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Our Ref: MJ: L.M00227.01.03.Report.docx

17 June 2020

City of Melbourne
GPO Box 1603
Melbourne VIC 3001
kate.berg@melbourne.vic.gov.au

Attention: Kate Berg

Dear Kate

**RE: Hobsons Road Catchment Flood Mapping Update**

***Background***

The City of Melbourne (Council) engaged Venant Solutions to review and update Council's Hobsons Road catchment 1% AEP (annual exceedance probability) flood mapping for the purposes of a planning scheme amendment (PSA) to introduce a special building overlay (SBO). The current flood mapping was prepared for Council by Engeny Water Management (Engeny) for the *JJ Holland Park Stormwater Harvesting Investigation* (Engeny, 2016) and the *Hobsons Road Flood Management Plan* investigation (Engeny, 2017).

The Hobsons Road catchment is shown in Figure 1. The 178 ha catchment slopes to the west with stormwater runoff discharging to the Maribyrnong River via the Dynon Road drain and a number of pipe outlets and overland flow paths. Other than the JJ Holland Park the catchment is fully urbanised with residential and commercial development, including the rail yards which occupy a large area within the catchment.

This letter presents the findings from the model review and the updated mapping, which is also provided electronically to Council in a GIS format.

***Scope and Methodology***

The scope of works was as follows:

- Review the Engeny RORB and TUFLOW models to ensure their suitability for the preparation of mapping for the PSA;
- Modify RORB and TUFLOW models as required;
- Increase design rainfall in RORB to account for potential changes associated with climate change and run the 1% AEP event;
- Adopt Maribyrnong River 10% AEP flood levels for the TUFLOW downstream water level boundaries;
- Run the TUFLOW model for the 1% AEP event
- Prepare unfiltered flood mapping;
- Prepare letter report.

The lower parts of the Hobsons Road catchment can be affected by flooding from both local catchment runoff and flooding from breakout and/or backwater flooding from the Maribyrnong River. The Hobsons Road catchment is significantly smaller than the Maribyrnong River catchment and hence the peak flooding from Hobsons Road catchment is caused by storm durations that are significantly shorter than those that cause flooding in the Maribyrnong River. Therefore the likelihood of peak local catchment runoff coinciding with peak runoff in the Maribyrnong River is remote. However, it is more likely that there will be some flooding in the Maribyrnong River when there is local catchment flooding in the Hobsons Road catchment. Therefore it was agreed in consultation with Council and Melbourne Water to assume a 10% AEP flood in the Maribyrnong River coinciding with the 1% AEP flood in the Hobsons Road catchment.

The 10% AEP Maribyrnong River flood levels were sourced from Melbourne Water's HEC-RAS model. The HEC-RAS model has a downstream water level boundary at the confluence with the Yarra River. Melbourne Water has recently completed an update to their Yarra River modelling and supplied the 10% AEP mapping, which incorporated climate change conditions. Venant Solution updated the downstream boundary of the HEC-RAS model and ran the 10% AEP event.

As noted above the lower parts of the Hobsons Road catchment can be affected by flooding from breakout and/or backwater flooding from the Maribyrnong River. Mapping of the 1% AEP flood extent resulting from Maribyrnong River flooding was beyond the scope of this project.

The rainfall intensities adopted in the Engeny RORB model were based on the Bureau of Meteorology's 1987 data, the latest available at the time the mapping was prepared. Council required that the modelling be updated to account for potential increases in rainfall intensity associated with climate change. Council and Melbourne Water agreed on an 18.5% increase for the year 2100 in accordance with representative concentration pathway (RCP) 8.5.

