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To	**Moremac Pty Ltd, C/- KLM Spatial**	From	**Nina Barich**
Copy		Reference	**2403**
Date	**8 October 2024**	Pages (including this page)	**13**
Subject	**350 Narre Warren Cranbourne Road, Cranbourne East - Without Prejudice**		

1 Executive Summary

Incitus has been engaged by Moremac on behalf of Spring Lodge Pty Ltd to review the Melbourne Water Drainage Strategy for the Croskell PSP area. Moremac is managing development interests on behalf of Spring Lodge at 350 Narre Warren Cranbourne Road within and adjacent to the PSP. The property is 63.8ha of which 39.1ha is located within the Croskell PSP. The Incitus review considers the whole of the PSP area as well as contributing catchments and is not confined to the 350 Narre Warren – Cranbourne Road property. In completing its review, Incitus has applied best practice and met Melbourne Water guidelines. This has been achieved through balancing appropriate stormwater management while optimising the development potential of the land consistent with State policies. The outcome provides a strategy that meets Melbourne Water's requirements through efficient use of land and one that is cost effective for the PSP and drainage scheme.

The review has identified the following key changes to the Melbourne Water Croskell Drainage Strategy:

- The north-west catchment within the Croskell PSP should include the diversion of the 1% AEP plus climate change design flow in a subsurface system, diverted east to the existing outfall at Thompsons Road
- The removal of the proposed waterway G and waterway H from Melbourne Water's drainage strategy
- The inclusion of a drainage reserve for a sediment pond SP3A adjacent to Ti Tree Creek, immediately south of the existing VDP and transmission easement
- A reduction in the drainage reserves for WLRB2 west and east assets
- Potential realignment of Ti Tree Creek to maximise the developable land within the PSP

2 Site Location

The site at 350 Narre Warren Cranbourne Road, Clyde North is partially located in the future Croskell Precinct Structure Plan (PSP) and Melbourne Water's Ti Tree Creek Development Services Scheme (DSS).

The site is 63.8 ha, located on the east side of Narre Warren Cranbourne Road, approximately 430 m south of Thompsons Road and is irregular shaped. Approximately 24.7 ha is already zoned for residential purposes, and the balance of the site is within the future Croskell PSP.

Approximately 17 ha of the site is located north of an existing easement, with the easement accounting for approximately 14 ha of the site and the remaining 32.8 ha located south of the easement.

The northern portion of the site has an external catchment of approximately 51.7 ha contributing from the north, from which it must convey the stormwater runoff. The southern catchment is traversed by Ti

Tree Creek, which has a significant upstream catchment, of approximately 376 ha. The site generally drains towards Ti Tree Creek.

The site is illustrated in the current proposed Croskell PSP in **Figure 2.1**.

