
APPENDIX C: DATA VALIDATION REPORT





MERRI-BEK CITY COUNCIL

Stormwater Modelling Data Validation Report

DRAFT WORK IN PROGRESS

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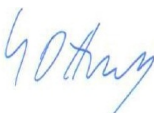
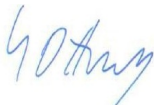
15 AUGUST 2023



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CONTENTS

1.	purpose	1
2.	Introduction	1
3.	Lidar Verification	2
	3.1.1 Change in LiDAR Elevations	2
	3.1.2 Impacts of Updated LiDAR on Stormwater Overland Flows	6
4.	Updated Drainage Data	11
	4.1 Water Sensitive Urban Design (WSUD) Infrastructure	12
	4.1.1 105 Newlands Road Retarding Basin, Sediment Pond and Bioretention	12
	4.1.2 Gavin Park Wetland	12
	4.1.3 Jones Park Wetland	12
	4.1.4 Moomba Park Wetland	13
	4.2 Melbourne Water Drainage Data	13
5.	Level Crossing Removal Project (LXRP) data	16
	5.1 Glenroy Level Crossing Removal Project (LXRP)	16
	5.2 Bell to Moreland Level Crossing Removal Project (LXRP)	17
6.	Conclusions	19
7.	Qualifications	20

Tables

Table 4.1: Newly constructed pipe summary	11
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Figures

Figure 3.1: LiDAR comparison 2007-08 to 2021.....	3
Figure 3.2: LiDAR Comparison 2007-08 to 2017-18.....	4
Figure 3.3: LiDAR Comparison 2017-18 to 2021	5
Figure 3.4: Extent difference 2007-08 LiDAR vs 2017-18 LiDAR location 1.....	7
Figure 3.5: Extent difference 2007-08 LiDAR vs 2021 LiDAR location 1.....	7
Figure 3.6: Extent difference 2007-08 LiDAR vs 2017-18 LiDAR location 2.....	8
Figure 3.7: Extent difference 2007-08 LiDAR vs 2021 LiDAR location 2.....	8
Figure 3.8: Extent difference 2007-08 LiDAR vs 2017-18 LiDAR location 3.....	9
Figure 3.9: Extent difference 2007-08 LiDAR vs 2021 LiDAR location 3.....	9
Figure 4.1: Jones Park Wetland	13
Figure 4.2: Changes in Melbourne Water and Council extent delineation	14
Figure 4.3: Example of a complex overland flow path.....	15
Figure 5.1: Glenroy LXRP overview	16
Figure 5.2: Bell to Moreland LXRP project location	17

Appendices

Appendix A: Council Drainage Upgrades

1. PURPOSE

Best practice stormwater overland flow mapping is enabled by using the best available information, to inform the preparation of models and creation of maps that are used for triggering a planning process and decision-making for land development outcomes. The purpose of this Validation Mapping Report is to consider newly available information and the merits of its inclusion into Merri-bek City Council (Council) stormwater models and maps for its local drainage catchments.

2. INTRODUCTION

In 2018 Engeny was engaged by the then Moreland City Council (now Merri-bek City Council) to undertake stormwater flow modelling of Council owned and managed drainage assets within the municipality. In 2021 Melbourne Water engaged Engeny to update our previous modelling of the city to include detailed modelling of all of Melbourne Water's drainage assets (excluding the major waterways of Moonee Ponds Creek, Merri Creek and Elgar Creek) and produce detailed mapping output deliverables.

It is understood that Merri-bek City Council (Council) and Melbourne Water now want to pursue a planning scheme amendment to update the planning scheme special building overlay and land subject to inundation overlay layers with updated data from the stormwater flow and flood modelling undertaken.

As the modelling project started in 2018, some of the data which has been used in the study may have been superseded by new information. There are also major infrastructure projects, most notably two significant level crossing removal projects (LXRP) in Preston/Bell and Glenroy which may have been undertaken since the original data for the modelling was collated. Council has also completed a number of drainage improvement projects since 2018 which are currently not included in the modelling. Council also obtained updated LiDAR data, which was captured in late 2021, compared to the previous LiDAR data which was captured in 2017/18.

Prior to Council progressing this amendment, Engeny has been asked to review the updated LiDAR, pipe and LXRP data and determine if there would be significant impacts on the stormwater overland flow extent flood extents as a result of the updated works and new data.

3. LIDAR VERIFICATION

LiDAR (Light aerial ranging) is topography data which is captured from an aeroplane and typically ground truthed against known survey points to establish a 3d surface of the ground. The lasers from the plane bounce back against the first hard surface they encounter. This is known as first strike data. Post processing is undertaken to remove trees and buildings from the data. High quality LiDAR is typically accurate to ± 100 mm vertically and ± 200 mm horizontally (root mean square error (RMSE) confidence of 68%).

The original model that Engeny developed for Council was based on LiDAR obtained in 2007 and 2008. This LiDAR data set was quoted as being accurate to 100 mm vertically and ± 200 mm horizontally (RMSE confidence of 68%).

Engeny has also completed stormwater overland flow mapping utilising an updated version of the models for Melbourne Water. Part of this update included using newer LiDAR data which was obtained in 2017 and 2018. The 2017-18 LiDAR was quoted as being accurate to 100 mm vertically and ± 200 mm horizontally (RMSE confidence of 68%). The 2017-18 LiDAR data set captured by the Victorian Government superseded the previous 2007-08 LiDAR data set (also captured by Victorian Government) as part of their periodic update of LiDAR data.

Council also has a program of LiDAR capture, largely for the purpose of assessing tree canopy cover. This LiDAR data was captured in 2021, making it more recent than both of the previous datasets used. Council have reported that the vertical accuracy of the data is ± 300 mm vertically and ± 300 mm horizontally. It is also understood that the density of point capture is higher in the 2021 LiDAR data set at 12 points per square metre compared with 8 points per square metre for the 2007-08 and 2017-18 data sets.

However, it has been advised that the 2021 LiDAR has not been calibrated against on-the-ground survey control points, whilst the 2017-18 data has. Vertical accuracy is particularly important given this accuracy informs the determination of flood levels for properties.. As such the 2017-18 LiDAR data is considered to be the best available vertical imaging data for flood modelling purposes.

3.1.1 Change in LiDAR Elevations

Engeny has compared Council's 2021 LiDAR data to the 2007-08 LiDAR used in the original Council stormwater overland flow mapping and the 2017-18 LiDAR used in the Melbourne Water stormwater overland flow mapping in 2023.

Figure 3.1 shows the difference between the 2007-08 LiDAR and the 2021 LiDAR. Figure 3.2 shows the difference between the 2007-08 LiDAR and the 2017-18 LiDAR. Areas where the 2021/2017-18 LiDAR is higher than the 2007-08 LiDAR data are shown in red and orange, areas where the 2021/2017-18 LiDAR is lower than the 2007-08 LiDAR is shown in blues.

Figure 3.3 shows the difference between 2017-18 LiDAR and 2021 LiDAR. Areas where the 2021 LiDAR is higher than the 2017-18 LiDAR data are shown in red and orange, areas where the 2021 LiDAR is lower than the 2017-18 LiDAR is shown in blues.

The figures shows that generally the newer LiDAR data sets (2017-18 and 2021) are slightly higher than the previous data set (2007-08) but that overall the change is not completely consistent. The figures also suggest little difference between the 2017-18 and 2021 LiDAR datasets and supports use of the 2017-18 LiDAR to inform any updated stormwater overland flow mapping because it is considered to be the best available vertical imaging data based on its accuracy.