It is beyond the scope of this report to document the RORB and TUFLOW model development as this was done by Engeny and included in Engeny (2016) and Engeny (2017). There was limited documentation of the development of the RORB model in these reports, but Engeny advised the following by email on 7 March 2019:

- The RORB model is based on ARR 1987 methodologies, including the loss approaches consistent with the Melbourne Water technical specification at the time, i.e., an initial loss of 10 mm and runoff coefficient of 0.6 for the 1% AEP event;
- Rainfall excess hydrographs from RORB were applied to TUFLOW as 2d_SAs and 1d_BCs:
    - This means that no routing was undertaken in RORB and hence validation of $k_c$ and reach type was not required as they had no influence on the hydraulic modelling.
    - The 2d_SA is applied to the JJ Holland Park and the 1d_BC approach is applied across the remainder of the model;
    - The 1d_BC approach applies runoff directly into the pipes with flow in excess of the pipe capacity surcharging into the 2D domain thereby flowing as overland flow. An alternative approach now available in TUFLOW is to apply the flows to the 2D domain into the grid/s to which the pipe is connected. There are advantages and disadvantages to both approaches and either is considered suitable for the purposes of this modelling and would give very similar outcomes.
    - This approach to applying the inflows boundaries is considered to be a suitable for the purposes of this modelling.

***Model Review***

The model review found that the RORB and TUFLOW models were suitable for the purposes of the PSA with only the following modifications to the TUFLOW model required:

1. Adjustment to loss modelling approach in the underground pipe network;
2. Adjustment to downstream boundary condition on the pipe in ;
3. Corrections to Manning's 'n' in rail yard;
4. Minor modifications to the spatial distribution of the inflows to the TUFLOW model;

Further details on changes 1 to 3 are provided below.

The supplied model applied the Engelund approach for manhole losses as well as inlet and outlet losses at the manholes of 0.5 and 1.0 respectively. This approach is in effect duplicating losses in the pipe network. The model was run using the Engelund approach which resulted in negligible changes to the 1% AEP flood levels and extents. This is not surprising given the majority of 1% AEP runoff is conveyed in overland flowpaths rather than in the pipe network.

As shown in Figure 3 an outflow (downstream) boundary was placed on the pipe network at the intersection of Mercantile Parade and Flockhart St. At this location the pipe discharges into 2D domain but in an area outside the mapping extent for this model. The area between the mapping extent and the 2D model extent is generally in the next catchment to the north, but there is crossflow from the Hobson Road catchment via the pipe network (see Figure 3) and overland flow. The supplied model applied a fixed level of 1.4 m AHD to this boundary which is approximately the pipe obvert. This is a typical approach when a pipe outlets into a receiving waterbody and is not submerged. However, at this location the controlling level on the pipe flow at the peak of the flood will be the flood level in the street, assuming the pipe is surcharging. A sensitivity test was undertaken using a fixed level of 2.2 m AHD. This change was found to only increase flood levels locally by about 15 mm and was adopted for the final run in the model.

In the rail yard the supplied model applied a Manning's 'n' for building to some of the parking and storage areas, i.e. 'n' was too high. There was also the 'n' value applied to different areas of rail was not consistent. These changes resulted in changes in flood level in the range ± 100 mm, but no areas outside of the rail yard were affected.

***Modelling and Mapping Outcomes***

The RORB model rainfall input data was increased by 18.5% to account for potential changes in rainfall intensities associated with climate change and the 1% AEP was run for durations from 10 minutes to 18 hours.

The TUFLOW model was updated with the corrections noted above, the 10% AEP downstream water level boundary which incorporated climate change conditions, and the revised inflows from RORB. A fixed water level boundary was adopted because the HEC-RAS model was steady-state, but the variation in peak water level along the river shown in the HEC-RAS model was reflected in the TUFLOW model boundaries. The TUFLOW model was run for each of the durations from 10 minutes to 18 hours and the results enveloped to obtain the peak water level. Over most of the area for which SBO mapping will be applied, the critical durations were less than two hours as would be expected. At some localised locations where runoff volume rather than peak flow rate controls the peak flood level, the critical duration was up to 9 hours.