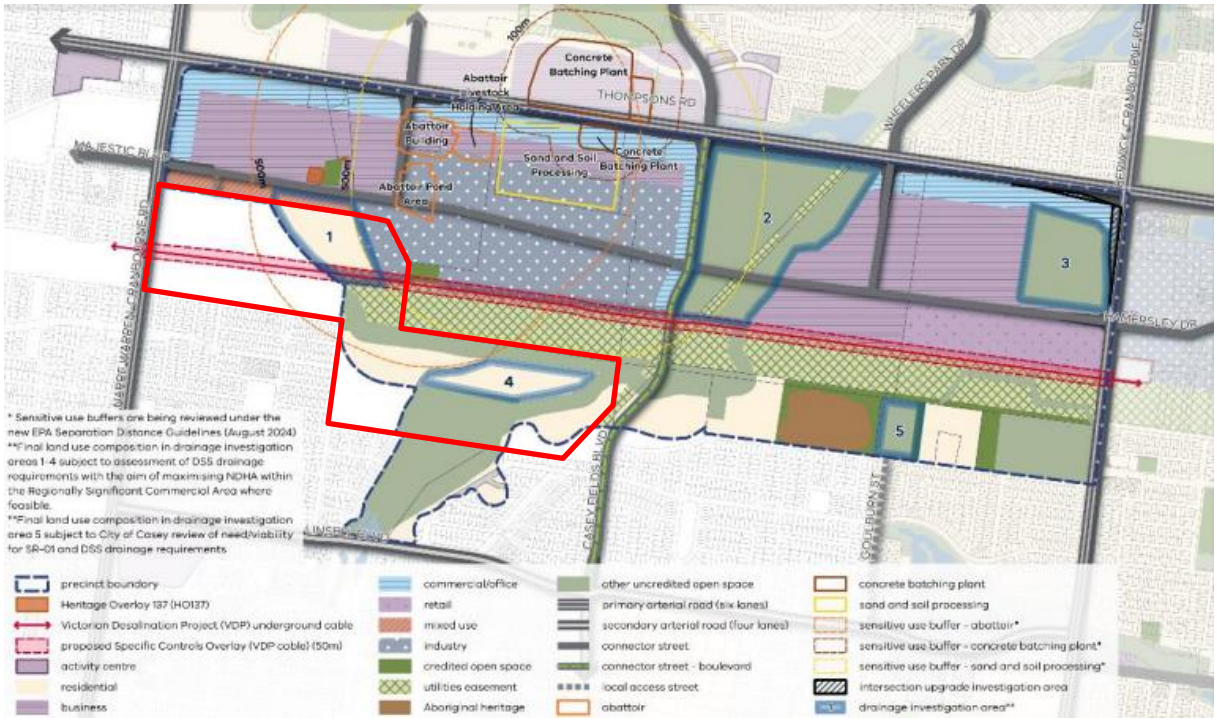

Figure 2.1 – Site in Relation to Croskell PSP

3 Croskell PSP Drainage Strategy

Melbourne Water have developed a drainage strategy for the Croskell PSP, which includes a portion of the proposed drainage reserve for WLRB3, along with a buffer for the drainage reserve. The total drainage reserve includes a constructed wetland with a sediment pond, a bypass channel and a waterway corridor for Ti Tree Creek.

The drainage strategy also includes a waterway corridor nominated with a 55 m width to convey flows across the existing easement containing the Victorian Desalination Pipeline (VDP), and a waterway with a corridor nominated as 70 m wide (although note this is nominated to be 55 m wide in the report) located adjacent to the southern easement boundary to connect the waterway to Ti Tree Creek.

The drainage strategy proposes to convey the majority of the flows from the northern catchment, including part of the site, east in a pipeline / road reserve to connect to Ti Tree Creek prior to crossing Thompsons Road. The drainage strategy has only allowed for the 1% AEP plus climate change design flow from the portion of the site north of the easement and already zoned residential to cross the easement. This is to minimise the peak flows and volumes crossing the VDP.

MW Hydrologic Modelling

Melbourne Water has provided Incitus with a RORB model for the Ti Tree Creek DSS for the intent of the DSS, called TITR16-Croskell-pre-dev-RevB.catg (known as the predeveloped), and for the inclusion of the Croskell PSP, called TITR16-Croskell-post-dev-with-mit-RevB.catg.

The drainage strategy report notes that the post development RORB model includes changes to the "predeveloped" model, such as:

- Alterations to the impervious values to represent the Croskell PSP
- Changing the reach types to be a 3 where there are pipes and roads

It is well documented that overland flow in road reserves, or the 1% AEP storm event in a road reserve, is best represented by type 2 reaches in RORB for routing, and therefore the type 3 reaches have the potential to overestimate the flow due to increased hydraulic efficiency. A road reserve does not have the same hydraulic efficiency as a reinforced concrete pipe.

For the western catchment of the RORB model, which encompasses this site, the model supplied for the developed conditions has subareas upstream of the outfall location, or the proposed drainage reserve, with areas ranging from 0.9 ha to 260 ha.

Whilst it is nominated that RORB subareas should be delineated by land-use, the reference to land-use is broader that the application of this model and should be taken as a land-use of rural versus urban for example.

The ARR'87 (note this is not referenced in ARR2019) states that all sub-catchments for RORB (subareas) should be all of the same order of size. The range adopted in the supplied model is not in the same order of size.

RORB should have at least 5 subareas upstream of any hydrograph printout location, such as at the northern boundary of the easement within the site, to allow sufficient smoothing and attenuation of the rainfall excess hyetographs. The model supplied only has 1 subarea intended to cross the easement.

The intent of the drainage strategy is to ensure that the post development 1% AEP design flows including climate change do not exceed the existing 1% AEP design flows at the crossings of the VDP and the existing Melbourne Water watermain, as well as at Thompsons Road.

MW Treatment Modelling

Melbourne Water has also supplied Incitus with a MUSIC model, Future_Development_Rev L_post_dev_RevB_02.sqz, for the stormwater quality treatment. The MUSIC model is limited to the extents of the Croskell PSP and the upstream catchment and does not have any consideration of the treatment provided for the overall catchment downstream.

At present, the treatment nominated in the drainage strategy is intended to provide current best practice pollutant reduction objectives for the Croskell PSP.

The MUSIC model provided is also not compliant with Melbourne Water's current MUSIC modelling guidelines (July 2024). The model has used the old rainfall template and has not been updated with the current rainfall template. It has also modelled the sediment ponds as a separate node, despite the design drawings indicating only a 100 mm difference, in normal water levels, and therefore should be modelled as an inlet pond in the wetland node in accordance with the current guidelines.

20% Buffer

Melbourne Water have adopted a 20% buffer for all the drainage reserve site conditions such as shallow ground water.

Even if ground water is encountered, the proposed waterway and drainage assets must be set at a level to ensure that the first pit upstream is dry. If the drainage invert level is raised, either the pipe network system upstream of the drainage asset would permanently hold water, or the whole catchment would require a significant amount of fill. Therefore, it is proposed that any groundwater can be managed through the construction and design, and that the drainage assets should not be raised.