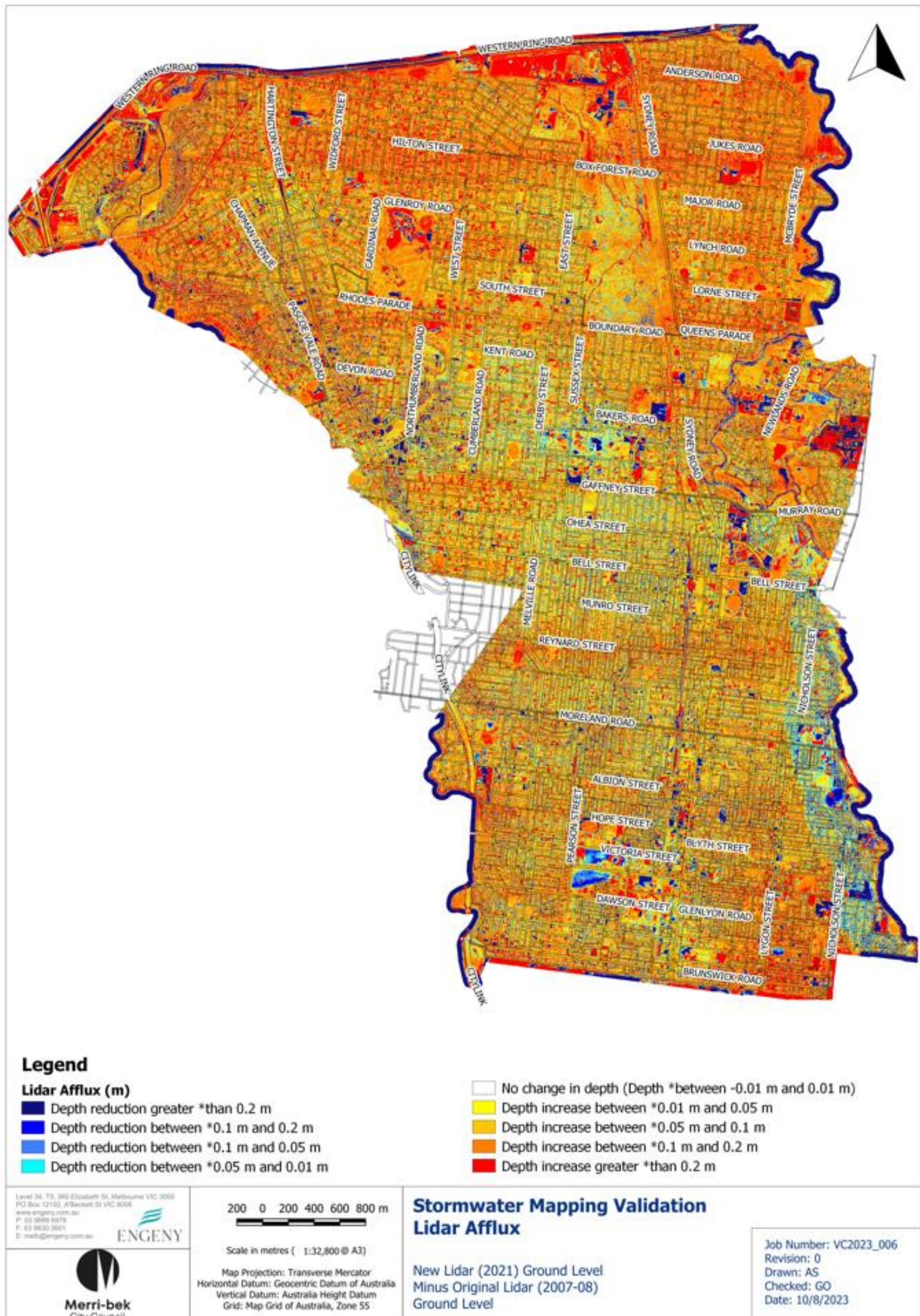


FIGURE 3.1: LIDAR COMPARISON 2007-08 TO 2021

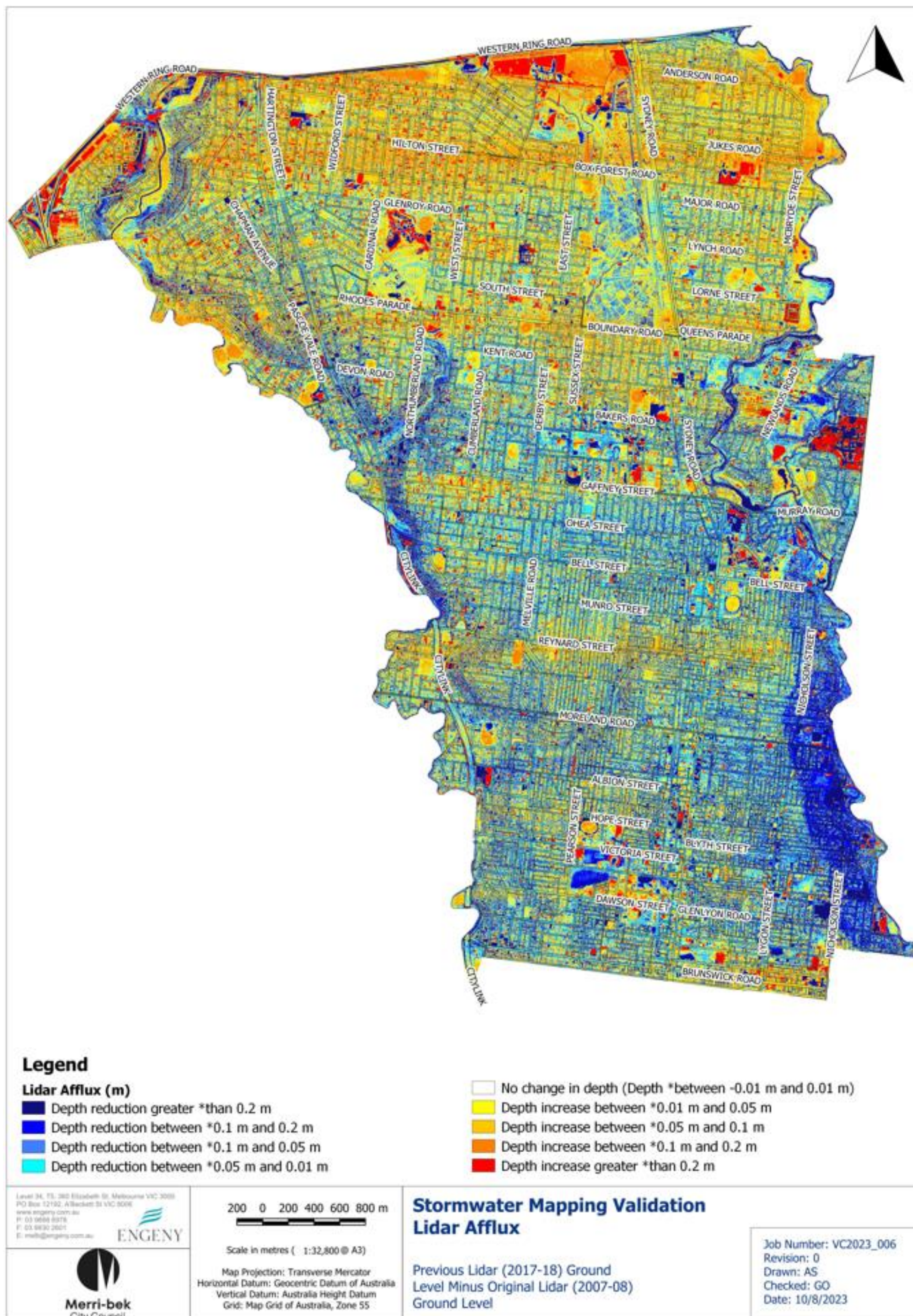


FIGURE 3.2: LIDAR COMPARISON 2007-08 TO 2017-18

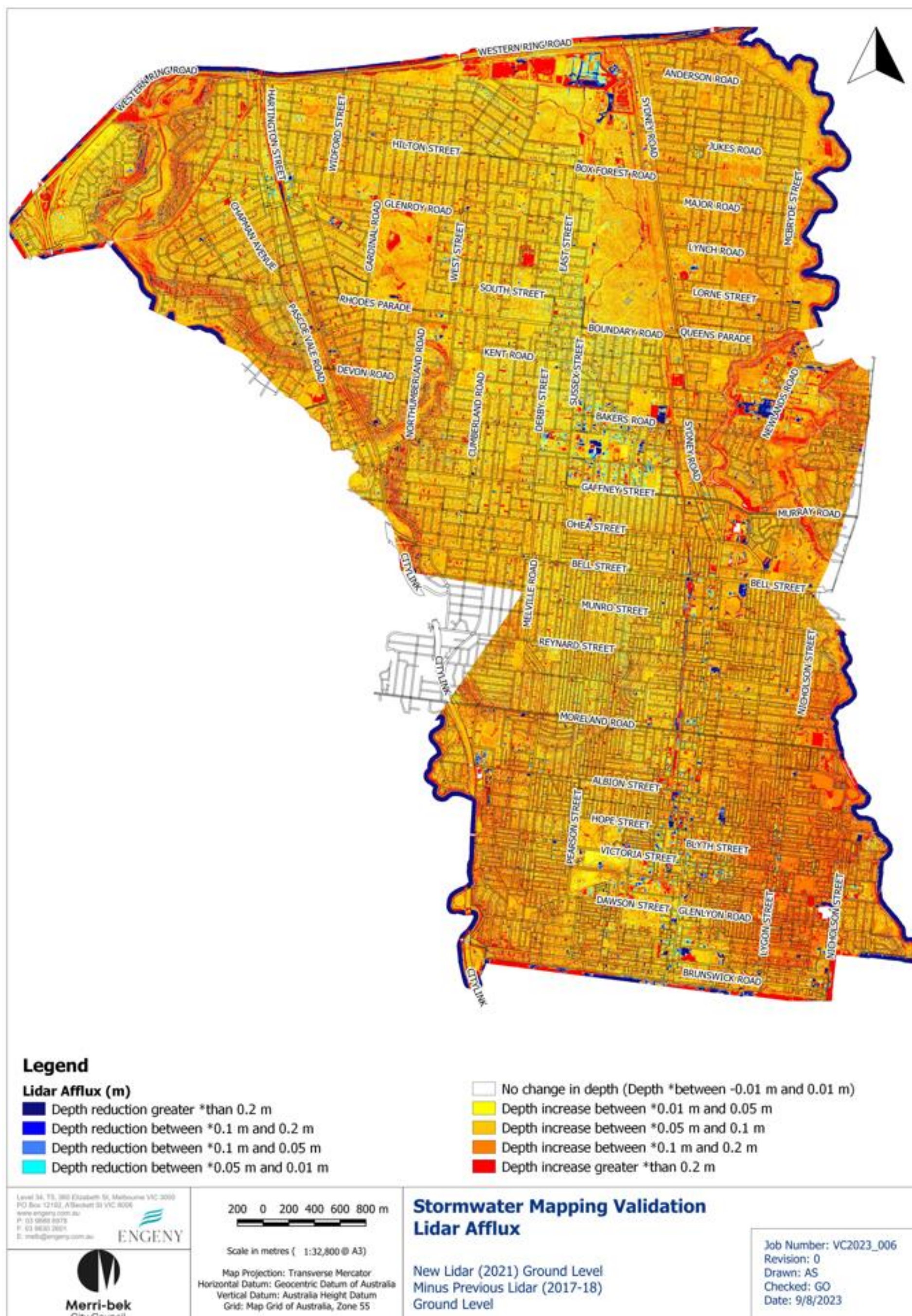


FIGURE 3.3: LIDAR COMPARISON 2017-18 TO 2021

3.1.2 Impacts of Updated LiDAR on Stormwater Overland Flows

The 2007-08 LiDAR dataset (captured by the Victorian Government) was used for the initial Council modelling and extent delineation. Following the completion of this modelling Engeny was engaged by Melbourne Water to update the flood models to develop flood extents for Melbourne Water's drains and waterways. This engagement started in 2020 and so the updated LiDAR from 2017-18 (also captured by the Victorian Government) was available and was used in the updated modelling. Some other changes to the model were also made at the time including:

- Updates to the Melbourne Water Drainage infrastructure
- Updates to other major drainage infrastructure including new wetlands/ponds in the Northern Memorial Park in Faulkner
- Updates to the hydrology to better conform to the practices of Australian Rainfall and Runoff 2019. The modelling for Council was undertaken using guidance from the draft Australian Rainfall and Runoff 2016. Between 2016 and 2020 the understanding and tools available to apply the recommendations within the updated Australian Rainfall and Runoff evolved and improved. This improved understanding was also captured in the update.
- Consideration of larger Areal Reduction Factors (only relevant for Melbourne Water controlled drainage areas but potentially impacting on interface points between Council and Melbourne Water extents.
- Other generally minor updates to the model to improve representation and model stability.