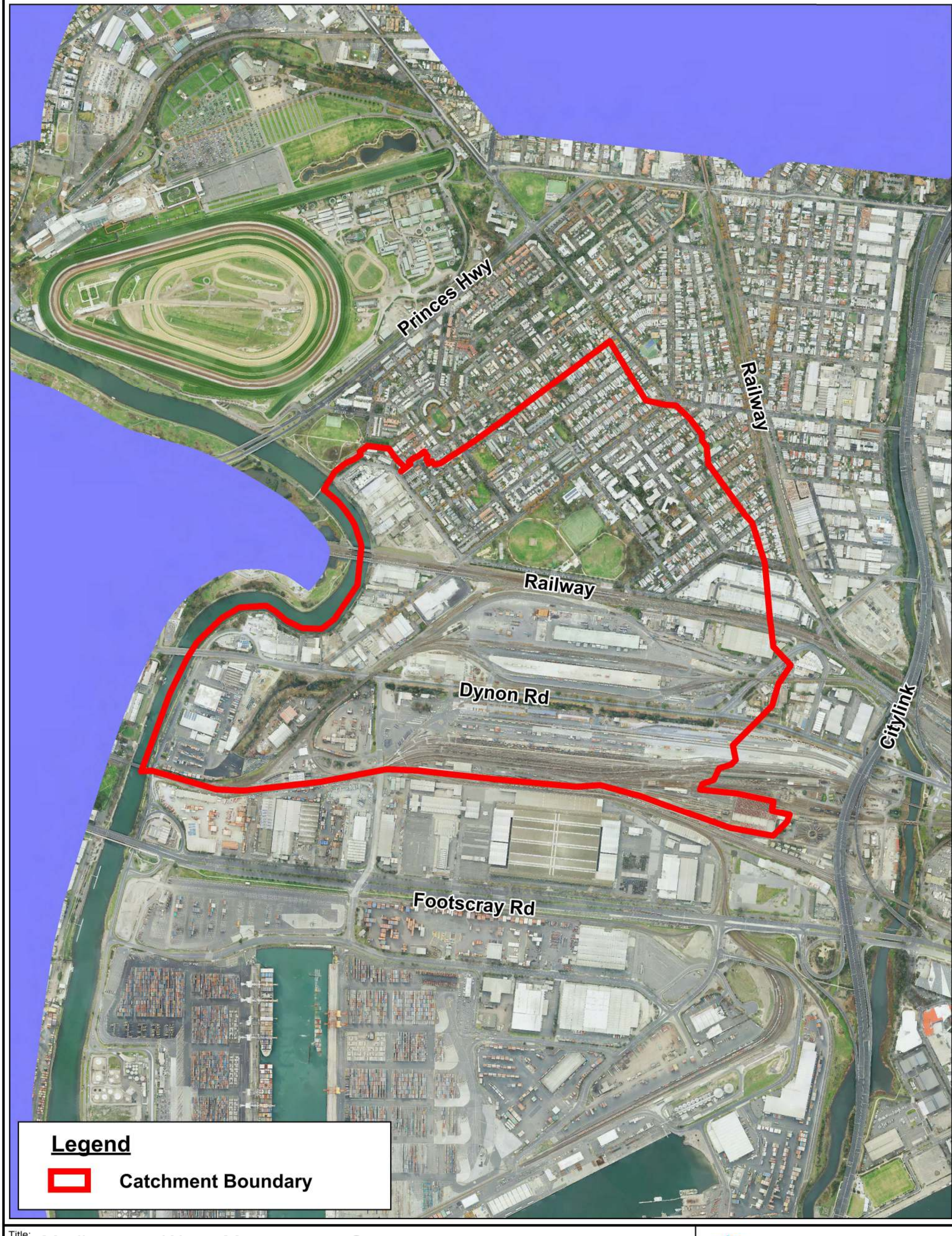
The 1% AEP unfiltered flood depth and extent mapping is shown in Figure 4. Digital copies of the models and flood mapping data will be provided to Council.

Please do not hesitate to contact the undersigned should you have any questions.

