# Schmidt’s Creek Flood Study 2025

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**Acknowledgments**

KBR acknowledges the Traditional Custodians throughout Australia and their continuing connection to land, water, culture and community, and pays respect to their Elders past and present.

**Limitations Statement**

The sole purpose of this report and the associated services performed by Kellogg Brown & Root Pty Ltd (KBR) is to undertake a flood study for the Schmidt's Creek catchment in accordance with the scope of services set out in the contract between KBR and Logan City Council ('the Client'). That scope of services was defined by the requests of the Client, by the time and budgetary constraints imposed by the Client, and by the availability of access to the site.

KBR derived the data in this report primarily from data provided by the Client and modelling. The passage of time, manifestation of latent conditions or impacts of future events may require further exploration at the site and subsequent data analysis, and re-evaluation of the findings, observations and conclusions expressed in this report.

In preparing this report, KBR has relied upon and presumed accurate certain information (or absence thereof) relative to the site provided by government officials and authorities, the Client and others identified herein. Except as otherwise stated in the report, KBR has not attempted to verify the accuracy or completeness of any such information.

The findings, observations and conclusions expressed by KBR in this report are not, and should not be considered, an opinion concerning existing facilities and projects in the local area. No warranty or guarantee, whether express or implied, is made with respect to the data reported or to the findings, observations and conclusions expressed in this report. Further, such data, findings, observations and conclusions are based solely upon information from the Client in existence at the time of the investigation.

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# Contents


| Section | | Page |
|---|---|---|
| **1** | **INTRODUCTION** | **1** |
| 1.1 | Background | 1 |
| 1.2 | Schmidt's Creek catchment description | 1 |
| **2** | **STUDY METHODOLOGY** | **3** |
| 2.1 | Data review and selection of calibration events | 3 |
| 2.2 | Joint model calibration | 3 |
| 2.3 | Hydrologic model development | 3 |
| 2.4 | Hydraulic model development | 4 |
| 2.5 | Design event modelling | 4 |
| **3** | **AVAILABLE DATA** | **5** |
| 3.1 | Topography data | 5 |
| 3.2 | Aerial imagery | 5 |
| 3.3 | Council GIS database | 5 |
| 3.4 | Site inspection | 5 |
| 3.5 | Water level gauges | 5 |
| 3.6 | Rainfall data | 6 |
| **4** | **HYDROLOGIC MODEL DEVELOPMENT** | **9** |
| 4.1 | Overview | 9 |
| 4.2 | URBS model configuration | 9 |
| 4.3 | Routing parameters | 12 |
| 4.4 | URBS model parameters | 12 |
| 4.5 | URBS outputs | 13 |
| **5** | **HYDRAULIC MODEL DEVELOPMENT** | **14** |
| 5.1 | Overview | 14 |
| 5.2 | TUFLOW model configuration | 14 |
| **6** | **JOINT CALIBRATION MODELLING METHODOLOGY** | **25** |
| 6.1 | Joint calibration | 25 |
| 6.2 | Hydrologic model | 25 |
| 6.3 | Hydraulic model | 29 |
| **7** | **JOINT CALIBRATION MODELLING RESULTS** | **32** |
| 7.1 | March 2018 calibration event | 32 |
| 7.2 | February 2020 calibration event | 36 |
| 7.3 | October 2022 calibration event | 40 |
| 7.4 | Hydrologic and hydraulic model validation | 44 |

| | | |
|---|---|---|
| 7.5 | Summary of model calibration and validation | 48 |
| 7.6 | Adoption for design event modelling | 49 |
| **8** | **DESIGN EVENT FLOOD MODELLING** | **50** |
| 8.1 | Overview | 50 |
| 8.2 | Design rainfall | 50 |
| 8.3 | Design temporal patterns | 53 |
| 8.4 | Areal Reduction Factor | 54 |
| 8.5 | Losses | 54 |
| 8.6 | Flood frequency analysis | 55 |
| 8.7 | Climate change | 55 |
| 8.8 | Structure blockage | 55 |
| 8.9 | Tailwater conditions | 56 |
| 8.10 | Summary of design inputs | 59 |
| 8.11 | Critical storm selection | 59 |
| 8.12 | Verification of peak flows using the Rational Method | 61 |
| 8.13 | Summary of model outputs | 65 |
| 8.14 | Summary of design event modelling | 65 |
| 8.15 | Summary of climate change event modelling | 73 |
| **9** | **SENSITIVITY ANALYSIS** | **78** |
| 9.1 | Sensitivity analysis | 78 |
| 9.2 | Methodology | 78 |
| 9.3 | Results | 78 |
| **10** | **SUMMARY AND CONCLUSIONS** | **81** |
| 10.1 | Overview | 81 |
| 10.2 | Hydrologic model development | 81 |
| 10.3 | Hydraulic model development | 81 |
| 10.4 | Joint calibration methodology | 82 |
| 10.5 | Design event flood modelling | 82 |
| 10.6 | Sensitivity analysis | 83 |
| 10.7 | Limitations | 84 |

**11 REFERENCES 85**

**APPENDIX A: SUBCATCHMENT PARAMETERS**

**APPENDIX B: HYDRAULIC STRUCTURES DETAILS**

**APPENDIX C: BOX PLOTS**

**APPENDIX D: DESIGN EVENT MAPPING**

**APPENDIX E: CLIMATE CHANGE EVENT MAPPING**

**APPENDIX F: DIFFERENCE IN FLOOD LEVELS – CLIMATE CHANGE**

**APPENDIX G: SENSITIVITY ANALYSIS MAPPING**

# 1 Introduction

## 1.1 BACKGROUND

KBR was engaged by Logan City Council (LCC) to conduct a flood study for Schmidt's Creek. The primary focus of this study is the develop and calibrate hydrologic and hydraulic models of the Schmidt's Creek catchment.

The models will be used by Council to provide planning scheme flood mapping and estimate f flood levels, depths, velocities, and flood hazard of design events along the Schmidt's Creek waterways and tributaries, where they fall within Council's Waterway Corridors Overlay.

The following tasks are to be undertaken to complete the study:

- Develop and calibrate the Unified River Basin Simulator (URBS) hydrological model and the TUFLOW model against selected calibration events.
- Use the calibrated models to conduct design event modelling for a range of design events from the 50% to the 0.05 % Annual Exceedance Probability (AEP) events, including the Probable Maximum Flood (PMF), and climate change event modelling.
- Conduct sensitivity testing on the hydrologic and hydraulic models for several model parameters.

This report presents the development and calibration of the URBS and TUFLOW models. Future submissions will include the design event modelling and sensitivity assessments.

## 1.2 SCHMIDT'S CREEK CATCHMENT DESCRIPTION

Schmidt's Creek (study area) is a tributary of the Logan River, that generally flows in a north-easterly direction before reaching Logan River south-west of James Fitzgerald Park in Waterford West. The creek has two distinct arms that join immediately downstream of Logan Reserve Road prior to the confluence with Logan River. The northern arm flows from Park Ridge through Crestmead and Marsden, while the southern arm flows from Chambers Flat through Logan Reserve, prior to the confluence of the two arms.

The Schmidt's Creek catchment that contributes to the confluence with the Logan River has an area of 19.0 $km^2$. The area of the northern arm of the catchment is approximately 10.6 $km^2$, while the southern arm of the catchment is approximately 6.8 $km^2$.

The Schmidt's Creek catchment consists of a mixture of urbanised residential areas and rural open areas. The catchment is predominantly zoned with low-density residential and emerging community purposes, suggesting that significant residential development will continue to occur in the future.

The Schmidt's Creek catchment has experienced significant development in recent years, especially in the Logan Reserve and Park Ridge areas. As a result, several large-scale detention basins have been implemented to regulate peak flows within the catchment. The downstream area of the Schmidt's Creek catchment is impacted by flooding from the Logan River and key roadways in this area generally have low flood immunity.

Figure 1-1 shows the approximate catchment extent of the study area.

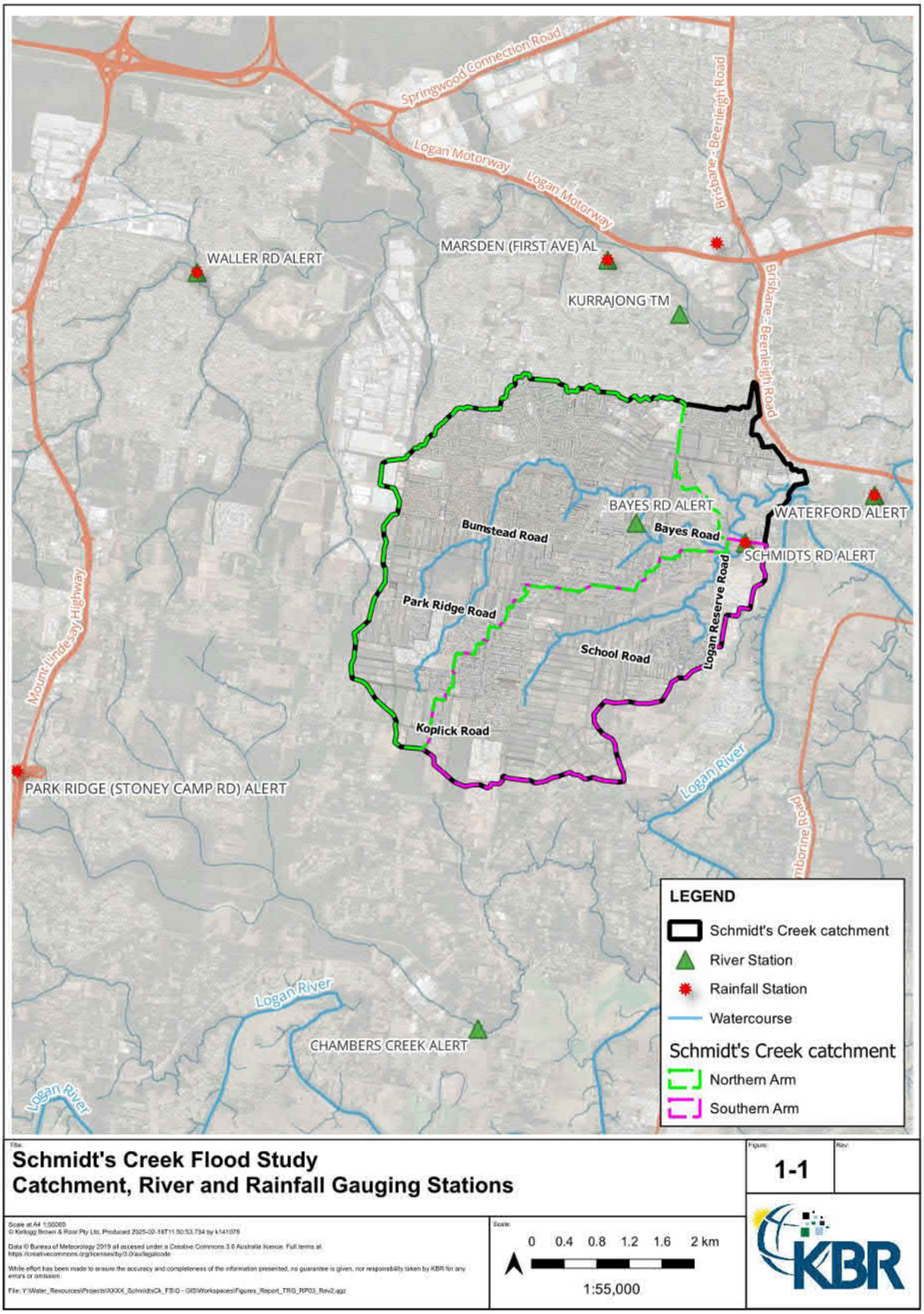



**Figure 1-1 Schmidt’s Creek catchments and rainfall gauging stations**

# 2 Study Methodology

## 2.1 DATA REVIEW AND SELECTION OF CALIBRATION EVENTS

A Data review was conducted to ensure that all necessary data required for the study was provided by Council. Data provided by Council included LiDAR (1 m), aerial photography, GIS database of hydraulic structures, streamflow data, rainfall data and building footprints.

From the provided stream flow data, suitable calibration events will be selected for conducting the joint model calibration.

## 2.2 JOINT MODEL CALIBRATION

Joint model calibration is an iterative process of calibrating both a hydrologic and hydraulic model so that modelled outputs match observed data, while simultaneously producing comparable modelled results in both the hydrologic and hydraulic models.

To undertake this study, the Unified River Basin Simulator (URBS) (Carroll, 2023) will be used to model rainfall, runoff and routing processes in the Schmidt’s Creek Catchment. Streamflow predicted by URBS will be used as inputs into the hydraulic modelling package, TUFLOW.

As neither URBS nor TUFLOW models have been developed for Schmidt’s Creek previously, both models require development and calibration. The joint model calibration process will be as follows:

1. URBS
    a. Develop the URBS hydrological model with nominal parameter values
    b. Simulate the selected calibration rain events
    c. Adjust the URBS catchment and routing parameters until the modelled flows achieves a close representation to the recorded historic water level and timing
    d. Extract the URBS hydrographs for input into the TUFLOW model.
2. TUFLOW
    a. Develop the TUFLOW model with nominal parameter values
    b. Simulate the TUFLOW model with the inflow from URBS representing the three selected calibration rain events
    c. Adjust roughness parameters until the modelled flows achieves a close representation to the recorded historic water level and timing
3. If modelled results differ significantly to recorded data, then iterative computations will be undertaken by adjusting parameters for both hydrologic and hydraulic models until the modelled results match acceptably with recorded data.
4. When modelled results match sufficiently with recorded data, the calibration is considered to be complete. Predicted outputs for both hydrologic and hydraulic models will be compared to ensure no major anomalies in the obtained results. This will conclude the joint calibration phase.

## 2.3 HYDROLOGIC MODEL DEVELOPMENT

The Unified River Basin Simulator (URBS) software was used to develop the Schmidt’s Creek catchment upstream of the Logan River. The URBS model was configured to mainly represent the calibration events’ conditions and the ultimate development conditions.

The URBS model was calibrated for the March 2018, February 2020 and October 2022 events using data provided by LCC, including rainfall and river height gauge data from rainfall and river gauges located within the vicinity of the Schmidt's Creek catchment. The aim of the calibration was to model similar peak levels and catchment response to the recorded historic water levels at two stream gauging stations situated at Bayes Road (Station ID:540674) and Schmidt's Road (Station ID:540675) in the lower reaches of the catchment.

Following suitable calibration of the hydrologic model, the ultimate development conditions hydrologic model was used to generate predicted inflows for the design flood events.

## 2.4 HYDRAULIC MODEL DEVELOPMENT

A TUFLOW 1D/2D hydraulic model was developed for the study which utilised the Heavily Parallelised Computing (HPC) engine. The TUFLOW model extends from the headwaters of both the north and south arms of the Schmidt's Creek to its outlet into the Logan River and includes one-dimensional (1D) elements such as culverts, trunk stormwater pipes and inlet pits. A 3 m grid size was adopted, with the Sub-Grid-Sampling (SGS) function implemented.

The TUFLOW hydraulic model was calibrated to acceptably match recorded water levels at two stream gauging stations for the March 2018, February 2020 and October 2022 historic rain events.

## 2.5 DESIGN EVENT MODELLING

The calibrated URBS hydrologic model was then used to estimate the discharge in the Schmidt's Creek catchments for a range of design events from the 50% AEP to the 0.05% AEP, and the Probable Maximum Flood (PMF) in accordance with Australian Rainfall and Runoff (AR&R) 2019 (Ball et al, 2019) guideline.

The future (2090) climate change condition estimates were simulated for the 50% AEP to the 0.2% AEP design events for the Representation Concentration Pathway (RCP) 4.5 pathway.

The calibrated TUFLOW hydraulic model was used to simulate the flood levels, depths and velocities for the design flood events.

# 3 Available Data

## 3.1 TOPOGRAPHY DATA

LCC provided the 1 m LiDAR captured in 2017 and 2021 for use in this study. The 2017 LiDAR was used to mainly delineate catchments and develop a hydrologic model for the 2018 event. The 2021 LiDAR was used to develop the hydrologic and hydraulic models for the February 2020 and October 2022 calibration events and for design event modelling.

As there were minimal differences in the waterway corridor between the two LiDAR sets, the 2021 LiDAR was used to conduct the hydraulic modelling for all calibration events and for design events modelling.

## 3.2 AERIAL IMAGERY

LCC provided aerial photography captured in 2018, 2020 and 2022 of the Schmidt's Creek catchment for use in this study to inform the land use for the respective calibration events.

## 3.3 COUNCIL GIS DATABASE

LCC provided a GIS database of vector file layers relevant to the study as GIS shapefile layers. The provided files included the following:

- Hydraulic structures – included box culverts, drainage network, bridges and pits, within the Schmidt's Creek catchment, and contained details of the hydraulic structures including their sizes, and invert levels. The drainage network was also used to refine the delineation of sub-catchments especially in the more urbanised areas of the catchment.
- Waterway Corridor (LP2025 draft version) – to inform and assign inflows in the hydraulic modelling and define the boundaries of the flood modelling.
- 2015 LCC Planning Scheme (LCC LPS2015 Zone) – to assign impervious and roughness values in the hydrologic and hydraulic models for conducting the design event modelling (ultimate case conditions).

## 3.4 SITE INSPECTION

KBR undertook a site visit on 3rd of April 2024 to verify a number of structures and identify structures not within the LCC database. KBR subsequently requested LCC for further details of structures which were unable to be accessed during the site visit and were not covered in Council's original GIS layers.

LCC conducted a further site investigation and provided KBR with information for the structures with missing data including surveyed invert levels and sizes.

## 3.5 WATER LEVEL GAUGES

There are two river height gauges located within the Schmidt's Creek catchment, which records water levels in the creek. These are the Bayes Road Alert (AL) gauge (Station ID:540674) and Schmidt's Road Alert gauge (Station ID:540675). Historical water levels for these two gauges were provided by LCC for selecting suitable calibration events to calibrate the hydrologic and hydraulic model against. No rating curves information was available for these gauges.

In addition, water level data from the Waterford Alert gauge (Station ID:040878) was also provided to assist in providing downstream tailwater conditions for the calibration events in the hydraulic model.

### 3.5.1 Selection of calibration events

From the provided water level gauge data, three calibration events were selected based on the minor, moderate and major events based on the flood classifications for the two gauging stations; Bayes Road Alert gauge (Station ID:540674) and Schmidt’s Road Alert gauge (Station ID:540675). The flood classifications are outlined in Bureau of Meteorology’s (BoM) River Height stations (BoM, 2022) and are presented in Table 3-1.

**Table 3-1 Flood classifications as outlined in BoM river height stations**

| Station ID | Gauge | Flood Classification Events | | |
|---|---|---|---|---|
| | | Minor | Moderate | Major |
| 540674 | Bayes Road AL | 7.6 mAHD | 8.0 mAHD | 8.4 mAHD |
| 540675 | Schmidt’s Road AL | 4.0 mAHD | 5.0 mAHD | 6.0 mAHD |

Due to the proximity of the two gauges to the Logan River, the Schmidt’s Road and Bayes Road gauges are affected by the water levels in the Logan River. The Waterford Alert gauge (Station ID:040878), located on the Logan River, is the nearest river height gauge station which records water levels for the Logan River. The Waterford Alert gauge was used to provide an assessment of the water levels in the Logan River and the river’s influences at the two calibration gauges. Calibration events were selected by prioritising events under which the calibration gauges have no or minimal backwater effects from Logan River.

A review of the supplied water levels was undertaken to determine the suitable flood events for calibration. It was concluded that all flood events classified as major flood events at the Schmidt’s Road and Bayes Road gauging sites were due to backwater effects from the Logan River, and hence these events were discounted from the calibration modelling.

Three flood events were selected for calibration, namely the March 2018, February 2020 and the October 2022 events. A summary of events which were considered and selected for calibration are presented in Table 3-2.

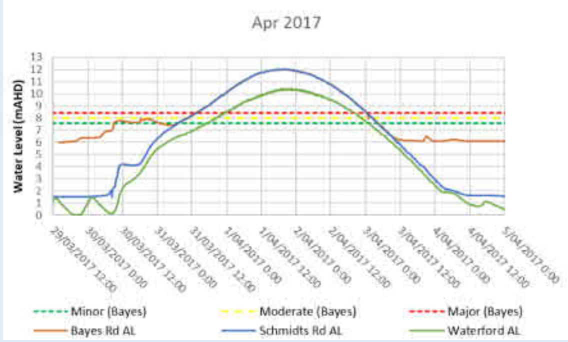
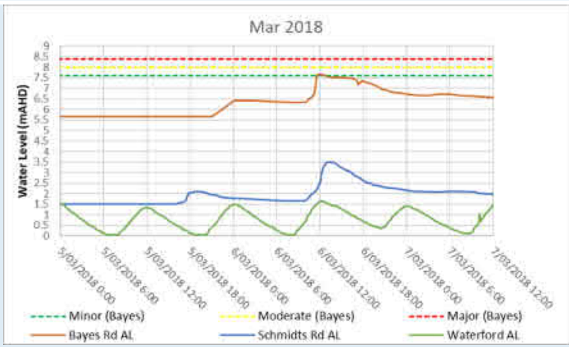
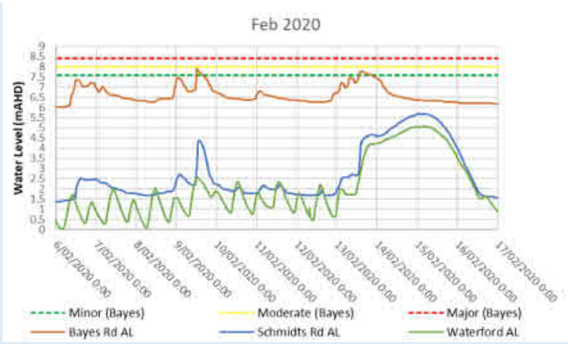
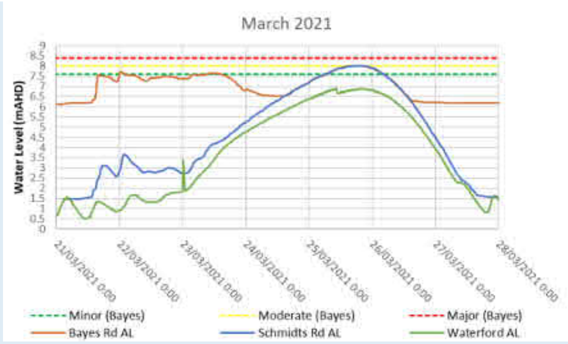
## 3.6 RAINFALL DATA

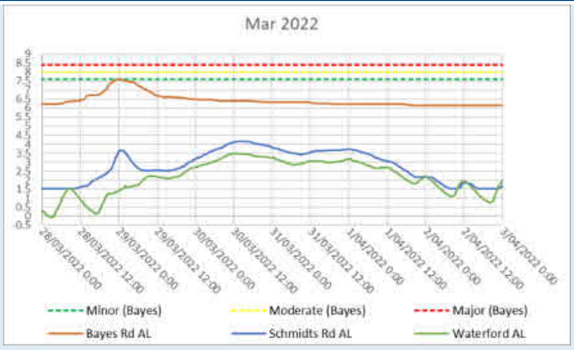
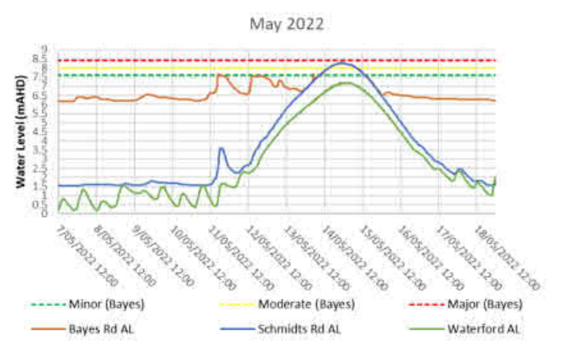
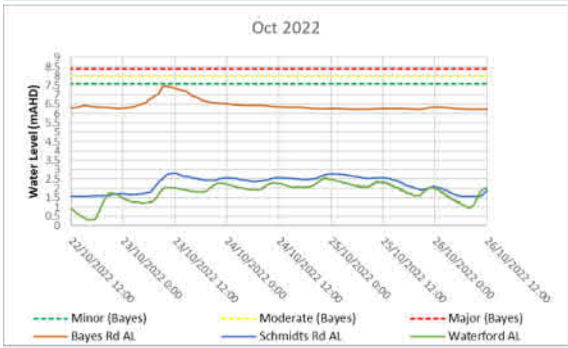
Pluviographic rainfall records from the Schmidt’s Road Alert and Marsden First Avenue (Station ID: 540078) were provided by LCC for the calibration events. The rainfall data was used as inputs into the URBS hydrological model to generate hydrographs for the calibration events at the Schmidt’s Road and Bayes Road gauges.

Rainfall data for additional rainfall stations around the area such as the Waller Road Alert (Station ID: 540692), Waterford Alert (Station ID: 040878), Park Ridge Alert (Station ID: 540787) and Bega Road Quarry Alert (Station ID: 540237) were also supplied but were not used.

The rainfall data are provided in Section 6.2.1 and Section 6.2.2.

**Table 3-2 Summary of historical events**

<table>
<tr><th>Event</th><th>Event classification</th><th>Observation</th><th>Water level plot</th></tr>
<tr><td>April 2017</td><td>Major flood event at both stations</td><td>The peak water levels at the gauging stations were heavily affected by water levels from the Logan River at both gauging stations.<br><br>Event was not considered for calibration due to significant influence from the Logan River at both gauges, which enveloped most of the period of localised catchment flows.</td><td>
</td></tr>
<tr><td>March 2018</td><td>Minor flood event</td><td>Minimal influence from the Logan River.<br><br>Selected for Joint hydrologic and hydraulic model calibration.</td><td>
</td></tr>
<tr><td>February 2020</td><td>Moderate flood event</td><td>The recorded water levels at the start of the event were primarily from the localised event within the creek's catchment. However, in the later parts, peak water levels at Schmidt's Road were directly influenced by water levels from the Logan River.<br><br>Selected for Joint hydrologic and hydraulic model calibration. However, only the start of the event was considered during the calibration as it had minimal influence from the Logan River.</td><td>
</td></tr>
<tr><td>March 2021</td><td>Major flood event</td><td>The recorded water levels at the start of the event were primarily from the localised event within the creek's catchment. However, the peak water levels at the gauging stations were affected by water levels from the Logan River at both gauging sites.<br><br>Event was not considered for calibration due to significant influence from the Logan River at both gauges.</td><td>
</td></tr>
</table>

| Event | Event classification | Observation | Water level plot |
|---|---|---|---|
| March 2022 | Minor flood event | Mainly localised catchment flows. However, some influences from the Logan River at the Schmidt's Road gauge were noted.<br><br>Event was not considered for calibration due to some influence from the Logan River the Schmidt's Road gauge. Other similar events were considered instead, which had less influence from the river. |  |
| May 2022 | Major flood event | The recorded water levels at the start of the event were primarily from the localised event within the creek's catchment. However, the peak water levels at the gauging stations were affected by water levels from the Logan River at both gauging sites.<br><br>Event was not considered for calibration due to significant influence from the Logan River at both gauges. |  |
| October 2022 | Minor flood event | Mainly localised flows. Minimal influence from the Logan River.<br><br>Selected for Joint hydrologic and hydraulic model calibration. |  |

# 4 Hydrologic Model Development

## 4.1 OVERVIEW

The Unified River Basin Simulator (URBS) (version 4.7.2) software was used to conduct the hydrologic modelling of the Schmidt's Creek catchment.

Two hydrological models were developed to simulate the calibration events and design events. They represent two different catchment conditions:

- Calibration Events' Conditions: the URBS model was configured to simulate conditions present at the time of the March 2018, February 2020 and October 20222 calibration events.
- Ultimate Development Condition: the URBS model was configured to simulate ultimate conditions in accordance with Councils' current Planning Scheme for design event modelling.

## 4.2 URBS MODEL CONFIGURATION

### 4.2.1 Sub-catchment delineation

The delineation of the catchments was done using the LiDAR, drainage network, hydraulic structures within waterway corridors and property boundaries. Council provided 1 m resolution LiDAR datasets from 2017 and 2021.

The sub-catchment delineation for the calibration and design events are as follows:

- March 2018 calibration event: The 2017 LiDAR was used for sub-catchment delineation which is shown in Figure 4-1.
- February 2020 calibration event: The 2021 LiDAR was used for sub-catchment delineation which is shown in Figure 4-2.
- October 2022 calibration event: The 2021 LiDAR was used for sub-catchment delineation which is shown in Figure 4-2.
- Design event modelling: The 2021 LiDAR was used for sub-catchment delineation which is shown Figure 4-2.

The areas of the sub-catchments were limited to 30 hectares. Both variations of the hydrologic model sub-catchment delineation consist of 157 catchments. Figure 4-1 and Figure 4-2 presents both variations of the sub-catchment delineations.

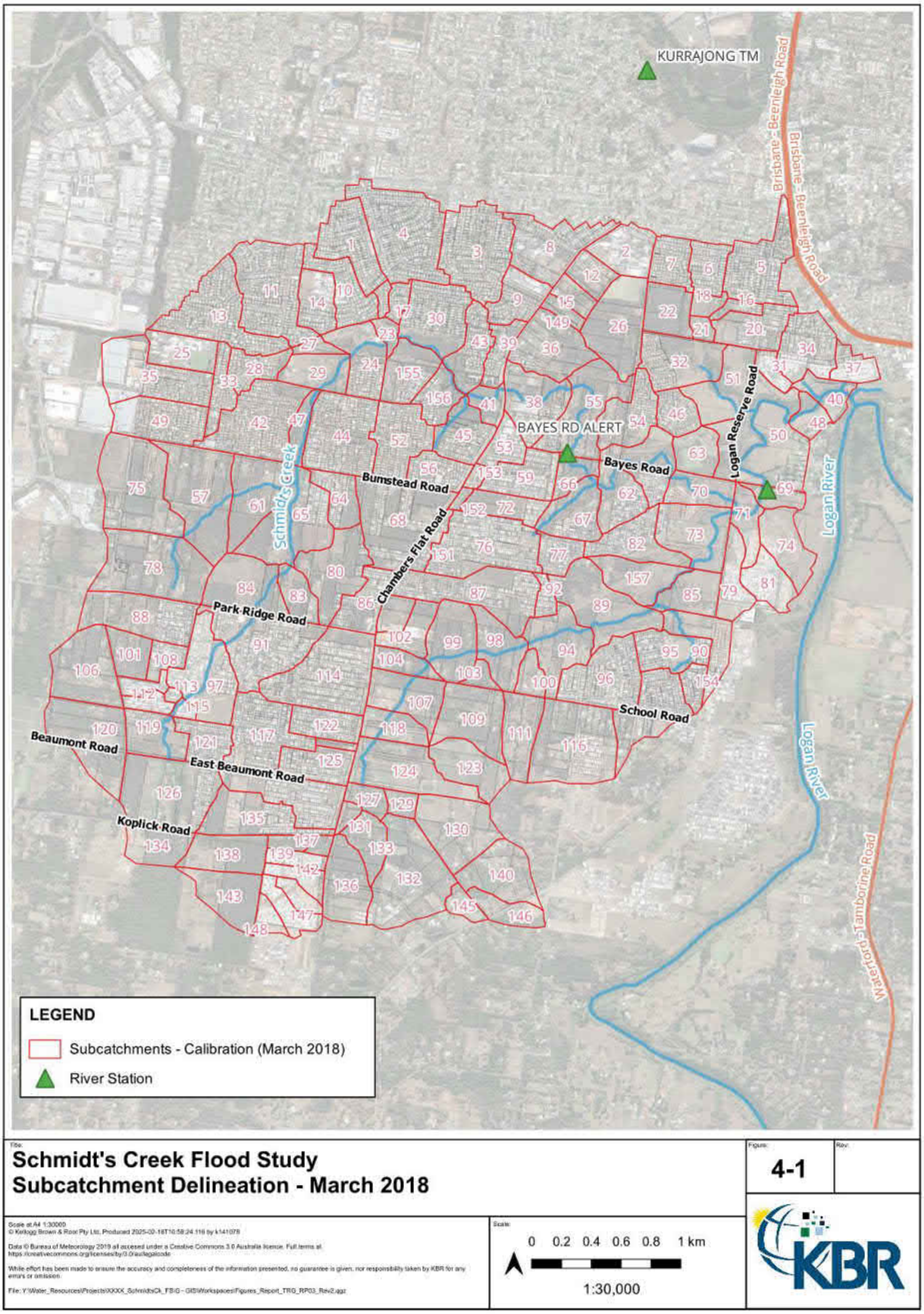



Figure 4-1  Sub-catchment delineation – March 2018 event

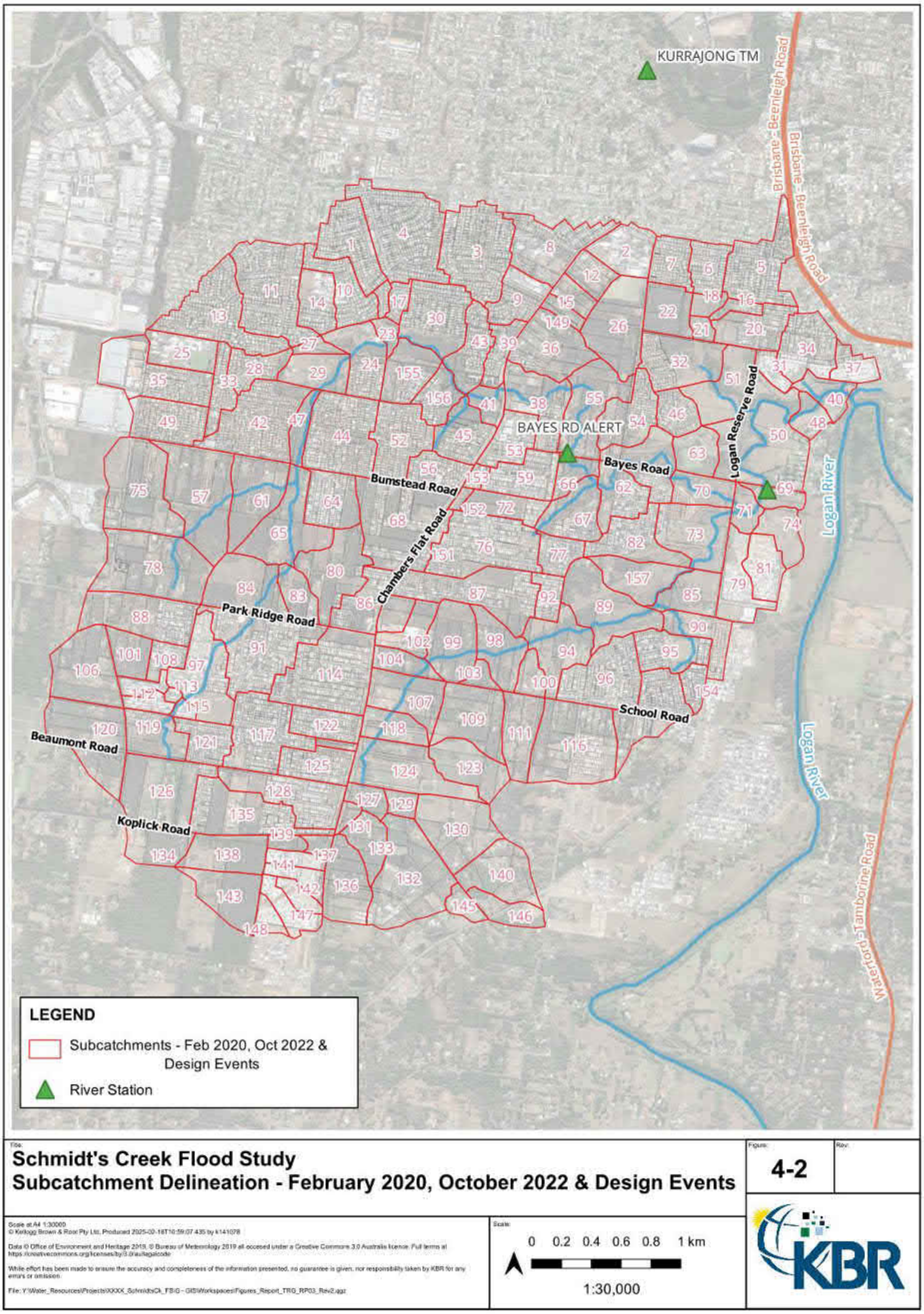



**Figure 4-2 Sub-catchment delineation – February 2020, October 2022 and design events**

### 4.2.2 Sub-catchment parameters

The Schmidt's Creek URBS hydrological model uses area and fraction impervious as catchment variables. The imperviousness values used in the calibration of each historic event were based on aerial photography at the time of the events.

For the ultimate development condition, the imperviousness values were based on the latest Logan Planning Scheme and Land Zoning (LPS2015 Zone).

The adopted imperviousness values for each land-use type are presented in Table 4-1.

**Table 4-1 Imperviousness values for each land-use type**

| Land use type | Fraction impervious (%) |
|---|---|
| Road Reserve | 90% |
| Recreation and Open Space | 5% |
| Rural Residential | 10% |
| Rural | 5% |
| Community Facilities | 65% |
| Environmental Management and Conservation | 0% |
| Low Density Residential | 55% |
| Low-Medium Density Residential | 65% |
| Centre/Industrial | 90% |
| Waterway Corridor | 0% |
| Emerging Community | 80% |

The subcatchment IDs and subcatchment parameters (total area and impervious values) implemented for each subcatchment for the three calibration events and ultimate development conditions are presented in Appendix A.

## 4.3 ROUTING PARAMETERS

Channel routing within the URBS model was configured by specifying reach lengths (L) and channel slope (Sc). The length and channel slope were derived using available topographic data.

## 4.4 URBS MODEL PARAMETERS

The URBS model used channel lag parameter (alpha), catchment lag parameter (beta) and catchment non-linearity parameter (m) as global catchment and routing parameters. These parameters were obtained from the hydrological model's calibration outlined in Section 6.2.3. The following URBS parameter values were derived and used in the calibration event modelling and design event modelling.

- Alpha = 0.03
- Beta = 1.5
- m = 0.8.

## 4.5 URBS OUTPUTS

The URBS predicted flows were used as TUFLOW inflows to the waterway corridor throughout the Schmidt's Creek catchment. As such, URBS print statements were applied frequently within the URBS text file.