As part of this data validation assessment Engeny has rerun the north-eastern catchment hydraulic model to compare the impacts of the updated LiDAR and other changes listed above on the resultant stormwater overland flow extent. The comparison has considered using the 2021 LiDAR or the 2017-18 LiDAR. Using either of the updated LiDAR sets results in some changes to the stormwater overland flow extents. Not all of the change is due to the LiDAR, however it is a contributing factor, particularly given the differences in vertical accuracies between the two LiDAR datasets with the 2017-18 LiDAR being the more vertically accurate dataset.

Figure 3.4 to Figure 3.9 show three comparison locations where the updates to the model, including the LiDAR, is having a significant impact on the proposed stormwater overland flow extents.

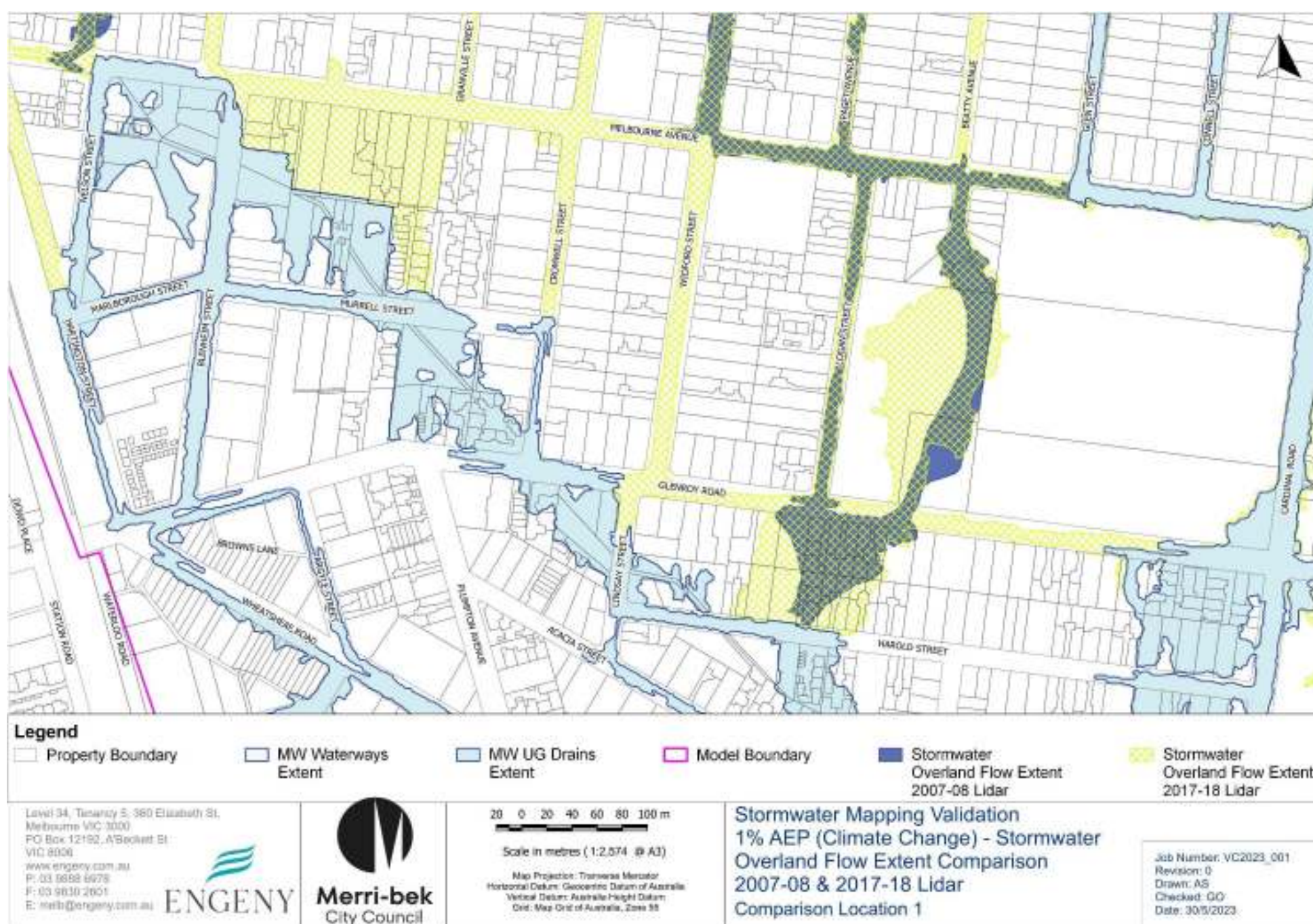


FIGURE 3.4: EXTENT DIFFERENCE 2007-08 LIDAR VS 2017-18 LIDAR LOCATION 1

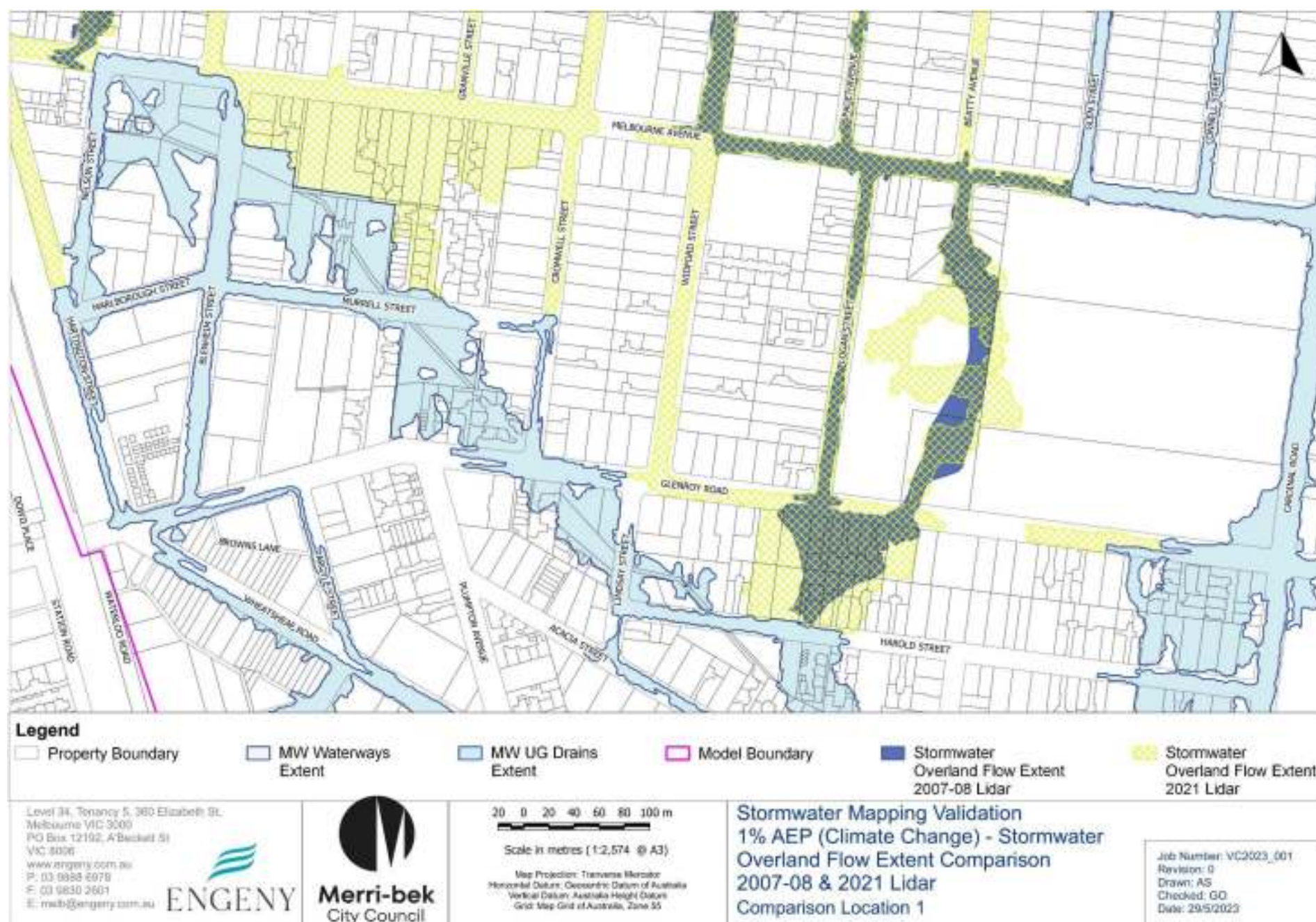


FIGURE 3.5: EXTENT DIFFERENCE 2007-08 LIDAR VS 2021 LIDAR LOCATION 1



FIGURE 3.6: EXTENT DIFFERENCE 2007-08 LIDAR VS 2017-18 LIDAR LOCATION 2



FIGURE 3.7: EXTENT DIFFERENCE 2007-08 LIDAR VS 2021 LIDAR LOCATION 2

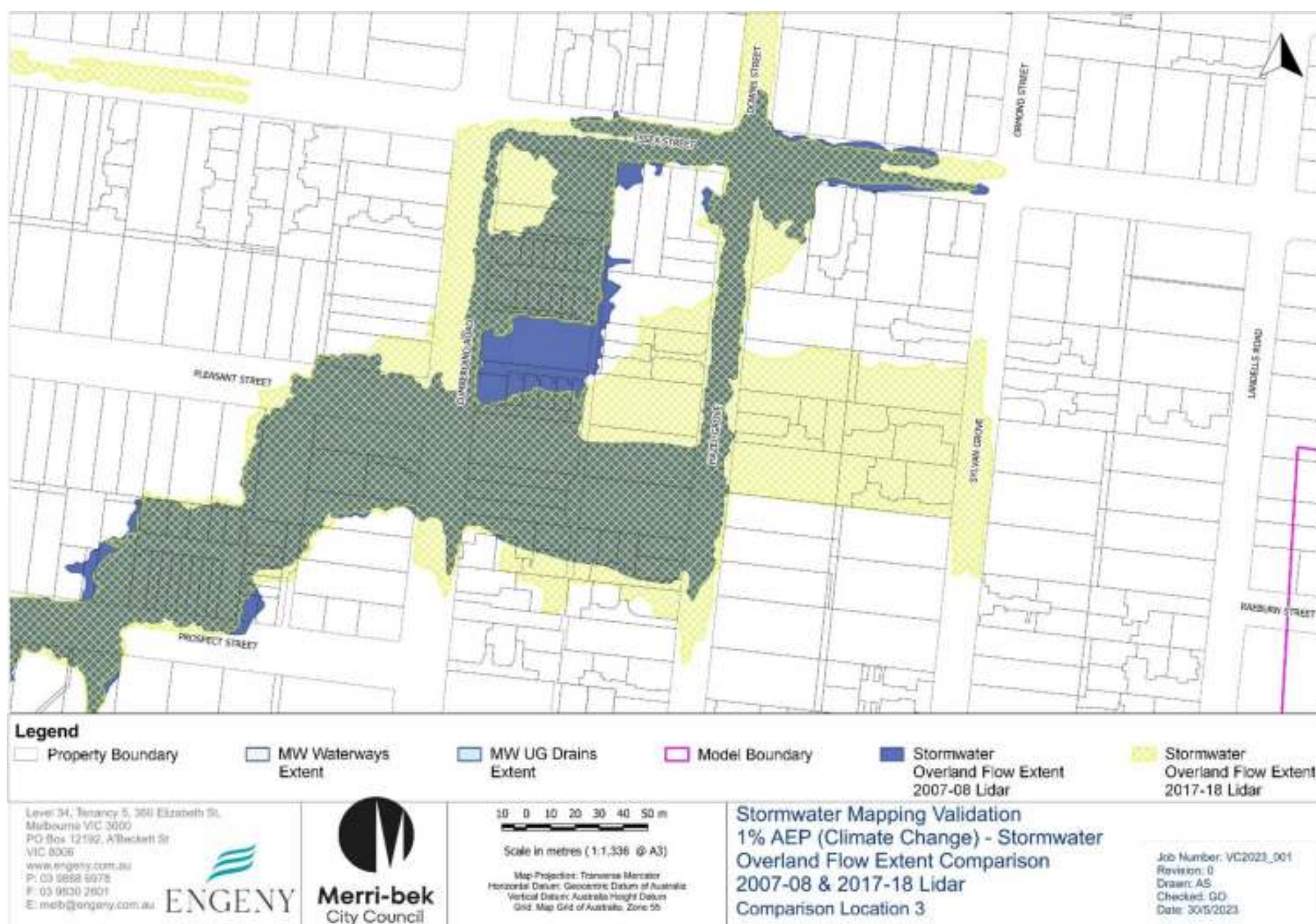


FIGURE 3.8: EXTENT DIFFERENCE 2007-08 LIDAR VS 2017-18 LIDAR LOCATION 3



FIGURE 3.9: EXTENT DIFFERENCE 2007-08 LIDAR VS 2021 LIDAR LOCATION 3

In general, the changes with both new sets of LiDAR are leading to longer or slightly deeper flow paths which will mean that more properties are captured by the extent. This lengthening and deepening of the flow paths is more likely a result of the changes in the hydrology. There are also changes to the extents which are less likely to be due to the hydrology changes and more likely due to the variations in the different LiDAR sets.

Given the accuracy differences between the 2017-18 and 2021 LiDAR sets Engeny would recommend that the 2017-18 LiDAR data should be adopted as the basis for modelling and for the stormwater overland flow path extent delineation. Engeny would expect similar differences in the other hydraulic models to those that are shown in the north-east catchments model. As Merri-bek is a well-developed municipality we would not expect there to be many areas where the ground levels have changed significantly between 2017-18 and 2021, however this can be investigated in more detail if the updated model results are used to reprocess the extents.

4. UPDATED DRAINAGE DATA

Council has provided Engeny with updated drainage GIS information at the start of 2023. This data includes all pipe and pit upgrades that Council has undertaken since the initial modelling was undertaken and the data previously supplied in Engeny in 2018. Engeny has compared the locations and magnitude of the new drainage works with the previous flood extents to determine if the works are likely or possible to have significant impact on the overland stormwater flow extent or levels.

In a 1% AEP storm event the pipe network capacity is typically exceeded and flows in excess of the drainage capacity must travel overland until they reach a waterway or receiving water body. Pipe upgrades can be constructed to mitigate flooding in a 1% AEP event, however it is very costly, effectively designing and building a pipe that the full capacity of is only going to be needed notionally once every 100 years. Engeny understands that Merri-bek typically targets major mitigation pipe upgrades to a 10% AEP storm, although in some circumstances rarer design storms are used as the design standard. Mitigation works designed and sized for a 10% AEP storm event will likely have some impact on overland stormwater flows, levels and extents in a 1% AEP storm event.

We also understand that Council undertakes numerous smaller drainage upgrades of the system to help resolve local drainage issues. This may include works such as installing underground drainage on streets that were not constructed with underground drainage when the original subdivision occurred, or may be fixing localised issues where runoff is unable to easily enter the stormwater network due to pits or pipes regularly blocking or being misaligned with current flow paths. The majority of these works are typically small sized pipe diameters or pipes to connect to new pits which are aimed at resolving pit inlet issues, which typically include a blockage component. These types of pipe upgrades are unlikely to have any significant impact on the overland stormwater flow extent or levels.

Table 4.1 shows a summary of the number of pipes of each diameter which have been constructed in Merri-bek Council since (and including) 2018. The table shows that the majority of pipe are small diameter being 450 mm or less, with the majority being 300 mm (the typically minimum standard pipe diameter for a drainage pipe under a road. The pipes smaller than 225 mm diameter are likely to be associated with water sensitive urban design assets or drainage of open spaces such as playing fields. The table also shows that a number of quite large pipes, up to 1200 mm in diameter has been installed. These larger diameter pipes are likely to convey a significant amount of water during a storm event.

TABLE 4.1: NEWLY CONSTRUCTED PIPE SUMMARY

Diameter	Number of pipes		Diameter	Number of pipes
0	22		525	54
100	20		600	40
150	118		675	7
200	1		750	29
225	159		825	23
300	802		900	14
330	1		1050	3
375	205		1200	4
450	136			
Total				1638