Yours faithfully,

Dr Mark Jempson

Director




Title: Maribyrnong Water Management Strategy
Hobsons Road Catchment

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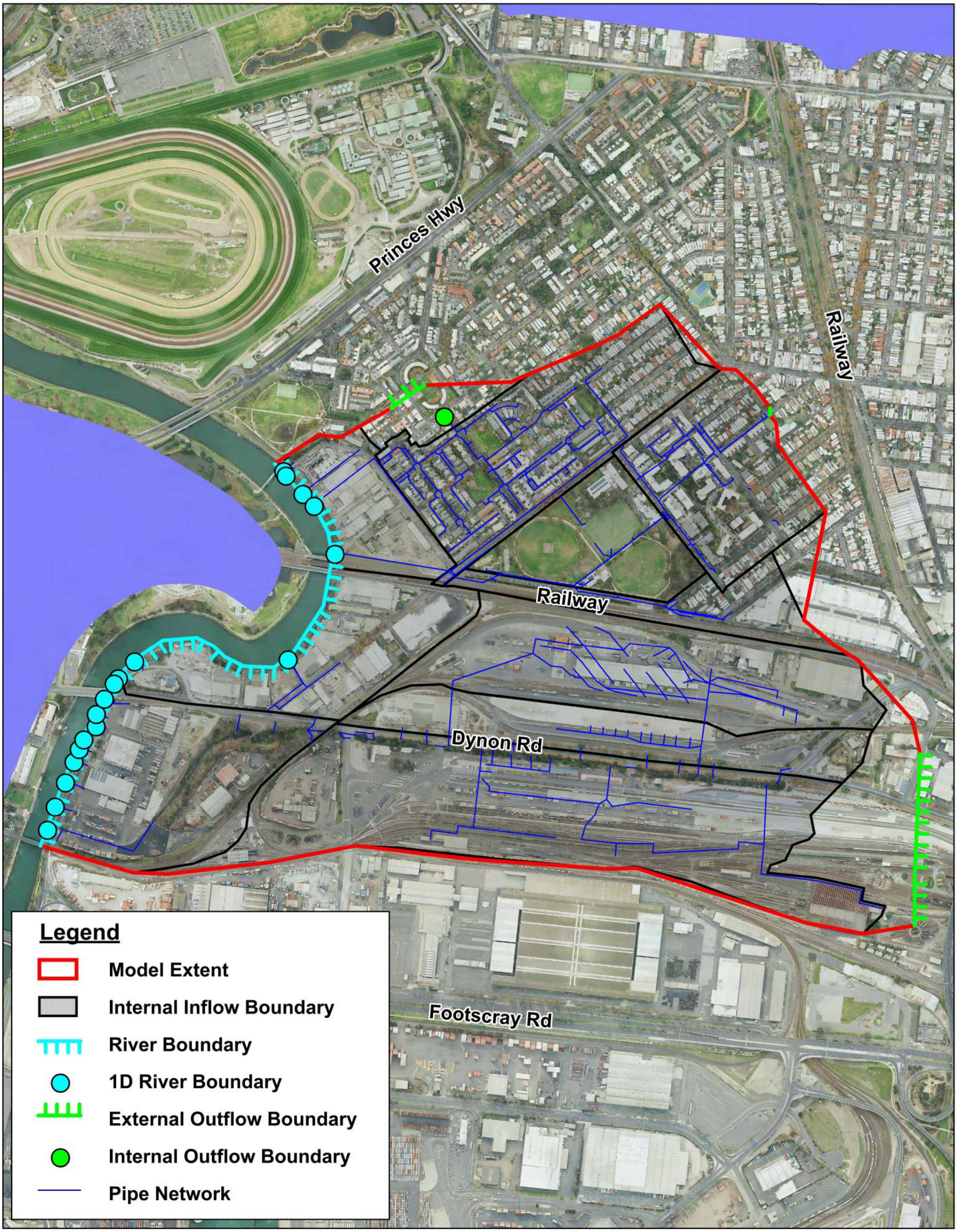
| Figure: | Rev: | Scale | Disclaimer | |
|---|---|---|---|---|
| 1 | A | N; 0 250 500m; Approx. Scale | This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented. | By: RG<br>Date: Jan 2020 |