There are two main types of flows entering the waterway corridor: the local catchment URBS flows and the routed URBS flows as summarised below:

- Local catchment flows refer to runoff generated within a sub-catchment which flow directly into the middle of the main reach. In an URBS hydrologic model, the local catchment flows are assumed to occur at the centroid of the respective sub-catchments.
- Routed flows refer to runoff from a sub-catchment centroid routed to the sub-catchment's outlet through a prescribed flow path. Where the centroidal flow does not lie on the main reach, the flow will first be routed to the main waterway and, if required, to the outlet. Routed flows may be from either a single sub-catchment or total flows from more than one sub-catchment.

# 5 Hydraulic Model Development

## 5.1 OVERVIEW

The TUFLOW package was adopted to conduct the hydraulic modelling of the Schmidt's Creek catchment, utilising its Heavily Parallelised Computing (HPC) engine, the 2023-03-AB-iSP-w64 solver, and the Sub-Grid-Sampling (SGS) function.

Two TUFLOW 1D/2D hydraulic model were developed for the Schmidt's Creek, one for calibration modelling and a design model for onward study. The model include:

- Calibration Events' Conditions: the TUFLOW model was configured to simulate conditions present at the time of the March 2018, February 2020 and October 2022 calibration events.
- Ultimate Development Condition: the TUFLOW model was configured to simulate ultimate conditions in accordance with Councils' current Planning Scheme for design event modelling.

## 5.2 TUFLOW MODEL CONFIGURATION

### 5.2.1 Model extent

The TUFLOW model extended from the headwaters of both the north and south arms of the Schmidt's Creek to the creek's outlet into the Logan River. Figure 5-1 shows the extent of the TUFLOW hydraulic model for the Schmidt's Creek catchment.

### 5.2.2 Grid cell size

A 3 m grid cell size was adopted along with a Sub-Grid-Sampling target distance of 1 metre which combined adequately represent the channel cross sections in the creek as well as result in reasonable simulation run times.

### 5.2.3 Topography

#### Calibration event

The 2017 LiDAR and 2021 LiDAR were provided for use in the calibration events.

A comparison of the 2017 LiDAR and 2021 LiDAR showed that while the topography of the catchment changed over the period of LiDAR survey, the changes in landforms were mainly concentrated outside of the main creek, where development had occurred. Within the creek and waterway corridor, there were minimal differences (±0.1m) between the two LiDAR datasets.

Noticeable differences in topography were observed at the western bound of the Schmidt's catchment, although they were mainly outside the Schmidt's' Creek catchment boundary. At the south-eastern corner, the landform changes required minor adjustments to sub-catchment's boundaries; the creek's topography was relatively unchanged within this area.

As minimal differences in LiDAR elevation within the waterway corridor were observed, the 2021 LiDAR was used as the base topography in simulating all the calibration events including the 2017 calibration event. Figure 5-2 presents the differences between the 2021 LiDAR and 2017 LiDAR datasets.

#### Design event

The 2021 LiDAR was used to carry out design event hydraulic modelling for the study area.

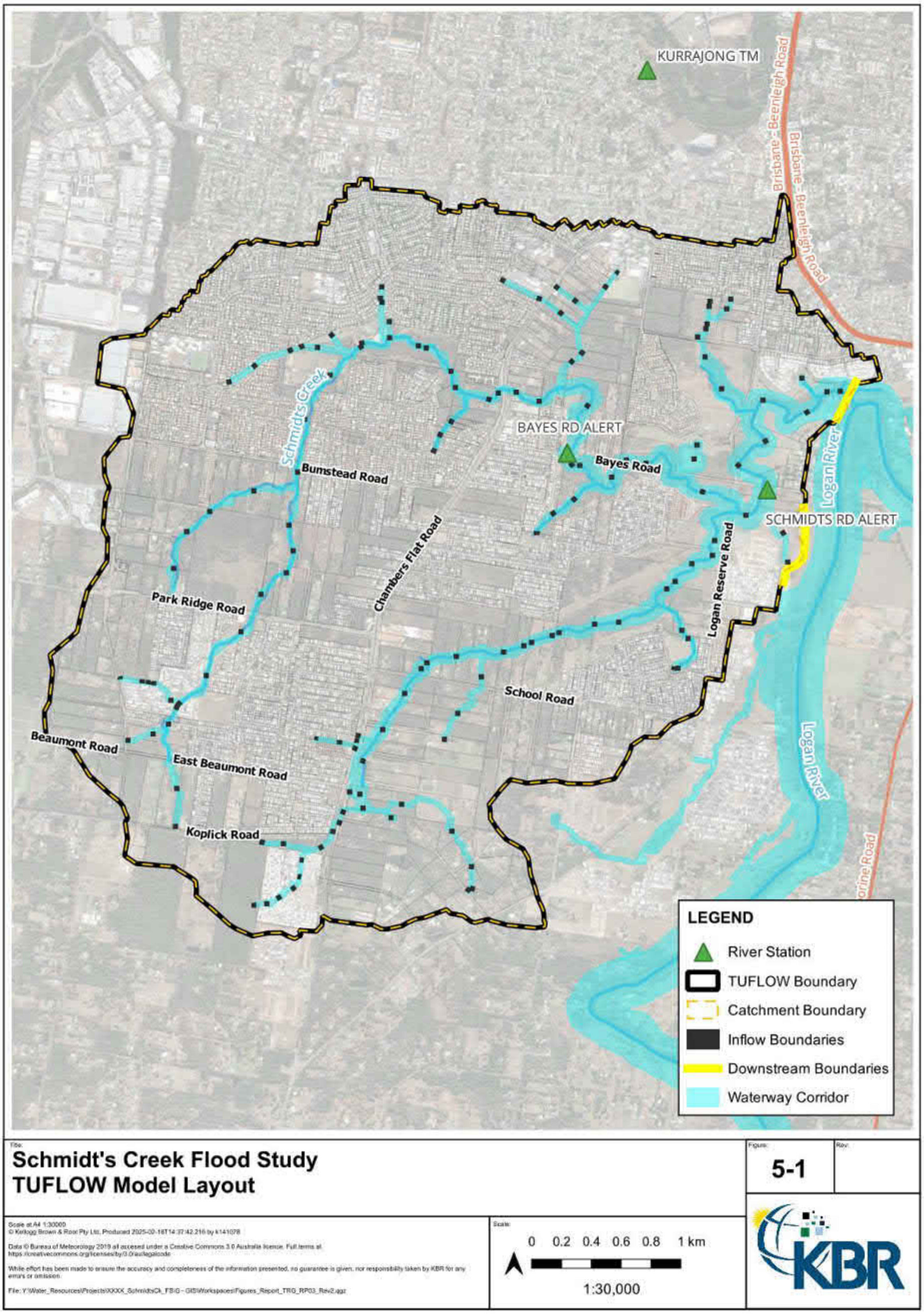



**Figure 5-1 TUFLOW model layout**

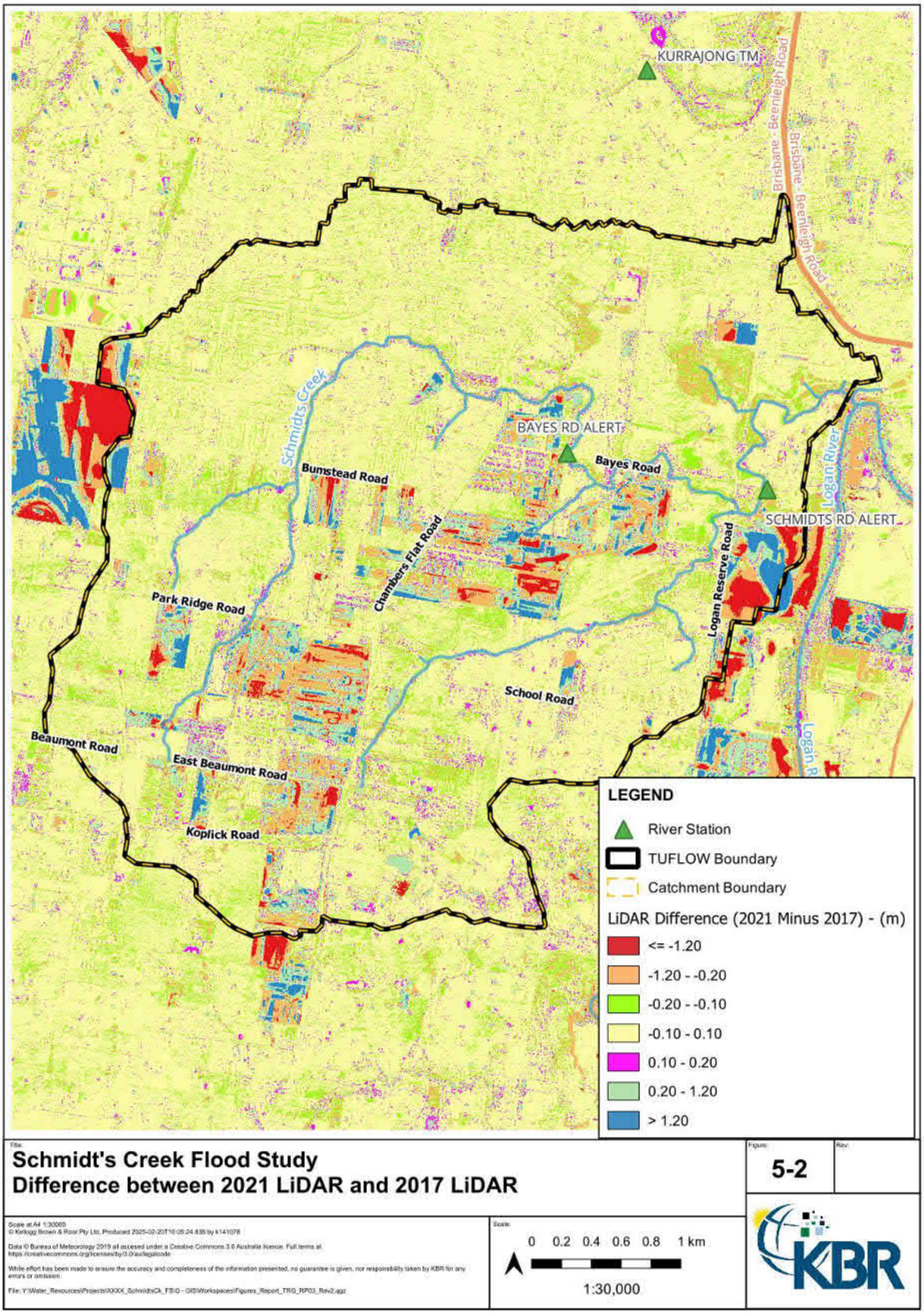



**Figure 5-2 Differences between 2021 LiDAR and 2017 LiDAR**

### 5.2.4 Inflow boundaries

Inflow boundaries within the TUFLOW model were applied using the surface-area (2d_sa) polygons. Hydrographs generated from the URBS model were adopted as inflows into the TUFLOW model. As the main focus of the study is modelling the waterway corridor, inflows were added into the waterway corridor as either local catchment URBS inflows or routed URBS inflows as outlined in Section 4.5.

Flows for sub-catchments which include the waterway corridor were added as local sub-catchment inflow hydrographs in the TUFLOW model. The inflow boundaries for these local sub-catchment flows were placed approximately at the middle of the reach within the sub-catchment's waterway corridor.

Sub-catchment flows which first enter the start of the waterway corridor, and which were delineated to be at the outlets of sub-catchments, were applied as routed URBS hydrographs; either from a single sub-catchment or routed total flows from more than one catchment. Centroidal flows not occurring within the main reach were routed to the main reach and added as routed flows.

The locations of these inflows remained the same for all calibration events and for the design event modelling.

The locations of the inflow boundaries are shown in Figure 5-1.

### 5.2.5 Outflow boundary

The hydraulic model has a single outflow boundary into the Logan River. The location of the outflow boundary is shown in Figure 5-1. Water level-time (HT) boundary condition was applied in both the calibration model and the design model, but for different purposes as outlined in the following sections.

#### Calibration event

The HT boundaries for the chosen calibration events were time varying recorded water levels translated from the Waterford Alert gauge and the Logan Village Alert, which are situated approximately 4.4 km downstream and 11 km upstream of the outlet, respectively. The methodology is outlined in further detail in Section 6.3.1.

#### Design event

The adopted tailwater levels for the design events are a fixed head boundary. The regional flood hydrographs simulated at Waterford Alert gauge and the maximum water level grids from the Logan and Albert Rivers Flood Study (WRM, 2023) were used to determine the fixed head boundary at the outlet for the design events. The methodology is outlined in further detail in Section 8.9.

### 5.2.6 Hydraulic roughness

Hydraulic roughness in TUFLOW is represented by Manning's roughness n values. The Manning's roughness values for the TUFLOW models were determined using the respective aerial photography for the calibration events and Council Land Use data for the design events.

Table 5-1 presents the Manning's roughness values adopted for the various land uses. Figure 5-3, Figure 5-4, Figure 5-5 and Figure 5-6 presents the manning's roughness values and distribution for the calibration events and design event modelling.

**Table 5-1 Manning's roughness for different land-use types**

| Material ID | Land use | Manning's roughness |
|---|---|---|
| 1 | Road Reserve | 0.025 |
| 3 | Recreation and Open Space | 0.045 |
| 4 | Rural Residential | 0.055 |
| 5 | Rural | 0.055 |
| 6 | Community Facilities | 0.060 |
| 7 | Environmental Management and Conservation | 0.090 |
| 8 | Low Density Residential | 0.100 |
| 9 | Low-Medium Density Residential | 0.200 |
| 10 | Centre/Industrial | 0.300 |
| 12 | Vegetation - Light | 0.050 |
| 13 | Vegetation - Moderate | 0.060 |
| 14 | Vegetation - High | 0.080 |
| 15 | Waterway - Main (centreline) | 0.035 |
| 16 | Waterway - Concrete Channel | 0.025 |
| 18 | Emerging Community | 0.250 |

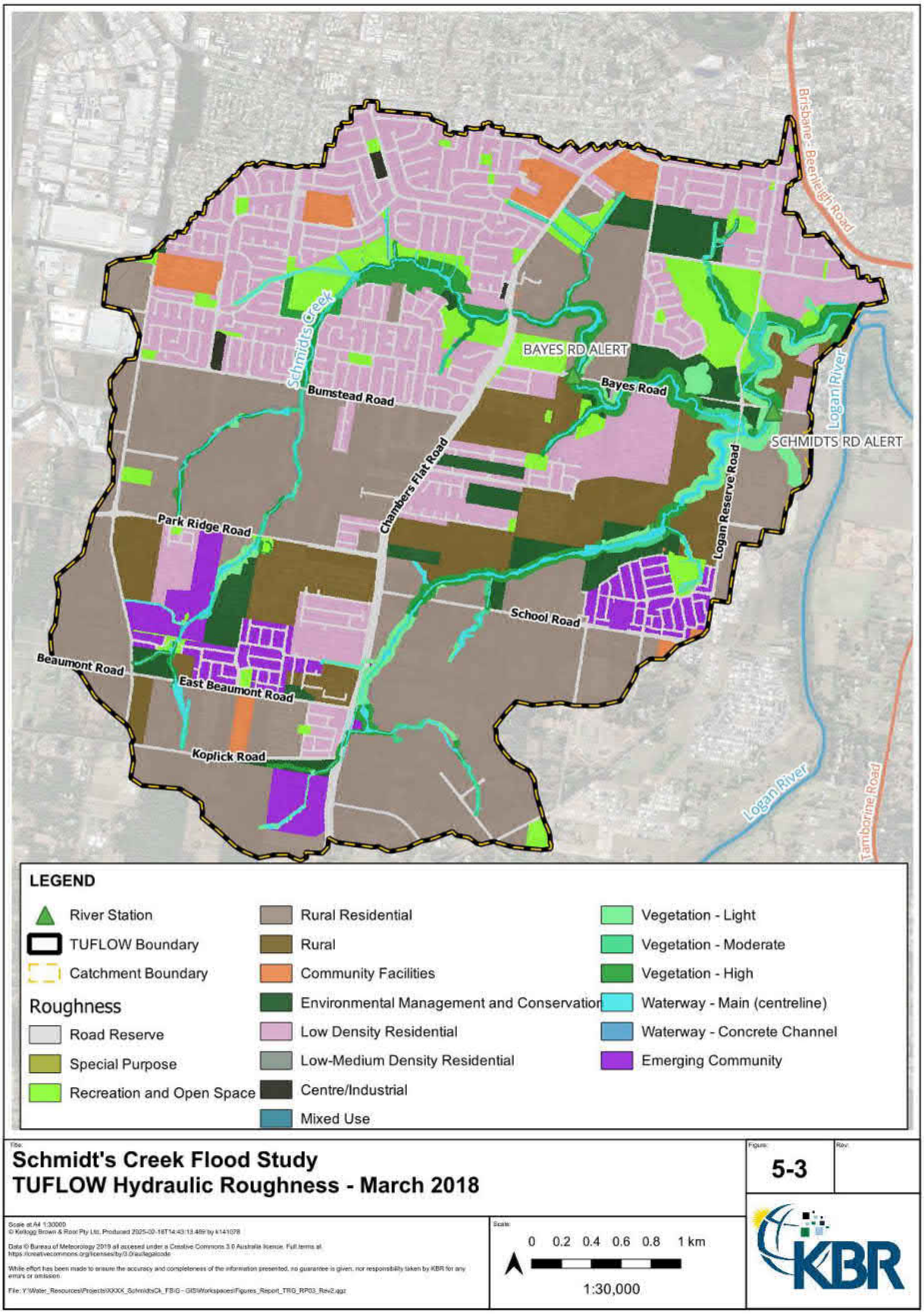



**Figure 5-3 TUFLOW hydraulic roughness – March 2018 event**

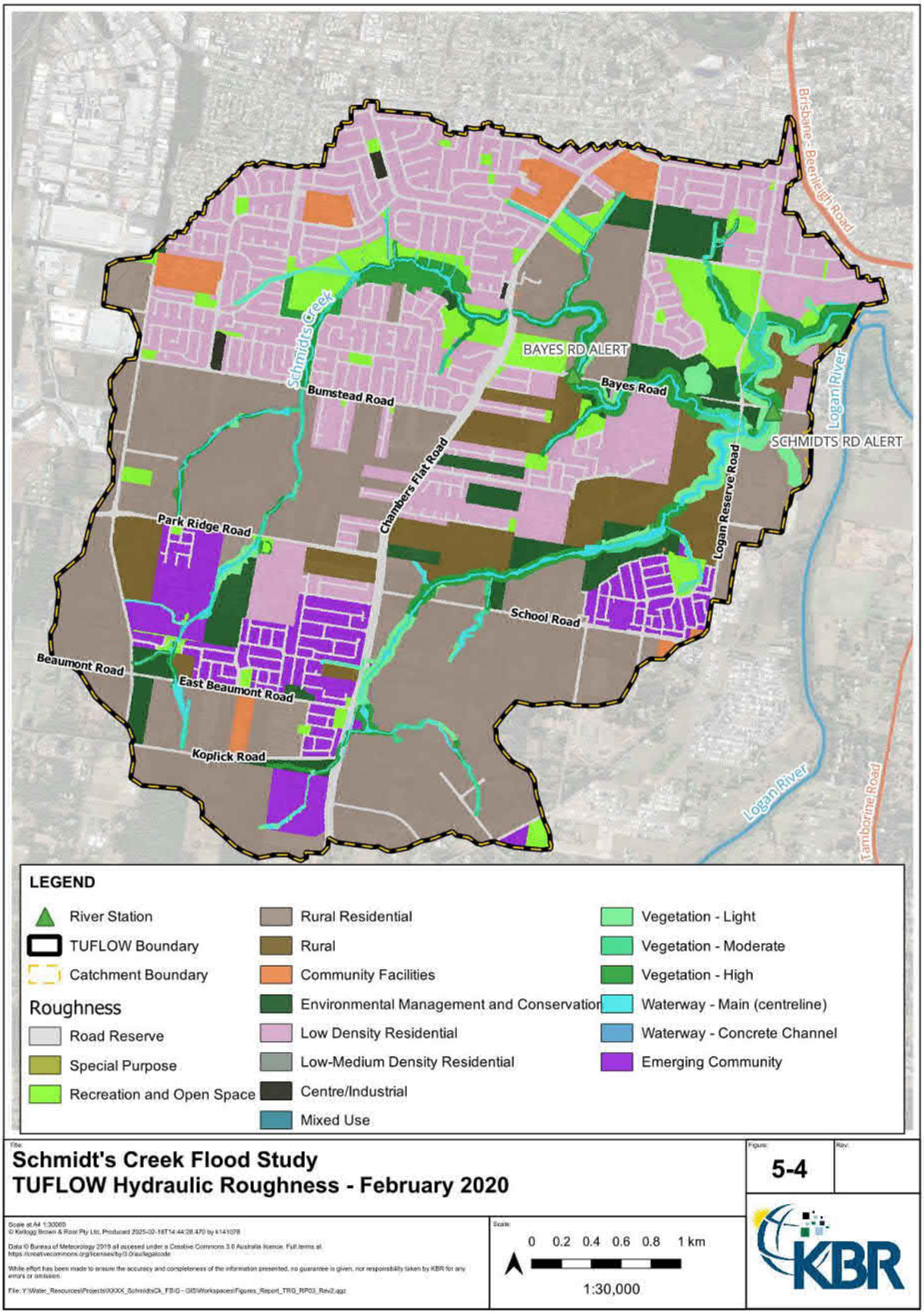



Figure 5-4 TUFLOW hydraulic roughness – February 2020 event

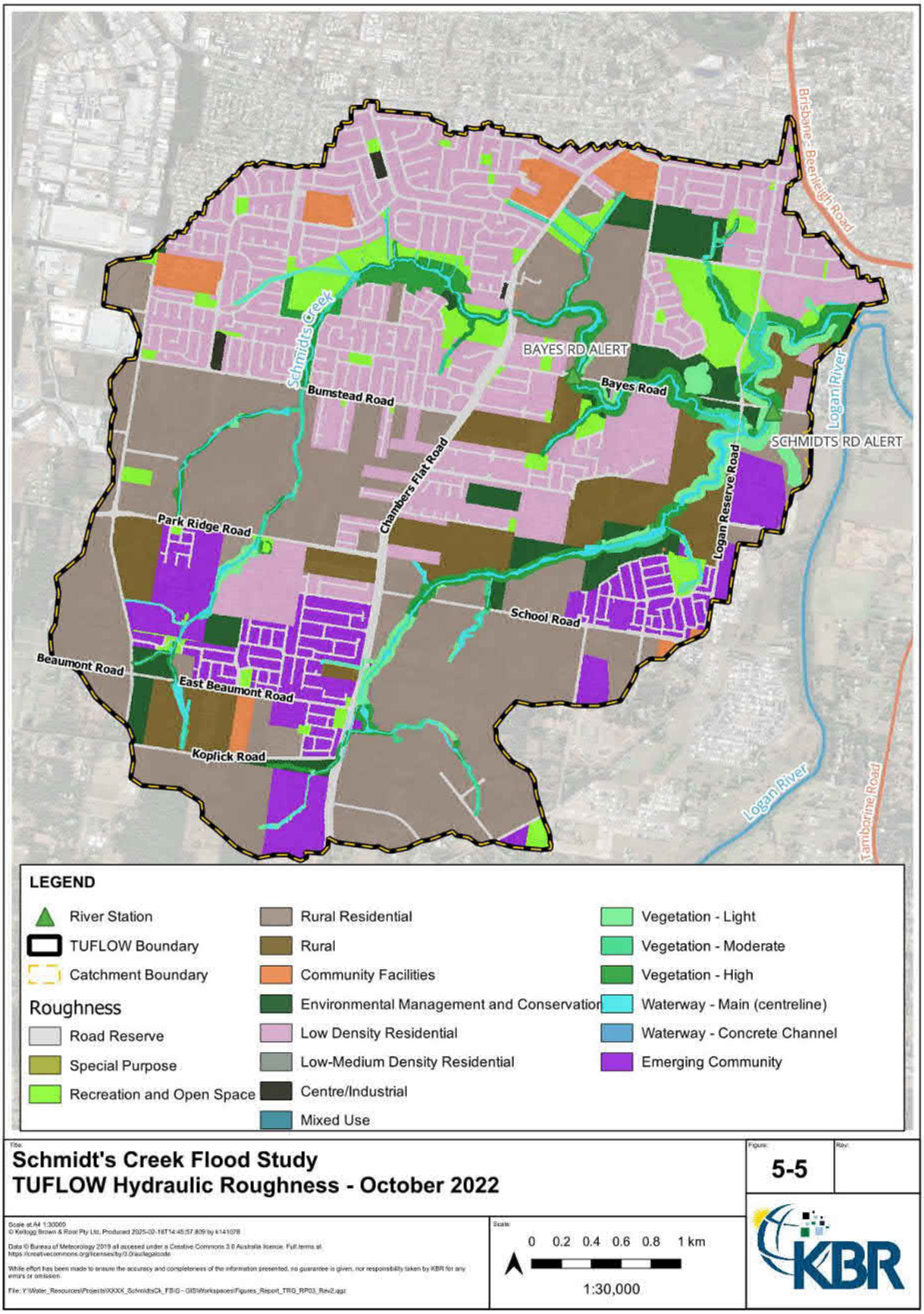



Figure 5-5 TUFLOW hydraulic roughness – October 2022 event

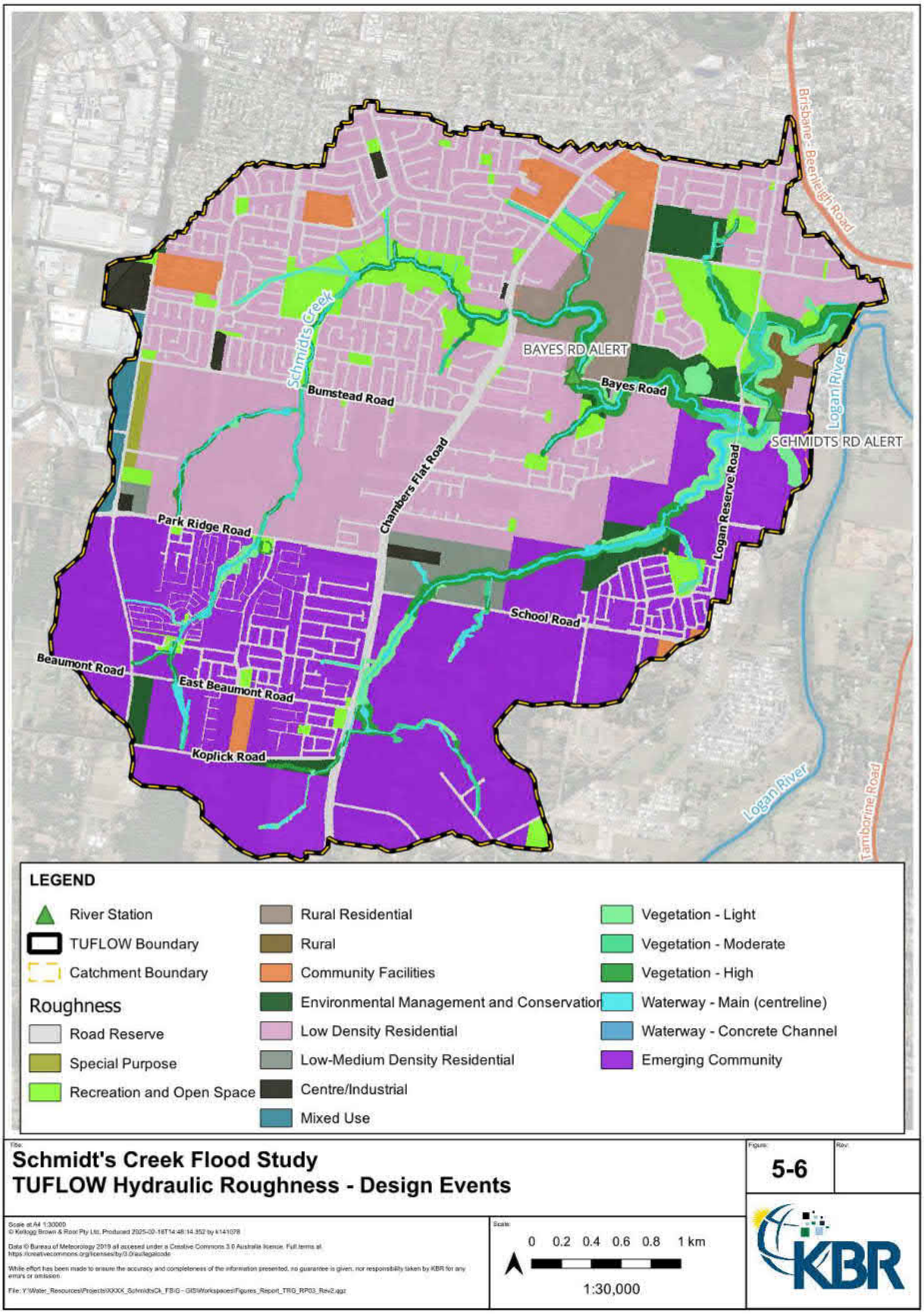



Figure 5-6 TUFLOW hydraulic roughness – Design event modelling

### 5.2.7 Hydraulic structures

A summary of all hydraulic structures included in the hydraulic model are provided below:

- 27 Box Culverts
- 101 Pipe culverts and underground pipes
- 18 Pits
- 5 Bridges.

Figure 5-7 presents the modelled hydraulic structures within the TUFLOW hydraulic model. Further details of the hydraulic structure modelled in TUFLOW are provided in Appendix B.

#### 5.2.7.1 Culverts

Culverts which immediately affect the flooding within the waterway corridor were included within the hydraulic modelling. Culverts not located immediately in the waterway corridor's flow path, but which are within the vicinity of the waterway and where backwater flows may occur (usually into basins) were also included. Culverts are represented within the TUFLOW model as 1D elements (1d network). The locations of the culverts are presented in Figure 5-7.

Culverts dimensions were obtained from:

- Council's stormwater network GIS database
- Council's supplied culvert survey
- Site Visit undertaken by KBR.

Where invert levels were missing from the database, or where there were large anomalies between the LiDAR and the recorded invert levels, the LiDAR levels were assigned as the culverts invert levels in the 1D network to ensure smooth flow transition between TUFLOWs 1D and 2D domain. The culvert configurations modelled in TUFLOW are provided in Appendix B.

#### 5.2.7.2 Bridges

Bridges were represented in the TUFLOW model as 2d layered flow constrictions (2d_lfcsh) polylines. The locations of the bridges are presented in Figure 5-7.

There are five bridges, mainly footbridges with widths no more than 5 m, located within the waterway corridor in the Schmidt's Creek catchment. Of the five bridges, only one of the bridges has nominally sized piers, while the remaining four bridges are open single span bridges. Three of the bridges do not have railings.

Deck depths, bridge widths and railing heights were measured for three of the bridges during the site visit. The LCC survey identified a further two bridges, with measurements provided as well.

At four of the bridge locations, LiDAR has picked up the bridge levels. Modifications to the topography were applied to remove the bridges from the topography using the 2d shape adjustment (2d_zsh) within the TUFLOW domain so that flow can pass below the modelled bridge decks modelled using the 2d_lfcsh method. The bridge configurations modelled in TUFLOW are provided in Appendix B.

#### 5.2.7.3 Underground drainage network

As the main focus of the study is the creek flooding, the underground urban drainage network within the urban areas was excluded from the modelling. Underground pipes within the main creek floodway which connected to detention basins were included to account for backwater flow into the basins.

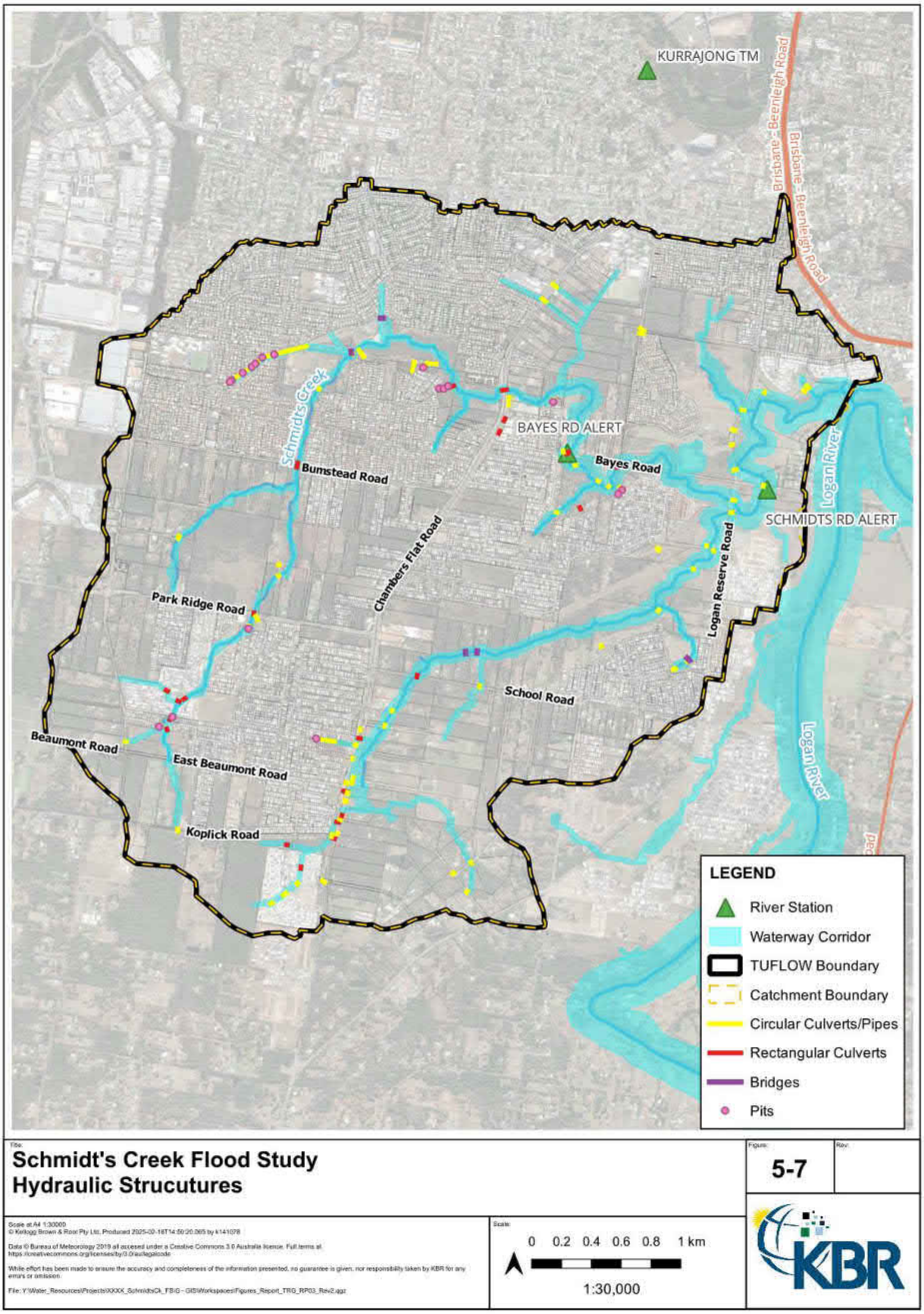



**Figure 5-7 Hydraulic structures within the study area**

# 6 Joint Calibration Modelling Methodology

## 6.1 JOINT CALIBRATION

Joint calibration for the developed Schmidt's Creek hydrologic and hydraulic models were conducted against recorded water levels at Bayes Road AL and Schmidt's Road AL located in the lower reaches of the catchments. There were no other recorded calibration data provided to calibrate the hydrologic and hydraulic models against.

The events selected (March 2018, February 2020 and October 2022) for calibration have been presented and discussed in Section 3.5.1. These three calibration events were jointly calibrated in the hydrologic and hydraulic model.

Inflow hydrographs for the three events were predicted by the URBS hydrological model and input as inflows into the TUFLOW hydraulic model.

The results from the hydraulic model were then compared against the recorded water levels at the Bayes Road and Schmidt's Road gauges.

The following sections outline the inputs into the hydrologic and hydraulic models to conduct the calibration event modelling.

## 6.2 HYDROLOGIC MODEL

### 6.2.1 Assignment of rainfall gauges to sub-catchments

The Schmidt's Road Alert gauge is the only rainfall gauge located immediately within the Schmidt's Creek catchment. Other rainfall stations on the outskirts of the catchments included the Waterford Alert gauge (Station ID:040878), Marsden First Avene (Station ID: 540078), Park Ridge Alert gauge at Stoney Camp Road (Station ID:540787) and Waller Road (Station ID: 540692).

The Thiessen Polygon method was used to assign rainfall gauges to the delineated sub-catchments and is shown in Figure 6-1. Sub-catchments which are fully within a polygon were assigned the respective rainfall station. Sub-catchments which cross two or more Thiessen polygons were assigned with the rainfall gauge that contributed the majority of the area. The Thiessen Polygon method resulted in most of the sub-catchments being assigned with the Schmidt's Road gauge, and much of the northern sub-catchments assigned to the Marsden rainfall gauge.

Small portions of some sub-catchments in the far-western area of the model are partially within the Thiessen polygons associated with the Park Ridge and Waller Road rainfall stations. These sub-catchments were assigned either the Marsden or Schmidt's Road rainfall stations based on their proximity to the relevant polygons.