Therefore, it is recommended that the 20% buffer adopted is removed prior to gazettal of the PSP.

General Summary of MW Drainage Strategy

It should be noted that there are discrepancies between the MUSIC model and the design plans with respect to the adopted operating levels, and that the levels adopted in the design drawings for the wetland do not match the levels included in the RORB model.

There are also discrepancies between the flood levels nominated in the design report, and what the flood level would be with a flood depth nominated in the report and the adopted normal water level on the plans.

Due to the numerous inadequacies in the Melbourne Water modelling, and the significant portion of developable land that the drainage reserves from the Melbourne Water proposed strategy would encumber, Incitus has undertaken independent modelling and design for the western catchment of the Croskell PSP.

4 Incitus Design

Hydrologic Modelling

Incitus has created an extract of the Melbourne Water RORB model encompassing the western catchment of the Croskell PSP Thompsons Road, with a revised subarea breakdown for the western catchment in the Croskell PSP to ensure there is a minimum of 5 subareas upstream of hydrograph print locations and with subareas more evenly distributed.

The Incitus existing conditions model has adopted type 1 reaches where there is no development or any existing cut drain, and type 2 reaches for existing urbanised areas.

The existing retarding basins 0619-16 (the Hunt Club) and 0619-45 (at Linsell Boulevard) have been included as per the Melbourne Water model, however it should be noted that 0619-16 has been moved to located it where the catchment is connecting (downstream of Incitus subarea B4, not where the Melbourne Water model has it at subarea C, as this subarea and upstream catchment bypasses around the 0619-16 asset).

The same modelling parameters were applied as those adopted in the Melbourne Water model; however, the kc value was altered to reflect the revised Dav of the model excerpt and a kc of 5.65 for existing conditions and a kc value of 5.57 for developed conditions is used. **Figure 4.1** illustrates the revised existing RORB subareas for the western catchment of the Croskell PSP, and **Figure 4.2** illustrates the revised developed RORB subareas for the western catchment of the Croskell PSP.