Filepath: S:\Projects\M00227.MJ.MaribyrnongIWMStrategy\GIS\Drawings\L.M00227.001\Fig1_Catchment.WOR




Title: Maribyrnong Water Management Strategy
TUFLOW Schematisation

Figure: 2

Rev: A

N

0 250 500m

Approx. Scale

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By: RG

Date: Dec 2019

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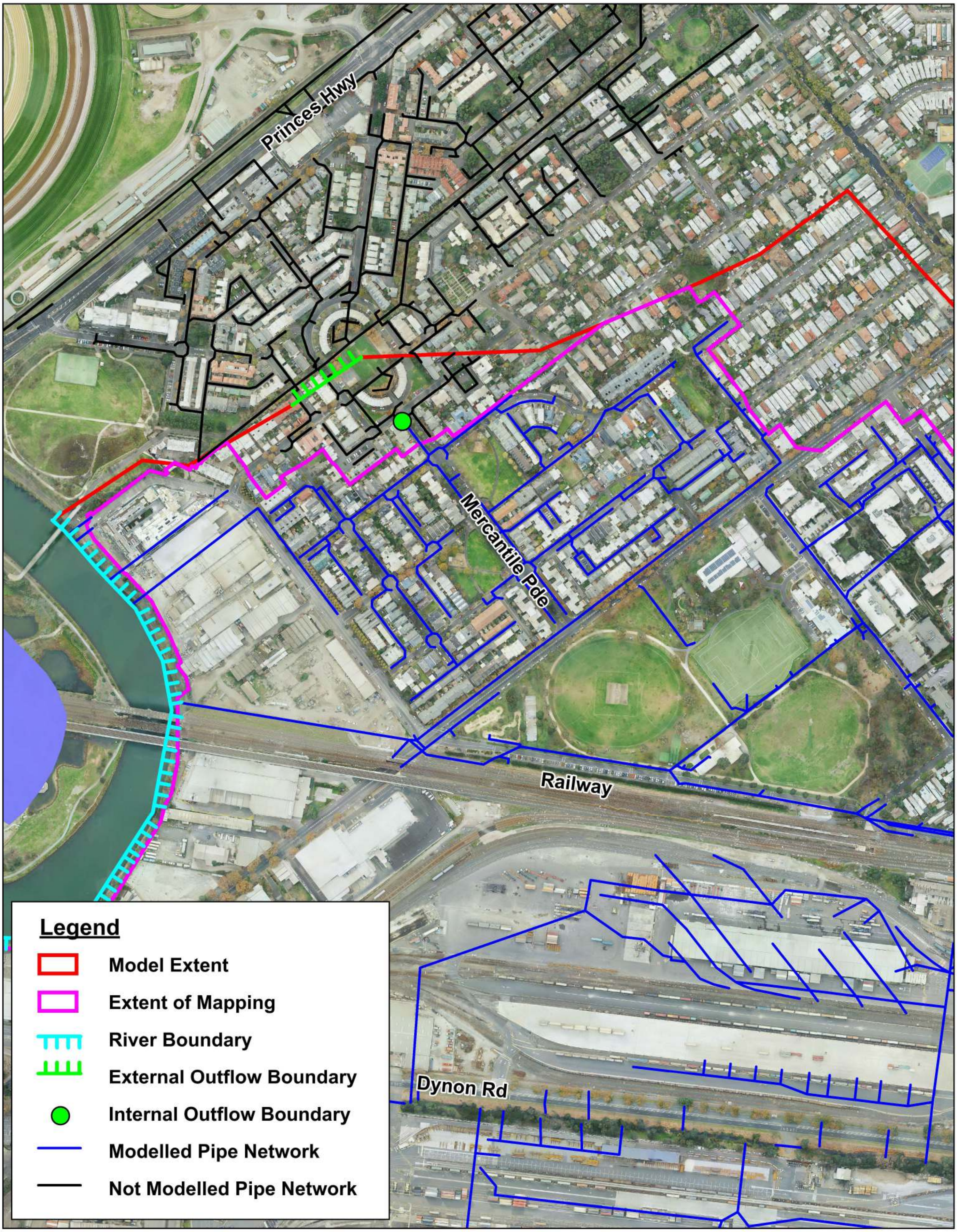
Filepath: S:\Projects\M00227.MJ.MaribyrnongIWMStrategy\GIS\Drawings\L.M00227.001\Fig2_TUFLOW Schematisation.WOR