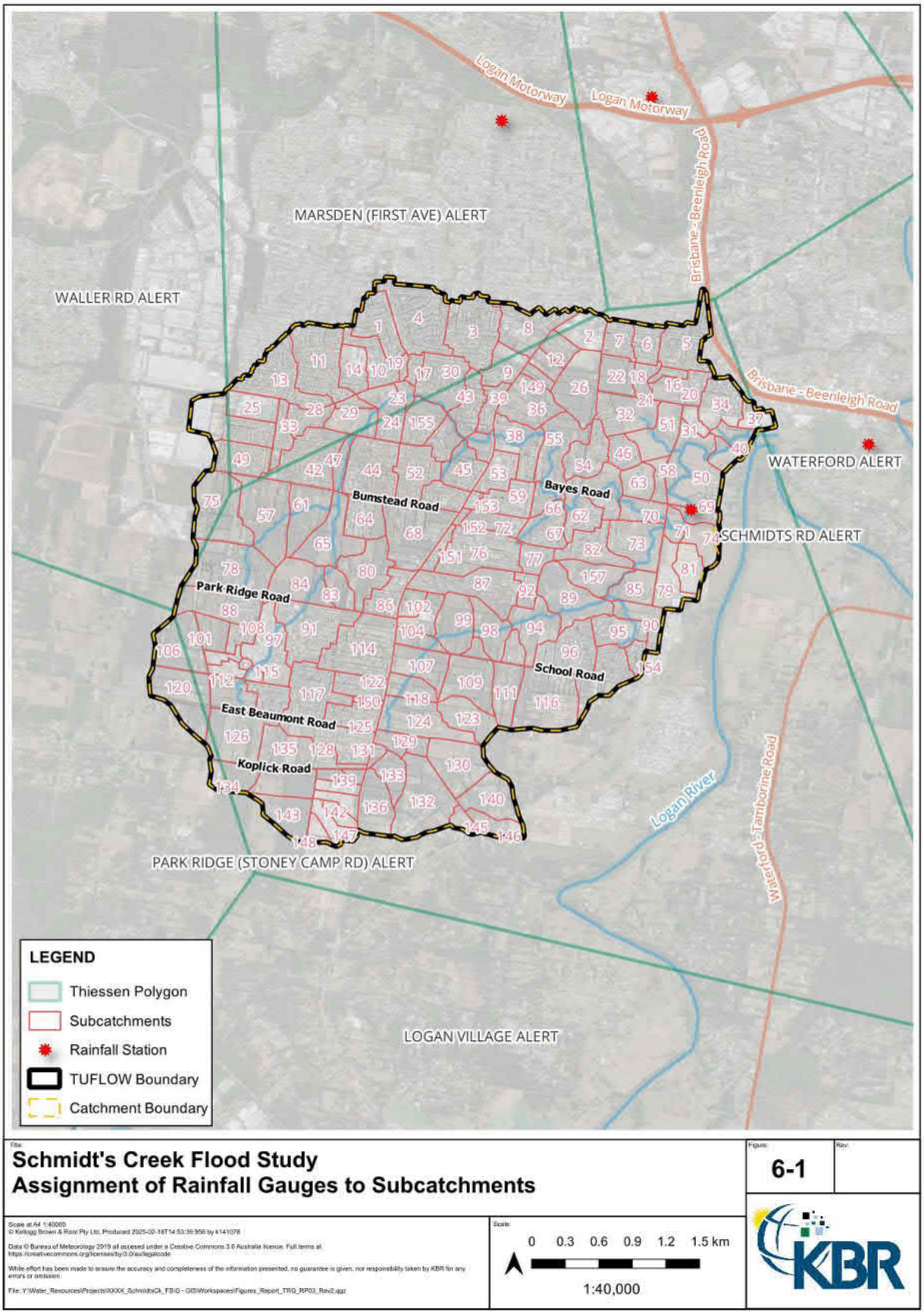



**Figure 6-1 Assignment of rainfall gauges to sub-catchments**

### 6.2.2 Rainfall data and temporal patterns

Total rainfall and temporal patterns for the chosen historic events were taken from the pluviograph rainfall data recorded at Schmidt's Road and Marsden First Avenue rainfall gauges.

A summary of the rainfall recorded at the Schmidt's Road and Marsden rainfall gauges for the calibration events is presented in Table 6-1. The cumulative rainfall records are also presented in Figure 6-2, Figure 6-3 and Figure 6-4.

**Table 6-1 Summary of rainfall data for calibration events**

| Event | Cumulative rainfall (mm) – Schmidt's Rd AL | Cumulative rainfall (mm) – Marsden AL | Start time | End time |
|---|---|---|---|---|
| March 2018 | 100 | 107 | 5/03/2018 12:30 PM | 8/03/2018 12:30 AM |
| February 2020 | 213 | 188 | 5/02/2020 5:45 PM | 10/02/2020 5:45 PM |
| October 2022 | 62 | 50 | 21/10/2022 5:00 PM | 26/10/2022 5:00 AM |

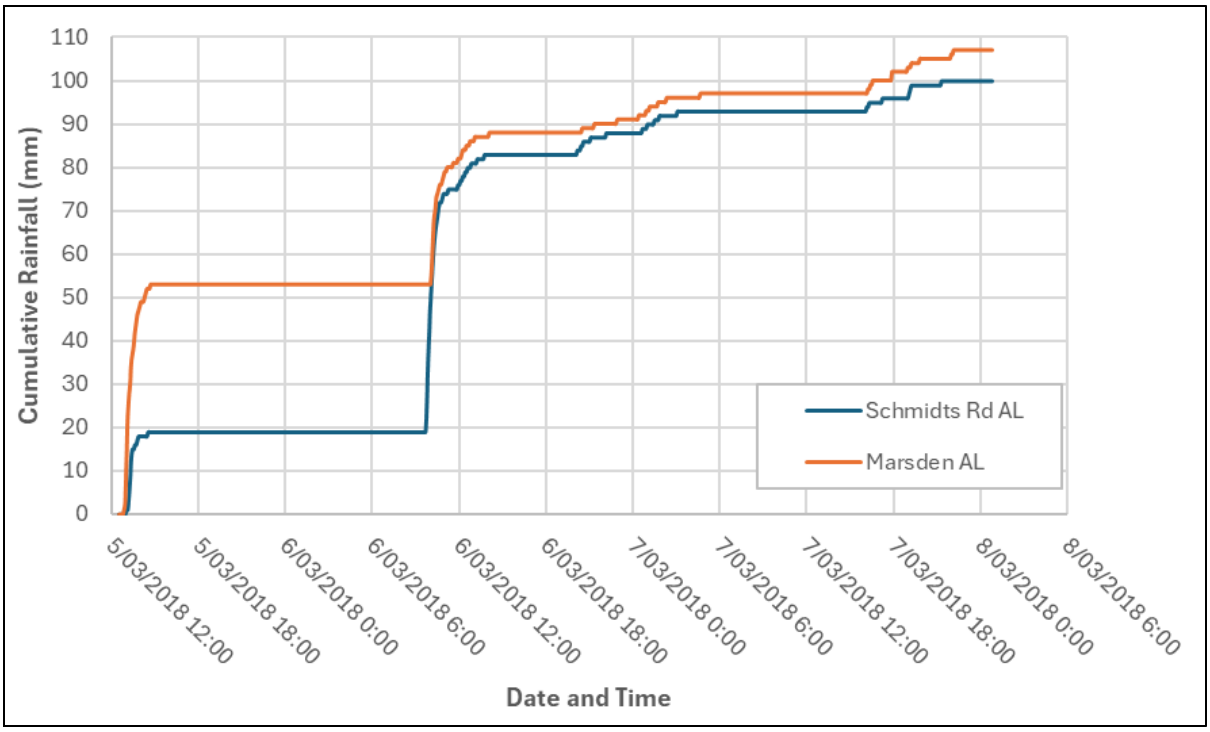



**Figure 6-2 Cumulative rainfall – March 2018 event**

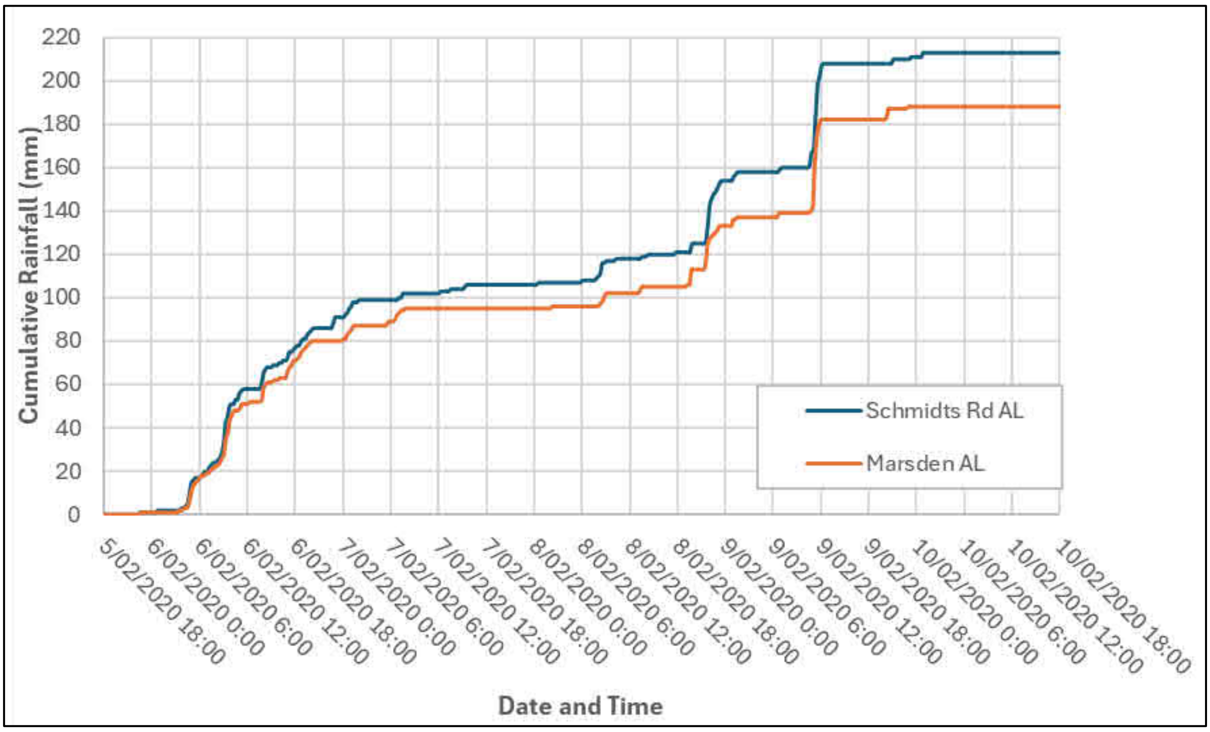



**Figure 6-3 Cumulative rainfall – February 2020 event**

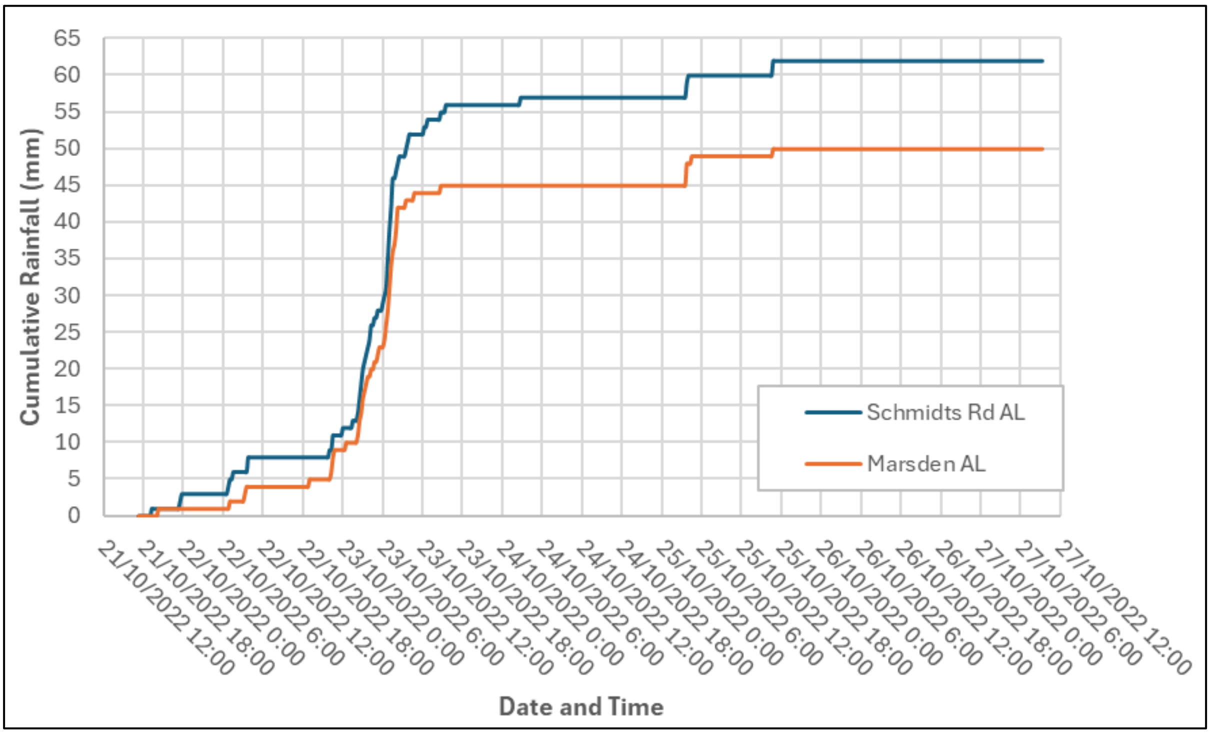



**Figure 6-4 Cumulative rainfall – October 2022 event**

### 6.2.3 URBS model parameters

The URBS hydrologic parameters, channel lag parameter (alpha), catchment lag parameter (beta) and catchment non-linearity parameter (m), were adjusted in order to replicate the catchment response of the calibration events suitably. Extensive calibration was undertaken to ensure that the same model parameters were applicable for the chosen calibration events. The final model parameters adopted for all three calibration events is summarised as below.

- Alpha = 0.03
- Beta = 1.5
- m = 0.8.

### 6.2.4 Initial and continuing losses

The URBS model applies zero losses to the impervious part of a sub-catchment. Initial loss and continuing loss specified within the URBS model are applied to the pervious part of the catchment. The initial losses and continuing losses were adjusted for each calibration event to achieve suitable calibration at the gauges. There was notable variance of initial losses determined in the calibration modelling which may be attributed to antecedent conditions for each calibration event. The initial losses and continuing losses from the calibration modelling are provided in Table 6-2.

**Table 6-2 Initial loss and continuing losses adopted for calibration events**

| Event | Initial loss (mm) | Continuing loss (mm/h) |
|---|---|---|
| March 2018 | 80 | 3 |
| February 2020 | 170 | 3 |
| October 2022 | 50 | 3 |

## 6.3 HYDRAULIC MODEL

### 6.3.1 Outflow boundaries

The three historic events identified for calibration are influenced by tidal behaviour in the Logan River and thus required an estimate of tailwater conditions at the outlet of the study area.

Nearby to the confluence on the Logan River, the Waterford Alert Gauge and the Logan Village Alert both record water levels (including tidal influence) of the Logan River. The Waterford Alert Gauge is approximately 4.4 km downstream of the creek confluence, whilst the Logan Village Way Alert is situated approximately 11 km upstream.

The recorded tailwater levels in the Logan River at the Waterford Alert gauge was translated to the outlet of the Schmidt's Creek as follows:

- Recorded peak water levels were compared at the Waterford Alert and Logan Village to determine the average differences between the two gauging stations during the period of the calibration events.
- The time of the recorded peak water levels at the two Logan River gauges were compared to determine the approximate average travel time between the two stations.
- The difference in tidal water levels and travel time from Waterford Gauge to the Schmidt's Creek confluence was then approximated with reference to the distance, time and levels of the two Logan River gauges.
- The recorded water levels and time stamps were adjusted to estimate tailwater conditions at the outlet during the selected calibration events.

The peak height and timing assessment suggests that the Schmidt's Creek confluence experiences a peak tide 19 minutes later than Waterford Gauge. The differences in peak height varied for each calibration event and is presented in Table 6-3. These adjustments were applied to the recorded data at Waterford Gauge to simulate Schmidt's Creek tailwater conditions from Logan River for all the calibration events.

**Table 6-3 Adjustments to tailwater conditions for calibration events**

| Calibration Event | Peak Water level difference (m) | Peak time difference (minutes) |
|---|---|---|
| March 2018 | -0.06 | 19 |
| February 2020 | -0.10 | 19 |
| October 2022 | +0.12 | 19 |

Figure 6-5, Figure 6-6 and Figure 6-7 presents the predicted tailwater conditions for the March 2018, February 2020 and October 2022 calibration events, respectively.

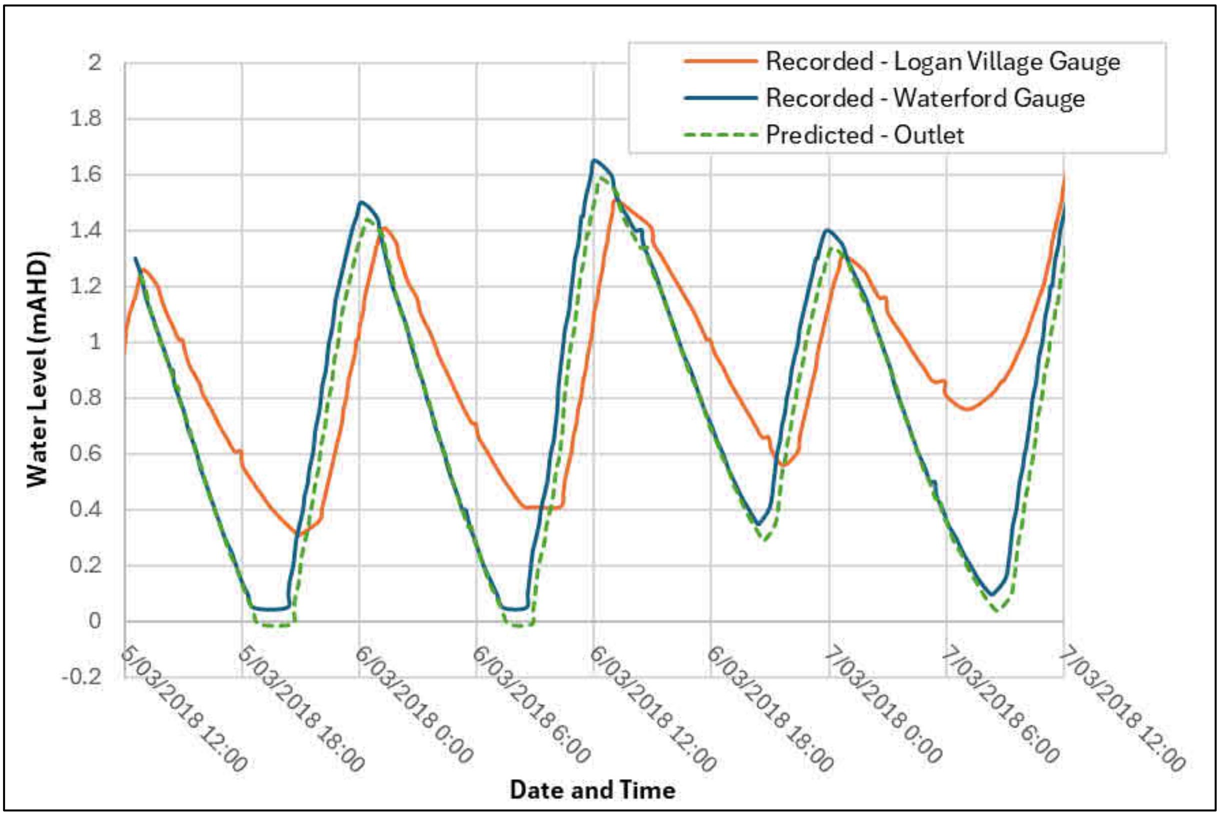



**Figure 6-5 Predicted tailwater conditions – March 2018 event**

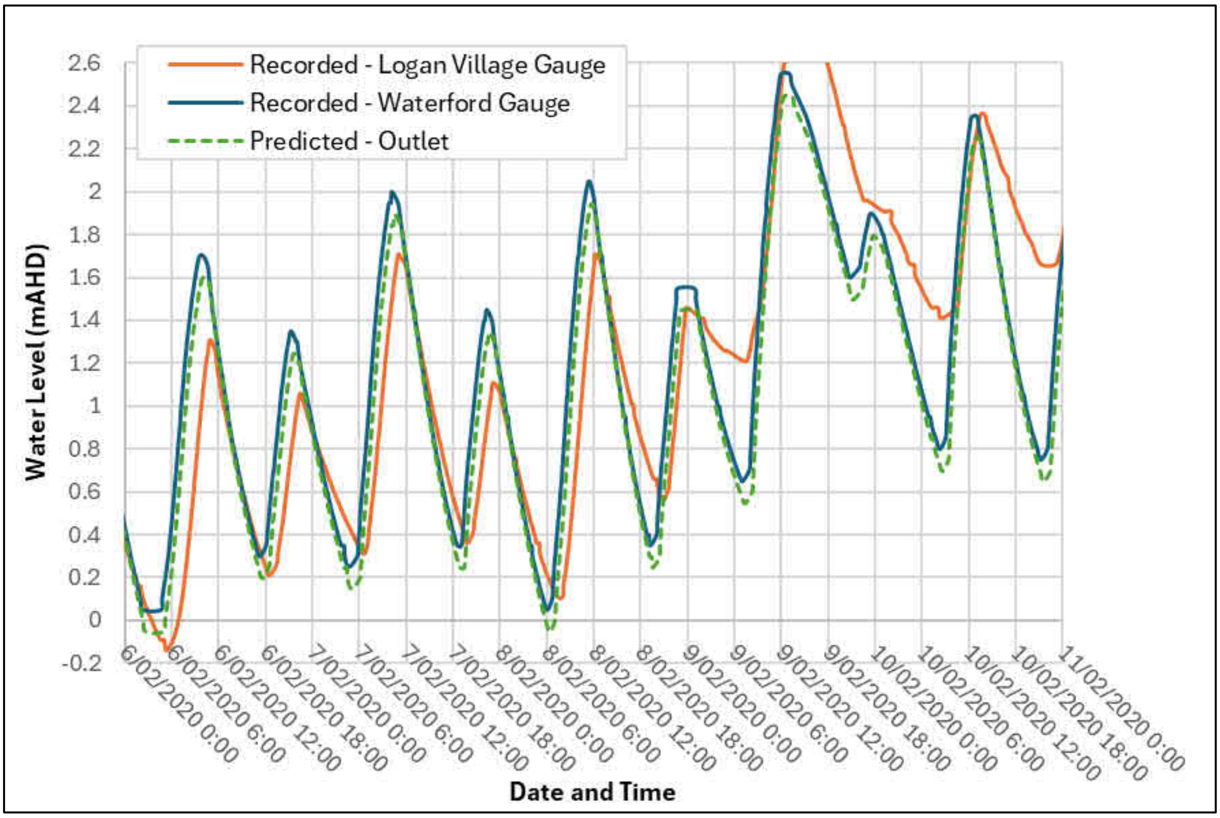



**Figure 6-6 Predicted tailwater conditions – February 2020 event**

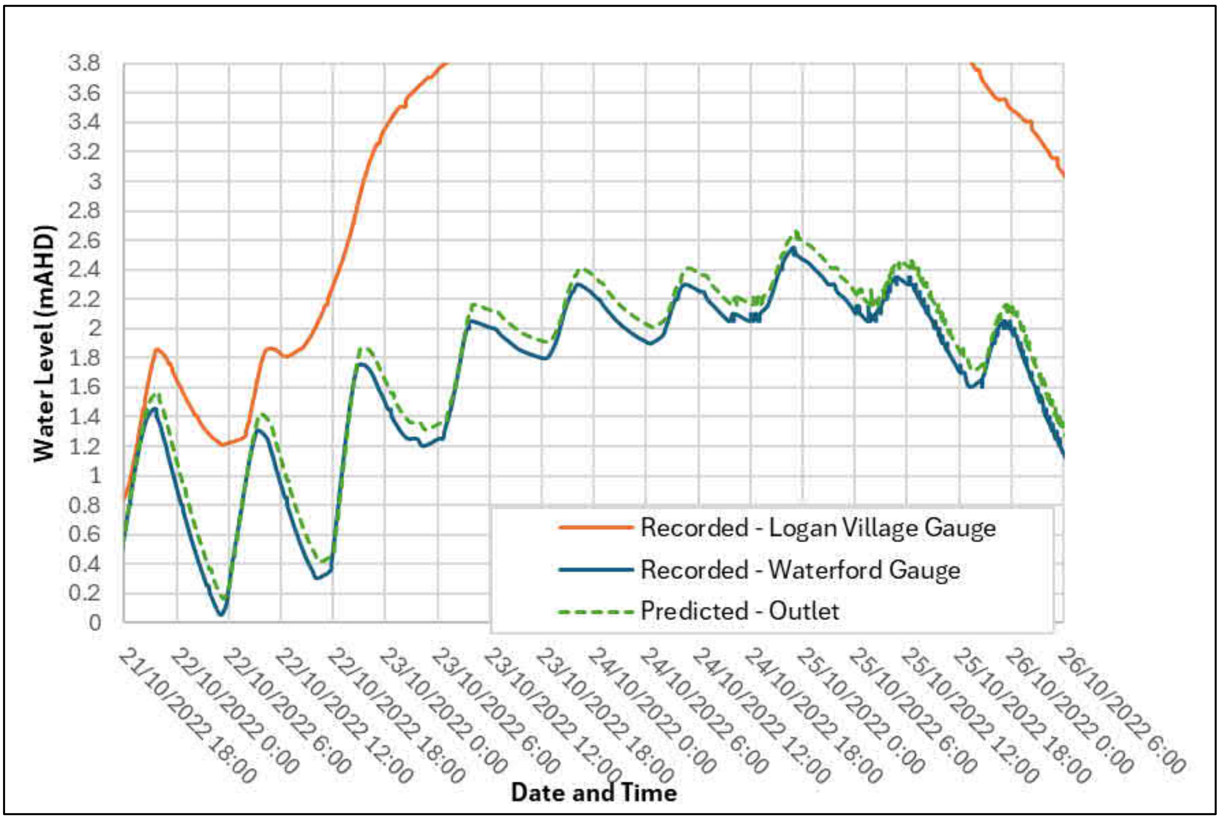



**Figure 6-7 Predicted tailwater conditions – October 2022 event**

# 7 Joint Calibration Modelling Results

## 7.1 MARCH 2018 CALIBRATION EVENT

### 7.1.1 Comparison of water level hydrograph

The modelled water levels for the March 2018 event from the TUFLOW model were compared against the recorded water levels at the Bayes Road and Schmidt's Road gauges. The modelled and recorded water levels at the two gauges are presented in Figure 7-1 and Figure 7-2. A comparison of the recorded water level data against the modelled results is also presented in Table 7-1. The flood depth mapping is provided in Figure 7-3.

The Bayes Road gauge did not record water levels during the start of the March 2018 event; presented as the constant water level at the start of the event and the absence of the first peak. There also appears to be a slight anomaly in the recorded peak water level which showed a sharp rise and fall over a short timeframe. Nevertheless, suitable calibration was observed as the modelled results achieved a similar shaped hydrograph and water levels as compared to the recorded data. A good timing of the peak water level was also observed, not including the slight irregularity of the recorded peak water level.

At the Schmidt's Road gauge, a suitable calibration was observed where the modelled results achieved a similar shaped hydrograph and water level as compared to the recorded data. The modelled peak timing occurred approximately one hour later than the recorded peak. A higher initial peak water level was simulated prior to the occurrence of the main peak.

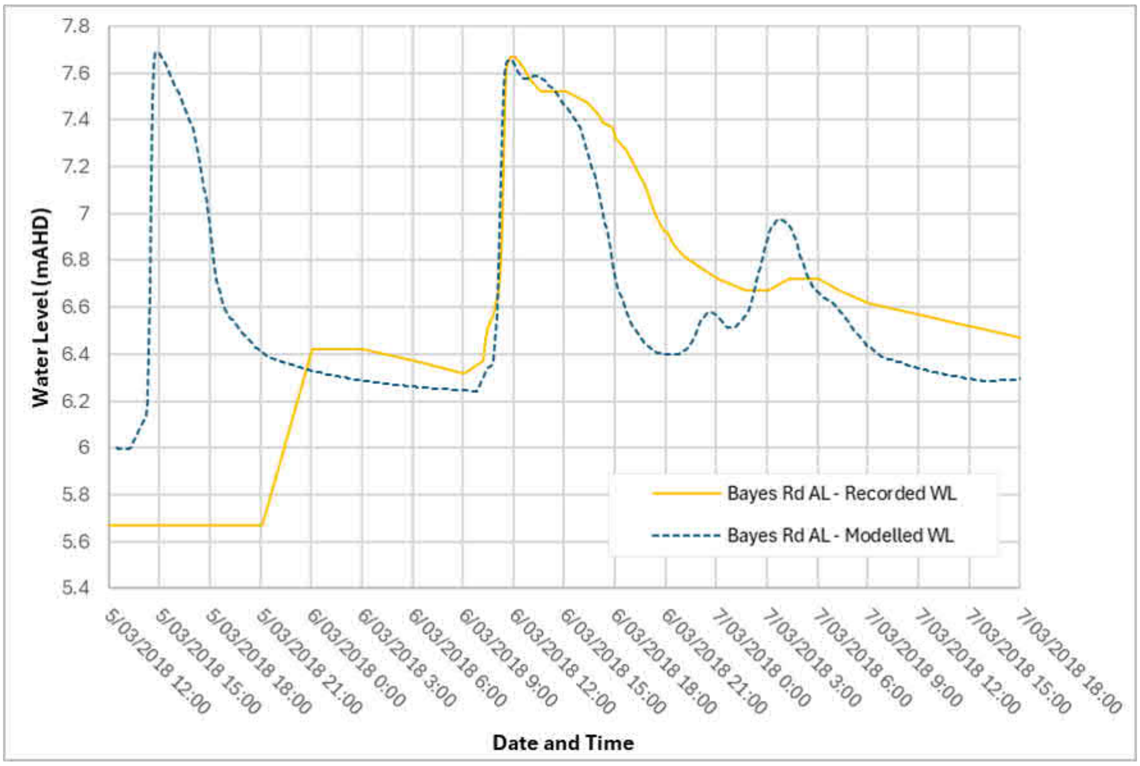



Figure 7-1 Modelled and recorded water levels at Bayes Road Alert (Station ID:540674) – March 2018

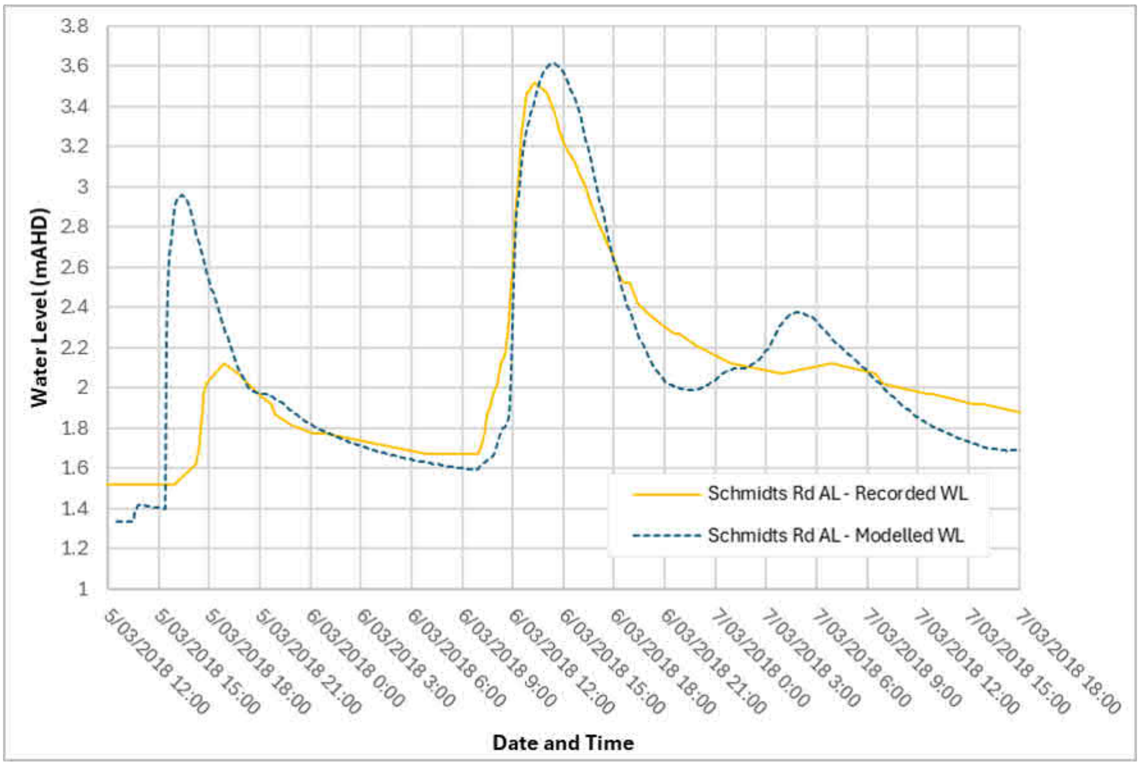



**Figure 7-2 Modelled and recorded water levels at Schmidt's Road Alert (Station ID:540675) – March 2018**

**Table 7-1 Comparison of recorded data against modelled calibration results – February 2020**

| Stream Gauge | Recorded Peak Water Level (mAHD) | Modelled Peak Water Level (mAHD) | Difference (m) | Recorded Time of Peak | Modelled Time of Peak | Difference (hours) |
|---|---|---|---|---|---|---|
| Bayes Rd AL | 7.67 | 7.66 | -0.01 | 6/03/2018 11:45 | 6/03/2018 11:45 | - |
| Schmidt's Rd AL | 3.52 | 3.62 | 0.10 | 6/03/2018 13:15 | 6/03/2018 14:25 | 1.17 |

### 7.1.2 Comparison of discharge hydrograph

The discharge hydrographs obtained from the URBS and TUFLOW model at the Bayes Road and Schmidt's Road gauges were compared and are shown in Figure 7-4 and Figure 7-5.

The peak discharges modelled in TUFLOW were slightly lower than the peak discharges modelled in URBS. The general timing and shape of the modelled hydrographs is similar between the modelled datasets, indicating similar modelled catchment responses.