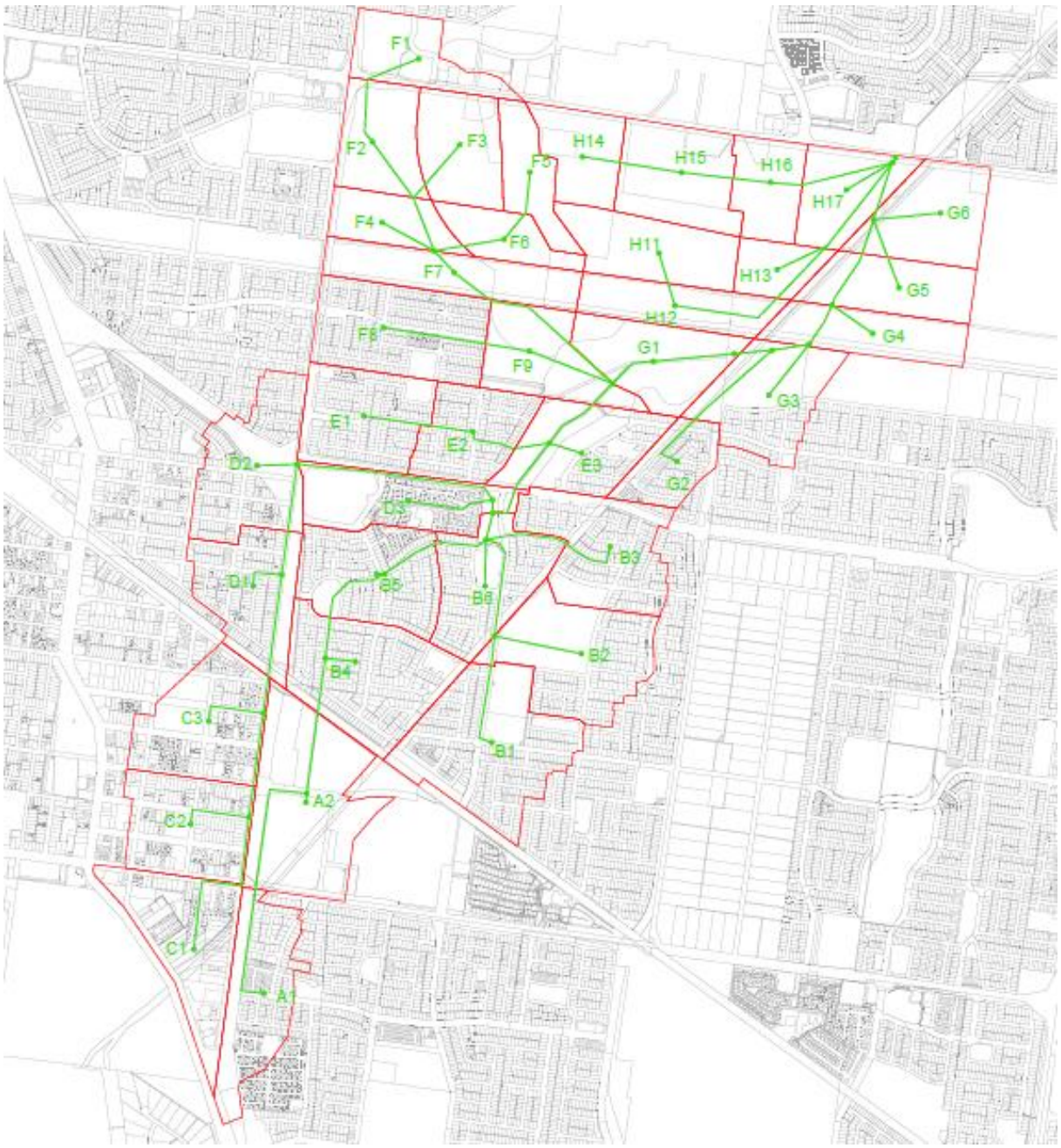

Figure 4.1 – Revised RORB Subareas Existing Conditions

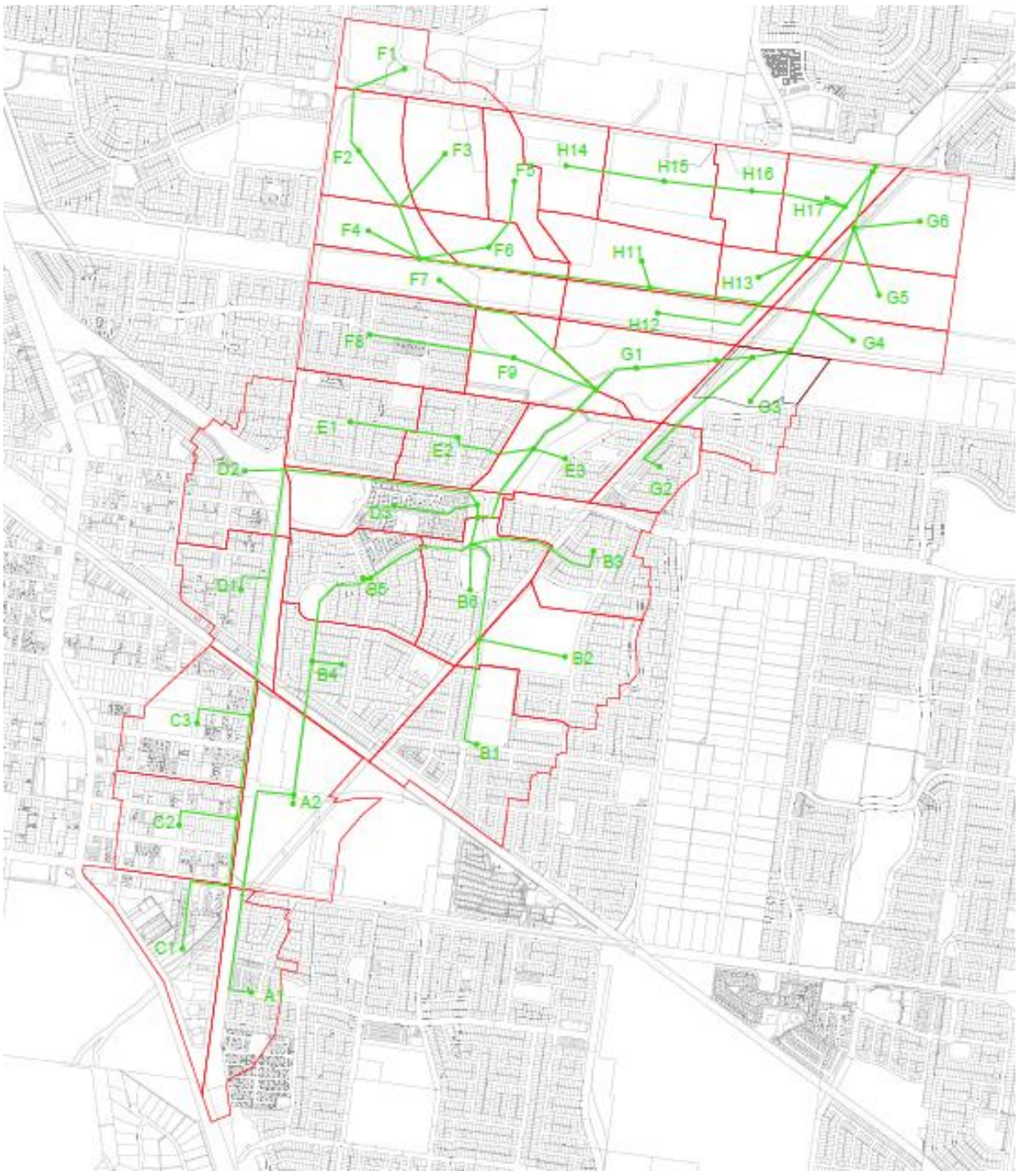

Figure 4.2 – Revised RORB Subareas Developed Conditions

The developed model has incorporated the proposed pipeline to connect the north-west catchment east along the northern boundary of the existing easement so that the existing volume is not exceeded. However, unlike the Melbourne Water model, the Incitus design RORB model has also diverted the runoff from the existing subarea F4 to the east. This decision was made as the additional runoff generated from this subarea increases the peak 1% AEP design flow with climate change at the pipe diversion location by only 2 m^3/s, which can be incorporated into the nominated pipes if they are marginally steepened. This option also removes the requirement to construct a crossing over the VDP.

The Incitus model is based on conveying the full 1% AEP design flow including climate change in the diversion pipe. This is because the pipeline needs to be conveyed through a minor hill, and the gap flows nominated to be conveyed in the road reserve by Melbourne Water's model cannot be done without a significant cut and additional land-take for the road reserve adjacent to the easement.

It should be noted that cutting a road reserve through the existing hill to facilitate the gap flow conveyance from the north-west catchment to the east would require a significant amount of earthworks and would require battering into the VDP easement due to the proximity of the proposed road to the easement. Thus, the intention to pipe the 1% AEP plus climate change design flow to the east.

The Melbourne Water drainage strategy proposes 2 x 1650 mm diameter pipes for the diversion from the west, conveyed east immediately north of the easement with the VDP. The Incitus model will require either 2 x 1650 mm diameter pipes at a longitudinal grade of 1 in 215, or 2 x 1800 mm diameter pipes at a longitudinal grade of 1 in 300. This will be determined based on levels around the outfall at Thompsons Road. This is discussed further below. It should be noted that diversion of the existing 1% AEP design flow along the proposed pipeline alignment would still require the construction of a 1650 mm diameter pipe. This would be needed irrespective of the adopted solution to minimise the flow volume crossing the VDP.

The Incitus model has elected to convey the full 1% AEP design flow plus climate change in the diversion pipe to minimise the flow volume crossing the VDP and remove the requirement to construct the west crossing of the VDP in the Croskell PSP.