Title: Maribyrnong Water Management Strategy
Pipe Schematisation on Mercantile Pde

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| Figure: | Rev: | | | | By: RG |
|---|---|---|---|---|---|
| 3 | A | N 0 125 250m Approx. Scale | | This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented. | Date: Apr 2020 |

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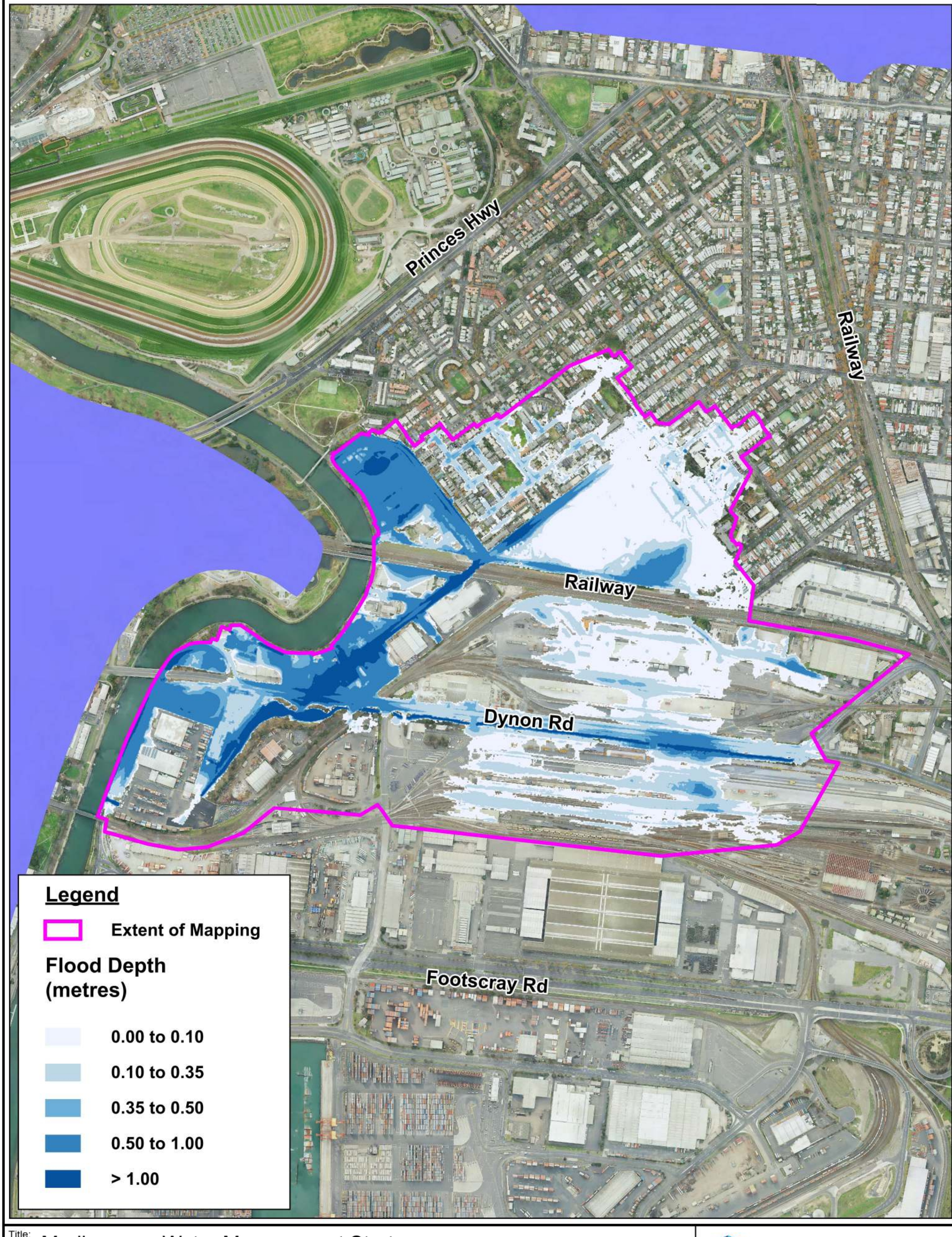