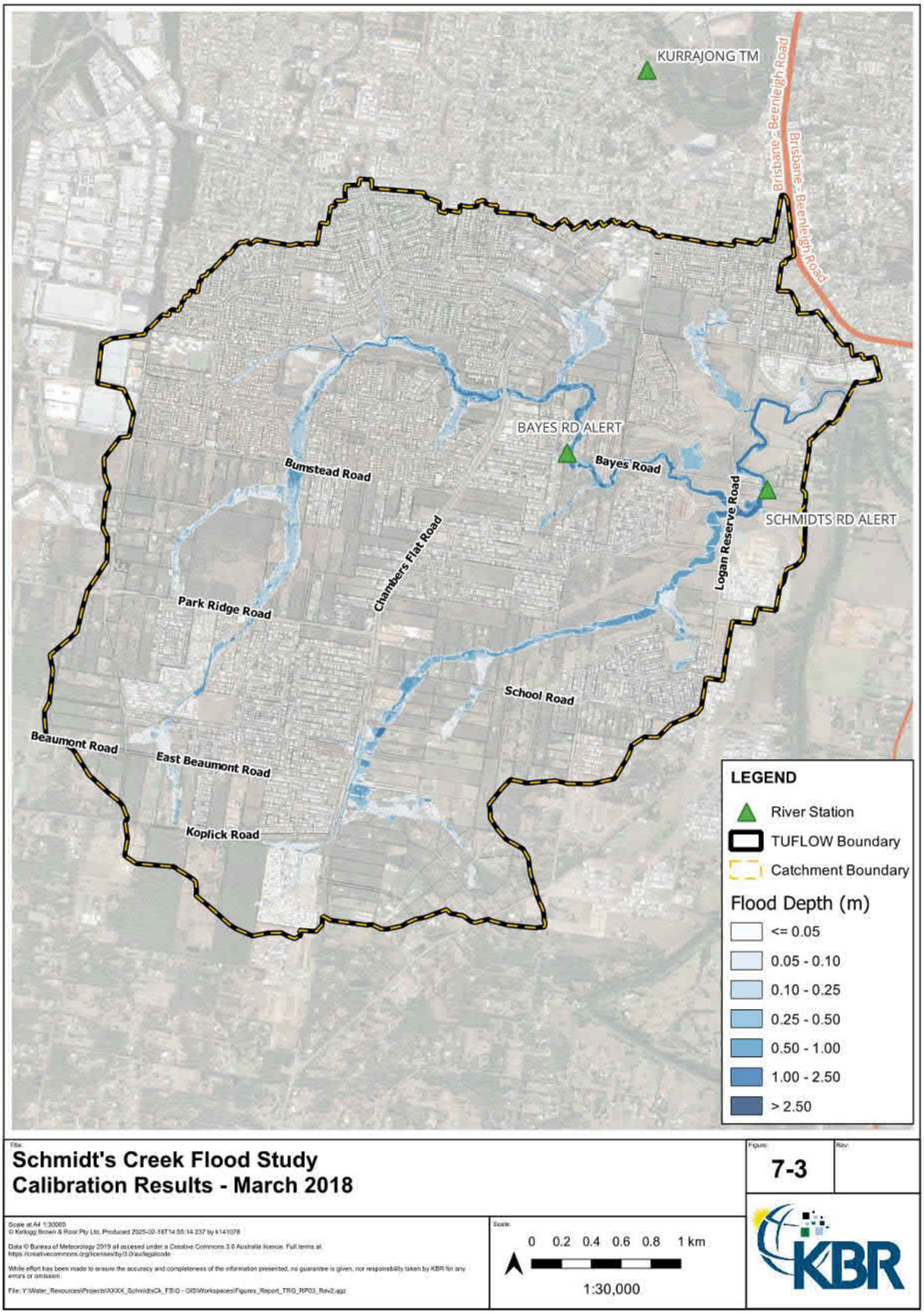



**Figure 7-3 Flood depth – March 2018**

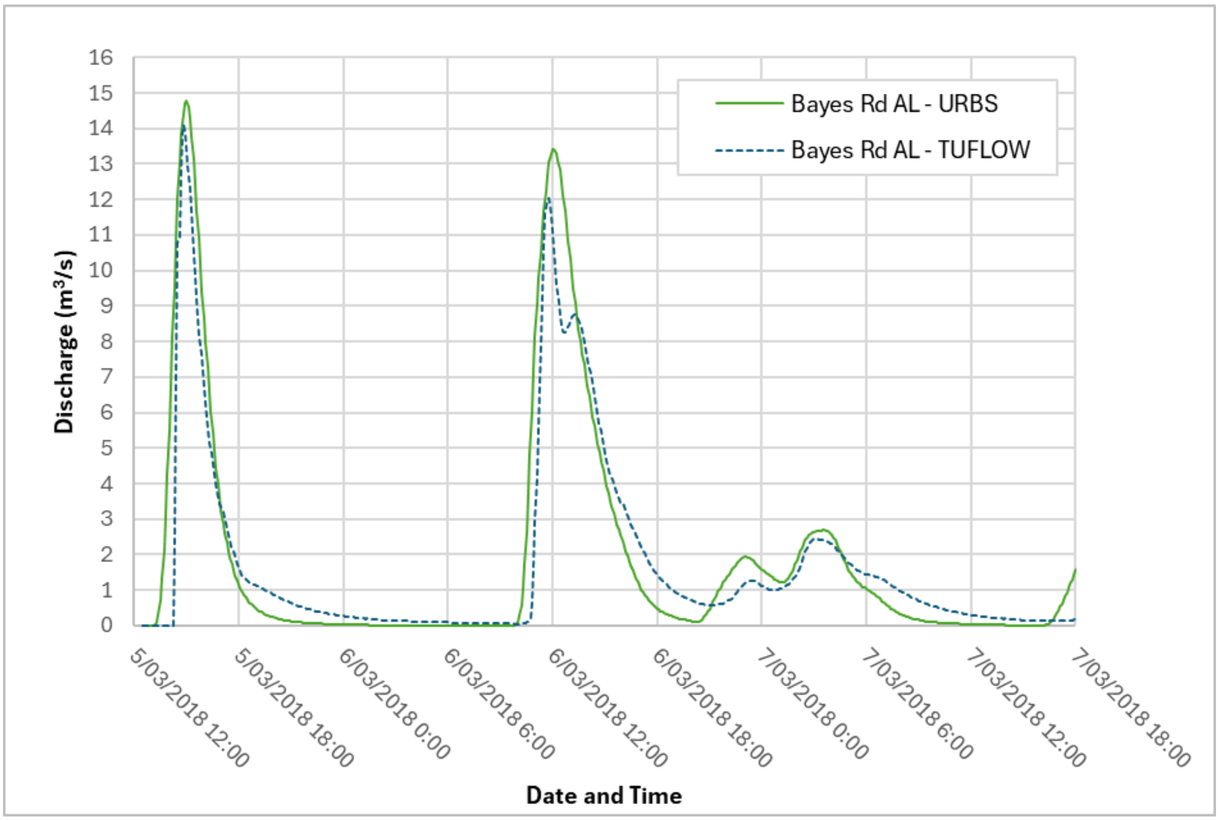



**Figure 7-4 Modelled URBS and TUFLOW discharges at Bayes Road Alert (Station ID:540674) – March 2018**

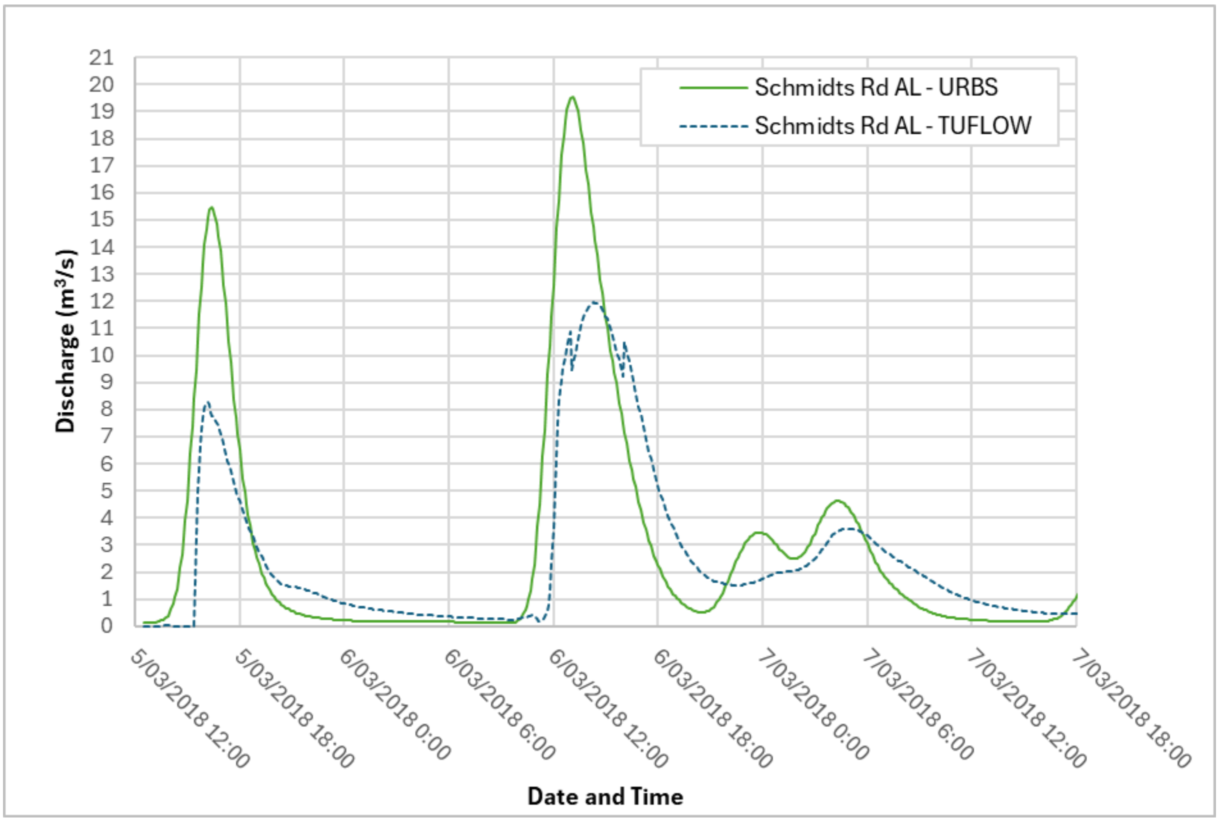



**Figure 7-5 Modelled URBS and TUFLOW discharges at Schmidt's Road Alert (Station ID:540675) – March 2018**

## 7.2 FEBRUARY 2020 CALIBRATION EVENT

### 7.2.1 Comparison of water level hydrograph

The hydraulic model results for the February 2020 event were compared against the recorded water levels at the Bayes Road and Schmidt's Road gauges. The modelled and recorded water levels at the two gauges are presented in Figure 7-6 and Figure 7-7. A comparison of the recorded water level data against the modelled results is also presented in Table 7-2. The flood depth mapping is provided in Figure 7-8.

At the Bayes Road gauge, the timing of the modelled peak water level occurred later, than the recorded peak level. The modelled peak water level was slightly higher than the recorded peak water level. Nonetheless, good calibration was observed with modelled results achieving similar shaped hydrograph and water levels when compared to the recorded data. A good match was observed on the rising and receding limbs of the modelled and recorded hydrographs.

At the Schmidt's Road gauge, suitable calibration of the main peak was observed, with the modelled results providing a similar shaped hydrograph, similar water levels and matching rising and receding limbs to the recorded water level data. The modelled peak timing occurred slightly later than the recorded peak time, with the modelled peak water level slightly higher than the recorded.

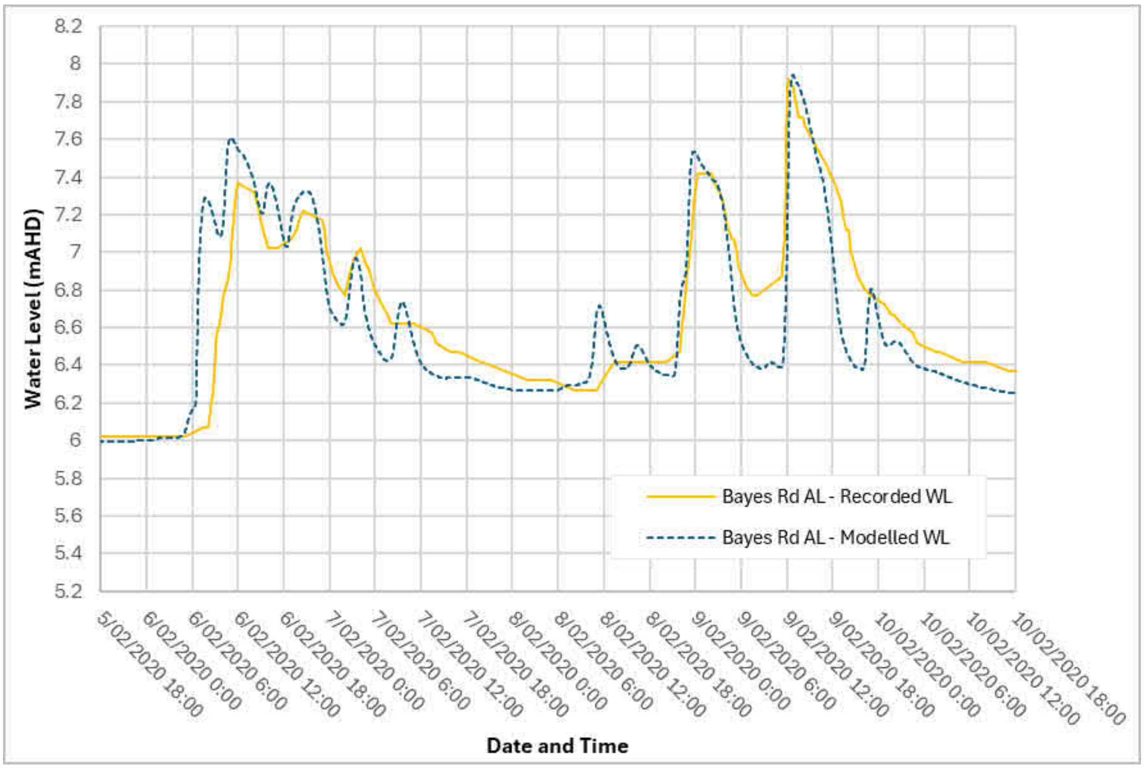



**Figure 7-6 Modelled and Recorded Water Levels at Bayes Road Alert (Station ID:540674) – February 2020**

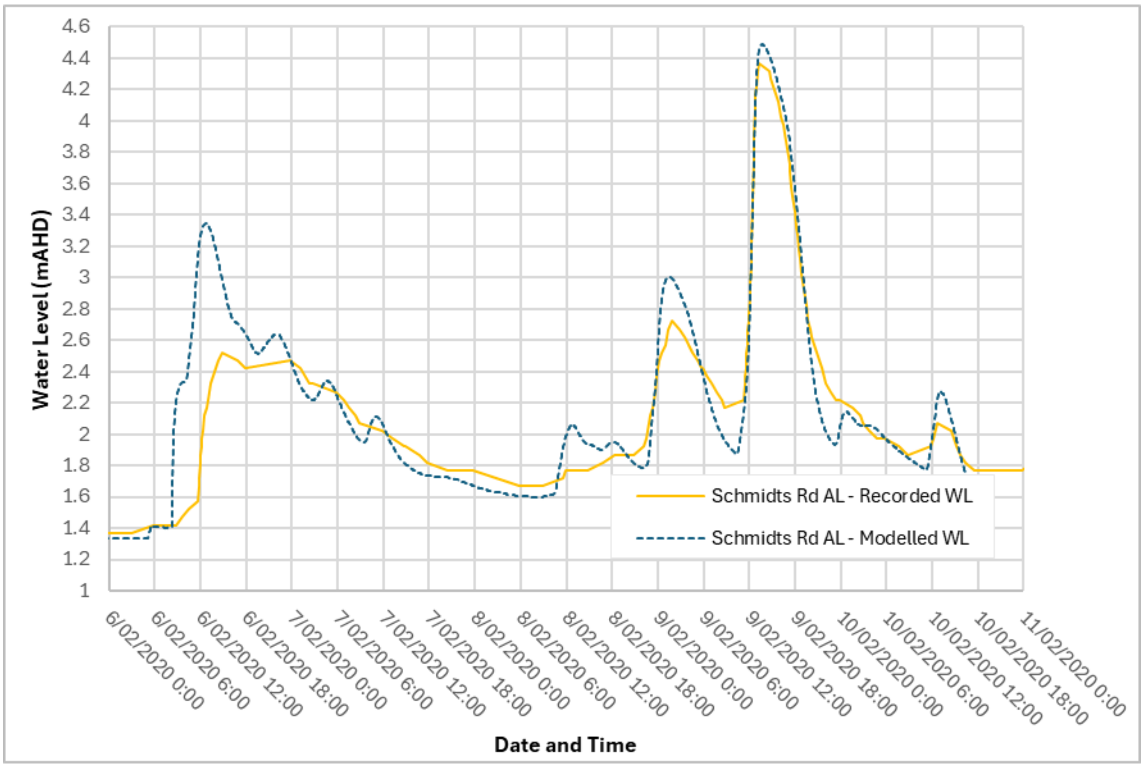



**Figure 7-7 Modelled and recorded water levels at Schmidt's Road Alert (Station ID:540675) – February 2020**

**Table 7-2 Comparison of recorded data against modelled calibration results – February 2020**

| Stream Gauge | Recorded Peak Water Level (mAHD) | Modelled Peak Water Level (mAHD) | Difference (m) | Recorded Time of Peak | Modelled Time of Peak | Difference (hours) |
|---|---|---|---|---|---|---|
| Bayes Rd AL | 7.92 | 7.94 | 0.02 | 9/02/2020 12:10 | 9/02/2020 12:45 | 0.58 |
| Schmidt's Rd AL | 4.37 | 4.49 | 0.12 | 9/02/2020 13:20 | 9/02/2020 13:40 | 0.33 |

### 7.2.2 Comparison of discharge hydrograph

The discharge hydrographs obtained from the URBS and TUFLOW model at the Bayes Road and Schmidt's Road gauges were compared and are shown in Figure 7-9 and Figure 7-10.

The peak discharges modelled in TUFLOW were slightly lower than the peak discharges modelled in URBS. The general timing and shape of the modelled hydrographs is similar between the modelled datasets, indicating similar catchment response in terms of routing.

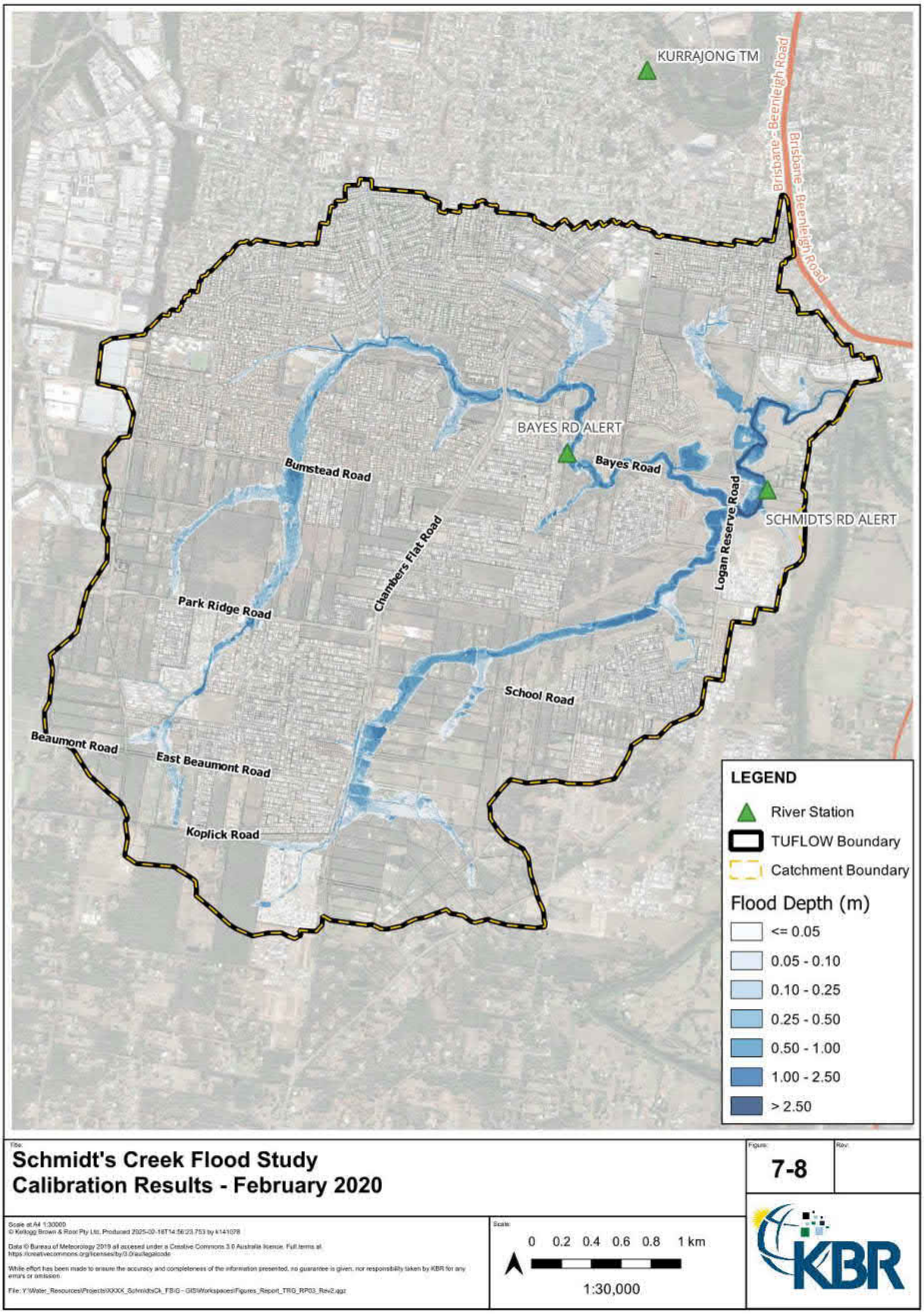



**Figure 7-8 Flood depth – February 2020**

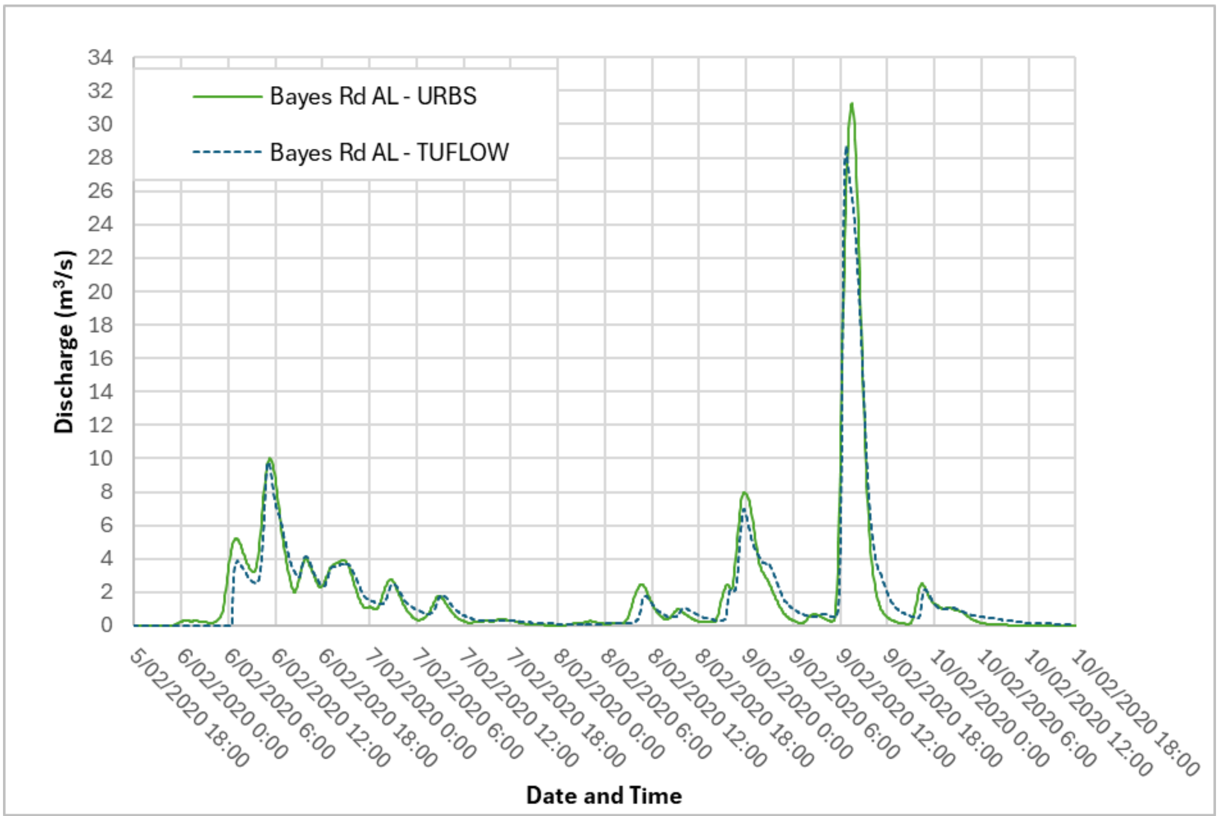



**Figure 7-9 Modelled URBS and TUFLOW discharges at Bayes Road Alert (Station ID:540674) – February 2020**

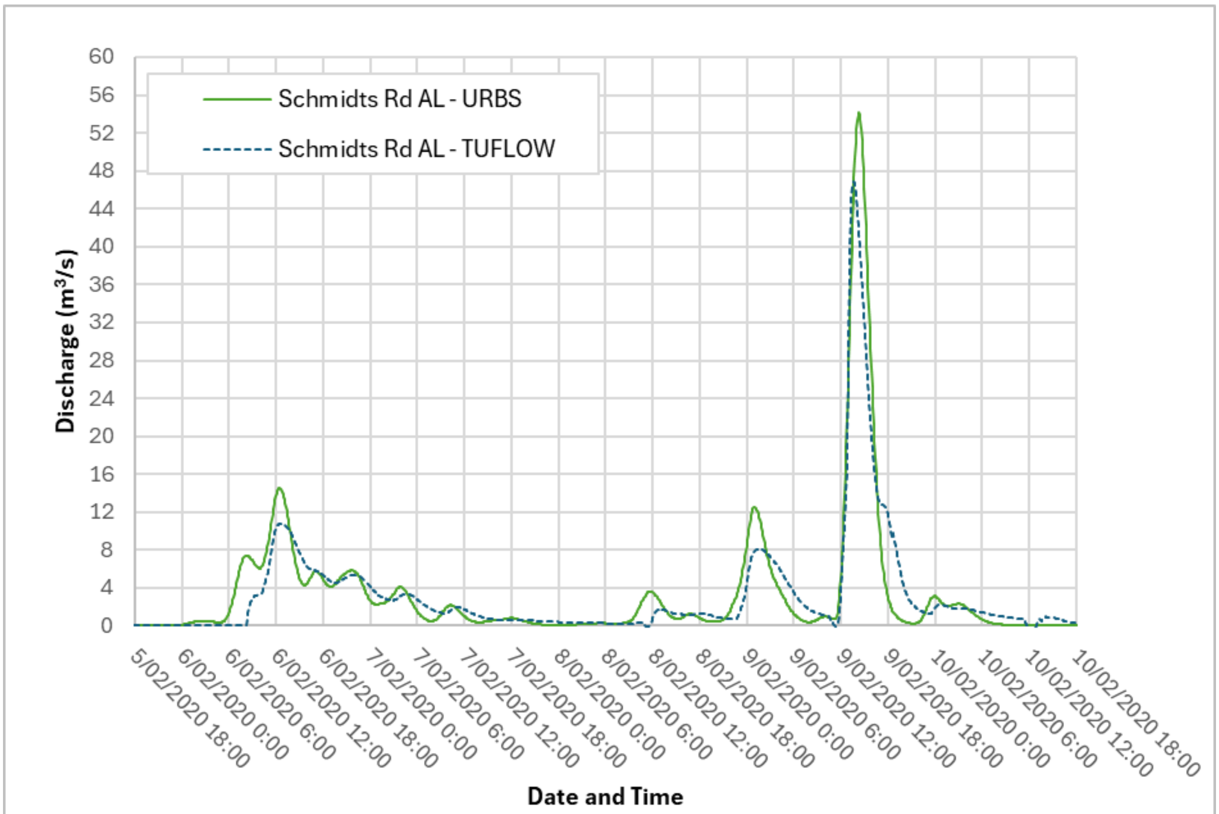



**Figure 7-10 Modelled URBS and TUFLOW discharges at Schmidt's Road Alert (Station ID:540675) – February 2020**

## 7.3 OCTOBER 2022 CALIBRATION EVENT

### 7.3.1 Comparison of water level hydrograph

The hydraulic model results for the October 2022 event were compared against the recorded water levels at the Bayes Road and Schmidt's Road gauges. The modelled and recorded water levels at the two gauges are presented in Figure 7-11 and Figure 7-12 The recorded and modelled water level data is presented in Table 7-3. The flood depth mapping is provided in Figure 7-13.

At the Bayes Road gauge, good calibration was observed with modelled results achieving similar shaped hydrograph and water levels when compared to the recorded data, with a good match on the rising and receding limbs of the hydrograph.

During the October 2022 event, the Schmidt's Road gauge was affected by minor tailwater conditions from the Logan River as shown by the regular tidal pattern. Suitable calibration was observed particularly regarding timings of the tidal influence peaks. The main peak water level at the start of the calibration event was modelled to be higher than recorded water levels. Following which, lower tidal peaks were simulated, highlighting the uncertainty in predicting the outflow boundaries.

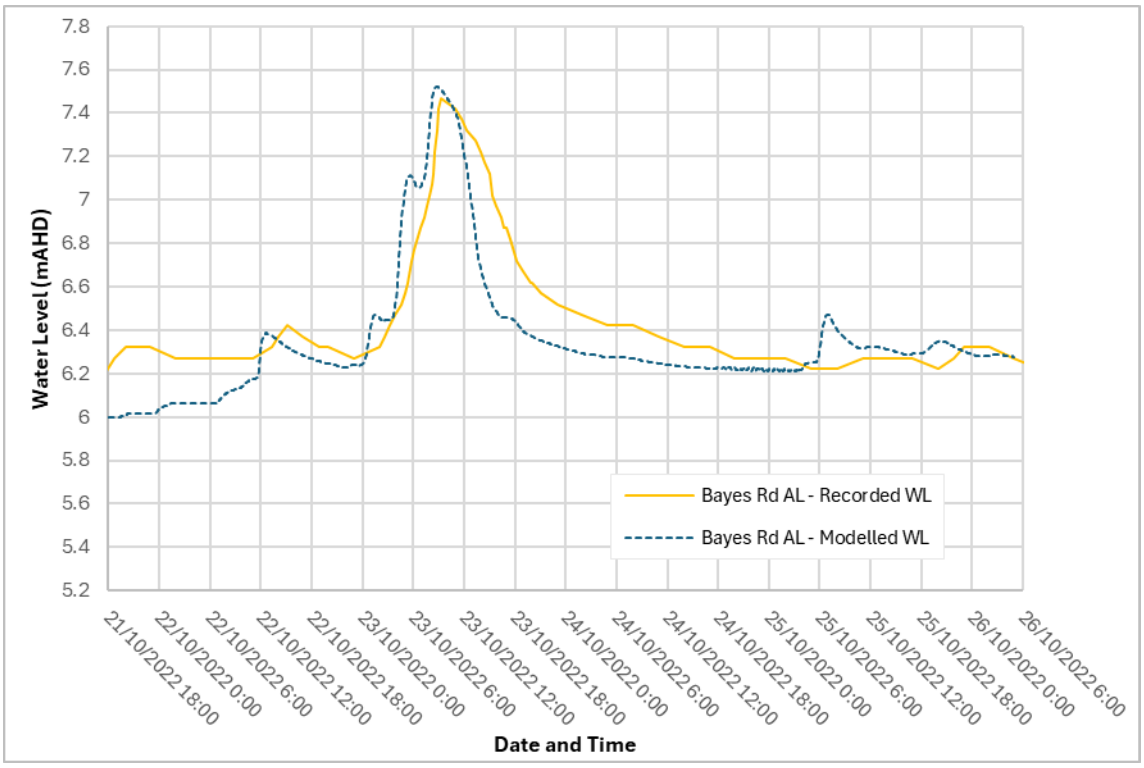



**Figure 7-11 Modelled and recorded water levels at Bayes Road Alert (Station ID:540674) – October 2022**

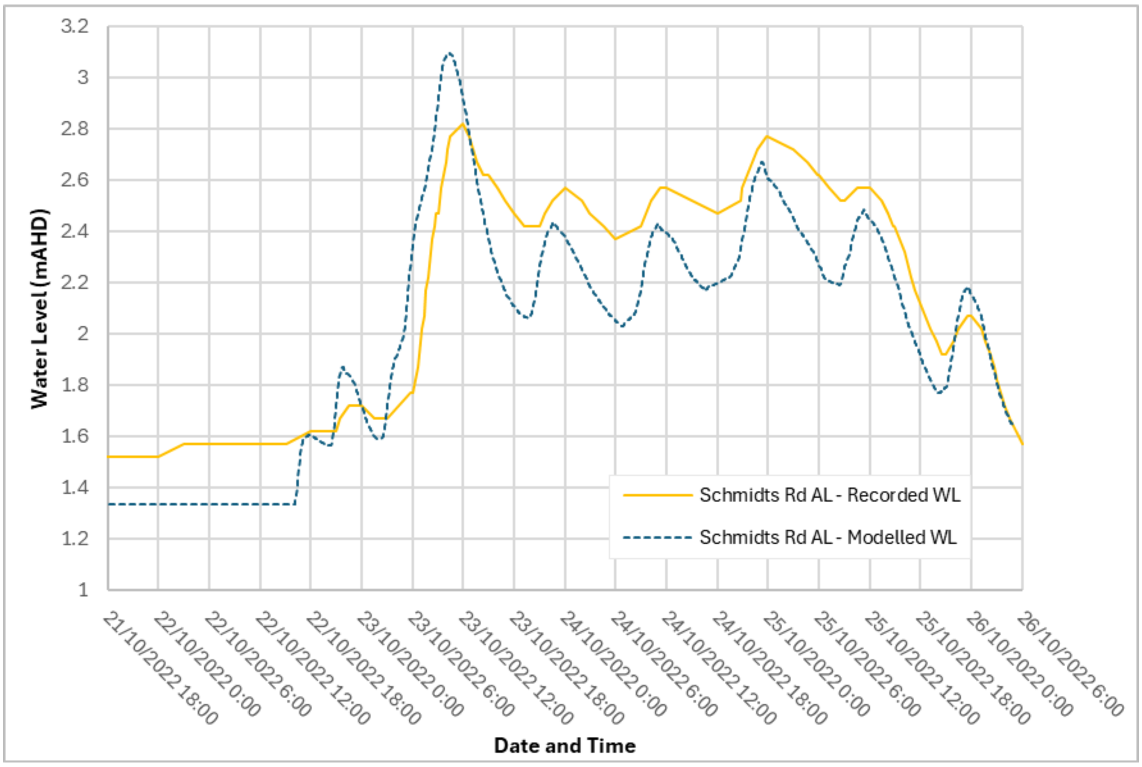



**Figure 7-12 Modelled and recorded water levels at Schmidt's Road Alert (Station ID:540675) – October 2022**

**Table 7-3 Comparison of recorded data against modelled calibration results – October 2022**

| Stream Gauge | Recorded Peak Water Level (mAHD) | Modelled Peak Water Level (mAHD) | Difference (m) | Recorded Time of Peak | Modelled Time of Peak | Difference (hours) |
|---|---|---|---|---|---|---|
| Bayes Rd AL | 7.47 | 7.52 | 0.05 | 23/10/2022 9:15 | 23/10/2022 8:45 | -0.50 |
| Schmidt's Rd AL | 2.82 | 3.09 | 0.27 | 23/10/2022 12:00 | 23/10/2022 10:20 | -1.67 |

### 7.3.2 Comparison of discharge hydrograph

The discharge hydrographs obtained from the URBS and TUFLOW model at the Bayes Road and Schmidt's Road gauges were compared and are shown in Figure 7-14 and Figure 7-15.

The peak discharges modelled in TUFLOW were slightly lower than the peak discharges modelled in URBS. The general timing and shape of the modelled hydrographs is similar between the modelled datasets, indicating similar catchment response in terms of routing.

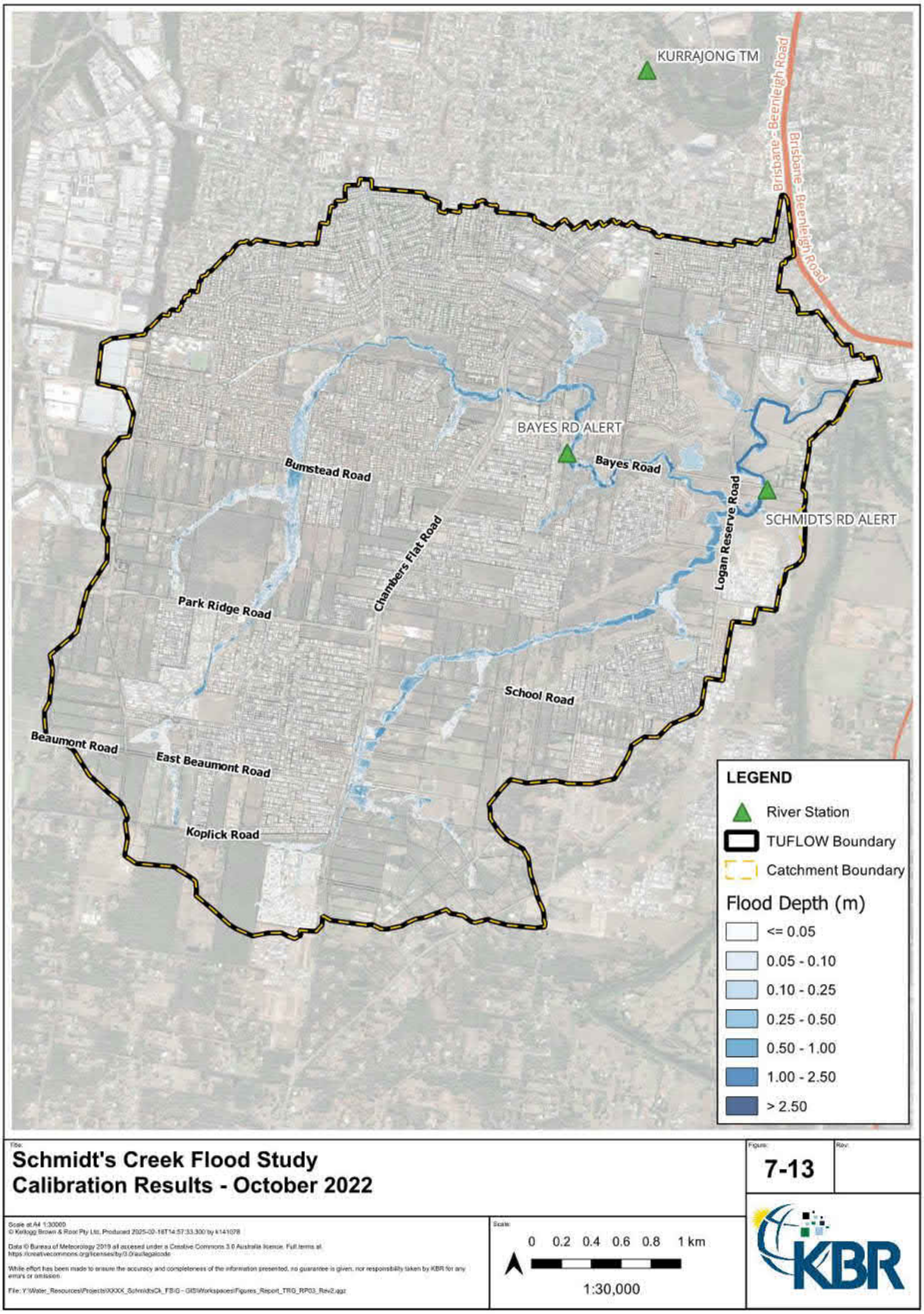



**Figure 7-13 Flood depth – October 2022**

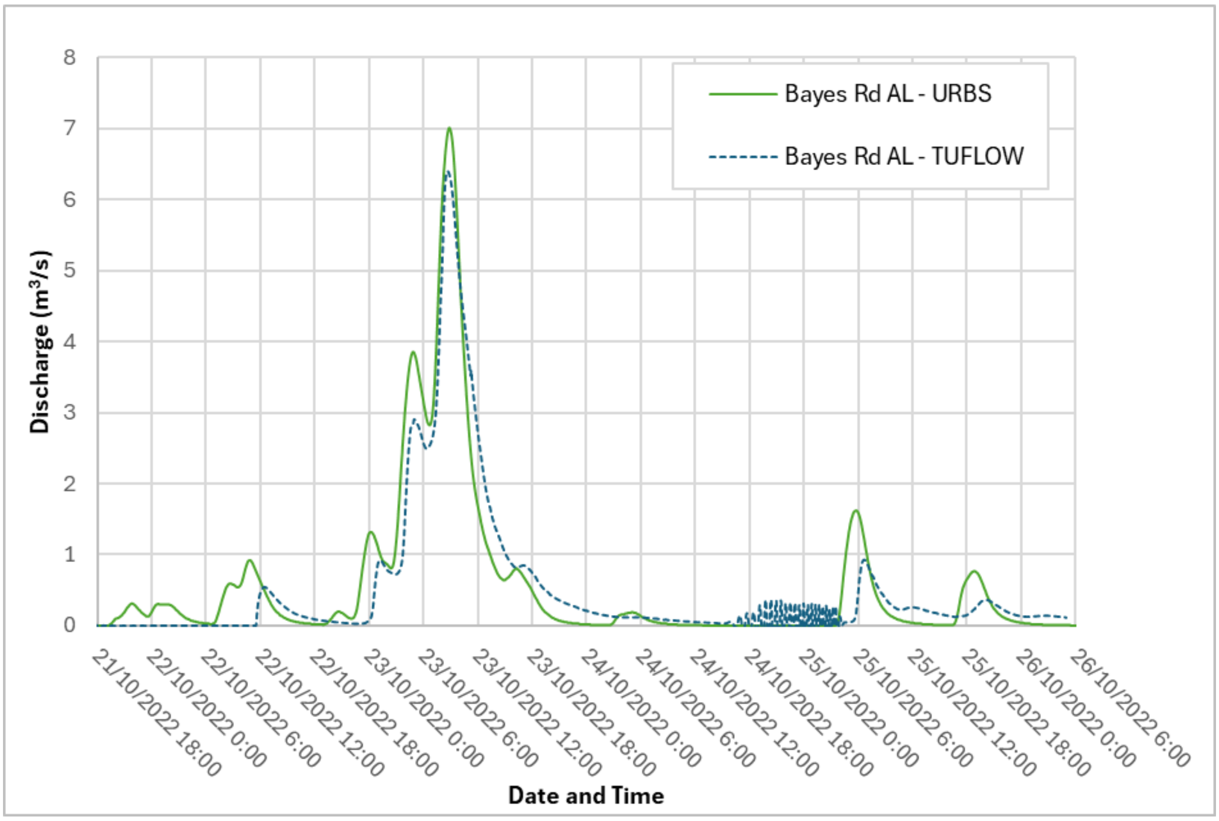



**Figure 7-14 Modelled URBS and TUFLOW discharges at Bayes Road Alert (Station ID:540674) – February 2020**

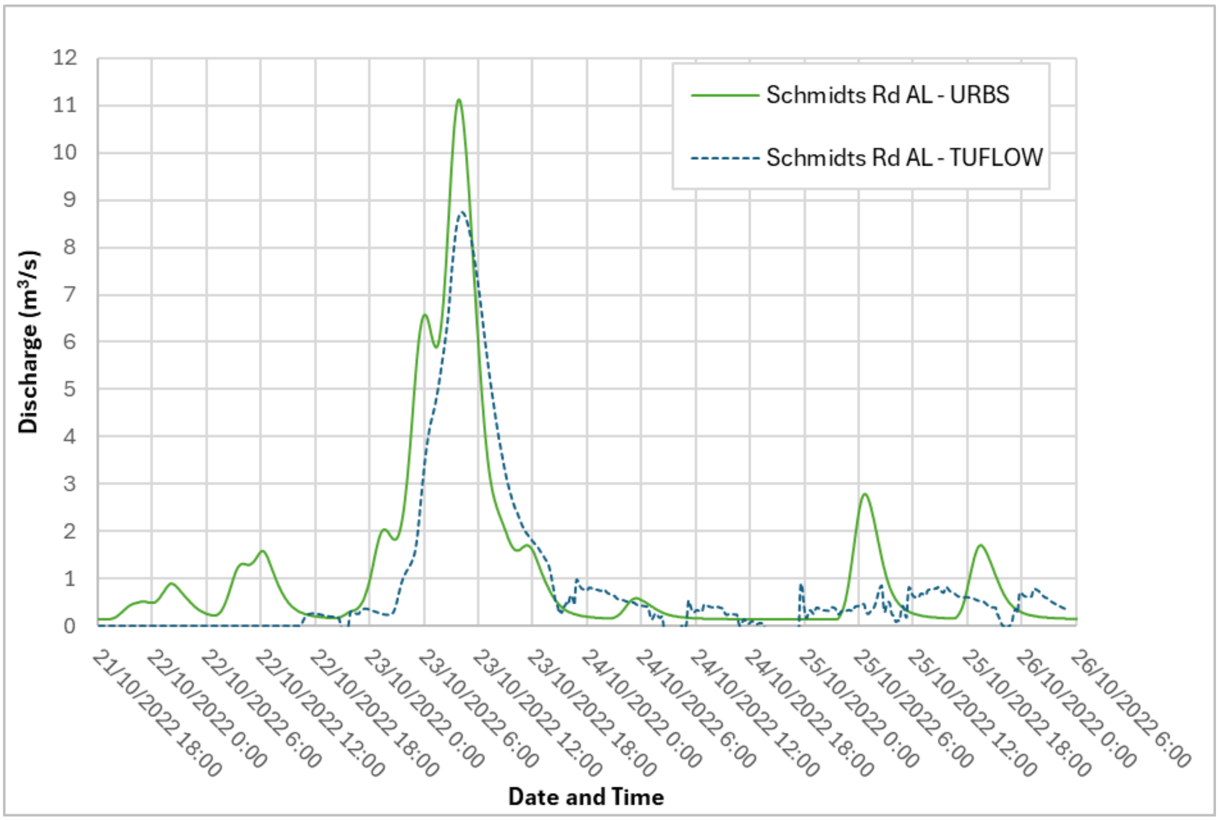



**Figure 7-15 Modelled URBS and TUFLOW discharges at Schmidt's Road Alert (Station ID:540675) – February 2020**

## 7.4 HYDROLOGIC AND HYDRAULIC MODEL VALIDATION

Hydrologic and hydraulic model validation was conducted to determine how the calibrated URBS and TUFLOW models would perform against another historic event.