The pipe will transition from at 10% AEP pipe to a 1% AEP plus climate change pipe throughout the site. The additional flows will be captured with the progressive transition in grated pits. This may require the construction of double grated pits to ensure the capture at more frequent intervals. This capture of the runoff is a standard requirement for subsurface drainage and is not a deviation from the typical engineering requirements, or what would occur for the capture of the 1% AEP design flow at a major road crossing.

In the event of any blockage in the proposed system to divert the 1% AEP design flow plus climate change from the north-west catchment to the east, the runoff will either pond in the road reserve until captured at a slower rate, or spill in very limited amounts and sheet flow across the existing easement. It should be noted that blockage is not likely to occur in the pipes, but rather at the inlets to the subsurface system. This can be overcome through the application of a blockage to the design of the inlets and has the same probability of occurring even if this is a 5% AEP system or a 10% AEP system.

The Incitus design model has included WLRB3 as modelled in the Melbourne Water model. The Incitus model has included a retarding basin at WLRB2 west, but significantly reduced from the Melbourne Water model, with the sizing based on the conceptual design discussed in the following sections.

Table 2.1 outlines the proposed peak flows extracted from the Incitus revised RORB model, noting the target flows are based on the existing flows with consideration for the land already zoned for residential purposes.

Table 4.1: Incitus RORB Flows

Location	Existing 1% AEP Peak Flow (m^3/s)	Post Development 1% AEP Peak Flow (m^3/s)	Post Development 1% AEP Peak Flow with CC (m^3/s)
West VDP Crossing	3.42 (1.5h)	N/A	N/A
Watermain Crossing South of VDP	19.24 (3h)	8.01 (12h)	9.57 (12h)
Ti Tree Creek Crossing of VDP	20.16 (3h)	8.78 (6h)	10.30 (6h)
Watermain Crossing near Thompsons Road	21.29 (4.5h)	10.25 (9h)	12.24 (9h)
Thompsons Road Outfall	23.69 (4.5h)	18.83 (1.5h)	23.33 (1.5h)

The Incitus RORB design model has demonstrated that the peak discharges are with the allowable limits and allowable discharges.

The existing culvert crossing of Thompsons Road consists of 5 x 1800 mm wide x 1500 mm high box culverts.

A check should be undertaken to ascertain the capacity of the existing Thompsons Road culverts, based on the 1% AEP flood level downstream and the available head loss in the system. Incitus has not been able to complete this as the downstream flood level has not been provided.

Hydraulic Modelling (Waterways)

The Incitus proposal has removed the requirement for the western crossing of the VDP, removing the requirement for the Melbourne Water drainage strategy waterway G.