In addition to the circular pipes, there were also 8 box culverts installed, the largest of which was 1200 mm x 300 mm, however most were considerably smaller (ie 300x 150 mm).

Appendix A shows the key locations in the Council where the large diameter pipes have been installed. We also note that there are some locations, such as Michael Street, in Brunswick where pipes have been installed since 2018 which are not included in the list above. Engeny has been engaged either directly or indirectly on some of Council's drainage mitigation works and so some of those assets, depending on exactly when they were built, have been captured in the modelling previously.

The maps provided in Appendix A also highlight the difference between the previous stormwater overland flow path (denoted by the dark blue shape) delineated in 2018 against the updated stormwater overland flow path (denoted by the yellow shape) delineated as part of this mapping validation project (2023). The updated stormwater overland path was only delineated in the test modelling catchment which covers the north-east area of the municipality (i.e., one of the four catchments models which cover the entire municipality) and is therefore only shown on some of the drainage upgrade areas shown in Appendix A. The maps also include existing Melbourne Water overland flow path extents denoted by the lighter blue shapes. The purpose of the comparison maps is to show key locations where new pipe drainage upgrades constructed since 2018 (denoted by the pink lines) could have a potential impact on the stormwater overland flow paths. In the locations shown above Engeny believes that the pipe upgrades may have a significant impact on the flood extents. Of these, five are located within the Melville model, one solely within the south-eastern catchments model (although three others are included in the overlapping areas with adjacent models where overland flows and pipe flows can travel into alternative catchments), and two are within the north-east catchments model. In order to capture the impact that these mitigation work have on the stormwater overland flow extent the models would need to be updated and rerun. There were no major pipe upgrades within the Chapman model. If the models are not updated and rerun the previous results would provide a conservative estimate of stormwater overland flow extent and levels and the mitigation works should reduce the impact of the overland flows, however are unlikely to completely mitigate the impact in the 1% AEP event.

4.1 Water Sensitive Urban Design (WSUD) Infrastructure

Council also informed Engeny that there have been a number of Water Sensitive Urban Design (WSUD) assets constructed across the municipality. Typically, WSUD assets are focused on treating small regular flows and will not have a significant impact on 1% AEP stormwater overland flows, however wetlands or larger other larger assets, like sedimentation basins, can have a significant volume of storage associated with them which can impact on overland flows in rare events. Council indicated four assets have been built since 2018 which meet the above criteria. They are discussed individually below:

4.1.1 105 Newlands Road Retarding Basin, Sediment Pond and Bioretention

These assets have been added as part of a new development on Newlands Road. This asset is largely designed to protect Merri Creek for increased pollutant loads and is located directly adjacent to the creek. It is also captured in the 2021 LiDAR dataset. It is not having a significant impact on stormwater overland flows due to location in the catchment right beside a receiving waterway.

4.1.2 Gavin Park Wetland

The Gavin Park wetland is treating runoff from a local catchment drain which runs south along Northumberland Road prior to it entering the Melbourne Water Main Drain of Westbreen Creek (an underground drain at this location). The wetland has been built in cut (i.e. excavated into the ground with no levees or embankments) and is located within the floodplain of the Westbreen Creek Drain. This means that the wetland may slightly reduce flooding along Westbreen Creek (associated with the Melbourne Water drain) but will not impact stormwater overland flow extents along the Council drainage system.

4.1.3 Jones Park Wetland

The Jones Park wetland is located within an existing Council Overland flow path (local catchment) and a Melbourne Water flood extent (Merri Creek). Figure 4.1 shows the Council extent (black hatch) and the Melbourne Water extent (Blue) with the wetland visible on the northwest corner of Harrison and Albion Streets. It was a replacement and enlargement of an existing wetland that was previously located on the site. From the drawings provided and the 2021 LiDAR it appears that the wetland may have reduced the available stormwater overland flow storage in the southwest corner of the park. The new wetland is constructed deeper than the previous wetland, however the normal water level and extended detention level of the wetland are in some areas above the previous ground surface. All area below the normal water level of a wetland is considered to be filled with water nearly all of the time and this may represent a loss of storage area for runoff in this park. Any changes to the stormwater overland flow extent are likely to be relatively minimal and contained to Jones Park, however the magnitude of change in extent of depths could be confirmed by updating the LiDAR data and rerunning the flood models.