Title: Maribyrnong Water Management Strategy
Flood Depth - 1% AEP with 10% Maribyrnong River Flood Level

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| Figure: | Rev: | | | By: | |
|---|---|---|---|---|---|
| 4 | A | N 0 250 500m Approx. Scale | This mapping product is based on techniques and data in accordance with the study scope. Users should consider the mapping in the context of the report. No two floods are the same and care should be taken in the use and interpretation of the results presented. | RG Date: Apr 2020 | |

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Our Ref: MJ: L.M00227.02.01.ReviewResponse.docx

22 April 2020

City of Melbourne
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Attention: Kate Berg

Dear Kate

**RE: Hobsons Road Catchment Flood Mapping – Response to Rain Consulting Model Review**

Rain Consulting provided feedback from their review of the Hobson Road modelling and report in a letter dated 28/2/202. The letter raised a number of matters requiring a response from Venant Solutions. The feedback and response are documented in the table below.

| Issue | Response |
|---|---|
| A wetting and drying depth of 0.002 has been used with areas of very shallow depth within the model. Do Venant Solutions believe that the use of this, over a lower depth (0.0002), would impact the flood extents for the PSA? | A depth of 0.002 m is the standard wetting and drying depth. A value of 0.0002 m is recommended when adopting a rain-on-grid approach, particularly in steep terrain, to assist in stability and mass error issues. A rain-on-grid approach was not adopted for this modelling. Putting aside stability and mass error issues, adopting a value of 0.0002 m does not improve mapping accuracy as even 0.002 m is well within the accuracy of the modelling and mapping. The value was left at 0.002 m. |
| Manning's values in the south of the model do not correlate well with the land-use, particularly around the rail yards.<br>Within the rail yards, there are large sections of type 10 - open waterway. The section to the north (looks like a truck container loading area) is modelled with a very high roughness for rail lines.<br>Upon review of the Manning's values used across the model, do Venant Solutions believe that the use of different Manning's values would impact the flood extents for the PSA? | The Manning's 'n' were reviewed and updates made in the rail yard as documented in the letter report. |
| The Engleund method of losses has been applied with entry and exit losses across all of the network set to 1 and 0.5. Would pit losses in line with Melbourne Water recommendations be likely to change the extent of flooding within the model? | The pipe losses in the model were reviewed and adjusted as documented in the letter report. |

| | |
|---|---|
| Minor negative depths are seen in the log files. Are these likely to be impacting the results at all? | The log files report 1 negative depth in the 2D domain. This will not be impacting on the results. |
| Please remove the reference to 800 mm sea level rise from the Lower Yarra – it's ended up being a bit more complex. | Letter report adjusted. |
| Are results from the checking of the Engeny model documented? Please provide | Findings are documented in the letter report. |
| Are you able to broadly comment on the RORB and inflow approach adopted by Engeny? | Additional commentary added to the letter report. |
| Please provide a comment in the report around why modelling was not completed past the 9-hour duration. | Additional commentary added to the letter report. |

Please do not hesitate to contact the undersigned should you have any questions.

Yours faithfully,

Dr Mark Jempson

Director