As it is not proposed to convey any flow across the VDP in the former waterway G, the flows generated from the catchment contributing to the Melbourne Water drainage strategy waterway H no longer warrant the requirement for a waterway and can be safely conveyed in a typical road and drainage network. Therefore, it is proposed to remove waterway H from the Croskell PSP.

In addition to the above mentioned modifications to the proposed waterways, it should also be noted that the Melbourne Water drainage strategy report has stated that the existing waterways do not have any ecological, environmental or geomorphic values.

Based on this, the Croskell PSP should consider the realignment of Ti Tree Creek north of the VDP easement to abut the existing Melbourne Water major watermain easement and increase the potential developable land within the PSP, as well as south of the existing VDP and transmission easement to maximise developable land.

Stormwater Quality Modelling

Incitus has assessed the former Ti Tree Creek DSS model with the current rainfall template and the current pervious area properties. The former Ti Tree Creek DSS model, prior to the inclusion of the Croskell PSP, meets the current best practice pollutant reduction objectives, although the model has included pond nodes as per the constructed DSS, and it is noted that no treatment reduction should be attributed to pond nodes in accordance with the current Melbourne Water modelling guidelines.

Based on this, and the information noted in the Melbourne Water drainage strategy report, the runoff generated from the Croskell PSP must meet the current best practice performance reduction objectives.

Incitus has created a model of the western catchment in the Croskell PSP. Modelling has been completed in accordance with the MW guidelines (July 2024). The proposed WLRB3 asset has been included in the model, with the assumption that the regular flows from the upstream catchment (376 ha catchment) will be diverted into the WLRB3 asset for treatment. This is in accordance with the Melbourne Water drainage strategy design plans for WLRB3.

It should be noted that the Melbourne Water drainage strategy treatment model has assumed that the pipe flows from the Incitus subareas F8 and F9 can connect to the WLRB3 asset for treatment. This is not possible as the approved engineering plans have a pipe outfall lower than the nominated sediment pond level, and the pipes cannot be diverted to achieve this treatment. (note: Incitus subarea F9 encompasses part of this site at 350 Narre Warren Cranbourne Road)

The intention of the WLRB3 asset in the Melbourne Water drainage strategy is to utilise existing land owned by Melbourne Water for the benefit of the Croskell PSP. Whilst the WLRB3 asset will not provide any stormwater quality treatment to the Croskell PSP catchment, the pollutant load reductions attributed to the proposed WLRB3 asset can be used to offset the load reductions required by the Croskell PSP, on the premise that the land within the Croskell PSP will be funding the construction of the WLRB3 asset as part of the Ti Tree Creek DSS.

Table 4.2 outlines the pollutant loads generated by the Croskell PSP land, the target pollutant reductions for the Croskell PSP land to meet the current best practice pollutant reduction objectives, and the pollutant reductions achieved from the WLRB3 asset in accordance with the Melbourne Water drainage strategy design.

Table 4.2: Croskell PSP Loads and Reductions with WLRB3

Pollutant	Source Load	Target Reduction Load	Load Reduction from WLRB3
Total Suspended Solids (kg/yr)	200,000	160,000	195,000
Total Nitrogen (kg/yr)	413	186	328
Total Nitrogen (kg/yr)	2,950	1,328	1,340
Gross Pollutants (kg/yr)	39,100	27,370	68,700

The results have demonstrated that the proposed WLRB3 asset provides sufficient pollutant reduction to meet the best practice pollutant reduction objectives for the Croskell PSP, without requiring any additional stormwater quality treatment assets.

However, to comply with Melbourne Water requirements, Incitus is proposing the inclusion of sediment ponds in small drainage reserves for removal of coarse sediments prior to any connection to a waterway in the Croskell PSP.

The Melbourne Water drainage strategy has a 44.3 ha catchment (excluding the existing VDP easement) that currently connects to Ti Tree Creek immediately south of the existing VDP easement without any sediment control. Incitus recommends the inclusion of a sediment pond immediately upstream of the connection to Ti Tree Creek for this catchment, to be referred to as SP3A.

The Melbourne Water drainage strategy has nominated a sediment pond for primary treatment of the catchment located south of the existing VDP easement and east of the existing Melbourne Water major watermain. It is intended to retain this proposed sediment pond.

There is an existing catchment located east of Ti Tree Creek, west of the existing Melbourne Water major watermain, north of Linsell Boulevard and south of the site at 350 Narre Warren Cranbourne Road which has 2 existing pipe outfalls to the existing Ti Tree Creek channel. These pipe outfalls will need to be augmented with the construction of WLRB3 and Ti Tree Creek, and therefore it is proposed to adopt gross pollutant traps for primary treatment of this existing catchment when the construction works are undertaken.