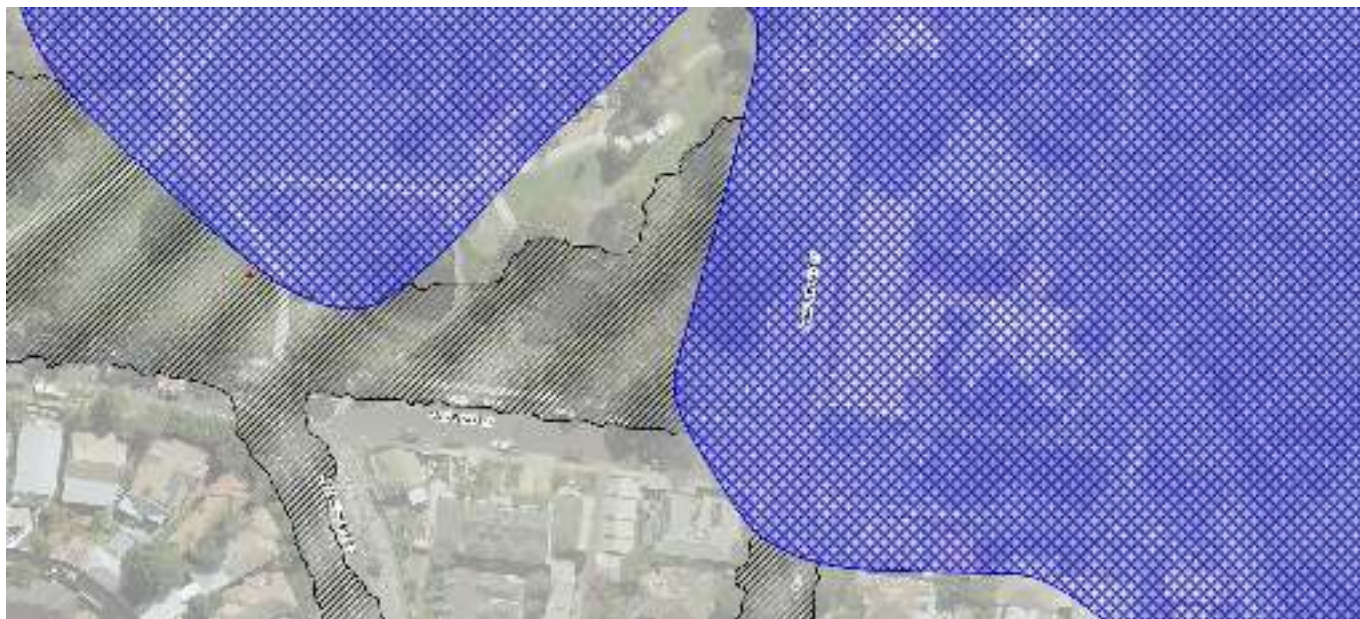


FIGURE 4.1: JONES PARK WETLAND

4.1.4 Moomba Park Wetland

The Moomba Park wetland has been constructed beside Merri Creek. It treats runoff from local council drains before they discharge into the creek. It is fully within the Melbourne Water Merri Creek flood extent. It would not be expected to influence Council stormwater overland flow extents given its location. It may have a small beneficial impact within the Merri Creek flood extent by increasing available floodplain storage, but it would likely be negligible in the scale of the flooding the creek can experience in a 1% AEP event.

4.2 Melbourne Water Drainage Data

Since Engeny originally developed the stormwater overland flow model for Council the model has been updated and rerun for Melbourne Water. The updated focused on improving the representation of the Melbourne Water drainage infrastructure that was included in the original Council model but not completely verified at the time as Melbourne Water was not directly involved in the original project. The modelling for Melbourne Water did update some pit and pipe data along the Melbourne Water system based on updated information provided by Melbourne Water. The updated modelling also considered the impacts of areal reduction factors to account for the larger catchment sizes along the Melbourne Water drains. The Melbourne Water modelling also utilised the 2017-18 LiDAR data.

Neither the updates to the pipe data nor the consideration of the areal reduction factors has significantly altered the Council stormwater over land flow extent. The updated modelling has however altered the delineation between the Council stormwater overland flow extents and the Melbourne Water flood extents. The original stormwater overland flow mapping was matched to the Melbourne Water flood extent which was current at the time of the modelling (2018), however the updated modelling (completed in 2022) has significantly changed the Melbourne Water flood extent. This will require changes to the delineation between Council and Melbourne Water extents. Figure 4.2 shows an example of the change in delineation between Council and Melbourne Water extents that will need to be updated, most likely by reducing the Council extent to match into the Melbourne Water extent.



FIGURE 4.2: CHANGES IN MELBOURNE WATER AND COUNCIL EXTENT DELINEATION

Melbourne Water typically takes ownership of a flood extent where some of the overland flow has originated from its underground drainage system. In Merri-bek this means that Melbourne Water has ownership of some flood extents which extend over Council drainage systems as the overland flow paths in Merri-bek are long and complex, splitting and flowing along the gridded road system and not confined to a single valley which may contain the main drain. Figure 4.3 shows an example of a complex flow path that is spreading out largely along the road network after originating from a Melbourne Water drain.



FIGURE 4.3: EXAMPLE OF A COMPLEX OVERLAND FLOW PATH

5. LEVEL CROSSING REMOVAL PROJECT (LXRP) DATA

Engeny has been provided with information from Council relating to two (2) Level Crossing Removal Projects (LXRP) within the City of Merri-Bek to review and determine whether the constructed works as part of both projects is likely to impact Council's municipal wide stormwater overland flow mapping project. The two (2) LXRP projects have been constructed after the modelling was undertaken and as such were not incorporated or factored into the stormwater overland flow mapping. The two (2) LXRP projects that have been reviewed are:

- Glenroy LXRP
- Bell to Moreland LXRP

Based on the information provided, Engeny understands the Glenroy LXRP provided supporting evidence to remove the need for detailed flood modelling to investigate the impacts of the proposed works on works whereas the Bell to Moreland LXRP undertook full detailed flood modelling as part of the design process.

5.1 Glenroy Level Crossing Removal Project (LXRP)

The Glenroy LXRP project broadly consists of the removal of Glenroy Road level crossing via a 'rail under road' solution and as a result is likely to have a potential impact on existing drainage / flooding patterns within and surrounding the projects works area. The project area for the project is shown in Figure 5.1 below.

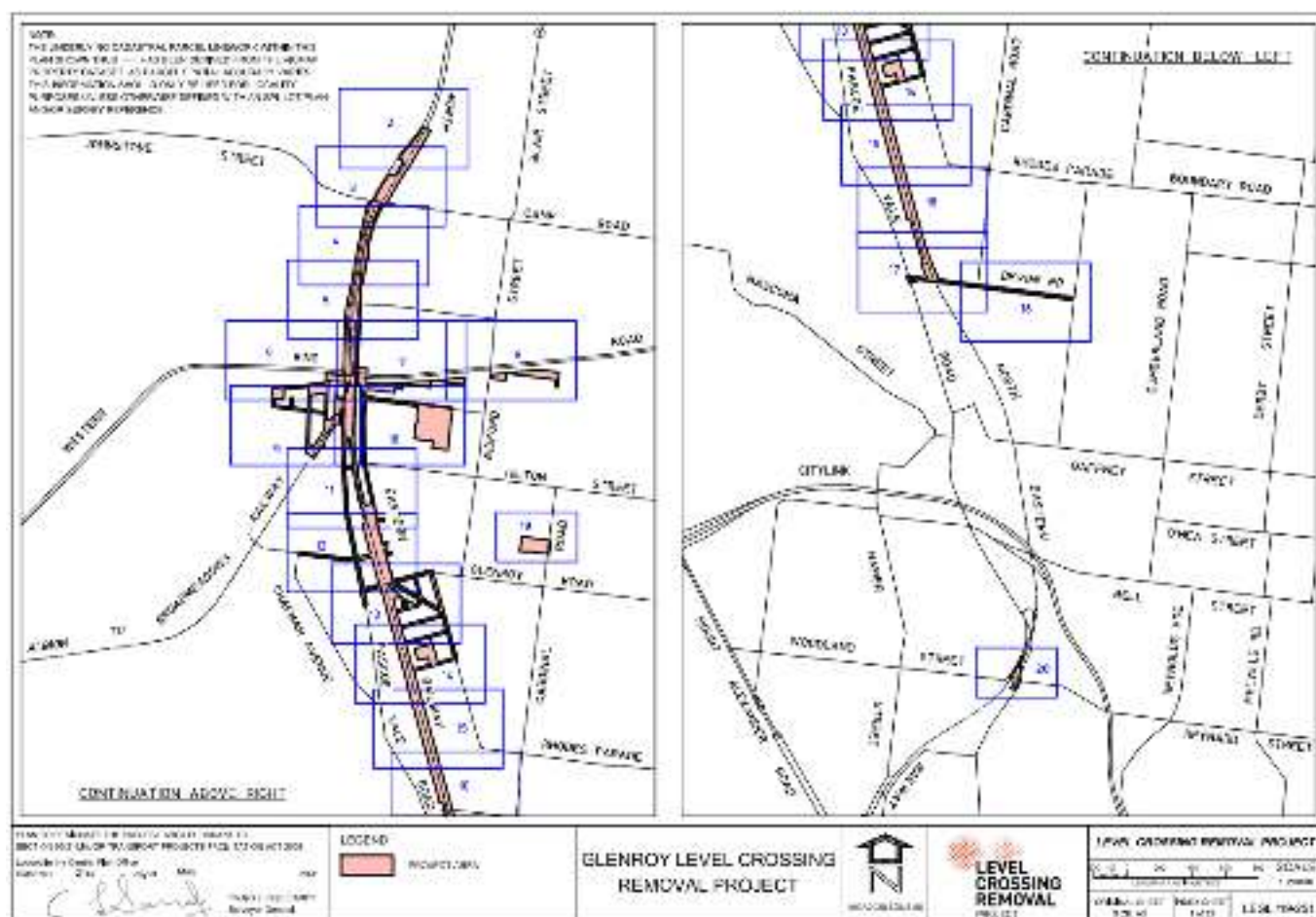


FIGURE 5.1: GLENROY LXRP OVERVIEW

Council has provided Engeny with the following information relating to the Glenroy LXP which has been reviewed as part of this project:

- North-Western Program Alliance (NWP) Glenroy Level Crossing Removal Memo – Drainage Strategy (dated 24/07/2020).
- As-Constructed Civil Drawing Package.