### 7.4.1 Selected validation event

As outlined in Section 3.5.1, the Bayes Road and Schmidt's Road gauges are directly influenced by water levels from the Logan River. The March 2021 event was selected to conduct the model validation as it had a reasonable initial period when the two gauges were not affected by water levels from the Logan River; the later part of the recorded hydrograph showed obvious influences from the Logan River at both gauges. As such, only the recorded water levels at the start of the event were used for model validation.

### 7.4.2 URBS and TUFLOW parameters

For this validation exercise, it is assumed that there were no major changes in land-use to the February 2020 event. As such, impervious values (URBS hydrology model) and Manning's roughness value (TUFLOW model) applied for the February 2020 event were used to simulate catchment conditions for the March 2021 validation event.

The calibrated URBS parameters outlined in Section 6.2.3, i.e. Alpha = 0.03, Beta = 1.5 and m = 0.8, were used to develop the hydrographs for the validation event model.

The continuing loss of 3 mm/h obtained from the calibration was used. Initial losses will vary for each individual historic event. An initial loss of 140 mm provided suitable validation outcomes.

### 7.4.3 Rainfall data

Rainfall data extracted from the Schmidt's Road and Marsden First Avenue rainfall gauges are presented in Table 7-4 and Figure 7-16. The rainfall data was input into the calibrated URBS model to provide inflow hydrographs for input into the TUFLOW model.

**Table 7-4 Summary of validation event**

| Event | Cumulative Rainfall (mm) Schmidt's Rd AL | Cumulative Rainfall (mm) Marsden AL | Start Time | End Time |
|---|---|---|---|---|
| March 2021 | 255 | 183 | 21/03/2021 12:00 PM | 24/03/2021 12:00 AM |

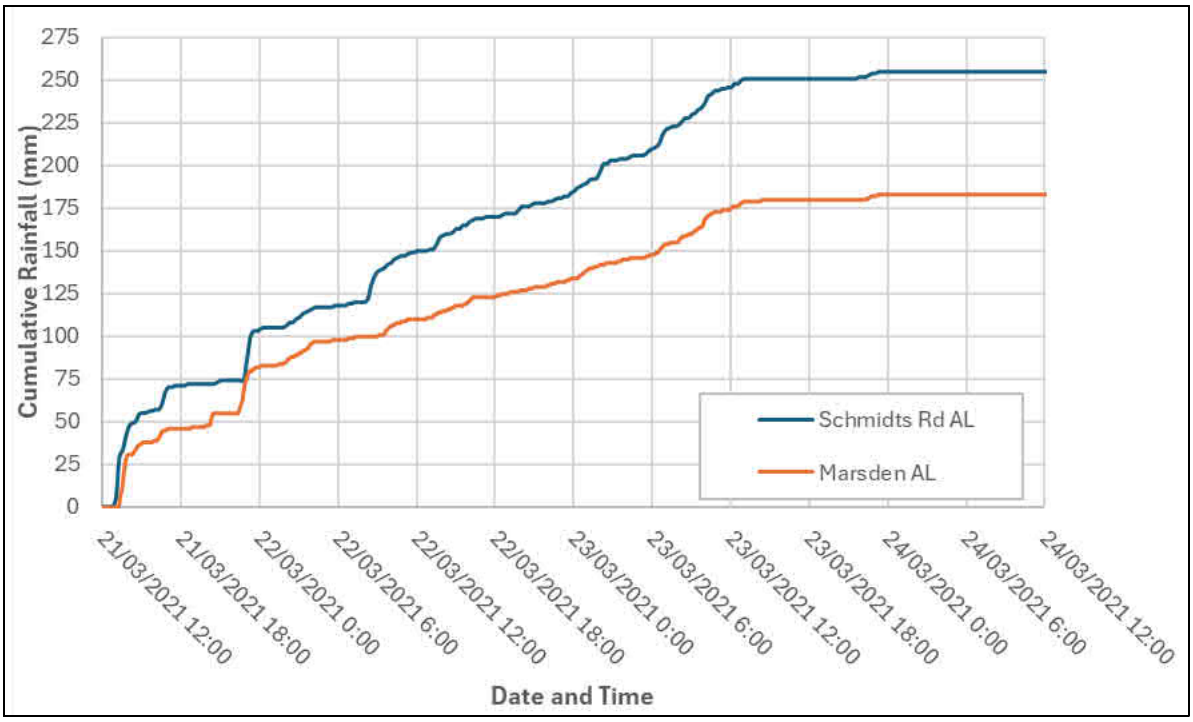



**Figure 7-16 Cumulative rainfall – March 2021 validation event**

### 7.4.4 Outlet boundary

The method described in 6.3.1 was used to determine tailwater conditions at the outlet. The time lag was maintained at 19 minutes and no changes to the water level, with reference to the recorded water levels at Waterford Gauge, was predicted at the outlet. The predicted tailwater condition is shown in Figure 7-17.

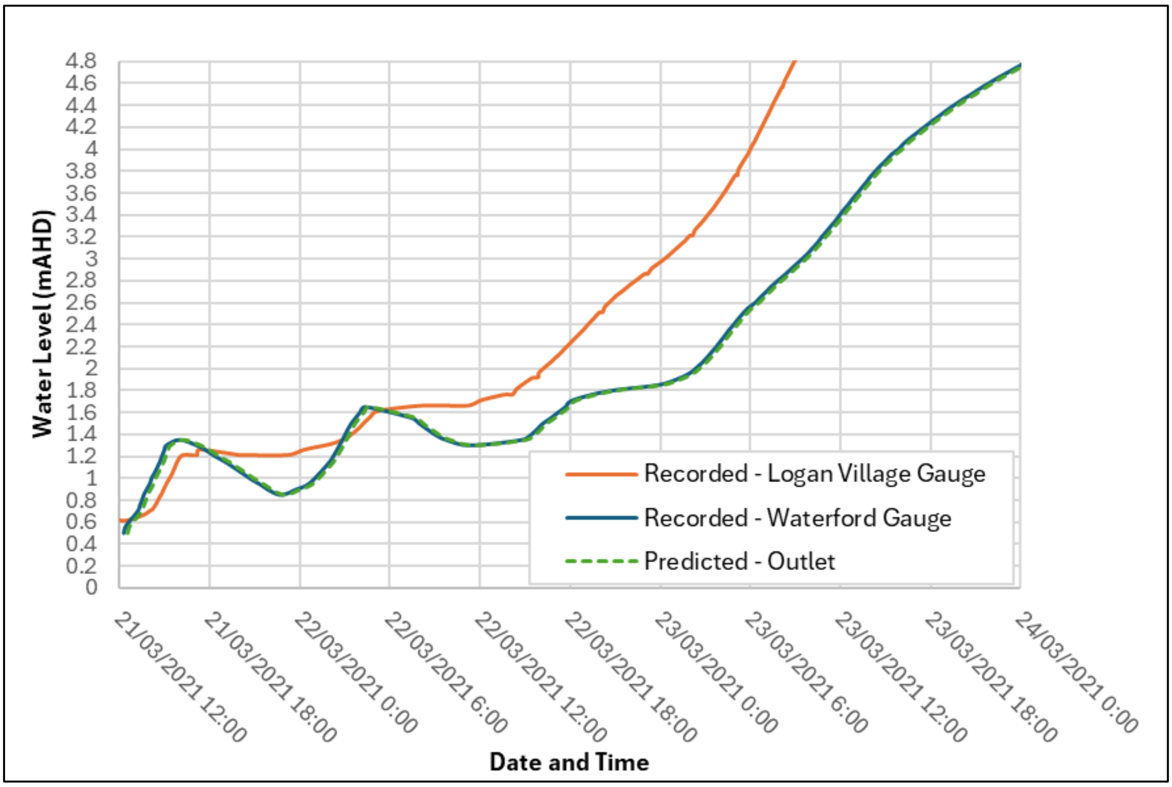



**Figure 7-17 Predicted tailwater conditions – March 2021 event**

### 7.4.5 Outcomes of validation event modelling

The hydraulic model results for the March 2021 event were compared against the recorded water levels at the Bayes Road and Schmidt's Road gauges. The modelled and recorded water levels at the two gauges are presented in Figure 7-18 and Figure 7-19.

At the Bayes Road gauge, there was very little variation in the recorded water levels over the duration of this event. The modelled results presented a similar shaped hydrograph with modelled water levels comparable to the recorded data.

At the Schmidt's Road gauge, water levels are affected by the Logan River earlier than the water levels at Bayes Road gauge. Nevertheless, modelled water levels at the start of the event produced a similar shaped hydrograph to the recorded water levels. After 23/03/2021 at 6 am, the water levels are heavily influenced by the Logan River.

The peak discharges modelled in the URBS and TUFLOW models showed similar shapes, peak flows and time of peaks, demonstrating similar catchment response in terms of routing. The peak discharges at the two gauges are presented in Figure 7-20 and Figure 7-21.

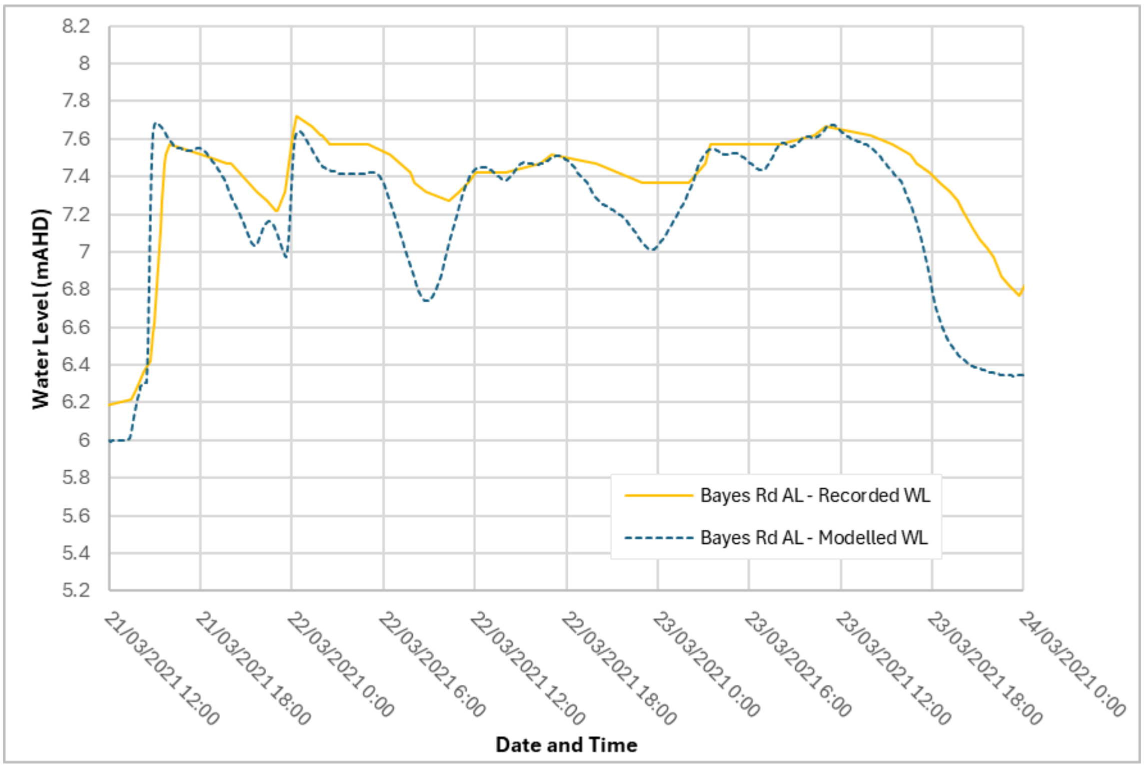



**Figure 7-18 Modelled and recorded water levels at Bayes Road Alert (Station ID:540674) – March 2021**

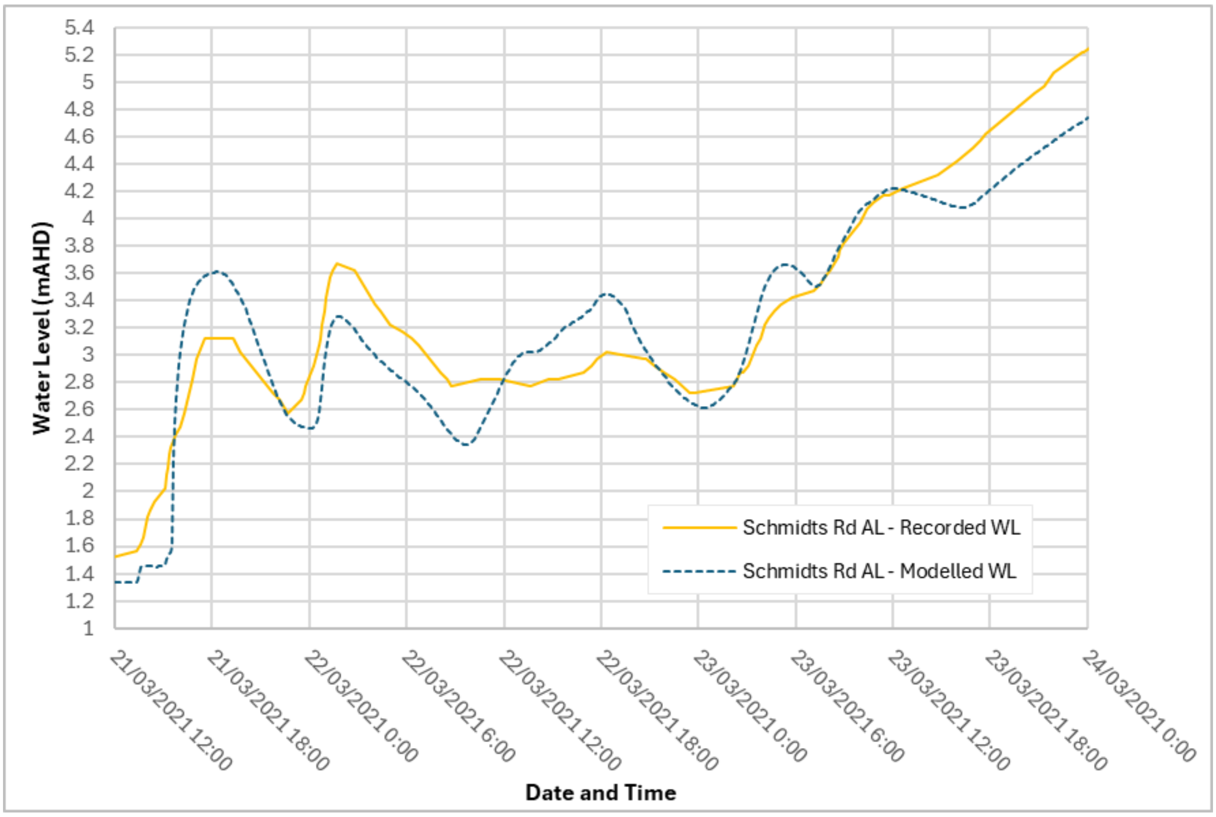



**Figure 7-19 Modelled and recorded water levels at Schmidt's Road Alert (Station ID:540675) – March 2021**

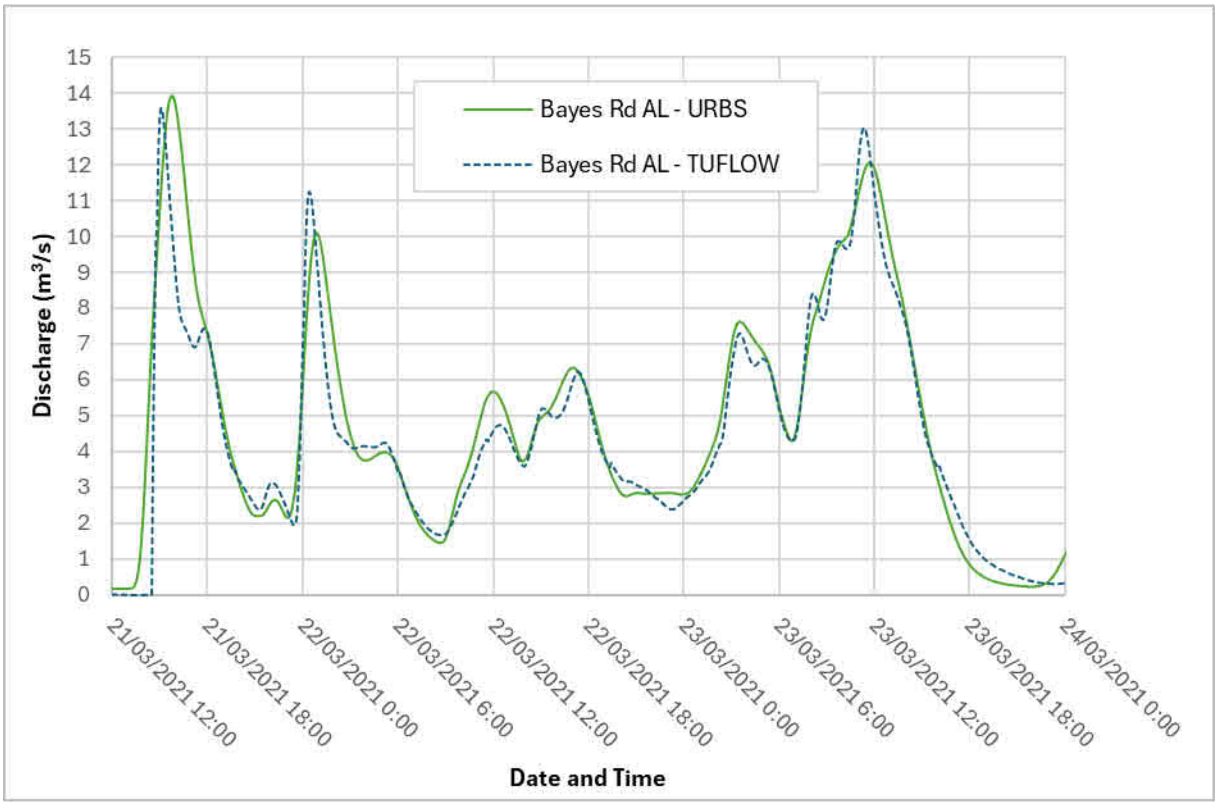



**Figure 7-20 Modelled URBS and TUFLOW discharges at Bayes Road Alert (Station ID:540674) – March 2021**

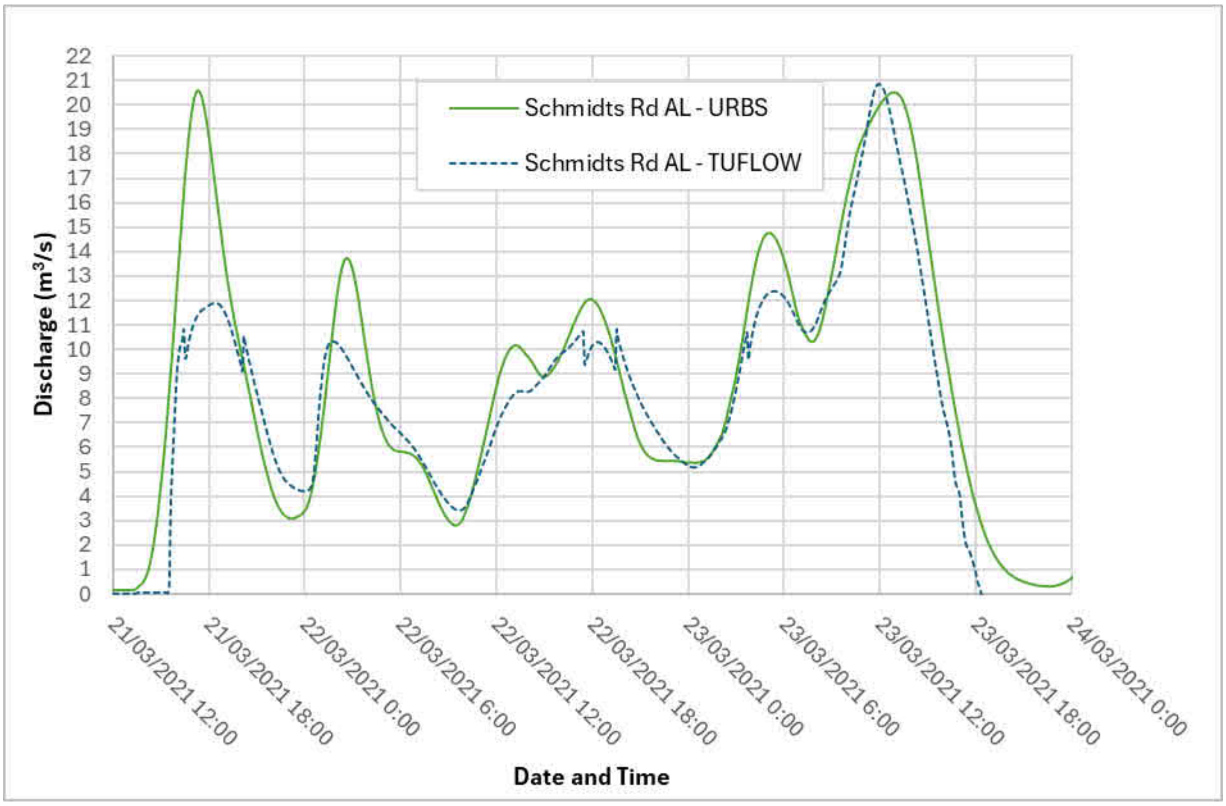



**Figure 7-21 Modelled URBS and TUFLOW discharges at Schmidt's Road Alert (Station ID:540675) – March 2021**

## 7.5 SUMMARY OF MODEL CALIBRATION AND VALIDATION

### 7.5.1 Calibration events modelling

The Schmidt's Creek catchment was represented in an URBS hydrological model and a TUFLOW hydraulic model.

The historic events selected for calibration are the March 2018, February 2020 and October 2022 events which were calibrated to the Bayes Road and Schmidt's Road stream gauges situated in the lower reaches of the Schmidt's Creek.

These calibration events did not exceed the moderate flood classification, as once the major flood classification was reached, the gauges were mainly affected by water levels from the Logan River.

Rainfall gauges at the Schmidt's Road and Marsden Road were applied to the URBS hydrological model to simulate the inflows for the calibration events.

A summary of the calibration results is as follows:

- At the Bayes Road gauge, the TUFLOW hydraulic model results present similar shaped water level hydrographs and peak timings to recorded water levels in all calibration events.

  At the Schmidt's Road gauge, modelled peak water levels in TUFLOW are similar to the recorded water levels. The modelled water levels at Schmidt's Road are also shown to be influenced by predicted water levels at the outlet, as demonstrated by noted minor spikes. The general shapes and timings of the peak water levels at the gauge is modelled to be similar to recorded water levels at the gauge.

- The peak discharges from the URBS hydrological and TUFLOW hydraulic models are shown to be similar for all calibration events at both Bayes Road and Schmidt's Road gauges.

Corresponding hydrograph shapes, peaks and timings were produced, demonstrating similar routing occurring in both the hydrologic and hydraulic models.

The results from the calibration event modelling showed that the hydrologic model can generate discharges that simulates recorded peak flood levels well in the hydraulic model for the Schmidt's Creek catchment. Furthermore, peak discharges from both the hydrologic and hydraulic models align well with one another. Thus, it can be concluded that suitable joint calibration of the hydrologic and hydraulic models has been achieved.

### 7.5.2 Validation event modelling

Hydrologic and hydraulic parameters derived from the calibration events were adopted in the validation event modelling (except initial losses). The validation modelling has shown that the hydrologic and hydraulic models can reproduce peak discharges and flood levels, which compares suitably to recorded water levels at the Bayes Road and Schmidt's Road gauges, providing further confidence in the modelling.

## 7.6 ADOPTION FOR DESIGN EVENT MODELLING

The results of the of the calibration events modelling and subsequent validation event modelling demonstrated that the hydrologic and hydraulic models are able to produce discharges which suitably replicate recorded water levels at the two gauges sufficiently.

The developed URBS model and TUFLOW models are considered sufficiently robust to be used for conducting the Design Event Modelling for the Schmidt's Creek catchment.

# 8 Design Event Flood Modelling

## 8.1 OVERVIEW

The calibrated URBS model was used to model the flood discharges and the calibrated TUFLOW model was used to estimate the flood levels, depths, velocities and flood hazard in the Schmidt's Creek catchments.

## 8.2 DESIGN RAINFALL

### 8.2.1 Intensity-Frequency-Duration

Design rainfalls for different storm durations for all AEPs up to and including the 0.05% AEP event were estimated using the AR&R 2016 Intensity-Frequency-Duration (IFD) extracted from BoM (BoM, 2016). The variation in design rainfalls within the Schmidt's Creek catchment was assessed by comparing the rainfall (IFDs) at the whole of catchment centroid to four key locations. The IFDs from the northern and southern arm centroids, upper reach of the northern branch and the confluence of the two arms of Schmidt's Creek were obtained from the BoM (BoM, 2016) and compared against the IFD obtained from the centroid of the total catchment. The locations from where the IFDs were extracted are presented in Table 8-1 and Figure 8-1.

**Table 8-1 IFD locations**

| ID | IFD location | Lat | Long | Proximity |
|---|---|---|---|---|
| 1 | Total Catchment – Centroid | -27.7033 | 153.0973 | Chambers Flat Road, Park Ridge |
| 2 | Northern arm catchment – Centroid | -27.6983 | 153.0921 | Bumstead Road, Crestmead |
| 3 | Northern arm catchment – Reach | -27.6863 | 153.1010 | Myall Street, Crestmead |
| 4 | Southern arm catchment – Centroid | -27.7139 | 153.1001 | School Road, Logan Reserve |
| 5 | Confluence - northern and southern arms | -27.7003 | 153.1157 | Logan Reserve Road, Logan Reserve |

The variations in design rainfall are presented in Table 8-2, Table 8-3, Table 8-4 and Table 8-5.The design rainfall intensities at the four key locations are  less than 4% higher than the design rainfall intensities at the centroid of the whole catchment, indicating small spatial variation.

**Table 8-2 Difference of design rainfall depth at centroid of northern arm (ID2) to the centroid of whole catchment (ID1)**

| Duration (mins) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 0.8% | 0.9% | 0.7% | 0.6% | 1.1% | 1.0% | 0.9% | 1.2% | 1.3% |
| 30 | 1.0% | 1.0% | 1.0% | 0.9% | 1.6% | 0.7% | 0.6% | 1.1% | 0.9% |
| 45 | 1.1% | 1.1% | 1.1% | 1.1% | 1.2% | 0.9% | 0.8% | 1.4% | 1.1% |
| 60 | 1.1% | 1.2% | 1.2% | 1.1% | 1.1% | 0.9% | 0.9% | 1.6% | 1.3% |
| 90 | 1.1% | 1.3% | 1.1% | 1.1% | 0.9% | 1.0% | 1.0% | 1.1% | 1.7% |
| 120 | 1.8% | 1.3% | 1.1% | 1.4% | 1.1% | 1.0% | 1.0% | 1.1% | 1.2% |
| 180 | 1.2% | 1.3% | 1.0% | 1.2% | 1.0% | 0.9% | 1.0% | 1.0% | 1.2% |
| 270 | 1.6% | 1.7% | 1.4% | 1.2% | 0.9% | 0.8% | 1.0% | 1.1% | 1.2% |
| 360 | 1.9% | 0.7% | 1.1% | 0.9% | 0.8% | 1.0% | 0.9% | 0.8% | 1.0% |
| 540 | 1.1% | 0.9% | 1.4% | 0.6% | 0.5% | 0.8% | 0.8% | 1.0% | 0.8% |

**Table 8-3 Difference of design rainfall depth at additional reach of northern arm (ID3) to the centroid of whole catchment (ID1)**

| Duration (mins) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 1.4% | 0.9% | 1.5% | 0.6% | 1.1% | 1.0% | 0.9% | 1.2% | 1.3% |
| 30 | 1.7% | 1.5% | 1.4% | 0.9% | 1.6% | 0.7% | 1.3% | 1.1% | 1.3% |
| 45 | 2.0% | 1.8% | 1.6% | 1.7% | 1.2% | 0.9% | 1.6% | 2.1% | 1.7% |
| 60 | 2.2% | 2.0% | 2.0% | 1.8% | 1.9% | 1.7% | 1.9% | 2.4% | 2.0% |
| 90 | 2.2% | 2.1% | 2.2% | 2.2% | 2.2% | 2.2% | 2.1% | 2.3% | 2.5% |
| 120 | 2.7% | 2.5% | 2.4% | 2.5% | 2.4% | 2.5% | 2.3% | 2.5% | 2.6% |
| 180 | 3.0% | 2.5% | 2.8% | 2.7% | 2.7% | 2.8% | 2.7% | 2.8% | 2.8% |
| 270 | 3.1% | 3.3% | 3.2% | 3.1% | 3.2% | 3.0% | 3.0% | 3.0% | 3.1% |
| 360 | 3.8% | 2.6% | 3.3% | 2.8% | 3.0% | 3.3% | 3.0% | 3.1% | 3.1% |
| 540 | 2.9% | 3.4% | 3.5% | 3.0% | 2.9% | 3.4% | 3.4% | 3.3% | 3.2% |

**Table 8-4 Difference of design rainfall depth at centroid of southern arm (ID4) to the centroid of whole catchment (ID1)**

| Duration (mins) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 0.6% | 0.0% | 0.7% | 0.0% | 0.6% | 0.0% | 0.0% | 0.0% | 0.0% |
| 30 | 0.9% | 0.6% | 0.5% | 0.0% | 0.8% | 0.0% | 0.0% | 0.0% | 0.0% |
| 45 | 0.9% | 0.8% | 0.7% | 0.6% | 1.2% | 0.0% | 0.0% | 0.7% | 0.6% |
| 60 | 0.8% | 0.8% | 1.0% | 0.9% | 1.0% | 0.9% | 0.9% | 0.8% | 0.7% |
| 90 | 1.1% | 1.0% | 1.1% | 1.1% | 1.1% | 1.2% | 1.2% | 1.1% | 1.7% |
| 120 | 1.3% | 1.3% | 1.3% | 1.4% | 1.5% | 1.6% | 1.5% | 1.5% | 1.3% |
| 180 | 1.8% | 1.3% | 1.4% | 1.8% | 1.7% | 1.9% | 1.9% | 1.6% | 1.7% |
| 270 | 1.6% | 2.2% | 1.8% | 1.9% | 2.2% | 2.2% | 2.2% | 2.1% | 2.1% |
| 360 | 1.9% | 1.3% | 2.2% | 1.8% | 2.3% | 2.3% | 2.1% | 2.0% | 2.1% |
| 540 | 1.6% | 1.7% | 2.1% | 2.4% | 2.4% | 2.5% | 2.7% | 2.3% | 2.4% |

**Table 8-5 Difference of design rainfall depth from confluence of northern and southern arm (ID5) to the centroid of whole catchment (ID1)**

| Duration (mins) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 0.6% | 0.0% | 0.7% | 0.0% | 0.6% | 0.0% | 0.0% | 0.0% | 0.0% |
| 30 | 0.9% | 0.6% | 0.5% | 0.0% | 0.8% | 0.0% | 0.0% | 0.0% | 0.0% |
| 45 | 0.9% | 0.8% | 0.7% | 0.6% | 1.2% | 0.0% | 0.0% | 0.7% | 0.6% |
| 60 | 0.8% | 0.8% | 1.0% | 0.9% | 1.0% | 0.9% | 0.9% | 0.8% | 0.7% |
| 90 | 1.1% | 1.0% | 1.1% | 1.1% | 1.1% | 1.2% | 1.2% | 1.1% | 1.7% |
| 120 | 1.3% | 1.3% | 1.3% | 1.4% | 1.5% | 1.6% | 1.5% | 1.5% | 1.3% |
| 180 | 1.8% | 1.3% | 1.4% | 1.8% | 1.7% | 1.9% | 1.9% | 1.6% | 1.7% |
| 270 | 1.6% | 2.2% | 1.8% | 1.9% | 2.2% | 2.2% | 2.2% | 2.1% | 2.1% |
| 360 | 1.9% | 1.3% | 2.2% | 1.8% | 2.3% | 2.3% | 2.1% | 2.0% | 2.1% |
| 540 | 1.6% | 1.7% | 2.1% | 2.4% | 2.4% | 2.5% | 2.7% | 2.3% | 2.4% |

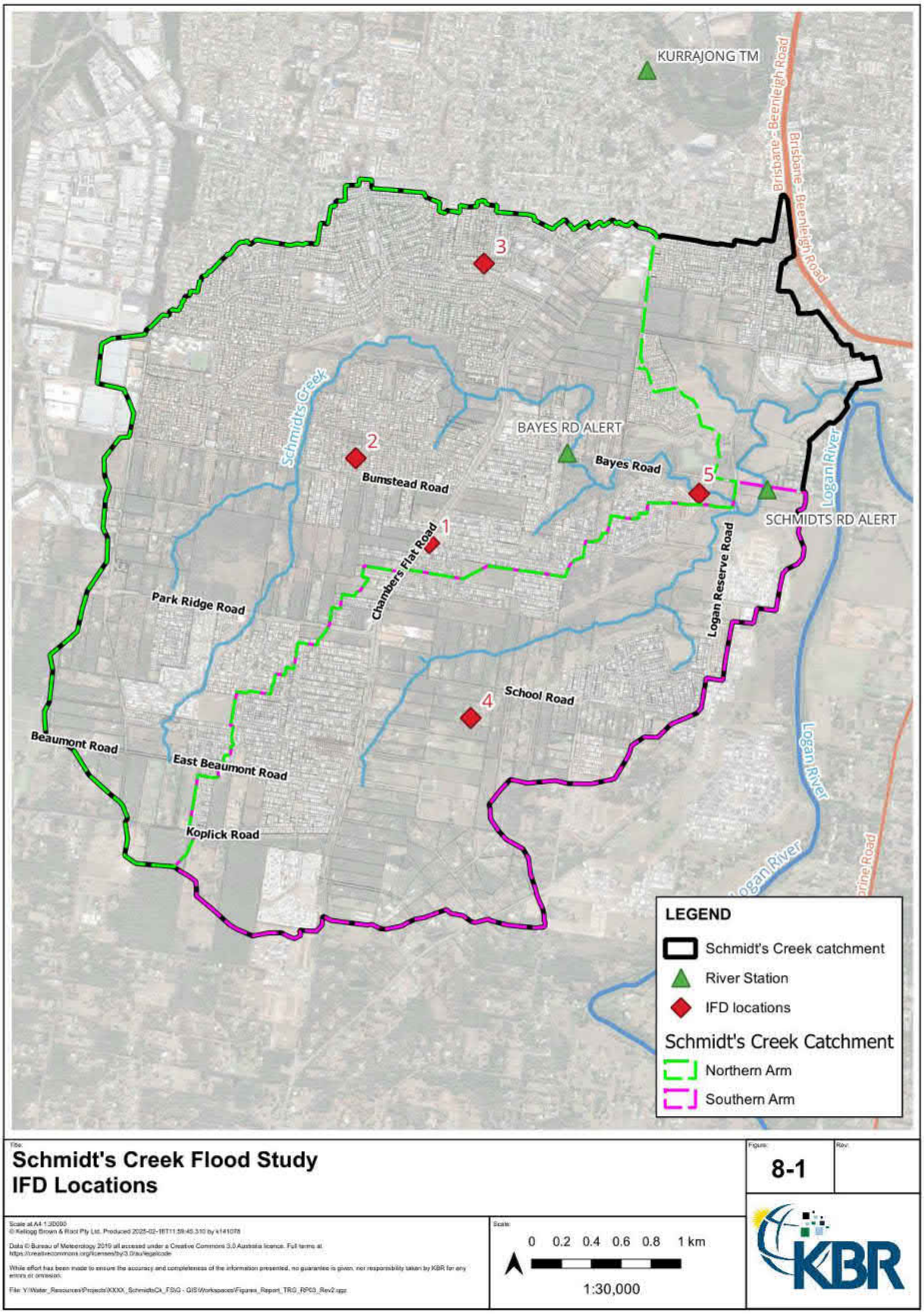



**Figure 8-1 Locations of IFDs assessed**

### 8.2.2 Probable Maximum Precipitation (PMP)

The critical durations for larger storm design events does not exceed more than 6 hours within the study catchment. Hence, the BoM Generalised Short-Duration Method (GSDM), which is applicable for Probable Maximum Precipitation (PMP) events with durations of up to 6 hours, was implemented to calculate the PMP rainfall.