An additional catchment located east of Ti Tree Creek, west of the existing Melbourne Water major watermain and north of the existing development also has not been provided primary treatment prior to connection to the waterway in the Melbourne Water drainage strategy. This catchment consists of approximately 1.7 ha of land already zoned for residential purposes, and an additional approximately 2.6 ha of catchment in the Croskell PSP. As this catchment is only approximately 4.2 ha in total (noting rounding on the breakdown above), it is also proposed to include a gross pollutant trap for this catchment.

It is noted that the catchments located north of the easement will require sediment ponds for primary treatment prior to connection to a waterway. This will require a sediment pond at the WLRB2 east asset location, and at the WLRB2 west asset location.

The proposed sediment ponds have been sized in accordance Melbourne Water requirements, using the Fair and Geyer method for sizing and ensuring a 95% reduction of the particles with a diameter of 125 µm for the 4 Event per Year design flow (EY) and a 5 year clean-out frequency. The sediment pond sizes have been based on the adoption of a 350 mm extended detention depth and a total depth of 1.5 m.

The require sediment pond sizes and approximate drainage reserve sizes is included in **Table 4.3**.

Table 4.3: Croskell PSP Standalone Sediment Pond Sizes

Parameter	SP3A	SB2	WLRB2 East	WLRB2 West
Sediment Pond NWL Area Required (m^2)	782	540	913	1,911
Sediment Pond Sediment Storage Volume Required (m^3)	420	271	433	1,538
Sediment Pond Area Adopted at NWL (m^2)	917	587	965	2,723
Dry-out Area (m^2)	840	540	870	3,080
Approximate Drainage Reserve Size (ha)	0.48	0.46^	0.54	3.0*

*Includes a bypass for Ti Tree Creek sized to convey the 10% AEP and is sized as a retarding basin

As Melbourne Water's proposed WLRB3 provides sufficient nutrient reduction for the runoff generated from the Croskell PSP, it is not proposed to incorporate any additional treatment for nutrient reduction in the western catchment. The drainage reserve sizes have accounted for safe batters to the normal water level (NWL) of the sediment ponds, the dry-out area required, a path surrounding the perimeter of the sediment ponds and appropriate offset to development. The drainage reserve for WLRB2 West also includes retardation, adopting a bypass for Ti Tree Creek to convey the 10% AEP design flow.

Figure 2.3 illustrates the proposed drainage reserves for the Croskell PSP, noting that the Ti Tree Creek waterway reserve has not been realigned in this Figure with the exception of through WLRB2 West.

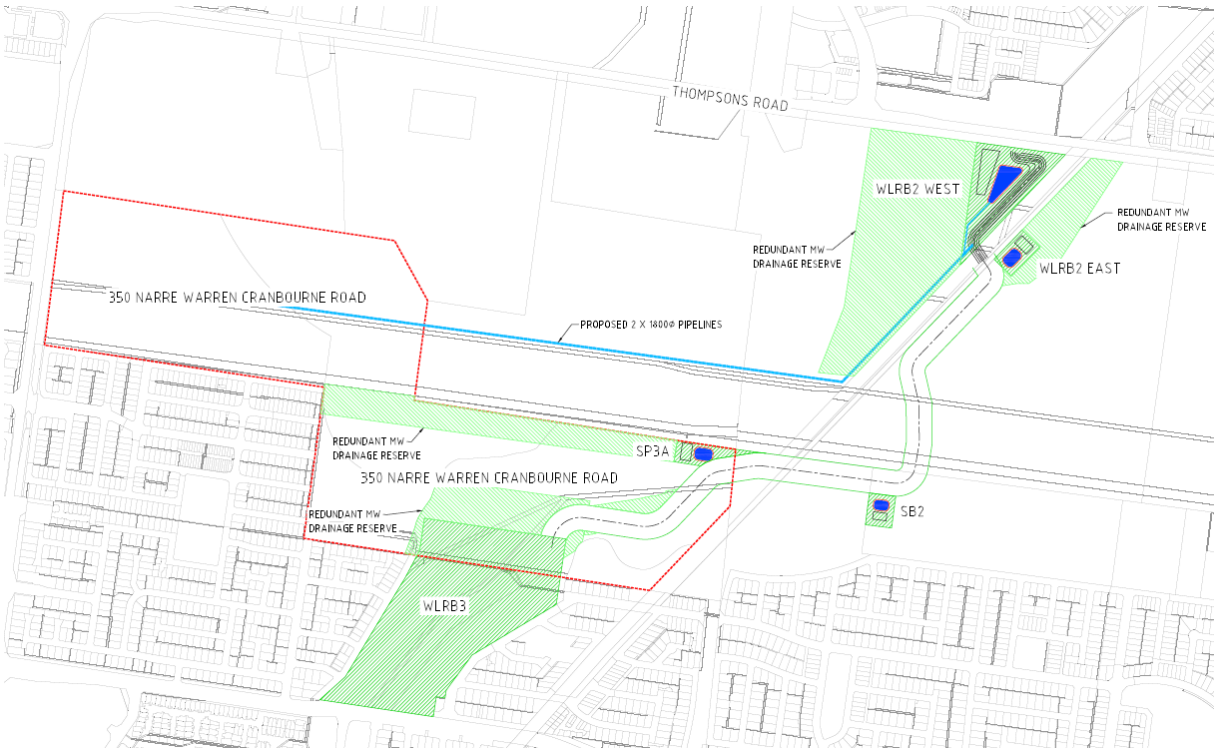

Figure 4.3 – Incitus Proposed Drainage Reserves, Excluding Ti Tree Creek Waterway Reserve and Without Buffers, for the Croskell PSP Western Catchment