The drainage strategy memo was initially provided to Melbourne Water as a means of summarising existing and proposed (design) hydrological conditions throughout the projects works area and potential impacts to the existing extent of Melbourne Water Special Building Overlay (SBO). The memo briefly summarises three (3) discharge points between the project site and the surrounding areas, their respective upstream catchments and the likely change in the catchment drainage to each discharge point under design conditions.

A review of the memo and the high-level catchment analysis undertaken by the project team suggests the Glenroy LXP is unlikely to have any material impact on the stormwater overland flow path mapping undertaken by Council.

The memo states a 1200 mm diameter pipe and surcharge pit will be provided at the downstream end of the works parallel to Currajong Street (referred to as Discharge Point 1 in the memo) to mimic existing flow conditions in the rail corridor however the proposed 1200 mm diameter pipe could not be located in the provided civil design drawings. It is recommended confirmation that this pipe was constructed be sought.

5.2 Bell to Moreland Level Crossing Removal Project (LXP)

The Bell to Moreland LXP is noted as one of the more complicated LXP being undertaken and broadly consists of the removal of four (4) level crossings at Bell Street, Munro Street, Reynard Street, and Moreland Road. Unlike Glenroy LXP, the Bell to Moreland LXP provides rail over road solutions, however the body of construction has the potential to impact existing drainage / flooding patterns within and surrounding the projects works area. The project area for the project is shown in Figure 5.2 below.

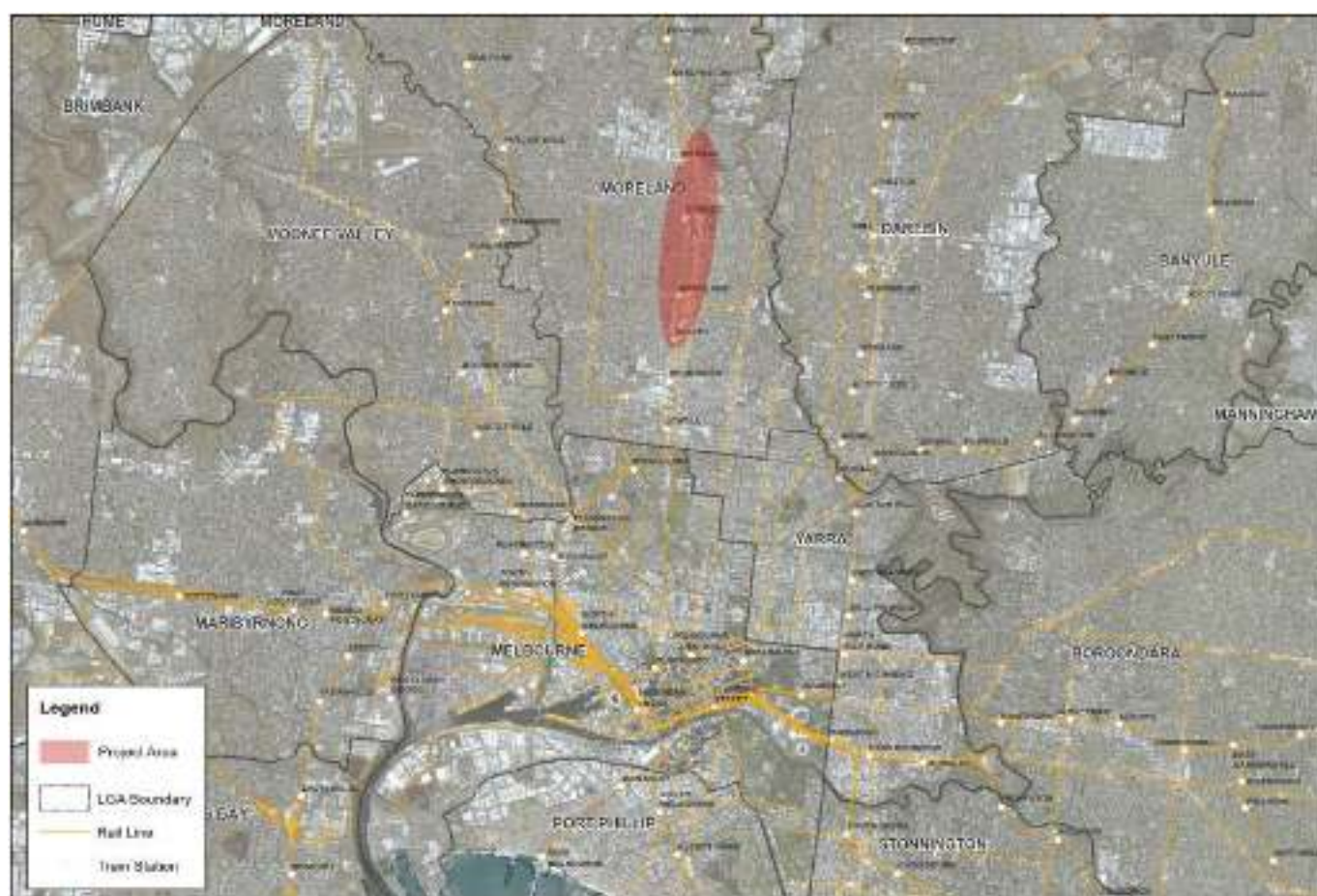


FIGURE 5.2: BELL TO MORELAND LXP PROJECT LOCATION

Council has provided Engeny with the following information relating to the Bell to Moreland LXP which has been reviewed as part of this project:

- NWPA Bell to Moreland Road Drainage Diversions & Overland Flow Design Report (April 2020).
 - Council have forwarded through the detailed flood modelling outputs which form the basis for the above report document.
- As-Constructed Civil Drawing Package.

The overland flow and flood modelling investigations undertaken by the project to assess impacts to existing flooding patterns are based on detailed TUFLOW hydraulic modelling prepared by Engeny for Council. Engeny has undertaken review of the reported updates / refinement made to the previous Engeny TUFLOW models and the 1% AEP flood modelling outputs which utilise the proposed design conditions for the LXP works. The below summarises the review of 1 % AEP design conditions flood modelling results:

- Increase in flooding (afflux) in excess of 150 mm as a result of the proposed design are noted within the project area however these are limited to within the rail corridor.
 - Increases in flooding in excess of 150 mm (based on the information presented in the design report) are also noted slightly outside of the rail corridor albeit still within rail authority land (i.e. Coburg IDO site between Bell Street & Victoria Street)
- Decreases in flooding (afflux) up to 50 mm as a result of the proposed works are noted outside of the project area however are generally contained within Council roadways.
 - Engeny notes such decreases in flooding are located within Council's previous overland flow extents however are unlikely to alter / impact Council's extents in this area because such areas are already subject to depths in excess of 100 mm.

A review of the design report (April 2020) along with the accompanying 1 % AEP flood modelling results suggests although the Bell to Moreland LXP impacts flooding patterns, such impacts are generally limited to the rail corridor / rail land or are considered minor and therefore are unlikely to impact the proposed Council stormwater overland flow extents.

6. CONCLUSIONS

The purpose of this mapping validation report is to consider newly available information and the merits of its inclusion into Council's stormwater models and maps for its local drainage catchments. Best practice stormwater mapping is enabled by using the best available information to inform the preparation of stormwater models and maps that are used for triggering a planning process and decision-making for land development outcomes.

Engeny has reviewed the updated LiDAR, drainage data and LXP data provided by Council and makes the following conclusions in relation to its impacts on the stormwater flow modelling project.

- There are a number of drainage pipe upgrades which are of sufficient magnitude to impact on the proposed Council stormwater overland flow extent. Council could choose to leave the stormwater overland flow extent as it is or could update the modelling to include these new assets. If the modelling was not updated then the extent will include properties which may have a lower risk of inundation than the modelling results show. A sensitivity run of the modelling could be completed to quantify what the changes are.
- The updated LiDAR data and associated other updates to the modelling showed a considerable difference in the number of properties which were included in the Council stormwater overland flow extent. This is largely due to increases in depths in the upstream ends of the catchments, which are where the Council controlled drains and overland flow paths are located. The change in extents shown in the north-east catchments (NEC) model are significant enough to suggest that rerunning the model in the other catchments may yield similar changes in extents. Engeny considers that the 2017-18 LiDAR data provides the best balance between accuracy of data and minimal time elapsed since its capture. There may be localised areas where the 2021 LiDAR data could be considered for use if there has been significant change in the landform.
- The level crossing removal projects were rigorously assessed by Melbourne Water and in the case of the Bell to Moreland LXP project, significant design effort was put into ensure that the impacts of flooding were limited to changes within railways land or public streets. The impacts of these projects on the stormwater overland flow extents managed by Council is considered negligible based on the information Engeny has reviewed.

There will always be a lag between completely complex hydraulic modelling and being able to make that information publicly available in the planning scheme. During this time Council may undertake drainage upgrade works or commission new LiDAR data or drainage survey data, all of which could change the actual risk of stormwater overland flow inundation for properties or the modelled risk of stormwater overland flow inundation. The model represents a snapshot in time (and data) and is the best available estimate of which properties will be impacted by stormwater overland flows in a 1% AEP event (including climate change in this case). While as much available data as possible should be included in the model it is not reasonable to say that because some newer data exists the modelling is invalid or incorrect as a blanket statement.

Engeny recommend Council considers the following:

- Between the upgrades to the drainage network and the impacts of the updated LiDAR data there is/would be sufficient changes in the modelling results or uncertainty in the drainage data in specific locations to justify adding the new data and rerunning the models on the Council controlled drainage areas. Engeny has completed runs using the 2017-18 LiDAR data as part of the Melbourne Water stormwater overland flow mapping update, however this does not consider the additional Council drainage data.
- Given that the Council extent likely needs to be updated to include the changes to the LiDAR and other factors that were adopted in the Melbourne Water modelling, it would be relatively simple to rerun the models with the updated drainage data. This then reduces the uncertainty associated with leaving this data out of the model.
- If the model is rerun the updated drainage and topography data associated with the level crossing removal project should also be added, however that is not expected to impact on stormwater overland flow extents based on the assessments that have already been completed on those projects.

Council will need to weigh this consideration against the additional cost and delay that updating the modelling would lead to and determine if it agrees that the investment is worthwhile.

Engeny is not aware of any additional drainage which have been constructed associated with Melbourne Water's network. Given the most likely change to the model would be to include some Council drainage projects it is unlikely that a rerun model would produce meaningful differences along the Melbourne Water controlled flow paths.