The PMP rainfall was run through the URBS models to generate the hydrographs required to simulate the PMF event for the Schmidt's Creek catchment in the TUFLOW model.

The PMP rainfall parameters are provided in Table 8-6.

**Table 8-6 PMP rainfall parameters**

| PMP Parameter | Value |
|---|---|
| Catchment Area ($km^2$) | 19.0 |
| Roughness Value | 1 |
| Elevation Adjustment Factor | 1 |
| Moisture Adjustment Factor | 0.83 |
| Temporal Pattern | GSDM |

### 8.2.3 Adopted design rainfall

As shown in Section 8.2.1, the variations in design rainfalls are not significant throughout the catchment and as such, the IFD from the centroid of the total catchment was adopted for all sub-catchments of the study area for the 50% AEP to 0.05% AEP design events. The IFD for the PMP event was calculated based on the parameters outlined in Table 8-6. The adopted IFDs for conducting the design event modelling are presented in Table 8-7.

**Table 8-7 Design rainfall intensity (mm/h)**

| Duration (mins) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP | PMP |
|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 83.1 | 114.0 | 134.0 | 154.0 | 179.0 | 198.0 | 222.0 | 258.0 | 317.0 | 680.0 |
| 30 | 57.3 | 78.9 | 93.5 | 108.0 | 126.0 | 141.0 | 158.0 | 184.0 | 227.0 | 500.0 |
| 45 | 44.3 | 61.3 | 73.0 | 84.5 | 99.8 | 112.0 | 126.0 | 146.0 | 181.0 | 413.0 |
| 60 | 36.5 | 50.7 | 60.5 | 70.4 | 83.6 | 94.1 | 106.0 | 123.0 | 153.0 | 370.0 |
| 90 | 27.5 | 38.4 | 46.1 | 53.9 | 64.6 | 73.1 | 82.3 | 95.8 | 118.0 | 313.0 |
| 120 | 22.4 | 31.4 | 37.9 | 44.4 | 53.5 | 60.8 | 68.4 | 79.6 | 98.4 | 275.0 |
| 180 | 16.9 | 23.8 | 28.8 | 33.9 | 41.1 | 46.9 | 52.6 | 61.2 | 75.4 | 220.0 |
| 270 | 12.8 | 18.1 | 22.0 | 26.0 | 31.6 | 36.2 | 40.5 | 47.0 | 57.8 | 178.0 |
| 360 | 10.6 | 15.1 | 18.3 | 21.7 | 26.4 | 30.2 | 33.8 | 39.2 | 48.1 | 148.0 |
| 540 | 8.2 | 11.7 | 14.2 | 16.9 | 20.6 | 23.6 | 26.3 | 30.5 | 37.4 | 99.1 |

## 8.3 DESIGN TEMPORAL PATTERNS

Temporal patterns were obtained from the AR&R Data Hub based on a point location at the centroid of the Schmidt's Creek catchment. Design point patterns from the 'East Coast (North)' region were used for design events up to the 0.05% AEP.

The GSDM temporal pattern distribution outlined in Table 1 of *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method* (BoM, 2003) was adopted for the PMP flood event.

## 8.4 AREAL REDUCTION FACTOR

The AR&R 2019 guidelines recommend the implementation of Areal-Reduction Factors (ARF). The ARF adopted was based on the centroid of the smaller southern arm catchment of Schmidt's Creek (6.8 $km^2$) rather than from the larger areas of the northern arm (10.6 $km^2$) or the whole catchment (19.0 $km^2$). As the ARF area is based on the centroid, the ARFs was calculated based on half the area of the smaller southern catchment area, i.e., 3.4 $km^2$. The ARF was adopted for the whole Schmidt's Creek catchment and provided more conservative ARF values than if the ARF values based on the larger areas (i.e., either total catchment or northern arm catchment) were used, thus avoiding the under-representation of rainfall in the upper catchments. The calculated ARF are presented in Table 8-8.

**Table 8-8 Areal Reduction Factors**

| Duration (mins) | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 0.94 | 0.94 | 0.94 | 0.93 | 0.93 | 0.93 | 0.93 | 0.93 | 0.92 |
| 30 | 0.96 | 0.96 | 0.95 | 0.95 | 0.95 | 0.95 | 0.94 | 0.94 | 0.94 |
| 45 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.95 | 0.95 | 0.95 | 0.94 |
| 60 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.96 | 0.95 | 0.95 | 0.95 |
| 90 | 0.98 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.95 | 0.95 |
| 120 | 0.98 | 0.98 | 0.97 | 0.97 | 0.96 | 0.96 | 0.96 | 0.95 | 0.95 |
| 180 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.96 | 0.96 | 0.95 | 0.95 |
| 270 | 0.99 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 | 0.97 | 0.96 | 0.96 |
| 360 | 0.99 | 0.99 | 0.99 | 0.98 | 0.98 | 0.98 | 0.98 | 0.97 | 0.97 |
| 540 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.99 | 0.98 | 0.98 | 0.98 |

## 8.5 LOSSES

The initial loss (IL) and continuing loss (CL) method was used for this study. There was variance of initial losses determined in the calibration and validation event modelling, due to antecedent catchment conditions. As such, the recommended IL of 20 mm from the AR&R Data Hub was adopted.

For the study area, AR&R 2019 recommends a CL of 1.5mm/h. However, the CL of 3.0 mm/h derived from the calibration modelling and will therefore be adopted for this study. The calibration derived CL value is also consistent with other studies conducted within the Logan Region. Table 8-9 presents the losses used in the design event modelling.

**Table 8-9 Initial and continuing losses adopted for design event modelling**

| Design events (AEP) | IL (mm) | CL (mm/h) |
|---|---|---|
| 20% AEP, 50% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP | 20 | 3.0 |
| 0.5% AEP, 0.2% AEP, 0.05% AEP | 0 | 3.0 |
| PMF | 0 | 3.0 |

The median design event pre-burst rainfall depths were obtained from the AR&R Data Hub.

For the design events which have an initial loss (i.e., 20% AEP, 50% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP), UBRS subtracts the median design event pre-burst rainfall depths from the initial loss value. If pre-burst values exceed initial loss vales, URBS sets the excess pre-burst and initial loss to zero

For design events with no initial loss (i.e., 0.5% AEP, 0.2% AEP, 0.05% AEP and PMF), URBS sets the excess pre-burst rainfall and initial loss values to zero.

## 8.6 FLOOD FREQUENCY ANALYSIS

A Flood Frequency Analysis cannot be undertaken at the two gauges (Bayes Road and Schmidt's Road) at Schmidt's Creek as these gauges have very short periods of record (~12 years). Furthermore, as the gauges are in close proximity to the Logan River they will experience backwater effects from the larger regional system.

## 8.7 CLIMATE CHANGE

The RCP4.5 climate change projections for a planning horizon of the year 2090 was adopted to obtain the climate change design flow hydrographs. The adopted projection represented a 9.5% increase in design rainfall intensities and were applied to the following design events:

- 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEP design flood events.

Climate change rainfall uplift was not required for the 0.05% AEP and PMF flood event.

The RCP4.5 climate change projections for this study was adopted to provide consistency with climate change scenarios implemented in other flood studies conducted within the Logan region which implement the AR&R 2019 methodology. As such, updates to the climate change guidance in AR&R 2019 (version 4.2) (Ball et al, 2019b) published during the completion of this study were not utilised for the Schmidt's Creek flood study.

## 8.8 STRUCTURE BLOCKAGE

Both the major hydraulic structures and stormwater drainage network are subject to blockage from debris being mobilised in the catchments in the event of flooding. The structure blockage assessment was based on guidelines in Book 6 – Chapter 6 of AR&R 2019 (Ball et al, 2019). The following assessment was conducted to determine and simulate blockage conditions for the design event modelling:

- An $L_{10}$ value of 2.0 m was adopted based on the urbanised nature of the catchment and from imagery and site observations.
- Debris Availability – "Medium"; Mixture of urban and rural areas with high dense vegetation.
- Debris Mobility – "Medium"; Medium gradient (~3%) source areas with defined streams.
- Debris transportability – "Low"; relatively flat bed slope (<1%)

Based on the blockage assessment, the Schmidt's Creek catchment has a "Low" debris potential classification. Table 8-10 presents the blockage factors which were adopted for the study, where 'W' represents the width of a single barrel.

**Table 8-10 Culverts blockage factors**

| | Design Blockage | | | Sensitivity Analysis |
|---|---|---|---|---|
| Design events (AEP) | $W < L_{10}$ (A)# | $L_{10} < W < 3*L_{10}$ (B) | $W > 3*L_{10}$ (C) | No blockage (D) |
| 50% AEP, 20% AEP, 10% AEP | 25% | 0% | 0% | 0% |
| 5% AEP, 2% AEP, 1% AEP, 0.5% AEP | 25% | 0% | 0% | 0% |
| 0.2% AEP, 0.05% AEP, PMF | 25%^ | 10% | 0% | 0% |

Note: #Alphabetic Letters in parentheses represents the blockage category used in the ARR blockage matrix.
^Blockage reduced from 50% to 25% to ensure consistency in the hydraulic model results between the 0.5% AEP and extreme design events (rarer than 0.5% AEP).

Based on preliminary results of design event hydraulic modelling, it was found that adopting default AR&R blockage values resulted in lower flood levels for the 0.5% AEP design event compared against the 0.2% AEP design event at some locations downstream of Category A assigned culverts. The higher flood levels were due to a significant step up in blockage from 25% to 50% between the 0.5% AEP and 0.2% AEP design events.

To resolve this issue, the blockage factor for Category A was reduced from 50% to 25% for the 0.2% AEP and rarer events, resulting in an equal blockage factor of 25% across all events for Category A culverts. While this approach is a departure from the AR&R 2019 recommendations, it was considered necessary to ensure consistency in flood levels for the design events.

Design blockage factors were applied to all cross-drainage culverts and pipes. No blockage was applied to underground stormwater pipes.

For bridges, besides the blockage applied for piers, no further blockage was applied as the widths of the bridges were wider than the adopted $L_{10}$ value of 2.0 m.

## 8.9 TAILWATER CONDITIONS

Tailwater levels in the Logan River are likely to influence peak flood levels near the outlet of Schmidt's. At the primary TUFLOW outlet of Schmidt's Creek, a constant tailwater level has been adopted to be approximately coincident with Logan River flood level for each AEP. The following data, provided by LCC were used to derive a tailwater level:

- the water level hydrographs for 9 or 12 hour storm durations for various AEPs modelled at various locations on the Logan River from the Logan-Albert Rivers Flood Study (WRM, 2023).
- the modelled design event flood level grids from the outputs of the Logan-Albert Rivers Flood Study (WRM, 2023).

The *'Hydrograph procedure for non-tidal creeks and rivers'* procedure given in the background notes of the Queensland Urban Drainage Manual (QUDM) (IPWEAQ, 2017) was used to estimate the tailwater levels at the creek's outlet. The method incorporates:

- Determining hydrographs for main and side waterways from appropriate runoff/routing models and
- Reading the tailwater level at the time corresponding to the peak of the smaller stream's critical duration storm

The nearest modelled hydrograph to the Schmidt's Creek outlet on the Logan River was at the Waterford Gauge (approximately 4.4 km downstream of the outlet). As shorter duration hydrographs (<6hours critical duration for Schmidt's Creek) were not available for Logan River, the 9 or 12 hour hydrographs were adopted but shifted by 6 or 2 hours (trimming the rising limb from the hydrograph); the assumption is that for shorter critical duration storms, hydrographs on the Logan River would have earlier rising water levels, and similar rate of rise than the longer storm duration events.

The simulated water levels in the Logan River at the Waterford Alert gauge were translated to the outlet of Schmidt's Creek to determine the creek's outlet conditions as follows:

1. The time of peak discharge of Schmidt's Creek at its outlet is estimated to be approximately 5 hours (conservative estimate based on hydrologic modelling results).
2. For each design event, the water levels at Waterford Gauge at the 5 hour (time of peak discharge) was noted from the design water level hydrographs.
3. From the maximum water level grids (for various AEPs) modelled for the Logan-Albert Rivers Flood Study (WRM, 2023), a maximum water level grid which has a similar (or higher) water

level at the Waterford Gauge as noted in Step 2 was identified. The design AEP of this maximum water level grid was recorded.

4. From the same grid as identified in Step 3, the water level at the outlet of Schmidt's Creek was obtained and used to model the tailwater conditions at the Schmidt's Creek outlet.

Figure 8-2 presents the assessment of the modelled water level hydrographs at Waterford Gauge on the Logan River and maximum water level grids. Table 8-11 summarises the assessment of the modelled water levels at the Waterford Gauge and corresponding water levels at the Schmidt's Creek outlet.

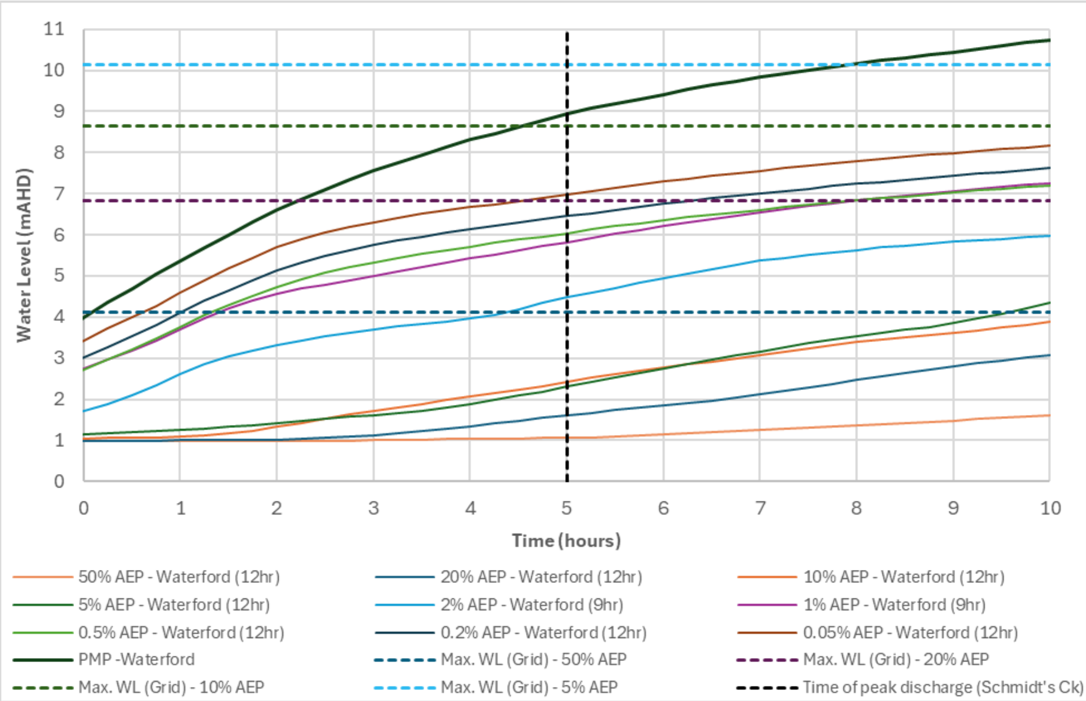



**Figure 8-2 Assessment of water level at Waterford Gauge on the Logan River**

**Table 8-11 Summary of water level assessment at Waterford Gauge on the Logan River**

| Design Event | Water Level at peak discharge – hydrograph | Coincidental Max. Water Level – flood grid | Design AEP at Logan River | Corresponding Water level at Schmidt's Creek outlet |
|---|---|---|---|---|
| 50% AEP | 1.06 mAHD | - | <50% AEP | - |
| 20% AEP | 1.61 mAHD | - | <50% AEP | - |
| 10% AEP | 2.42 mAHD | 4.14 mAHD | 50% AEP – Logan River | 5.25 mAHD |
| 5% AEP | 2.30 mAHD | 4.14 mAHD | 50% AEP – Logan River | 5.25 mAHD |
| 2% AEP | 4.48 mAHD | 6.84 mAHD | 20% AEP – Logan River | 8.23 mAHD |
| 1% AEP | 5.82 mAHD | 6.84 mAHD | 20% AEP – Logan River | 8.23 mAHD |
| 0.5% AEP | 6.04 mAHD | 6.84 mAHD | 20% AEP – Logan River | 8.23 mAHD |
| 0.2% AEP | 6.45 mAHD | 6.84 mAHD | 20% AEP – Logan River | 8.23 mAHD |
| 0.05% AEP | 6.97 mAHD | 8.65 mAHD | 10% AEP – Logan River | 10.34 mAHD |
| PMF | 8.94 mAHD | 10.15 mAHD | 5% AEP – Logan River | 12.16 mAHD |

For design events more frequent than the 10% AEP flood event of Schmidt's Creek, river levels at Waterford Gauge on the Logan River shows little response at the time of peak discharge as noted in Figure 8-2. Therefore, for design events more frequent than the 10% AEP, a static head boundary condition of 1.5 mAHD, was used as the tailwater condition, i.e., the mean water level at Schmidt's Road AL under normal conditions.

The adopted tailwater conditions for the design event conditions are presented in Table 8-12.

**Table 8-12 Adopted tailwater conditions for design events**

| Design Flood Event | Tailwater Level (Outlet) | Outlet Condition at Schmidt's Creek |
|---|---|---|
| 50% AEP, 20% AEP | 1.50 mAHD | Mean Water Level – Logan River |
| 10% AEP, 5% AEP | 5.25 mAHD | 50% AEP – Logan River |
| 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP | 8.23 mAHD | 20% AEP – Logan River |
| 0.05% AEP | 10.34 mAHD | 10% AEP – Logan River |
| PMF | 12.16 mAHD | 5% AEP – Logan River |

### 8.9.1 Tailwater levels for climate change design events

The climate change design runs adopted tailwater levels with climate change applied (from maximum water level grids from Logan-Albert Rivers Flood Study). As an example, the 1% AEP climate change event will adopt the 20% AEP (with climate change) water level as its tailwater condition. The Logan River maximum water level grid for the 50% AEP with climate change was not modelled in the Logan-Albert Rivers Flood Study and hence, not available for this study.

An analysis of the maximum flood grids from the Logan-Albert Rivers Flood Study at the Schmidt's Creek outlet showed that the differences in water levels between the present day design events and climate change events increases under more frequent events. The water level at the Logan River is modelled to be 0.7m higher in the 20% AEP with climate change scenario. Further, the Schmidt's Creek outlet is situated at the lower reaches of the Logan River which is tidally affected. The State of the Environment Report 2020 (Queensland Government, 2025) projects sea level rise from climate change to rise by approximately 0.8m in the future.

Considering this analysis and projected sea level rise, the 50% AEP tailwater level and Logan River water levels will be increased by 0.8m to reflect climate change conditions.

A summary of the adopted tailwater conditions for the climate change events are presented in Table 8-13 and as follows:

- For the 50% AEP, 20% AEP Climate change events, the tailwater applied was the mean water level on the Logan River (1.5 mAHD) plus 0.8m.
- For the 10% AEP, 5% AEP Climate change events, the tailwater applied was the 50% AEP present day design event tailwater on the Logan River (5.25 mAHD) plus 0.8m.
- For the 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP Climate change events, the tailwater applied was the 20% AEP with climate change on the Logan River (8.93 mAHD).

**Table 8-13 Adopted tailwater conditions for climate change design events**

| Design Flood Events | Tailwater Level (Outlet) | Outlet Boundary Condition at Schmidt's Creek |
|---|---|---|
| Climate change – 50% AEP, 20% AEP | 2.3 mAHD | Mean Water Level + 0.8m – Logan River |
| Climate change – 10% AEP, 5% AEP | 6.05 mAHD | 50% AEP (present day) + 0.8m – Logan River |
| Climate change – 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP | 8.93 mAHD | 20% AEP with CC – Logan River |

## 8.10 SUMMARY OF DESIGN INPUTS

A summary of the adopted design hydrology parameters for this study is provided in Table 8-14.

**Table 8-14 Summary of design hydrology inputs**

| Parameter | AEP | Source | Comment |
|---|---|---|---|
| Rainfall Depth | ≤ 0.05% AEP, i.e.<br>50%, 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% and 0.05% | AR&R 2019 | Industry Standard |
| | PMF | BoM GSDM | Industry Standard for duration ≤ 6hours |
| Areal Reduction Factor (ARF) | ≤ 0.05% AEP and PMF, i.e.<br>50%, 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2%, 0.05% and PMF | AR&R 2019 | Adopted an ARF based on half the area of the smaller southern catchment area, i.e., 3.4 km2 |
| Temporal Pattern | ≤ 0.05% AEP, i.e.<br>50%, 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% and 0.05% | AR&R 2019 ensemble | Industry Standard |
| | PMF | BoM GSDM | Industry Standard |
| Spatial Distribution | ≤ 0.05% AEP, i.e.<br>50%, 20%, 10%, 5%, 2%, 1%, 0.5%, 0.2% and 0.05% | AR&R 2019 | Inspection of IFD at 4 locations determined that there were minimal differences in the IFDs and hence the IFD obtained from the centroid of the catchment was used. |
| | PMF | GSDM | No spatial distribution as per normal design events |
| Rainfall losses | ≤ 1% AEP, i.e.<br>50%, 20%, 10%, 5%, 2% and 1% | AR&R 2019 | Adopted initial and pre-burst losses were based on estimate provide in AR&R 2019. Continuing losses were based on calibration. |
| | > 1% AEP to PMF, i.e.,<br>0.5%, 0.2%, 0.05% and PMF | Adopt minimum losses | Adopted 0mm initial losses and continuing losses based on calibration outcomes. |
| Climate Change Factors | ≤ 0.2% AEP, i.e.<br>50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.2% AEP | AR&R 2019 | Adopted RCP4.5 climate change projections for planning horizon 2090. |

## 8.11 CRITICAL STORM SELECTION

The design event modelling was conducted based on the Council's ultimate land use intent. This required applying the Manning's roughness coefficient based on the ultimate land use as outlined in the Logan Planning Scheme.

AR&R 2019 introduced a suite of 10 temporal patterns per duration with the rarity of events considered in three categories: frequent, intermediate and rare.

For this study, the storm with temporal pattern and duration which predicts median (6$^{th}$ ranked) peak levels to be considered the critical design storm.

The following is the methodology set out for determining the design storm pattern in an iterative manner:

1. Simulate all 10 temporal patterns for each storm duration of each temporal pattern bin (i.e. 1% AEP event for rare bin, 5% AEP for intermediate bin and 20% AEP for frequent bin) through the hydrologic model.

2. Use the outputs of the hydrological model as input to the hydraulic model and conduct hydraulic simulations of the temporal pattern bins, resulting in 10 flood level grids for each AEP and duration.
3. From the outputs of the hydraulic model, create a median flood grid for each duration, i.e. based on the 10 temporal patterns, followed by a maximum of the median flood grids.
4. From the outputs of the hydraulic model, select a representative temporal pattern for each duration for each design event. This will be the temporal pattern which is the dominating temporal pattern (area-wise), and which results in minimal differences in water levels for the respective durations median flood grid (Step 3).
5. From the outputs of the hydraulic model, create a max-max of the flood grids from the chosen TPs selected from the hydraulic model as outlined in step 4.
6. Compare outputs from max-max of chosen TP (Step 5) to outputs of median grids from all TPs (Step 4).
7. If the differences in peak flood levels across the study are within acceptable limit (i.e. 50 mm) of the maximum median results, this is considered acceptable. Where significant differences occur, the TP will be selected again, and the process repeated till the threshold is met. In certain cases, it may be inevitable to select an additional TP to satisfy the criteria.
8. The selected TP will be implemented through their respective bins, i.e. TP selected for:
    - frequent bin applied to 20% AEP and 50% AEP
    - intermediate bin applied to 10% AEP and 5% AEP
    - rare bin applied to 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP, 0.05% AEP.
  - The climate change design events will also utilise the same selected TPs (i.e. a 1% AEP climate change design event will implement the selected TPs from the 1% AEP design event run).

The methodology outlined is a standard industry approach and the selected temporal patterns was used to conduct the design event modelling of the Schmidt's Creek Flood Study. The selected temporal pattern representative of each duration for each design event will significantly reduce overall simulation times and data storage required, rather than running the 10 design ensembles.

Table 8-15 presents the selected critical storms from the outlined methodology.

**Table 8-15 Selected critical storms**

| AEP | Critical Storm Selection | Temporal Pattern Bin |
|---|---|---|
| 50%, 20%<br><br>50% (RCP4p5), 20% (RCP4p5) | 45min/ TP07<br>60min/ TP04<br>90min/ TP08<br>120min/ TP08<br>180min/ TP08<br>270min/TP09 | Frequent |
| 10%, 5%<br><br>10% (RCP4p5), 5% (RCP4p5) | 045min/ TP05<br>060min/ TP05<br>090min/ TP06<br>120min/ TP09<br>180min/ TP04 | Intermediate |
| 2%, 1%, 0.5%, 0.2%, 0.05%<br><br>2% (RCP4p5), 1% (RCP4p5), 0.5% (RCP4p5) | 30min/ TP07<br>45min/ TP02<br>60min/ TP05<br>90min/ TP03<br>120min/ TP01 | Rare |
| PMF | 60min, 120min, 180min, 270min | GSDM |

Note: The table presents typical AR&R temporal pattern numbering (i.e. TP01 to TP10). The URBS numbering of temporal pattern starts at zero (0) which have been adopted for the TUFLOW model runs. Therefore, for the same temporal pattern, the URBS and TUFLOW TP numbering is one less than ARR numbering, e.g. in the frequent bin, the 45min/TP07 would be the 45m_E6 run in the URBS/TUFLOW model

## 8.12 VERIFICATION OF PEAK FLOWS USING THE RATIONAL METHOD

The current recommended industry approach, as outlined in AR&R 2019, in gauged catchments is to develop a hydrologic model (such as the adopted URBS software) and calibrate to the available gauge information. This process was followed for this study resulting in a good correlation achieved between the URBS and TUFLOW models at the two gauges (Bayes Road and Schmidt's Road) in the catchment for the March 2018, February 2020 and October 2022 events.

Of the three historic events selected for calibration, the February 2020 event presented the highest recorded water levels at the two gauges. The February 2020 event was estimated to be approximately a 50% AEP event based on comparisons of the recorded rainfall depths at Schmidt's Road Alert and BoM IFDs as presented in Figure 8-3. The modelled peak flows for the February 2020 event at the two gauges was also compared against the modelled design event flow estimates. The peak flows modelled for the February 2020 event were 28.7m$^3$/s and 46.9m$^3$/s at the Bayes Road and Schmidt's Road Alerts, respectively. Based on the modelled design discharges at the two gauges (See Table 8-18), the February 2020 event was estimated to be a 50% AEP event, which is consistent with the observed rainfall, providing confidence in the frequent design event modelling.

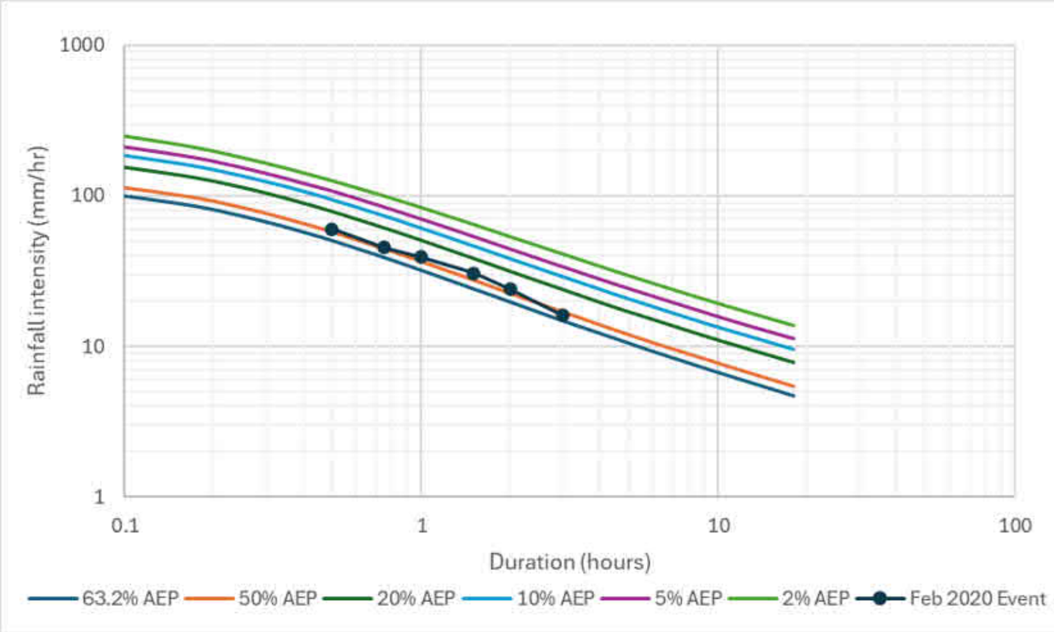



**Figure 8-3 Comparison of 2022 calibration event against BoM IFDs**

Further checks were required to provide confidence in the flows simulated for the higher magnitude events. The Rational Method was used as a means of checking the flows for the higher magnitude events, especially in the upper catchments where gauged data is currently unavailable.

Current AR&R 2019 guidance specifies less reliance on the Rational Method in determining design flows for a catchment should calibration data be readily available. However, in the absence of higher quality calibration data to verify flows for the larger design events in the Schmidt's Creek catchment, the Rational Method was used as a means of cross-checking to ensure that the adopted calibration parameters provided relevant flows for the higher magnitude events.

The simulated 1% AEP and 10% AEP flows generated by the calibrated URBS and TUFLOW model were cross-checked against the 1% AEP and 10% AEP flows estimated using the Rational Method for several sub-catchments in the upstream reaches of the study catchment. These checks were undertaken for flows in the main creek, and inflows entering the Council's identified waterway corridor and are limited to catchment sizes less than 500 hectares (as outlined in QUDM). The comparisons of the modelled flows against the Rational Method are presented in Table 8-16 and Table 8-17 for the 1% AEP and 10% AEP events, respectively, for the various locations around the catchment. The flow locations are presented in Figure 8-4.

The URBS and TUFLOW models generally produced lower discharge than the Rational Method due to the application of ARF in the hydrology and the effects of flood attenuation (e.g., floodplain storage) modelled in these models, which the Rational Method is unable to account for. Nevertheless, the comparisons in Table 8-16 and Table 8-17 provided acceptable correlation of the design flows for the 1% AEP and 10% AEP design event to the Rational Method. Thus, the Rational Method flow check provided additional verification on the peak flow estimates for the design events especially for the higher magnitude events.

Table 8-16 Comparison of 1% AEP peak flows – Rational Method against modelled URBS and TUFLOW flows

| PO identifier | Total Area (ha) | Fraction Impervious | Tc (min) | Rational Flow ($m^3/s$) | TUFLOW Peak Flow ($m^3/s$) | URBS Peak Flow ($m^3/s$) |
|---|---|---|---|---|---|---|
| **Main Creek Flow** | | | | | | |
| Sch121_POI | 77.1 | 0.71 | 61 | 19.4 | 13.8 | 16.7 |
| Sch091_POI | 165.7 | 0.74 | 80 | 36.2 | 29.5 | 29.8 |
| Sch065_POI | 361.8 | 0.66 | 96 | 67.9 | 59.0 | 56.8 |
| Sch137_POI | 55.3 | 0.73 | 57 | 14.8 | 11.4 | 13.6 |
| Sch107_POI | 318.1 | 0.75 | 92 | 63.3 | 56.1 | 57.7 |
| Sch051_POI | 98.1 | 0.37 | 67 | 20.7 | 17.0 | 19.4 |
| **Inflows Entering Waterway** | | | | | | |
| SCH003_LOC | 25.6 | 0.61 | 42 | 7.9 | 5.5 | 5.5 |
| SCH033_TOT | 52.5 | 0.71 | 53 | 14.6 | 11.5 | 12.3 |
| SCH143_LOC | 14.0 | 0.79 | 37 | 4.9 | 3.7 | 3.8 |
| SCH120_LOC | 23.1 | 0.81 | 40 | 7.8 | 5.2 | 5.4 |
| SCH056_TOT | 36.7 | 0.61 | 48 | 10.4 | 7.6 | 7.7 |

Table 8-17 Comparison of 10% AEP peak flows – Rational Method against modelled URBS and TUFLOW flows

| PO identifier | Total Area (ha) | Fraction Impervious | Tc (min) | Rational Flow ($m^3/s$) | TUFLOW Peak Flow ($m^3/s$) | URBS Peak Flow ($m^3/s$) |
|---|---|---|---|---|---|---|
| **Main Creek Flow** | | | | | | |
| Sch121_POI | 77.1 | 0.71 | 61 | 10.4 | 8.4 | 10.8 |
| Sch091_POI | 165.7 | 0.74 | 80 | 19.2 | 17.7 | 18.3 |
| Sch065_POI | 361.8 | 0.66 | 96 | 35.6 | 33.9 | 35.0 |
| Sch137_POI | 55.3 | 0.73 | 57 | 7.9 | 6.8 | 8.8 |
| Sch107_POI | 318.1 | 0.75 | 92 | 33.3 | 32.4 | 35.2 |
| Sch051_POI | 98.1 | 0.37 | 67 | 11.0 | 10.2 | 11.5 |
| **Inflows Entering Waterway** | | | | | | |
| SCH003_LOC | 25.6 | 0.61 | 42 | 4.3 | 3.5 | 3.5 |
| SCH033_TOT | 52.5 | 0.71 | 53 | 7.9 | 7.4 | 8.0 |
| SCH143_LOC | 14.0 | 0.79 | 37 | 2.7 | 2.3 | 2.3 |
| SCH120_LOC | 23.1 | 0.81 | 40 | 4.3 | 3.4 | 3.4 |
| SCH056_TOT | 36.7 | 0.61 | 48 | 5.7 | 4.9 | 4.9 |

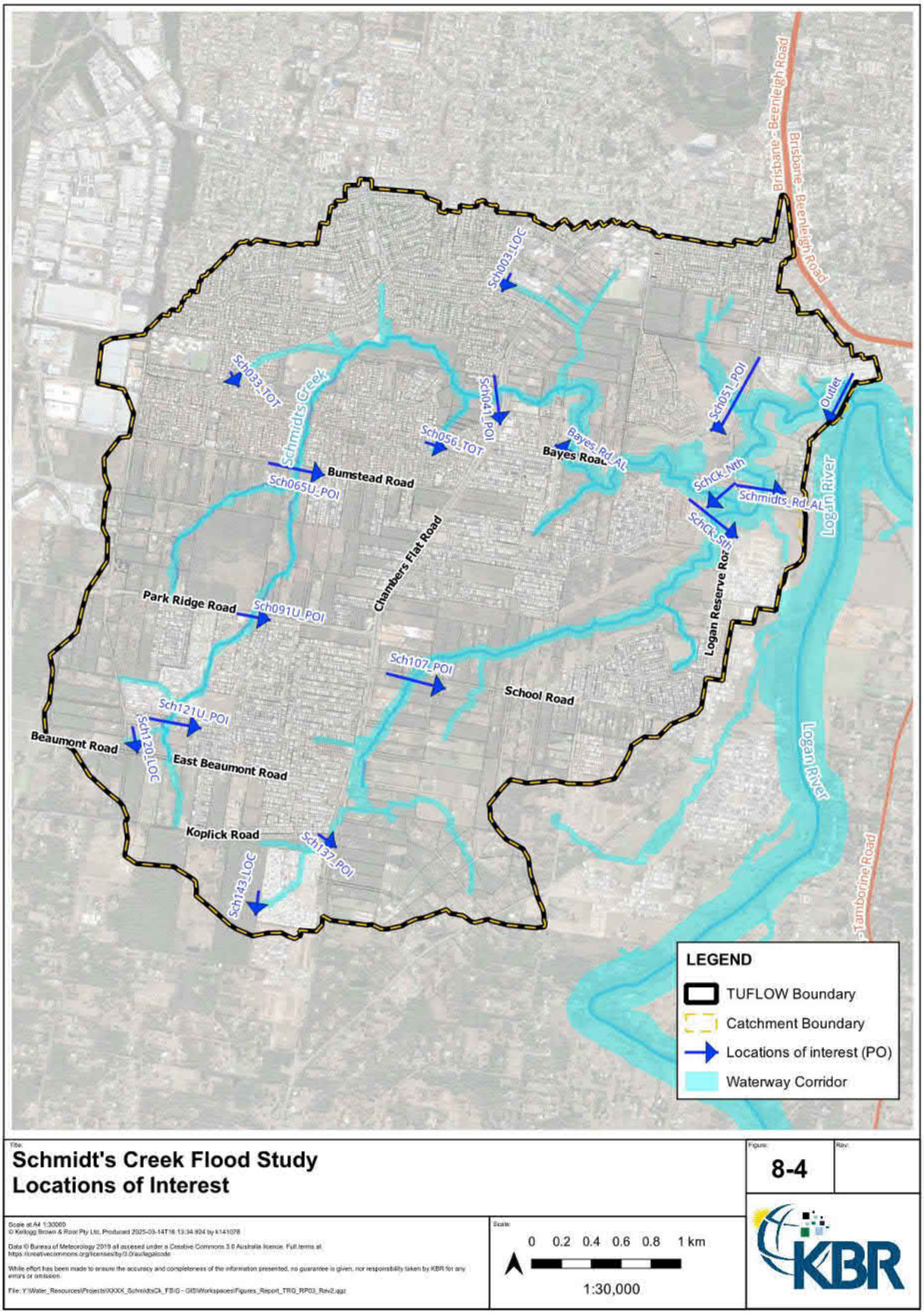



Figure 8-4 Locations of interest

## 8.13 SUMMARY OF MODEL OUTPUTS

### 8.13.1 Design events and climate change events

Flood mapping for the design events are provided in Appendix D. Climate change (RCP 4.5) design events flood maps are presented in Appendix E. These maps represent the max-max of the durations and their representative temporal patterns. The following maps are provided:

- Peak flood level
- Peak flood depth
- Peak flood velocity
- Critical duration mapping
- Flood hazard classifications for the following three flood hazard criteria:
    - Depth x Velocity (D x V) product – Z0
    - Australian Emergency Management Institute (AEMI) Classifications – ZAEM1
    - Queensland Reconstruction Authority (QRA) Classifications – ZQRA

Longitudinal profile plots of water surface levels are also provided in the subsequent sections.