5 Croskell PSP Drainage Investigation Areas

The Croskell PSP has included Drainage Investigation Areas 1 and 4, both predominantly located within the site at 350 Narre Warren Cranbourne Road, which would otherwise be zoned for residential purposes.

It is understood that Drainage Investigation Area 1 has been highlighted to mitigate the north-west catchment at the VDP easement with the intent to either reduce the diversion pipeline, reduce the size of the drainage reserve proposed for the WLRB2 west asset, or both.

The location for Drainage Investigation Area 1 is on topography that naturally increases slope, with the existing change in level from the north to the south of the area being approximately 10 m, and the flattest grade in the area being approximately 3%. These slopes are not conducive to incorporating a retarding basin, especially when compared to the land surrounding the outlet at Thompsons Road, which has grades of approximately 0.7%.

It is also important to note that even with retardation in the Drainage Investigation Area 1, the flow volumes generated from the north-west catchment will exceed the existing flow volumes by over 100 ML / year, noting that it is a requirement for a VDP crossing to not exceed the existing flow volume. Therefore, a diversion pipe to the east is still required.

To convey the predeveloped flow from the north-west catchment to the east, the Ti Tree Creek DSS would require a 1500 mm diameter pipe. Whilst the design proposal stated above requires twin pipes at one or two sizes greater than what is required to convey the predeveloped flows, a significant portion of the cost is the construction of the pipes through the existing ridge line. Hence, it is believed that the construction of the twin pipelines is a better outcome for the DSS than the acquisition of additional land and construction of another retarding basin in Drainage Investigation Area 1. It should also be noted that the design proposal above provides a significant reduction to the drainage reserve size required for the WLRB2 West asset, located at the Thompsons Road outfall.

The main constraints downstream of the Drainage Investigation Area 4 relate to the crossing of the watermain and the VDP. The diversion of the north-west catchment and the inclusion of the WLRB3 asset mitigates any potential constraints for drainage conveyance at the Drainage Investigation 4 area and therefore this area should also be disregarded.

6 Proposed Drainage Reserve Sizes

Table 6.1 outlines the nominated drainage reserves in the Melbourne Water drainage strategy for the treatment and / or retarding assets compared to the proposed Incitus drainage strategy.

Table 6.1: Croskell PSP Drainage Reserves (Excluding Waterways)

Site	MW Drainage Reserve (ha)	Incitus Drainage Reserve (ha)
350 Narre Warren Cranbourne Road	6.68	3.50
1580 Thompsons Road	14.84	3.00
1660 Thompsons Road	3.30	0.54

7 Conclusion

The Melbourne Water drainage strategy for the western catchment within the Croskell PSP has significantly overestimated the drainage reserve sizes required to manage the stormwater runoff from the development of the Croskell PSP.

The Incitus drainage strategy has outlined how the stormwater runoff from the development of the western catchment within the Croskell PSP can be managed, whilst meeting the requirements for the stormwater including:

- Retarding to the existing, or the original Ti Tree Creek DSS, 1% AEP design flow at Thompsons Road, for the post developed 1% AEP design flow plus climate change at the year 2100
- Ensuring that the existing 1% AEP design flow magnitudes are maintained at the VDP crossings and the watermain crossings
- Ensuring pre-treatment is provided prior to connection to a waterway
- Ensuring treatment to current best practice pollutant reduction objectives at Thompsons Road for the western catchment within the Croskell PSP
- Complying with the current Melbourne Water guidelines

Specifically for the site at 350 Narre Warren Cranbourne Road, the Incitus drainage strategy proposes

- The diversion of the 1% AEP plus climate change post development flow east towards the proposed WLRB2 West asset
- The removal of the proposed VDP crossing waterway G
- The removal of the proposed waterway H adjacent to the southern boundary of the existing VDP easement
- The inclusion of a drainage reserve for a sediment pond SP3A to provide primary treatment prior to discharging into Ti Tree Creek

Adoption of the Incitus drainage strategy for the western catchment within the Croskell PSP will unlock required employment land and residential land without compromising the function of the proposed and existing Ti Tree Creek DSS assets.

The proposed Incitus drainage strategy results in a significant reduction in land-take required for drainage purposes whilst still achieving stormwater management requirements for the Croskell PSP.