7. QUALIFICATIONS

- (a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.
- (b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.
- (c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:
 - (i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or
 - (ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.
- (d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.
- (e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Report.
- (f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Report or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.
- (g) This Report does not provide legal advice.

APPENDIX A: COUNCIL DRAINAGE UPGRADES





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Merri-bek
City Council

8 0 8 16 24 32 40 m

Scale in metres (1:980 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 58

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 1

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



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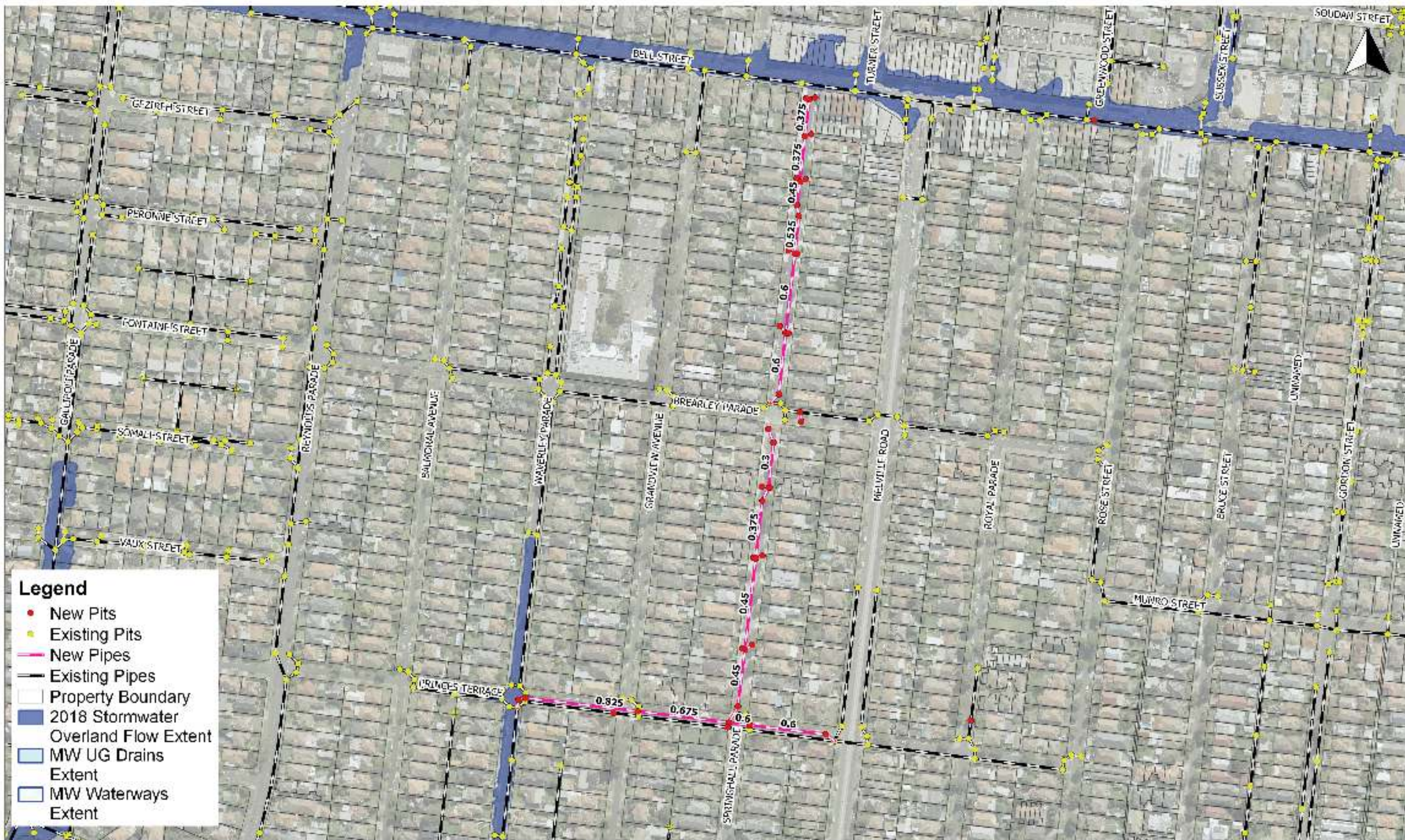
Scale in metres (1:1,430 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 1

Job Number: VC2023_001
Revision: 0
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20 0 20 40 60 80 100 m

Scale in metres (1:2,904 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 2

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



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City Council

10 0 10 20 30 40 50 m

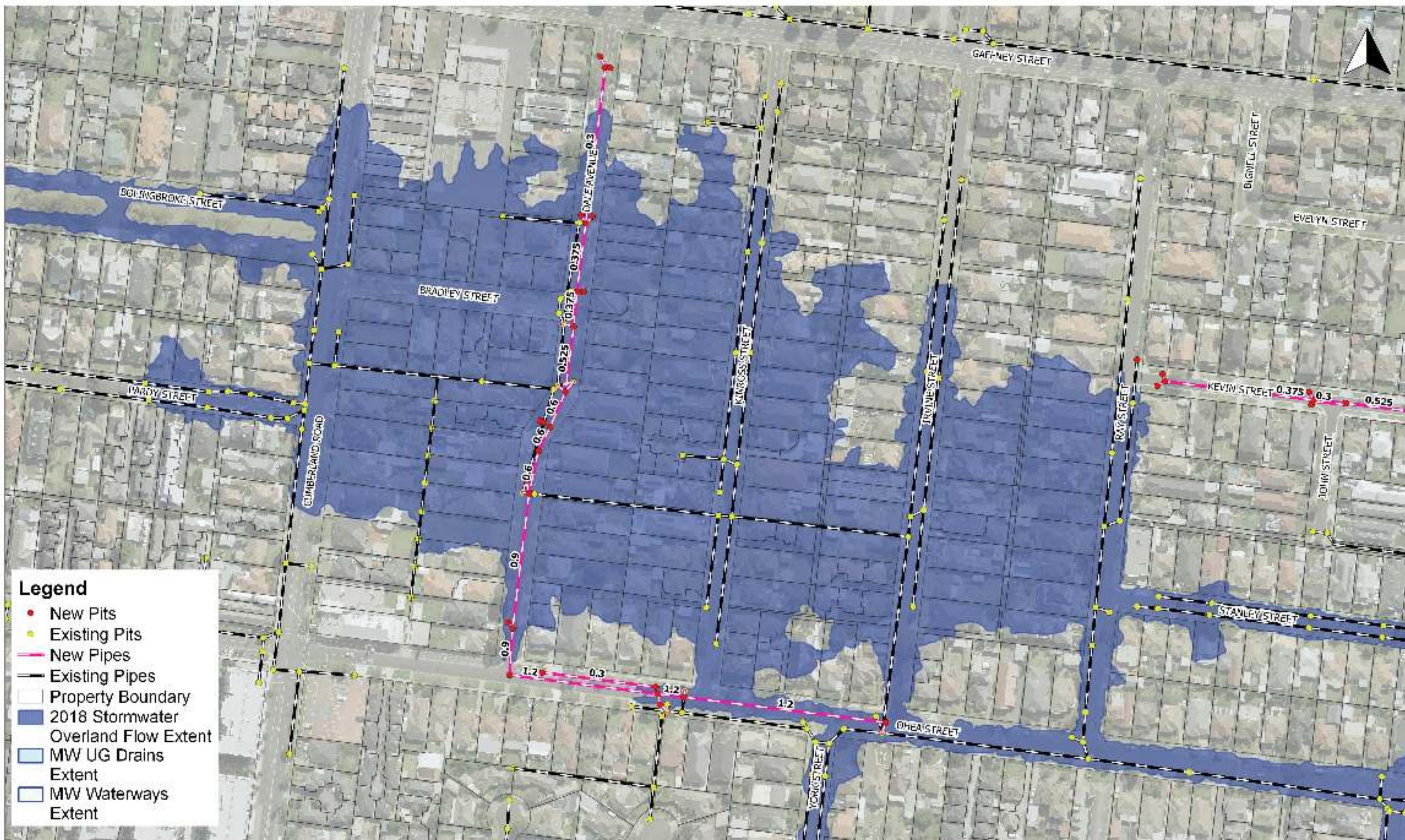
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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 2

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



Legend

- New Pits
- Existing Pits
- New Pipes
- Existing Pipes
- Property Boundary
- 2018 Stormwater Overland Flow Extent
- MW UG Drains Extent
- MW Waterways Extent

