinct is guided by Goulburn Valley Water strategic planning department and modelling.

Recent network modelling of the sewerage network revealed that additional capacity was required to reduce the current risk of environmental spill. With respect to the growth precinct, the existing network does not have capacity for new connections, therefore a higher order solution would be required to accommodate the future development and futureproof the existing network.

Millar Merrigan investigated numerous sewer servicing strategies in conjunction with GVW and their sewer modelling contractor, including sewer pump stations, and rising mains but after cost benefit analysis and future growth, a trunk gravity sewer extension was decided as the preferred way forwards for the township.

Millar Merrigan are working through the design component of the sewer which includes interaction with multiple stakeholders, including Council, Taungurung Clans.

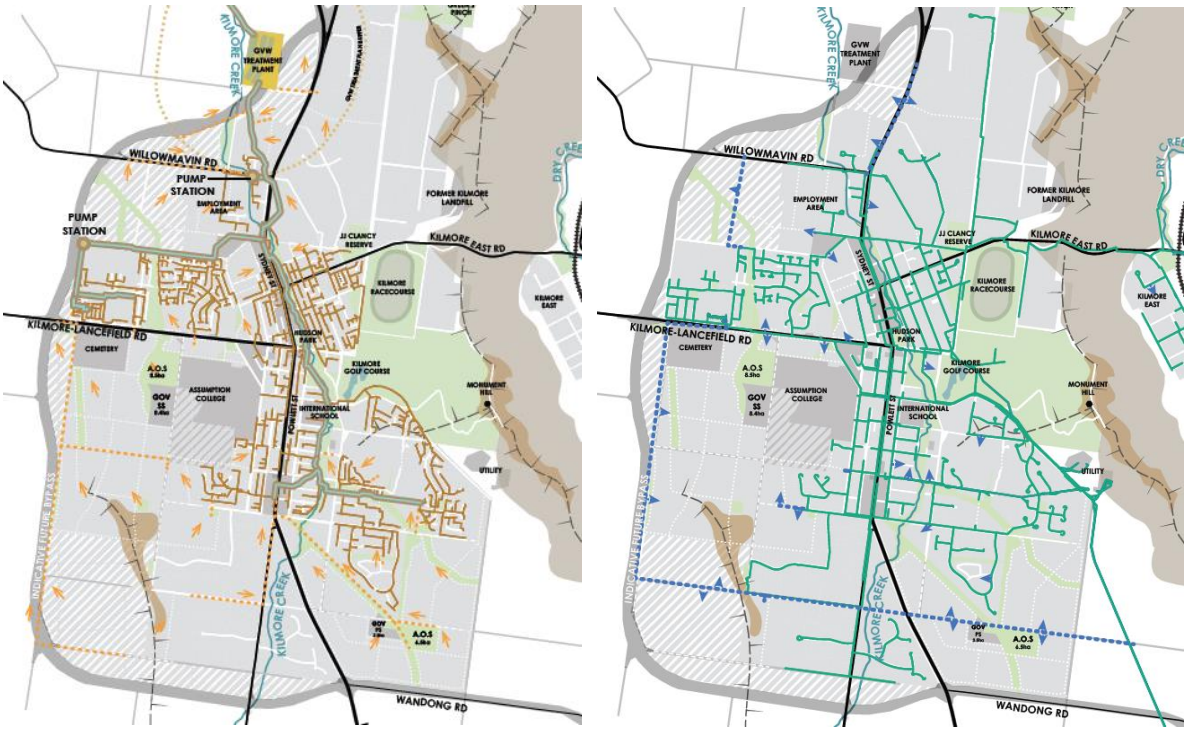

Figure 3 – Sewer & Water Concept Plans from the KSP (Aug 2016)

Water reticulation will be extended to provide the development the required level of water service, with connection points to generally follow the concept plans within the Kilmore Structure Plan as depicted below.

It is understood through preliminary advice and feasibility investigations from GVW that the existing water reticulation network has capacity to service the future proposed development region.

2.3 ELECTRICAL

The responsible authority for electrical services is Ausnet Services. There are multiple existing overhead electricity lines running throughout the sites and along the existing road reserves which, in conjunction with an electrical design consultant, will be appropriately managed to facilitate the development.

There is a major Ausnet substation site located east of Quinn Road about halfway up the precinct from Wandong Road. It is understood the development can be serviced from the 22kV high voltage lines along McIvors Road and from existing infrastructure within Graves Street and Tootle Street.

2.4 TELECOMMUNICATIONS

The responsible authority for telecommunications is NBN Co.

The region is within the NBN C roll out plan, and existing NBN telecommunications infrastructure is located within Graves Street and Tootle Street which will be extended within the site to service the development.

2.5 NATURAL GAS

The responsible authority for telecommunications is APA Group, and while natural gas is not an essential service in terms of development, there is gas infrastructure available nearby that could be extended within and throughout the development area.

3 CONCLUSION

The south east growth precinct appears to have the opportunity to provide all relevant drainage and services infrastructure in line with the existing strategic framework. Given the size of the precinct, collaborative consultation with service authorities will continue to ensure the best outcomes are planned for.

For information on the contents of this memorandum, please contact the undersigned.

DENNIS GRAF
Civil Engineer

e dgraf@millarmerrigan.com.au

Millar | Merrigan