Flood mapping of the flood level differences between the climate change and present day design events are presented in Appendix F.

### 8.13.2 Sensitivity assessment – Manning's, blockage, tailwater, climate change and revegetation

Flood level impact mapping is also provided for the sensitivity analysis results (as outlined in Section 9) in Appendix G including impacts of:

- Increasing Manning's roughness values by 20% on the 1% AEP design flood levels
- Decreasing Manning's roughness values by 20% on the 1% AEP design flood levels
- Removing blockages at culverts on the 1% AEP design flood levels
- Increasing static water level at the downstream boundary on the 1% AEP design flood levels
- Decreasing static water level at the downstream boundary on the 1% AEP design flood levels
- Implementing the RCP6.0 climate change factor on the 1% AEP design flood levels
- Implementing the RCP8.5 climate change factor on the 1% AEP design flood levels.
- Revegetating within the waterway corridor on the 20% AEP and 1% AEP design flood levels, simulated by increasing the waterway's Manning's roughness value.

## 8.14 SUMMARY OF DESIGN EVENT MODELLING

### 8.14.1 Peak flow summary

Peak flows from the TUFLOW model for the for the 50% AEP to PMF design flood events design events have been summarised at a number of locations throughout the Schmidt's Creek catchment in Table 8-18. The respective critical durations are provided in Table 8-19.

The locations from where the modelled peak flows were extracted are shown in Figure 8-4.

The boxplots of the flows for the 1% AEP, 5% AEP and 20% AEP events (temporal pattern bins) at various locations in the catchment are presented in Appendix C.

### Peak flow observations

Between Schmidt's Road and the outlet, peak flows are noted to be reduced for the lower magnitude design events (≤20% AEP). The low tailwater conditions (1.5mAHD) adopted and the relatively flat gradient at the downstream reaches into the Logan River provides a retarding effect which reduces the peak flows for the lower magnitude events. Conversely, the higher tailwater (≥5.25 mAHD) adopted for the higher magnitude events (≥10% AEP) negates this retarding effect and flows are able to freely exit at the outlet.

On the creek's northern arm, peak flows are noted to have reduced significantly between Bayes Road to Logan Reserve Road for the 10% AEP and higher magnitude design events. A breakaway flow path occurs through a park to the north, as shown in Figure 8-5, resulting in the lower flows modelled at Logan Reserve Road (northern arm). The breakaway flow rejoins Schmidt's Creek upstream of the catchment's outlet.

## 8.14.2 Peak flood level summary

Table 8-20 summarises the design peak flood levels at key locations in the Schmidt's Creek catchment for the 50% AEP to PMF design events. The reporting points are shown in Figure 8-6, along with chainages for each arm.

Flood mapping of the design events for water levels and all other outputs are provided in Appendix D.

All flood levels are reported based on the max-max water surface level for each design event from the TUFLOW model simulations.

The design flood levels for the 50% AEP to 1% AEP design events are summarised as follows:

- Design flood levels at Park Ridge Road range from 24.08 mAHD for the 50% AEP event to 24.38 mAHD for the 1% AEP event.
- Design flood levels at Chambers Flat Road range from 10.72 mAHD for the 50% AEP event to 12.04 mAHD for the 1% AEP event.
- Design flood levels at Bayes Road Alert range from 8.03mAHD for the 50% AEP event to 8.84 mAHD for the 1% AEP event.
- Design flood levels at School Road range from 12.92 mAHD for the 50% AEP event to 13.23 mAHD for the 1% AEP event.
- Design flood levels at Schmidt's Road Alert range from 4.55 mAHD for the 50% AEP event to 8.42 mAHD for the 1% AEP event.

A comparison of the design flood levels for the higher magnitude events (0.5% AEP, 0.2% AEP, 0.05% AEP and PMF) against the 1% AEP design flood levels is summarised as follows:

- Design flood levels for the 0.5% AEP event are generally higher by between 0.05m to 0.3m.
- Design flood levels for the 0.2% AEP event are generally higher by between 0.15m to 0.6m.
- Design flood levels for the 0.05% AEP event are generally higher by between 0.3m to 2.1m.
- Design flood levels for the PMF event are generally higher by between 1.0m to 4.0m.

Figure 8-7 and Figure 8-8 present the longitudinal section plots showing the TUFLOW model topography and design peak water surface levels on both branches of the Schmidt's Creek. The chainages of the longitudinal section plots for both branches are shown in Figure 8-6.

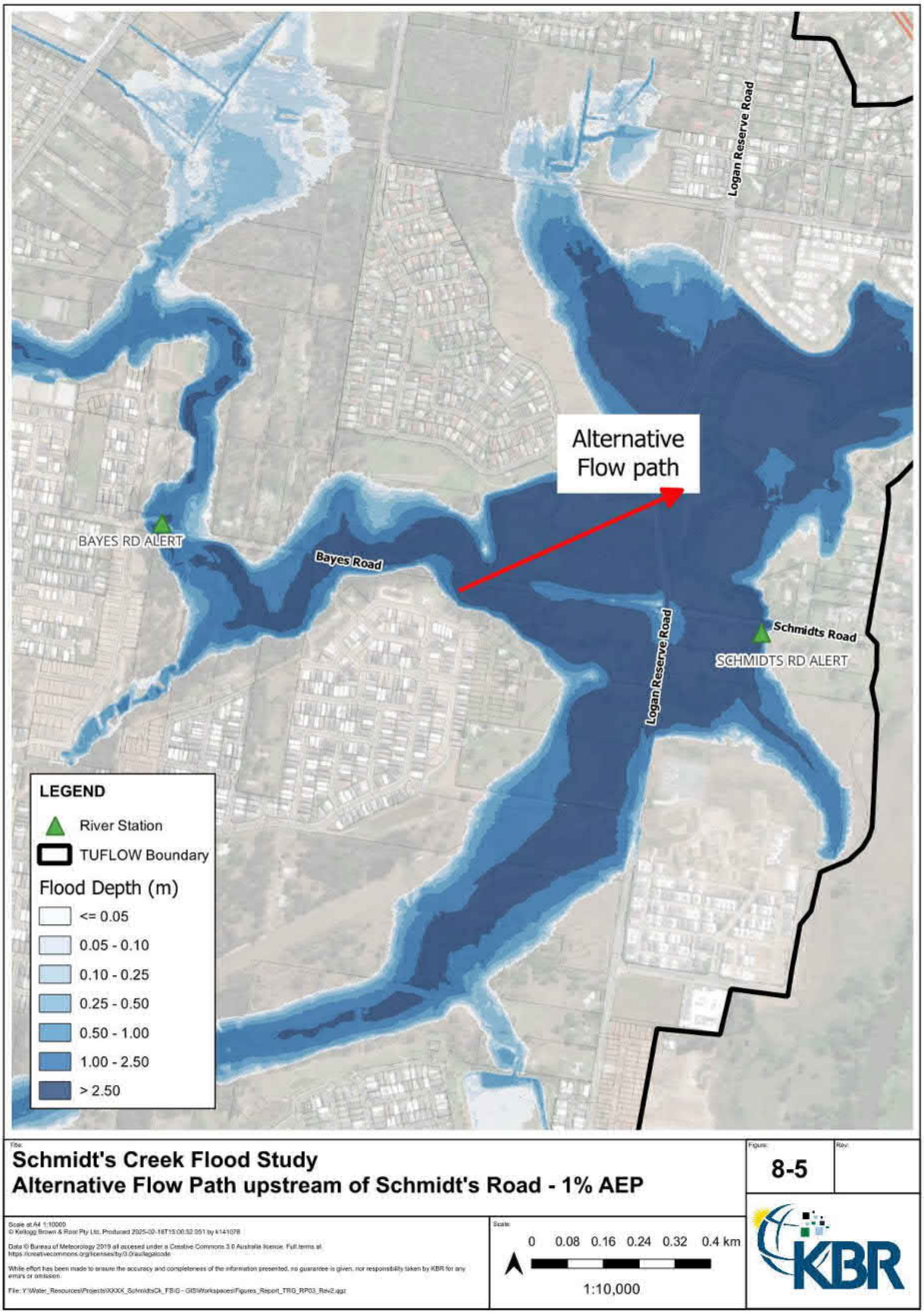



**Figure 8-5 Breakaway flow path upstream of Schmidt's Road**

**Table 8-18 Peak flows of design events at locations of interest**

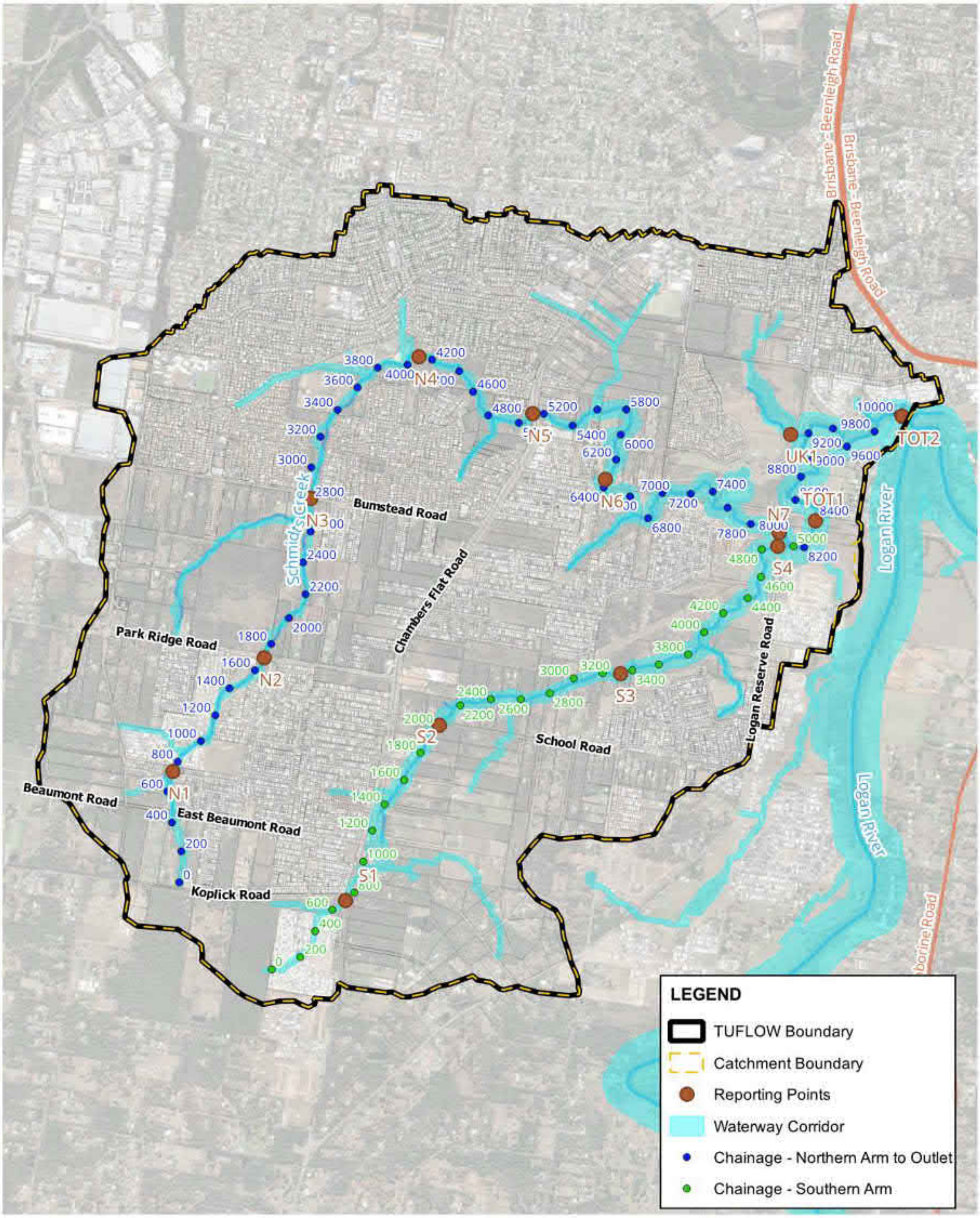
| Location | PO identifier | Peak flow (m³/s) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP | PMF |
| **Northern Arm** | | | | | | | | | | | |
| Mt Huntley St | Sch121U_POI | 4.5 | 7.0 | 8.4 | 10.2 | 12.2 | 13.8 | 16.3 | 20.9 | 26.7 | 79.9 |
| Park Ridge Rd | Sch091U_POI | 7.8 | 14.2 | 17.7 | 21.3 | 26.1 | 29.8 | 33.9 | 41.6 | 53.8 | 162.5 |
| Bumstead Rd | Sch065U_POI | 13.4 | 25.0 | 33.9 | 42.4 | 51.7 | 58.9 | 68.6 | 81.9 | 104.7 | 335.9 |
| Crestmead Pk | Sch023_POI | 22.8 | 35.8 | 51.0 | 63.9 | 79.6 | 92.8 | 107.8 | 129.0 | 165.1 | 548.7 |
| Chambers Flat Rd | Sch041_POI | 27.1 | 40.2 | 56.6 | 70.0 | 84.3 | 96.3 | 107.9 | 120.5 | 141.8 | 616.9 |
| Bayes Road AL | Bayes_Rd_AL | 33.4 | 49.4 | 66.4 | 82.4 | 98.8 | 113.3 | 127.3 | 143.8 | 171.7 | 351.9 |
| Logan Reserve Rd | SchCk_Nth | 31.3 | 50.4 | 42.7 | 46.5 | 17.3 | 20.0 | 22.8 | 26.8 | 21.6 | 41.3 |
| **Southern Arm** | | | | | | | | | | | |
| Chambers Flat Rd | Sch137_POI | 3.7 | 5.3 | 6.8 | 8.4 | 10.0 | 11.4 | 13.8 | 17.1 | 22.5 | 60.6 |
| School Rd | Sch107_POI | 14.3 | 23.9 | 32.4 | 40.1 | 49.0 | 56.1 | 65.8 | 78.4 | 100.7 | 304.4 |
| Open Area | Sch094_POI | 18.5 | 32.1 | 44.1 | 54.7 | 68.1 | 78.2 | 92.4 | 109.9 | 143.4 | 442.6 |
| Logan Reserve Rd | SchCk_Sth | 21.3 | 34.3 | 47.8 | 58.1 | 77.6 | 88.2 | 103.0 | 122.1 | 177.2 | 533.4 |
| **Downstream of Confluence** | | | | | | | | | | | |
| Schmidt's Rd AL | Schmidts_Rd_AL | 50.3 | 82.2 | 84.9 | 96.2 | 71.7 | 82.3 | 92.4 | 105.8 | 120.6 | 253.9 |
| Outlet | Outlet | 44.1 | 71.7 | 105.3 | 125.8 | 186.8 | 213.1 | 239.6 | 274.6 | 395.9 | 1226.5 |
| **Unknown waterway** | | | | | | | | | | | |
| Logan Reserve Rd | Sch051_POI | 5.3 | 8.6 | 10.2 | 12.2 | 14.9 | 17.0 | 19.5 | 22.4 | 35.5 | 88.8 |

**Table 8-19 Critical storm durations (minutes) of design events at locations of interest**

| Location | PO identifier | Critical duration (minutes) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP | PMF |
| **Northern Arm** | | | | | | | | | | | |
| Mt Huntley St | Sch121U_POI | 060m | 060m | 045m | 045m | 060m | 060m | 045m | 045m | 045m | 060m |
| Park Ridge Rd | Sch091U_POI | 060m | 060m | 090m | 090m | 060m | 060m | 060m | 060m | 045m | 060m |
| Bumstead Rd | Sch065U_POI | 120m | 120m | 090m | 090m | 090m | 090m | 090m | 090m | 060m | 090m |
| Crestmead Park | Sch023_POI | 270m | 120m | 180m | 120m | 120m | 120m | 090m | 090m | 090m | 090m |
| Chambers Flat Rd | Sch041_POI | 270m | 180m | 180m | 180m | 120m | 120m | 120m | 120m | 090m | 120m |
| Bayes Road AL | Bayes_Rd_AL | 270m | 270m | 180m | 180m | 120m | 120m | 120m | 120m | 120m | 120m |
| Logan Reserve Rd | SchCk_Nth | 270m | 270m | 180m | 180m | 120m | 120m | 090m | 090m | 120m | 060m |
| **Southern Arm** | | | | | | | | | | | |
| Chambers Flat Rd | Sch137_POI | 060m | 060m | 045m | 045m | 045m | 045m | 045m | 045m | 045m | 060m |
| School Rd | Sch107_POI | 120m | 090m | 090m | 090m | 090m | 090m | 090m | 060m | 060m | 060m |
| Open Area | Sch094_POI | 180m | 120m | 120m | 120m | 090m | 090m | 090m | 090m | 090m | 090m |
| Logan Reserve Rd | SchCk_Sth | 270m | 180m | 180m | 180m | 090m | 090m | 090m | 090m | 090m | 090m |
| **Downstream of Confluence** | | | | | | | | | | | |
| Schmidt's Rd AL | Schmidts_Rd_AL | 270m | 270m | 180m | 180m | 120m | 120m | 120m | 090m | 090m | 120m |
| Outlet | Outlet | 270m | 270m | 180m | 180m | 120m | 120m | 120m | 120m | 120m | 120m |
| **Unknown waterway** | | | | | | | | | | | |
| Logan Reserve Rd | Sch051_POI | 060m | 060m | 045m | 045m | 045m | 045m | 045m | 045m | 045m | 060m |

**Table 8-20 Peak flood levels of design events at locations of interest**

| Location | ID | Peak flood level (mAHD) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 50% AEP | 20% AEP | 10% AEP | 5% AEP | 2% AEP | 1% AEP | 0.5% AEP | 0.2% AEP | 0.05% AEP | PMF |
| **Northern Arm** | | | | | | | | | | | |
| Mt Huntley St | N1 | 28.55 | 28.79 | 28.92 | 29.09 | 29.29 | 29.53 | 29.83 | 30.06 | 30.13 | 30.55 |
| Park Ridge Rd | N2 | 24.08 | 24.21 | 24.26 | 24.30 | 24.35 | 24.38 | 24.42 | 24.50 | 24.58 | 25.06 |
| Bumstead Rd | N3 | 18.16 | 18.39 | 18.48 | 18.54 | 18.6 | 18.64 | 18.7 | 18.79 | 18.88 | 19.49 |
| Crestmead Park | N4 | 12.80 | 12.94 | 13.09 | 13.19 | 13.31 | 13.39 | 13.48 | 13.59 | 13.77 | 15.15 |
| Chambers Flat Rd | N5 | 10.72 | 10.99 | 11.3 | 11.55 | 11.81 | 12.04 | 12.25 | 12.61 | 13.09 | 14.40 |
| Bayes Road AL | N6 | 8.03 | 8.22 | 8.37 | 8.50 | 8.75 | 8.84 | 8.92 | 9.02 | 10.49 | 12.55 |
| Logan Reserve Rd | N7 | 4.65 | 4.95 | 5.83 | 6.00 | 8.38 | 8.42 | 8.46 | 8.53 | 10.43 | 12.43 |
| **Southern Arm** | | | | | | | | | | | |
| Chambers Flat Rd | S1 | 19.72 | 19.85 | 19.95 | 20.03 | 20.1 | 20.15 | 20.22 | 20.32 | 20.4 | 20.71 |
| School Rd | S2 | 12.92 | 13.02 | 13.09 | 13.14 | 13.19 | 13.23 | 13.28 | 13.35 | 13.46 | 14.47 |
| Open Area | S3 | 7.73 | 7.86 | 7.97 | 8.07 | 8.50 | 8.56 | 8.65 | 8.75 | 10.48 | 12.53 |
| Logan Reserve Rd | S4 | 4.61 | 4.93 | 5.83 | 6.00 | 8.38 | 8.42 | 8.46 | 8.53 | 10.43 | 12.42 |
| **Downstream of Confluence** | | | | | | | | | | | |
| Schmidt's Rd AL | TOT1 | 4.55 | 4.79 | 5.80 | 5.97 | 8.38 | 8.42 | 8.46 | 8.52 | 10.43 | 12.42 |
| Outlet | TOT2 | 2.61 | 3.09 | 5.32 | 5.35 | 8.25 | 8.26 | 8.27 | 8.28 | 10.35 | 12.20 |
| **Unknown waterway** | | | | | | | | | | | |
| Logan Reserve Rd | UK1 | 3.91 | 4.51 | 5.76 | 5.93 | 8.37 | 8.41 | 8.45 | 8.52 | 10.42 | 12.40 |




Title:
**Schmidt's Creek Flood Study**
**Reporting Points and Chainage (Longitudinal Profile)**

Figure: **8-6** Rev:

Scale at A4 1:30000
© Kellogg Brown & Root Pty Ltd. Produced 2025-02-18T15:04:26.794 by k141078

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While effort has been made to ensure the accuracy and completeness of the information presented, no guarantee is given, nor responsibility taken by KBR for any errors or omission.

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Scale: 0 0.2 0.4 0.6 0.8 1 km
1:30,000

KBR

**Figure 8-6 Locations of reporting points and chainages of longitudinal profile**

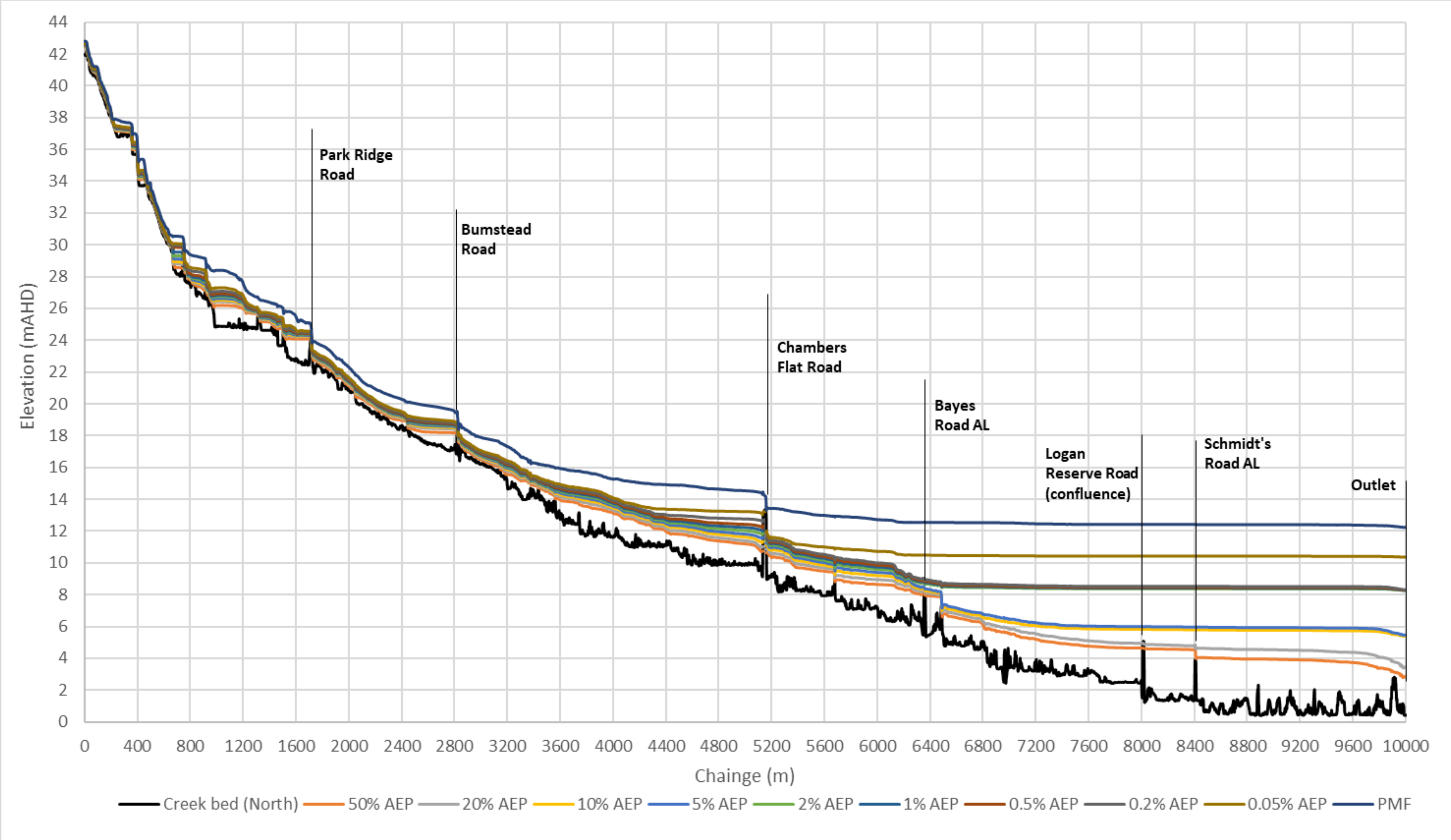


**Figure 8-7 Longitudinal section of TUFLOW model topography and peak water surface levels along Schmidt's Creek (Northern Arm to Outlet) – Design Events**

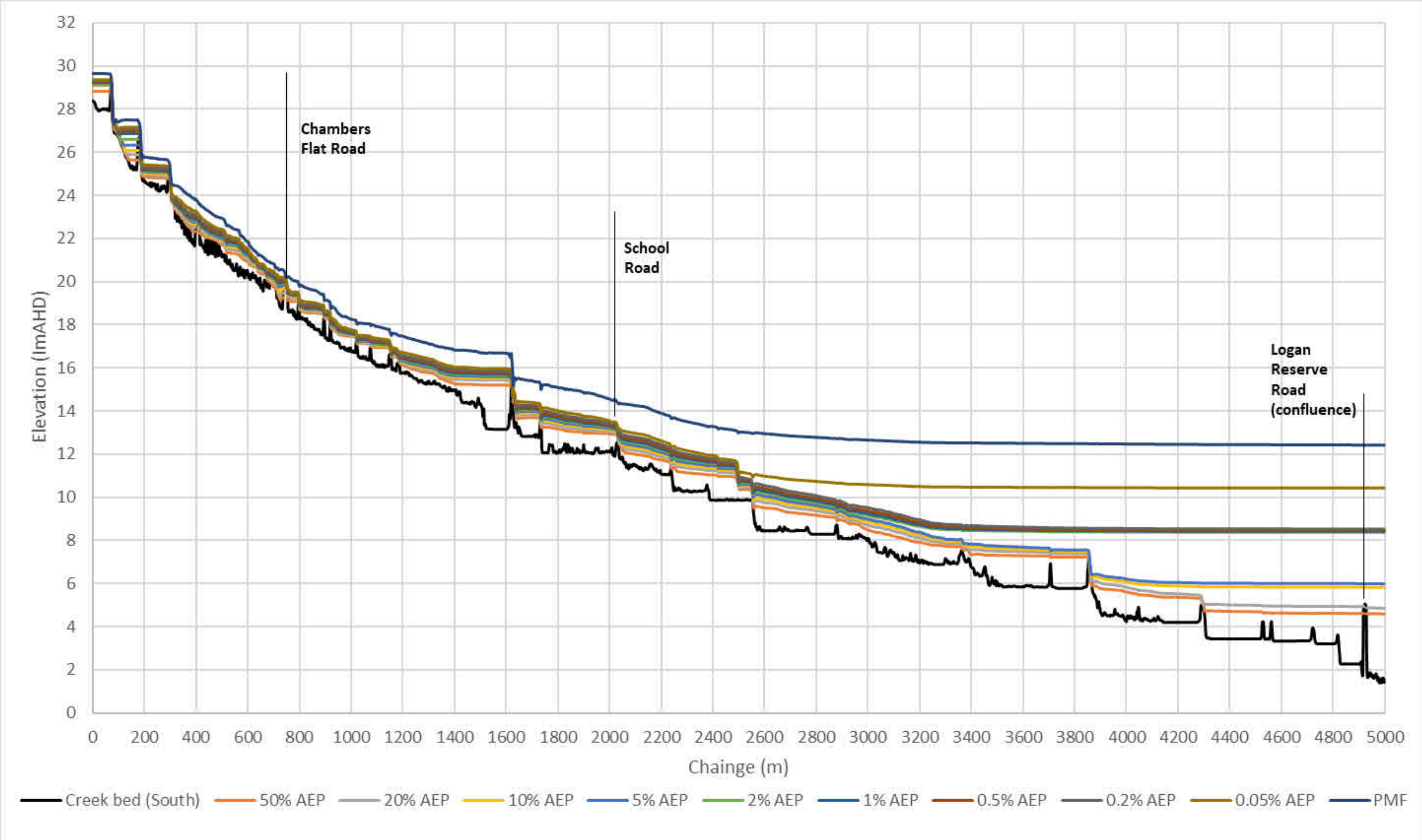


**Figure 8-8 Longitudinal section of TUFLOW model topography and peak water surface levels along Schmidt's Creek (Southern Arm to Confluence) – Design Events**

## 8.15 SUMMARY OF CLIMATE CHANGE EVENT MODELLING

### 8.15.1 Peak flow summary

Peak flows from the TUFLOW model for the for the 50% AEP to 0.2% AEP climate change (RCP4.5) events have been summarised at a number of locations throughout the Schmidt's Creek catchment in Table 8-21. The respective critical durations are presented in Table 8-22. The locations from where the modelled peak flows were extracted are shown in Figure 8-4.

### 8.15.2 Peak flood level summary

Table 8-23 summarises the design peak flood levels for the 50% AEP to 0.2% AEP for the climate change (RCP4.5) events at key locations in the Schmidt's Creek catchment. The reporting points are shown in Figure 8-6.

Flood mapping of the climate change (RCP 4.5) events for water levels and all other outputs are provided in Appendix E.

All flood levels are reported based on the max-max water surface level for each design event from the TUFLOW model simulations.

The modelled flood levels for the 50% AEP to 1% AEP climate change (RCP4.5) events are summarised as follows:

- Compared to the 1% AEP design event, the peak flood levels for the 1% AEP climate change (RCP4.5) events along the Schmidt's Creek main channel are increased by up to 0.69m.
- Design flood levels at Park Ridge Road range from 24.13 mAHD for the 50% AEP climate change (RCP4.5) to 24.41 mAHD for the 1% AEP climate change (RCP4.5) events.
- Design flood levels at Chambers Flat Road range from 10.78 mAHD for the 50% AEP climate change (RCP4.5) events to 12.21 mAHD for the 1% AEP climate change (RCP4.5) events.
- Design flood levels at Bayes Road Alert range from 8.03 mAHD for the 50% AEP climate change (RCP4.5) events to 9.25 mAHD for the 1% AEP climate change (RCP4.5) events.
- Design flood levels at School Road range from 12.92 mAHD for the 50% AEP climate change (RCP4.5) events to 13.27 mAHD for the 1% AEP climate change (RCP4.5) events.
- Design flood levels at Schmidt's Road Alert range from 4.55 mAHD for the 50% AEP climate change (RCP4.5) events to 9.05 mAHD for the 1% AEP climate change (RCP4.5) events.

A comparison of the design flood levels for the higher magnitude climate change (RCP4.5) events against the 1% AEP climate change (RCP4.5) events design flood levels is summarised as follows:

- Design flood levels for the 0.5% AEP climate change (RCP4.5) event are generally higher by between 0.05m to 0.3m.
- Design flood levels for the 0.2% AEP climate change (RCP4.5) events are generally higher by between 0.1m to 0.6m.

The differences in flood levels between the climate change (RCP4.5) events and the design events are also presented as flood maps in Appendix F. The longitudinal section plots of the TUFLOW model topography and design peak water surface levels of the climate change (RCP 4.5) events on both branches of the Schmidt's Creek are presented in Figure 8-9 and Figure 8-10. The chainages of the longitudinal section plots for both branches are shown in Figure 8-6.

**Table 8-21 Peak flows of climate change (RCP4.5) events at locations of interest**

| Location | PO identifier | Peak flow (m³/s) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 50% AEP (RCP4.5) | 20% AEP (RCP4.5) | 10% AEP (RCP4.5) | 5% AEP (RCP4.5) | 2% AEP (RCP4.5) | 1% AEP (RCP4.5) | 0.5% AEP (RCP4.5) | 0.2% AEP (RCP4.5) |
| **Northern Arm** | | | | | | | | | |
| Mt Huntley St | Sch121U_POI | 5.1 | 7.8 | 9.4 | 11.5 | 13.4 | 15.1 | 18.8 | 23.2 |
| Park Ridge Rd | Sch091U_POI | 9.6 | 16.1 | 19.6 | 23.6 | 28.9 | 32.7 | 37.9 | 46.3 |
| Bumstead Rd | Sch065U_POI | 15.5 | 28.4 | 38.3 | 47.5 | 57.5 | 65.7 | 76.3 | 91.6 |
| Crestmead Park | Sch023_POI | 25.1 | 41.9 | 57.6 | 72.2 | 89.1 | 103.1 | 120.5 | 144.3 |
| Chambers Flat Rd | Sch041_POI | 30.0 | 46.1 | 63.9 | 77.7 | 93.0 | 105.5 | 117.4 | 129.7 |
| Bayes Road AL | Bayes_Rd_AL | 37.0 | 54.5 | 74.9 | 91.8 | 109.7 | 124.9 | 139.6 | 156.2 |
| Logan Reserve Rd | SchCk_Nth | 36.0 | 55.2 | 32.2 | 36.7 | 14.8 | 17.5 | 20.3 | 24.9 |
| **Southern Arm** | | | | | | | | | |
| Chambers Flat Rd | Sch137_POI | 4.1 | 6.1 | 7.8 | 9.5 | 11.0 | 13.0 | 15.7 | 19.0 |
| School Rd | Sch107_POI | 16.4 | 27.3 | 36.5 | 44.8 | 54.6 | 62.9 | 73.3 | 87.3 |
| Open Area | Sch094_POI | 20.9 | 36.8 | 49.9 | 61.5 | 76.9 | 88.7 | 103.3 | 123.0 |
| Logan Reserve Rd | SchCk_Sth | 24.2 | 39.3 | 53.8 | 65.2 | 91.4 | 104.7 | 121.5 | 142.7 |
| **Downstream of Confluence** | | | | | | | | | |
| Schmidt's Rd AL | Schmidts_Rd_AL | 57.8 | 90.4 | 75.4 | 87.4 | 75.7 | 86.7 | 98.6 | 113.8 |
| Outlet | Outlet | 50.9 | 79.8 | 124.6 | 147.9 | 220.4 | 251.1 | 282.0 | 322.9 |
| **Unknown waterway** | | | | | | | | | |
| Logan Reserve Rd | Sch051_POI | 6.1 | 9.8 | 11.6 | 13.4 | 18.2 | 20.4 | 23.3 | 26.0 |

**Table 8-22 Critical durations (minutes) of climate change (RCP4.5) events at locations of interest**

| Location | PO identifier | Critical duration (minutes) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 50% AEP (RCP4.5) | 20% AEP (RCP4.5) | 10% AEP (RCP4.5) | 5% AEP (RCP4.5) | 2% AEP (RCP4.5) | 1% AEP (RCP4.5) | 0.5% AEP (RCP4.5) | 0.2% AEP (RCP4.5) |
| **Northern Arm** | | | | | | | | | |
| Mt Huntley St | Sch121U_POI | 060m | 060m | 045m | 045m | 060m | 060m | 045m | 045m |
| Park Ridge Rd | Sch091U_POI | 060m | 060m | 090m | 090m | 060m | 060m | 060m | 060m |
| Bumstead Rd | Sch065U_POI | 120m | 120m | 090m | 090m | 090m | 090m | 090m | 090m |
| Crestmead Park | Sch023_POI | 270m | 120m | 120m | 120m | 120m | 120m | 090m | 090m |
| Chambers Flat Rd | Sch041_POI | 270m | 120m | 180m | 180m | 120m | 120m | 120m | 090m |
| Bayes Road AL | Bayes_Rd_AL | 270m | 270m | 180m | 180m | 120m | 120m | 120m | 120m |
| Logan Reserve Rd | SchCk_Nth | 270m | 270m | 180m | 180m | 120m | 120m | 090m | 120m |
| **Southern Arm** | | | | | | | | | |
| Chambers Flat Rd | Sch137_POI | 060m | 060m | 045m | 045m | 045m | 045m | 045m | 045m |
| School Rd | Sch107_POI | 120m | 090m | 090m | 090m | 090m | 090m | 060m | 060m |
| Open Area | Sch094_POI | 180m | 120m | 120m | 090m | 090m | 090m | 090m | 090m |
| Logan Reserve Rd | SchCk_Sth | 270m | 120m | 180m | 120m | 090m | 090m | 090m | 090m |
| **Downstream of Confluence** | | | | | | | | | |
| Schmidt's Rd AL | Schmidts_Rd_AL | 270m | 270m | 180m | 180m | 120m | 120m | 090m | 090m |
| Outlet | Outlet | 270m | 270m | 180m | 180m | 120m | 120m | 120m | 120m |
| **Unknown waterway** | | | | | | | | | |
| Logan Reserve Rd | Sch051_POI | 060m | 060m | 045m | 045m | 045m | 045m | 045m | 045m |