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10 0 10 20 30 40 50 m

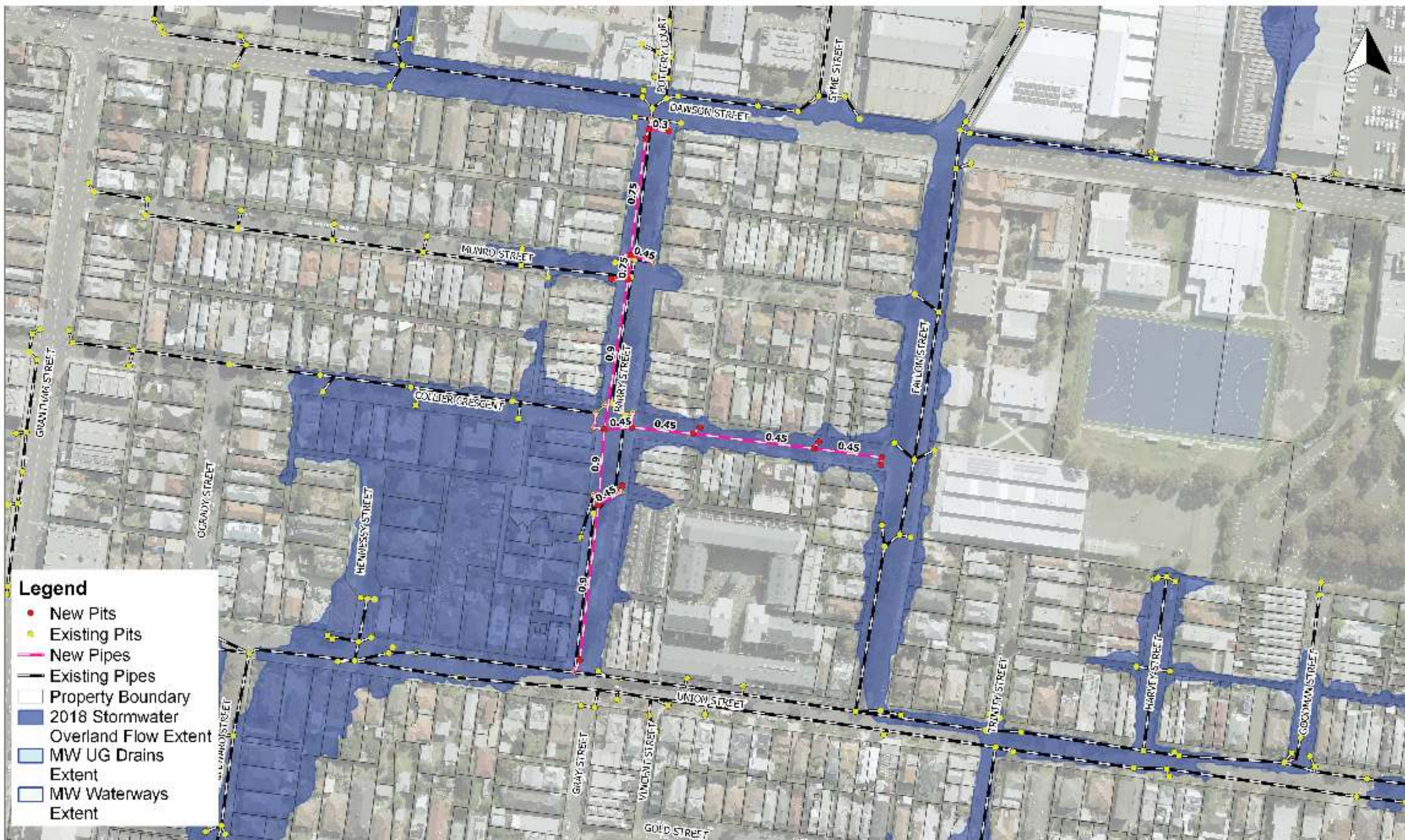
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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 3

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



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10 0 10 20 30 40 50 m

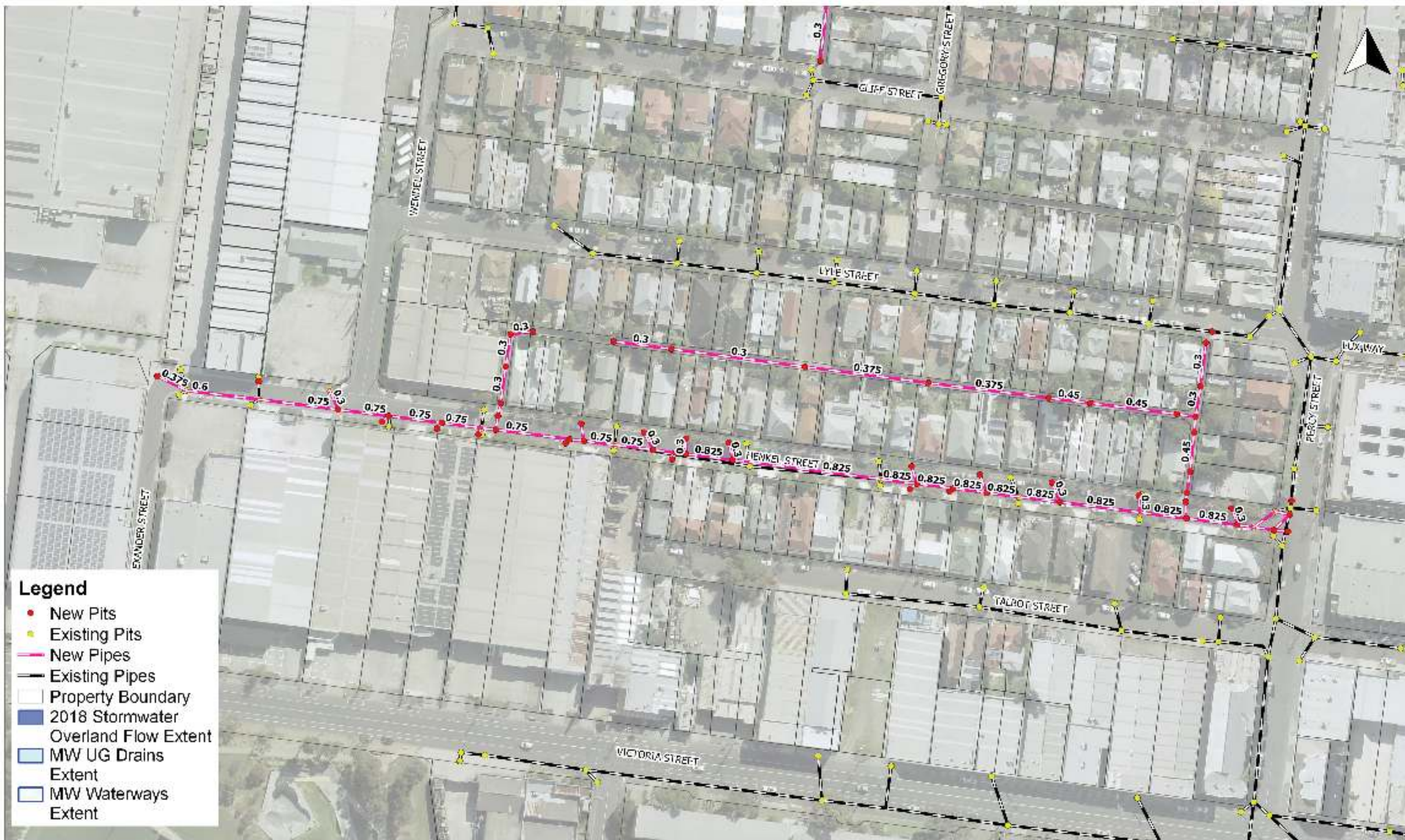
Scale in metres (1:1,792 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 4

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



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9 0 9 18 27 36 45 m

Scale in metres (1:1,193 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 5

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



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6 0 6 12 18 24 30 m

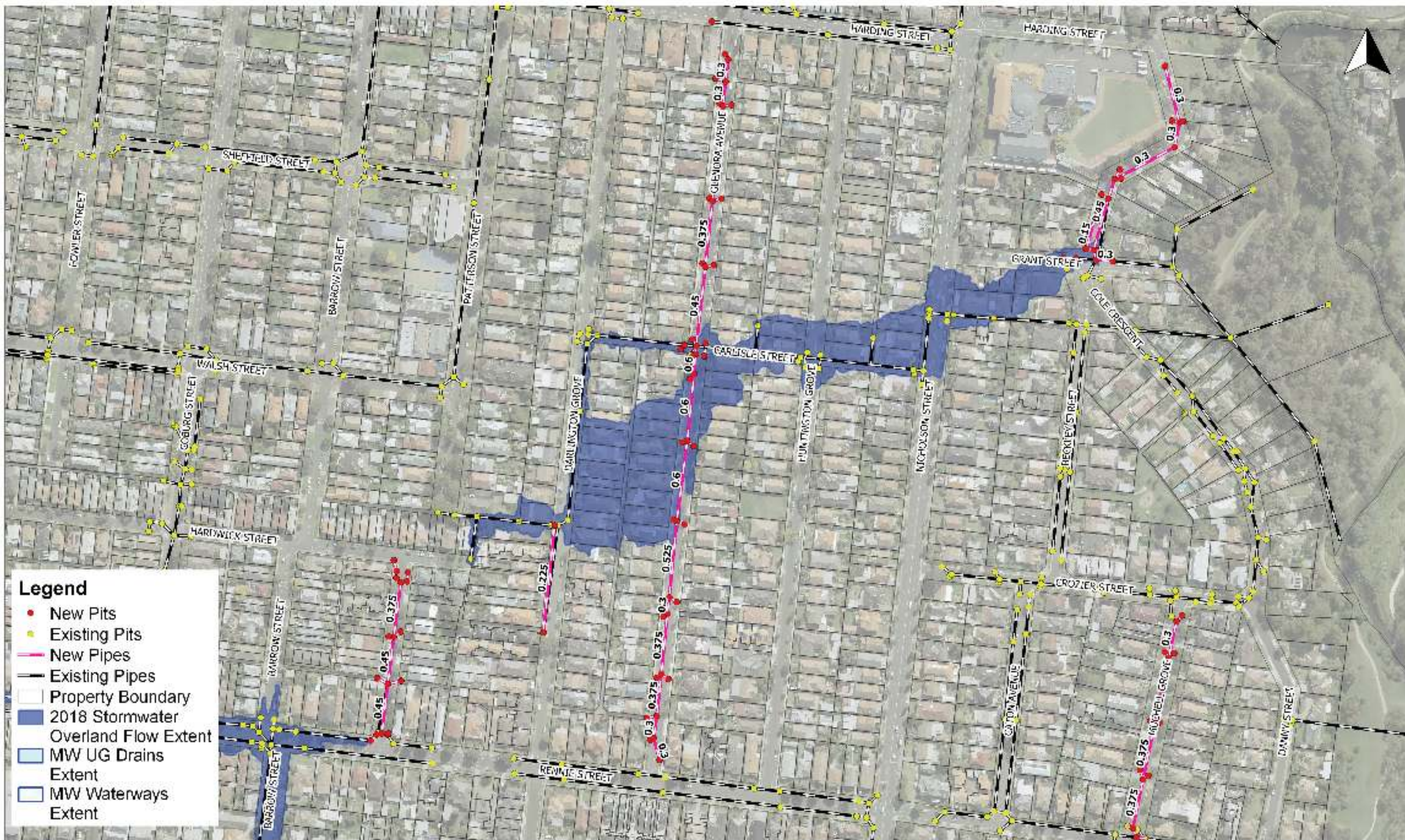
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Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 55

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 6

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023



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Merri-bek
City Council

20 0 20 40 60 80 100 m

Scale in metres (1:2,650 @ A3)

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Vertical Datum: Australia Height Datum
Grid: Map Grid of Australia, Zone 58

Stormwater Mapping Validation Consideration of Drainage Assets

Drainage Upgrade Location 7

Job Number: VC2023_001
Revision: 0
Drawn: AS
Checked: GO
Date: 9/8/2023