**Table 8-23 Peak flood levels of climate change (RCP4.5) events at locations of interest**

| Location | ID | Peak flood level (mAHD) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 50% AEP (RCP4.5) | 20% AEP (RCP4.5) | 10% AEP (RCP4.5) | 5% AEP (RCP4.5) | 2% AEP (RCP4.5) | 1% AEP (RCP4.5) | 0.5% AEP (RCP4.5) | 0.2% AEP (RCP4.5) |
| **Northern Arm** | | | | | | | | | |
| Mt Huntley St | N1 | 28.60 | 28.86 | 29.04 | 29.20 | 29.47 | 29.75 | 29.92 | 30.09 |
| Park Ridge Rd | N2 | 24.13 | 24.24 | 24.28 | 24.32 | 24.37 | 24.41 | 24.45 | 24.53 |
| Bumstead Rd | N3 | 18.24 | 18.43 | 18.51 | 18.58 | 18.64 | 18.68 | 18.73 | 18.83 |
| Crestmead Park | N4 | 12.83 | 13.00 | 13.14 | 13.26 | 13.37 | 13.45 | 13.55 | 13.67 |
| Chambers Flat Rd | N5 | 10.78 | 11.10 | 11.44 | 11.70 | 11.97 | 12.21 | 12.43 | 12.81 |
| Bayes Road AL | N6 | 8.08 | 8.27 | 8.44 | 8.56 | 9.18 | 9.25 | 9.30 | 9.38 |
| Logan Reserve Rd | N7 | 4.72 | 5.05 | 6.46 | 6.60 | 9.03 | 9.05 | 9.08 | 9.13 |
| **Southern Arm** | | | | | | | | | |
| Chambers Flat Rd | S1 | 19.76 | 19.91 | 20.00 | 20.08 | 20.14 | 20.20 | 20.27 | 20.35 |
| School Rd | S2 | 12.94 | 13.05 | 13.12 | 13.17 | 13.23 | 13.27 | 13.32 | 13.39 |
| Open Area | S3 | 7.75 | 7.91 | 8.03 | 8.12 | 9.08 | 9.12 | 9.18 | 9.25 |
| Logan Reserve Rd | S4 | 4.69 | 5.04 | 6.46 | 6.60 | 9.03 | 9.05 | 9.08 | 9.13 |
| **Downstream of Confluence** | | | | | | | | | |
| Schmidt's Rd AL | TOT1 | 4.61 | 4.89 | 6.45 | 6.58 | 9.02 | 9.05 | 9.08 | 9.12 |
| Outlet | TOT2 | 2.79 | 3.22 | 6.10 | 6.13 | 8.94 | 8.95 | 8.95 | 8.96 |
| **Unknown waterway** | | | | | | | | | |
| Logan Reserve Rd | UK1 | 4.08 | 4.66 | 6.43 | 6.56 | 9.02 | 9.05 | 9.08 | 9.12 |

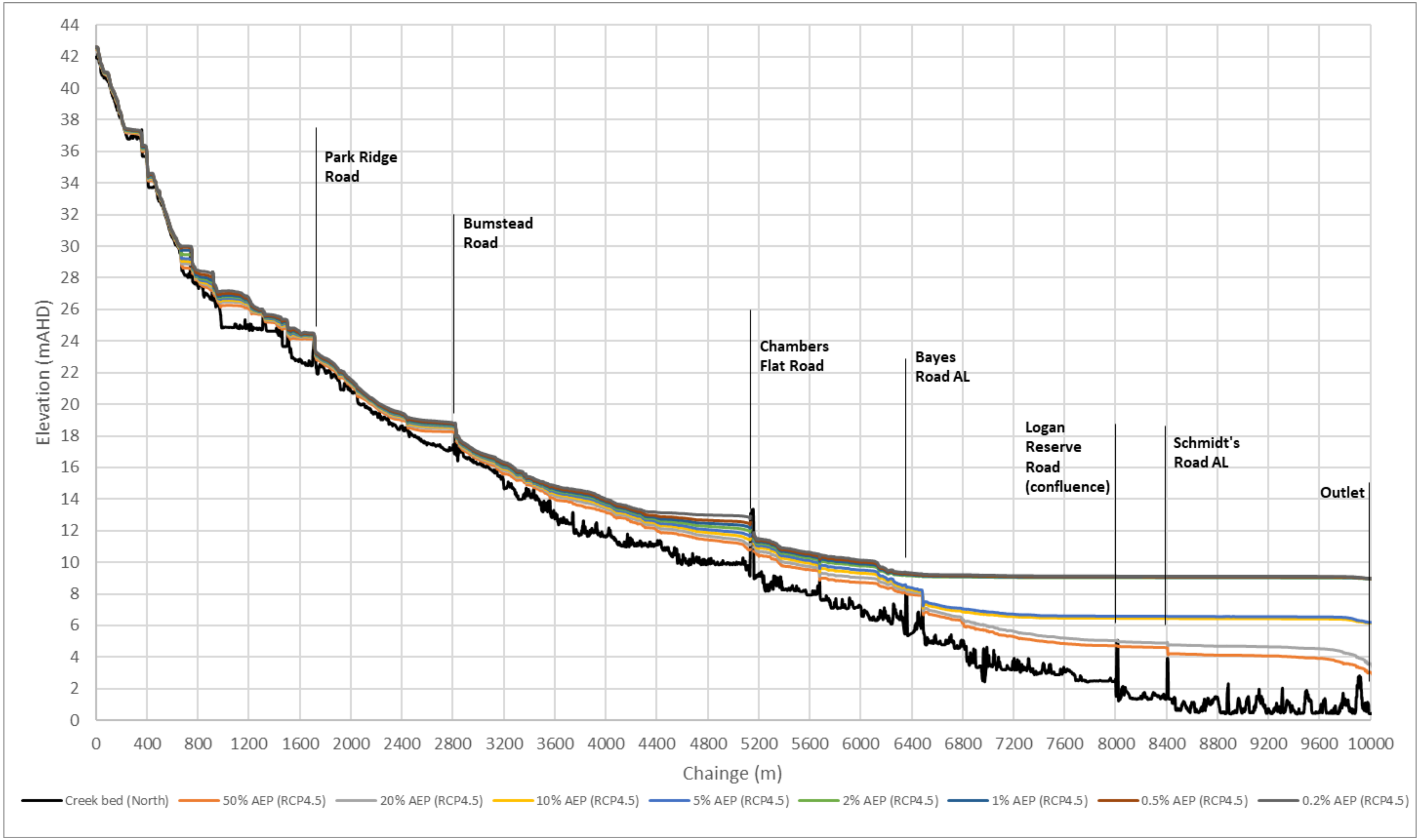


**Figure 8-9 Longitudinal section of TUFLOW model topography and peak water surface levels along Schmidt's Creek (Northern Arm to outlet) – Climate Change Events (RCP 4.5)**

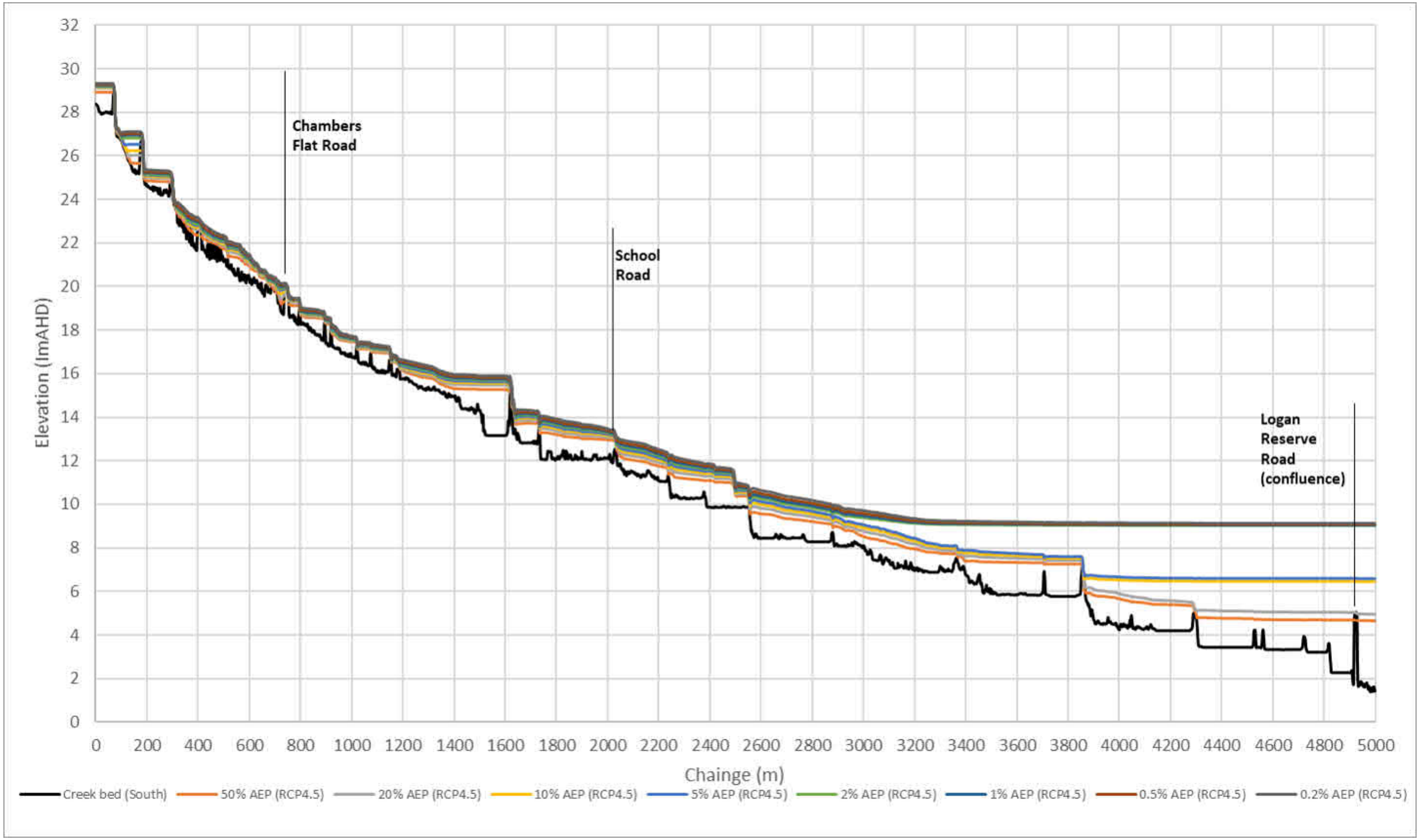


**Figure 8-10 Longitudinal section of TUFLOW model topography and peak water surface levels along Schmidt's Creek (Southern Arm to confluence) – Climate Change Events (RCP 4.5)**

# 9 Sensitivity Analysis

## 9.1 SENSITIVITY ANALYSIS

Sensitivity analysis was undertaken for the 1% AEP event to assess the impact of changes to modelling parameters. Sensitivity analysis of the following modelling parameters was conducted:

- 20% increase in Manning's roughness values.
- 20% decrease in Manning's roughness values.
- "No Blockage" Assessment, i.e. culverts with 0% blockage.
- Increase of the static water level at the downstream boundary.
- Decrease of the static water level at the downstream boundary.
- Climate change scenario RCP6.0.
- Climate change scenario RCP8.5.

In addition, a sensitivity analysis was also conducted for revegetation of the waterway, whereby the Manning's roughness values were updated for the waterway corridor. This analysis was conducted for the 1% AEP and 20% AEP design events.

## 9.2 METHODOLOGY

For each sensitivity analysis scenario, the 1% AEP design event was simulated with the selected temporal patterns for respective durations.

The maximum flood level results for the sensitivity analysis scenarios were then compared against the 1% AEP baseline flood levels, i.e. flood levels simulated in the design event modelling.

The flood level differences maps showing the impacts of the various sensitivity analysis are presented in Appendix G.

## 9.3 RESULTS

### 9.3.1 Increased Manning's roughness

A sensitivity analysis was conducted for increased floodplain roughness whereby the Manning's roughness values for all land uses were increased by a value of 20%. The adopted Manning's roughness values are shown in Table 9-1 .

The modelling indicates that increasing roughness produces a higher peak flood levels throughout the Schmidt's Creek catchment. In general, flood levels increased by up to 50mm in the upper and lower reaches of the catchment, while in the middle reaches, flood levels increased by up to 100mm.

### 9.3.2 Decreased Manning's roughness

The Manning's roughness values for all land uses were decreased by a value of 20%. The adopted Manning's roughness values are shown in Table 9-1.

The modelling indicates that decreased roughness produces in lower peak flood levels than the baseline case throughout the Schmidt's Creek catchment. In general, flood levels decreased by up to 50mm in the upper and lower reaches of the catchment, while in the middle reaches, flood levels decreased by up to 100mm.

Table 9-1 Manning's roughness – Sensitivity analysis

| ID | Land use | Manning's roughness – Design Case | Manning's roughness – increased | Manning's roughness – decreased |
|---|---|---|---|---|
| 1 | Road Reserve | 0.025 | 0.030 | 0.020 |
| 3 | Recreation and Open Space | 0.045 | 0.054 | 0.036 |
| 4 | Rural Residential | 0.055 | 0.066 | 0.044 |
| 5 | Rural | 0.055 | 0.066 | 0.044 |
| 6 | Community Facilities | 0.060 | 0.072 | 0.048 |
| 7 | Environmental Management and Conservation | 0.090 | 0.108 | 0.072 |
| 8 | Low Density Residential | 0.100 | 0.120 | 0.080 |
| 9 | Low-Medium Density Residential | 0.200 | 0.240 | 0.160 |
| 10 | Centre/Industrial | 0.300 | 0.360 | 0.240 |
| 12 | Vegetation - Light | 0.050 | 0.060 | 0.040 |
| 13 | Vegetation - Moderate | 0.065 | 0.078 | 0.052 |
| 14 | Vegetation - High | 0.085 | 0.102 | 0.068 |
| 15 | Waterway - Main (centreline) | 0.040 | 0.048 | 0.032 |
| 16 | Waterway - Concrete Channel | 0.025 | 0.030 | 0.020 |
| 18 | Emerging Community | 0.250 | 0.300 | 0.200 |

### 9.3.3 No blockage of culverts

A sensitivity analysis was conducted for removing the design blockages applied to culverts, i.e. no blockages applied to the culverts for the 1% AEP event.

The results indicate that there are minor differences in flood levels between the blockage scenario and baseline case. In general flood level increases of no more than 10mm were simulated within the catchment. Reduced flood levels of up to 50mm were simulated in parts of the upper reaches of the catchment.

### 9.3.4 Increased tailwater boundary

A sensitivity analysis was conducted considering an increased tailwater condition at the outlet of the Schmidt's Creek catchment whereby the tailwater boundary for the 1% AEP design event was increased from 8.23 mAHD to 10.34 mAHD. This represented a tailwater increase from a 20% AEP to a 10% AEP of the Logan River water level at the Schmidt's Creek outlet.

The results showed increased flood levels of more than 500mm within the lower reaches of the catchment, due to the increased tailwater level. The flood level differences reduce upstream of Chambers Flat Road on the northern arm of the catchment, and approximately 2.4km upstream of Logan Reserve Road in the southern arm.

### 9.3.5 Decreased tailwater boundary

A sensitivity analysis was conducted for a decreased tailwater condition at the outlet of the Schmidt's Creek catchment whereby the tailwater boundary for the 1% AEP design event was decreased from 8.23 mAHD to 5.25 mAHD. This represented a tailwater decrease from a 20% AEP to a 50% AEP of the Logan River at the Schmidt's Creek outlet.

The results showed decreased flood levels within the lower reaches of the catchment by more than 500mm. The flood level differences reduce from approximately 800m upstream of Bayes Road on the northern arm of the catchment and approximately 2km upstream of Logan Reserve Road on the southern arm.

### 9.3.6 Climate change scenario – RCP6.0

A sensitivity analysis was conducted for implementing a RCP6.0 climate change factor for a planning horizon of the year 2090. The RCP6.0 climate change projections represented a 11.5% increase in design rainfall intensities which was applied to the 1% AEP design event. The tailwater adopted for the 1% AEP climate change event was also implemented; i.e., the tailwater level was raised from 8.23 mAHD to 8.93 mAHD.

The RCP6.0 climate change scenario, resulted in increases in flood levels throughout the catchment as compared against the 1% AEP design event. The results indicate increased flood levels of up to 50mm in the upper reaches of the catchment and between 50mm to 500mm in the middle reaches. Flood levels in the downstream reaches increased by more than 500mm.

### 9.3.7 Climate change scenario – RCP8.5

A sensitivity analysis was conducted for implementing a RCP8.5 climate change factor for a planning horizon of the year 2090. The RCP8.5 climate change projections represented a 19.7% increase in design rainfall intensities which was applied to the 1% AEP design event. The tailwater adopted for the 1% AEP climate change event was also implemented; i.e., the tailwater level was raised from 8.23 mAHD to 8.93 mAHD.

There were increases in flood levels throughout the catchment for the RCP8.5 climate change scenario as compared against the 1% AEP design event. Within the upstream and middle reaches of the main channel of Schmidt's Creek, flood levels increased by between 50mm and 500mm. Increased flood levels of more than 500mm were simulated in the lower reaches of the catchment. The flood level differences presented in Appendix G show significantly more sections of the creek with increased flood levels in the RCP 8.5 scenario than in the RCP6.0 scenario.

### 9.3.8 Waterway Revegetation

A sensitivity analysis was conducted for revegetation of the waterway corridor. The intent of the sensitivity analysis was to represent revegetation of engineered waterways such as concrete and grass lined channels.

It was considered that concrete channels (n = 0.025), lightly vegetated channels (n = 0.05) and moderately vegetated channels (n = 0.06), in urbanised settings will be revegetated to a denser vegetation (n = 0.08) to reflect the rehabilitation of these channels to a more natural waterway condition. The sensitivity analysis was conducted for the 1% AEP and 20% AEP design events.

The results showed flood levels generally increased by up to 50mm for the 1% AEP event, in channels where revegetation has been conducted. Similarly, for the 20% AEP event, flood levels generally increased by up to 50mm.

# 10 Summary and Conclusions

## 10.1 OVERVIEW

An URBS hydrological model and TUFLOW hydraulic model were developed for the Schmidt's Creek catchment. The models were calibrated against the March 2018, February 2020 and October 2022 events and validated against the March 2021 event.

The calibrated URBS and TUFLOW model were used to simulate peak discharge, flood levels, depths, velocities and hazard for the Schmidt's Creek catchment for the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP, 0.05% AEP and the PMF events. Climate change scenarios were also simulated. The design event modelling was conducted in accordance with AR&R 2019.

Sensitivity testing was undertaken for the 1% AEP design event for a range of design parameters, including Manning's roughness coefficient, tailwater boundary and climate change scenarios. The impacts of proposed waterway revegetation within the waterway corridor were assessed for the 1% AEP and 20% AEP design events.

## 10.2 HYDROLOGIC MODEL DEVELOPMENT

Two URBS hydrological models were developed as part of the study; a Calibration Events Conditions URBS model for calibration event modelling and an Ultimate Development Conditions URBS model for design event modelling.

The URBS models encompass the entire Schmidt's Creek catchment from headwaters downstream to its outlet at the Logan River Sub-catchments were limited to an area of 30 hectares.

The URBS model used channel lag parameter (alpha), catchment lag parameter (beta) and catchment non-linearity parameter (m) as global catchment and routing parameters.

Fraction impervious for the URBS model for the design events were obtained based on ultimate catchment conditions in accordance with Councils' Planning Scheme current at the time of the flood study (2015 LCC Planning Scheme).

## 10.3 HYDRAULIC MODEL DEVELOPMENT

The TUFLOW model extends from the catchment's headwaters to the creek's outlet into the Logan River. The hydraulic modelling was undertaken using the TUFLOW build 2023-03-AB-iSP-w64 solver and utilised the Sub-Grid-Sampling function.

Hydrographs generated from the URBS model were adopted as inflow boundaries within the TUFLOW model using the surface-area (2d_sa) polygons.

Hydraulic roughness in the TUFLOW model was represented by Manning's roughness values which were determined using the respective aerial photography for the calibration events, and Council Land Use data for the design events.

Hydraulic structures incorporated into the model include 27 box culverts, 101 pipe culverts and underground pipes, 18 pits and 5 bridges. Culverts and underground pipes were represented within the hydraulic model as 1D elements (1d network) while bridges were represented as 2d layered flow constriction.

The adopted tailwater conditions for the design flood events were determined by estimating the design AEP flood levels at the Logan River at the time of peak of the design floods from the Schmidt's Creek.

The 2021 LiDAR was used to conduct the hydraulic modelling for all design events.

## 10.4 JOINT CALIBRATION METHODOLOGY

Joint calibration for the developed Schmidt's Creek hydrologic and hydraulic models were conducted against recorded water levels at Bayes Road Alert (Station ID:540674) and Schmidt's Road Alert (Station ID:540675) for the March 2018, February 2020 and October 2022 events. The two gauges are located in the lower reaches of the catchment.

The Thiessen polygon method was used to assign rainfall from the Schmidt's Road gauge and the Marsden (Station ID: 540078) rainfall gauge to the sub-catchments. Tailwater conditions for the calibration events were predicted from water levels recorded at the Waterford and Logan Village Gauges.

There were minor differences in the waterway corridor between the 2021 and 2017 LiDAR data. As such, the 2021 LiDAR was used to conduct the hydraulic modelling for all calibration events.

The URBS model parameters adopted for all three calibration events were alpha = 0.03, Beta = 1.5 and m = 0.8. The developed URBS model and TUFLOW model modelled discharges and replicated water levels at the two gauges sufficiently for the three calibration events, which was further validated by the March 2021 event. As such, the URBS and TUFLOW model were considered sufficiently robust to be used for conducting the design event modelling for the Schmidt's Creek catchment.

## 10.5 DESIGN EVENT FLOOD MODELLING

The calibrated URBS model was used to estimate design flood discharges in accordance with AR&R 2019 guidelines. Design flood discharges were estimated for the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP, 0.05% AEP and the PMF events.

Design flood discharges were also estimated for the future climate change scenario for design events up to and including the 0.2% AEP design events for the RCP4.5 scenario for the year 2090. The projections represented a 9.5% increase in rainfall intensities.

Design blockages for hydraulic structures were conducted based on Book 6 – Chapter 6 of AR&R 2019 (Ball et al, 2019).

The storm with temporal pattern and duration which predicted median (6th ranked) peak water levels was considered to be the critical design storm. A representative temporal pattern was selected for each duration simulated for the frequent, intermediate and rare temporal pattern bins. The representative temporal pattern was implemented through to their respective bins' (e.g. temporal patterns selected for frequent bin applied to 20% AEP and 50% AEP). The detailed methodology is outlined in Section 8.11.

The TUFLOW model was used to simulate the flood level, depth, velocity and hazard for the representative temporal patterns for the 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP, 0.05% AEP and the PMF events. Climate change scenarios were also simulated for design events up to 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP events.

High resolution flood maps are provided in Appendix D and Appendix E for the design events and climate change events, respectively. These maps represent the max-max of the durations and their representative temporal patterns.

### 10.5.1 Verification of peak flows using the Rational Method

As the calibration events only provided flow validation for the lower magnitude events, the Rational Method was used to check the flows simulated for the 1% AEP and 10% AEP design event in the upper catchments by the URBS and TUFLOW models. The comparison of the URBS and

TUFLOW flows for the 1% AEP and 10% AEP design events suggested good correlation of the design flows to the Rational Method for the upper catchments and at where inflows are first assigned to the waterway corridor. The Rational Method flow validation combined with the calibration results has provided further confidence that the models are producing suitable peak flow estimates for the design events.

### 10.5.2 Peak flow observations

An analysis of the simulated peak design flows identified that downstream of Schmidt's Road Alert to the outlet, a retarding effect reduces peak flows near the outlet for lower magnitude design events (≤20% AEP). Also, a breakaway flow path appears in the 10% AEP and higher magnitude design events, which results in noted reduced peak flows from Bayes Road to Logan Reserve Road.

## 10.6 SENSITIVITY ANALYSIS

The sensitivity analysis results are summarised as follows:

- Increasing the Manning's roughness by 20% resulted in flood levels increasing by up to 50mm in the upper and lower reaches of the catchment, while flood levels increased by up to 100mm in the middle reaches.
- Decreasing the Manning's roughness by 20% resulted in flood levels decreasing by up to 50mm in the upper and lower reaches of the catchment, while in the middle reaches, flood levels decreased by up to 100mm.
- Removing blockages in hydraulic structures (no blockage) resulted in flood levels reducing by up to 50mm, and which were mainly simulated in the upper reaches of the catchment.
- Increasing the tailwater boundary from 8.23 mAHD to 10.34 mAHD resulted in increased peak water levels by more than 500mm within the lower reaches of the catchment, with flood level differences reducing from upstream of Chambers Flat Road and Logan Reserved Road.
- Decreasing the tailwater boundary from 8.23 mAHD to 5.25 mAHD reduced peak water levels by more than 500mm within the lower reaches of the catchment, with flood level differences reducing from 800m upstream of Bayes Road and 2km upstream of Logan Reserved Road, for the northern and southern arms respectively.
- Implementing the RCP6.0 pathway for the climate change scenario resulted in increased simulated flood levels of up to 50mm in the upper reaches of the catchment, between 50mm to 500mm in the middle reaches; and more than 500mm in lower reaches of the catchment.
- Implementing the RCP8.5 pathway for the climate change scenario resulted in increased flood levels of between 50mm to 500mm in the main channel of the upstream and middle reaches of the catchment. Flood levels increased by up more than 500mm in the lower reaches of the catchment.
- Revegetation of the waterway corridor resulted in flood levels generally increasing by up to 50mm in both the 1% AEP and 20% AEP events within areas of revegetation.

Flood level impact maps of the sensitivity analyses conducted are provided in Appendix G.

### 10.7 LIMITATIONS

The main focus of the flood study is fluvial flooding from the Schmidt’s Creek. Hence, flood inundation caused by overland flow has not been considered in this study. As such, properties shown to be flood free in this study may still be impacted by overland flood inundation. A local flood assessment will be required to determine the extent and magnitude of overland flow flooding on properties, which is beyond the scope of this flood study. Overland flow flooding is usually associated with short storm duration but also recedes over a short period of time.

Tailwater conditions from Logan River influence water levels recorded at the Bayes Road Alert (Station ID:540674) and Schmidt’s Road Alert (Station ID:540675) gauges and hence limits the selection of historic events for calibrating local catchment conditions. Water level gauges installed in the Schmidt’s Creek catchment, upstream of the Logan River influence would allow collection of independent stream flow data and allow for refined calibration to the local catchment conditions.

# 11 References


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# Appendix A: Subcatchment Parameters

URBS Subcatchment Parameters

| URBS Subcatch ID | March 2018 | | February 2020 | | March 2021 | | October 2022 | | Ultimate Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious |
| 1 | 0.161 | 0.640 | 0.161 | 0.640 | 0.161 | 0.640 | 0.161 | 0.640 | 0.161 | 0.640 |
| 2 | 0.115 | 0.673 | 0.115 | 0.673 | 0.115 | 0.673 | 0.115 | 0.673 | 0.115 | 0.674 |
| 3 | 0.256 | 0.613 | 0.256 | 0.613 | 0.256 | 0.613 | 0.256 | 0.613 | 0.256 | 0.613 |
| 4 | 0.301 | 0.635 | 0.300 | 0.635 | 0.300 | 0.635 | 0.300 | 0.635 | 0.300 | 0.635 |
| 5 | 0.189 | 0.595 | 0.189 | 0.595 | 0.189 | 0.595 | 0.189 | 0.595 | 0.189 | 0.595 |
| 6 | 0.083 | 0.627 | 0.083 | 0.627 | 0.083 | 0.627 | 0.083 | 0.627 | 0.083 | 0.627 |
| 7 | 0.086 | 0.632 | 0.086 | 0.632 | 0.086 | 0.632 | 0.086 | 0.632 | 0.086 | 0.632 |
| 8 | 0.190 | 0.664 | 0.190 | 0.664 | 0.190 | 0.664 | 0.190 | 0.664 | 0.190 | 0.664 |
| 9 | 0.103 | 0.621 | 0.103 | 0.621 | 0.103 | 0.621 | 0.103 | 0.621 | 0.103 | 0.621 |
| 10 | 0.117 | 0.632 | 0.117 | 0.632 | 0.117 | 0.632 | 0.117 | 0.632 | 0.117 | 0.632 |
| 11 | 0.274 | 0.639 | 0.274 | 0.639 | 0.274 | 0.639 | 0.274 | 0.639 | 0.274 | 0.639 |
| 12 | 0.065 | 0.331 | 0.065 | 0.331 | 0.065 | 0.331 | 0.065 | 0.331 | 0.065 | 0.502 |
| 13 | 0.239 | 0.607 | 0.239 | 0.607 | 0.239 | 0.607 | 0.239 | 0.607 | 0.239 | 0.607 |
| 14 | 0.097 | 0.655 | 0.097 | 0.655 | 0.097 | 0.655 | 0.097 | 0.655 | 0.097 | 0.655 |
| 15 | 0.045 | 0.104 | 0.045 | 0.104 | 0.045 | 0.104 | 0.045 | 0.104 | 0.045 | 0.270 |
| 16 | 0.027 | 0.231 | 0.027 | 0.231 | 0.027 | 0.231 | 0.027 | 0.231 | 0.027 | 0.231 |
| 17 | 0.033 | 0.627 | 0.033 | 0.626 | 0.033 | 0.626 | 0.033 | 0.626 | 0.033 | 0.626 |
| 18 | 0.030 | 0.007 | 0.030 | 0.007 | 0.030 | 0.007 | 0.030 | 0.007 | 0.030 | 0.007 |
| 19 | 0.018 | 0.355 | 0.018 | 0.355 | 0.018 | 0.355 | 0.018 | 0.355 | 0.018 | 0.355 |
| 20 | 0.120 | 0.600 | 0.120 | 0.600 | 0.120 | 0.600 | 0.120 | 0.600 | 0.120 | 0.600 |
| 21 | 0.023 | 0.072 | 0.023 | 0.072 | 0.023 | 0.072 | 0.023 | 0.072 | 0.023 | 0.072 |
| 22 | 0.103 | 0.053 | 0.103 | 0.053 | 0.103 | 0.053 | 0.103 | 0.053 | 0.103 | 0.053 |
| 23 | 0.028 | 0.029 | 0.028 | 0.029 | 0.028 | 0.029 | 0.028 | 0.029 | 0.028 | 0.029 |
| 24 | 0.135 | 0.295 | 0.135 | 0.295 | 0.135 | 0.295 | 0.135 | 0.295 | 0.135 | 0.295 |
| 25 | 0.103 | 0.644 | 0.103 | 0.644 | 0.103 | 0.644 | 0.103 | 0.644 | 0.103 | 0.644 |
| 26 | 0.207 | 0.120 | 0.207 | 0.120 | 0.207 | 0.120 | 0.207 | 0.120 | 0.207 | 0.274 |
| 27 | 0.025 | 0.033 | 0.025 | 0.033 | 0.025 | 0.033 | 0.025 | 0.033 | 0.025 | 0.033 |
| 28 | 0.080 | 0.488 | 0.080 | 0.488 | 0.080 | 0.488 | 0.080 | 0.488 | 0.080 | 0.488 |
| 29 | 0.102 | 0.048 | 0.102 | 0.048 | 0.102 | 0.048 | 0.102 | 0.048 | 0.102 | 0.120 |
| 30 | 0.186 | 0.462 | 0.186 | 0.464 | 0.186 | 0.464 | 0.186 | 0.464 | 0.186 | 0.464 |
| 31 | 0.037 | 0.572 | 0.037 | 0.572 | 0.037 | 0.572 | 0.037 | 0.572 | 0.037 | 0.572 |
| 32 | 0.173 | 0.277 | 0.173 | 0.277 | 0.173 | 0.277 | 0.173 | 0.277 | 0.173 | 0.277 |
| 33 | 0.068 | 0.687 | 0.068 | 0.687 | 0.068 | 0.687 | 0.068 | 0.687 | 0.068 | 0.687 |
| 34 | 0.148 | 0.595 | 0.148 | 0.595 | 0.148 | 0.595 | 0.148 | 0.595 | 0.148 | 0.595 |
| 35 | 0.222 | 0.368 | 0.215 | 0.376 | 0.215 | 0.376 | 0.215 | 0.376 | 0.215 | 0.728 |
| 36 | 0.175 | 0.135 | 0.175 | 0.135 | 0.175 | 0.135 | 0.175 | 0.135 | 0.175 | 0.360 |
| 37 | 0.059 | 0.564 | 0.059 | 0.564 | 0.059 | 0.564 | 0.059 | 0.564 | 0.059 | 0.564 |

| | March 2018 | | February 2020 | | March 2021 | | October 2022 | | Ultimate Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| URBS Subcatch ID | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious |
| 38 | 0.165 | 0.115 | 0.160 | 0.134 | 0.160 | 0.134 | 0.160 | 0.184 | 0.160 | 0.235 |
| 39 | 0.068 | 0.614 | 0.068 | 0.614 | 0.068 | 0.614 | 0.068 | 0.614 | 0.068 | 0.614 |
| 40 | 0.068 | 0.105 | 0.068 | 0.105 | 0.068 | 0.105 | 0.068 | 0.105 | 0.068 | 0.105 |
| 41 | 0.050 | 0.145 | 0.050 | 0.145 | 0.050 | 0.145 | 0.050 | 0.145 | 0.050 | 0.145 |
| 42 | 0.249 | 0.593 | 0.249 | 0.593 | 0.249 | 0.593 | 0.249 | 0.593 | 0.249 | 0.593 |
| 43 | 0.112 | 0.480 | 0.112 | 0.480 | 0.112 | 0.480 | 0.112 | 0.480 | 0.112 | 0.480 |
| 44 | 0.237 | 0.612 | 0.237 | 0.612 | 0.237 | 0.612 | 0.237 | 0.612 | 0.237 | 0.612 |
| 45 | 0.119 | 0.478 | 0.119 | 0.478 | 0.119 | 0.478 | 0.119 | 0.478 | 0.119 | 0.478 |
| 46 | 0.074 | 0.646 | 0.074 | 0.646 | 0.074 | 0.646 | 0.074 | 0.646 | 0.074 | 0.646 |
| 47 | 0.049 | 0.043 | 0.049 | 0.043 | 0.049 | 0.043 | 0.049 | 0.043 | 0.049 | 0.043 |
| 48 | 0.051 | 0.106 | 0.051 | 0.106 | 0.051 | 0.106 | 0.051 | 0.106 | 0.051 | 0.106 |
| 49 | 0.167 | 0.510 | 0.138 | 0.595 | 0.138 | 0.595 | 0.138 | 0.595 | 0.138 | 0.635 |
| 50 | 0.295 | 0.160 | 0.295 | 0.160 | 0.295 | 0.160 | 0.295 | 0.160 | 0.295 | 0.160 |
| 51 | 0.148 | 0.077 | 0.148 | 0.077 | 0.148 | 0.077 | 0.148 | 0.077 | 0.148 | 0.077 |
| 52 | 0.163 | 0.645 | 0.163 | 0.645 | 0.163 | 0.645 | 0.163 | 0.645 | 0.163 | 0.645 |
| 53 | 0.067 | 0.503 | 0.097 | 0.396 | 0.097 | 0.396 | 0.097 | 0.619 | 0.097 | 0.621 |
| 54 | 0.136 | 0.301 | 0.136 | 0.301 | 0.136 | 0.301 | 0.136 | 0.301 | 0.136 | 0.301 |
| 55 | 0.211 | 0.086 | 0.186 | 0.084 | 0.186 | 0.084 | 0.186 | 0.087 | 0.186 | 0.087 |
| 56 | 0.088 | 0.662 | 0.088 | 0.662 | 0.088 | 0.662 | 0.088 | 0.662 | 0.088 | 0.662 |
| 57 | 0.280 | 0.112 | 0.280 | 0.112 | 0.280 | 0.112 | 0.280 | 0.112 | 0.280 | 0.529 |
| 58 | 0.048 | 0.143 | 0.048 | 0.143 | 0.048 | 0.143 | 0.048 | 0.143 | 0.048 | 0.143 |
| 59 | 0.123 | 0.228 | 0.123 | 0.284 | 0.123 | 0.284 | 0.123 | 0.508 | 0.123 | 0.572 |
| 60 | 0.139 | 0.027 | 0.140 | 0.027 | 0.140 | 0.027 | 0.140 | 0.156 | 0.140 | 0.156 |
| 61 | 0.171 | 0.103 | 0.171 | 0.103 | 0.171 | 0.103 | 0.171 | 0.103 | 0.171 | 0.511 |
| 62 | 0.111 | 0.056 | 0.108 | 0.056 | 0.108 | 0.056 | 0.108 | 0.416 | 0.108 | 0.416 |
| 63 | 0.083 | 0.012 | 0.083 | 0.012 | 0.083 | 0.012 | 0.083 | 0.012 | 0.083 | 0.012 |
| 64 | 0.084 | 0.346 | 0.126 | 0.320 | 0.126 | 0.320 | 0.126 | 0.491 | 0.126 | 0.598 |
| 65 | 0.240 | 0.099 | 0.198 | 0.095 | 0.198 | 0.095 | 0.198 | 0.098 | 0.198 | 0.490 |
| 66 | 0.056 | 0.046 | 0.056 | 0.046 | 0.056 | 0.046 | 0.056 | 0.046 | 0.056 | 0.273 |
| 67 | 0.128 | 0.038 | 0.128 | 0.220 | 0.128 | 0.220 | 0.128 | 0.310 | 0.128 | 0.359 |
| 68 | 0.277 | 0.184 | 0.279 | 0.235 | 0.279 | 0.235 | 0.279 | 0.342 | 0.279 | 0.592 |
| 69 | 0.046 | 0.131 | 0.046 | 0.131 | 0.046 | 0.131 | 0.046 | 0.131 | 0.046 | 0.511 |
| 70 | 0.090 | 0.074 | 0.083 | 0.077 | 0.083 | 0.077 | 0.083 | 0.077 | 0.083 | 0.348 |
| 71 | 0.074 | 0.077 | 0.050 | 0.066 | 0.050 | 0.066 | 0.050 | 0.071 | 0.050 | 0.265 |
| 72 | 0.085 | 0.050 | 0.085 | 0.050 | 0.085 | 0.050 | 0.085 | 0.054 | 0.085 | 0.550 |
| 73 | 0.180 | 0.051 | 0.180 | 0.052 | 0.180 | 0.052 | 0.180 | 0.109 | 0.180 | 0.492 |
| 74 | 0.123 | 0.078 | 0.081 | 0.080 | 0.081 | 0.080 | 0.081 | 0.080 | 0.081 | 0.636 |

| | March 2018 | | February 2020 | | March 2021 | | October 2022 | | Ultimate Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| URBS Subcatch ID | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious |
| 75 | 0.284 | 0.156 | 0.262 | 0.160 | 0.262 | 0.160 | 0.262 | 0.160 | 0.262 | 0.734 |
| 76 | 0.253 | 0.265 | 0.253 | 0.377 | 0.253 | 0.377 | 0.253 | 0.480 | 0.253 | 0.574 |
| 77 | 0.066 | 0.267 | 0.066 | 0.602 | 0.066 | 0.602 | 0.066 | 0.641 | 0.066 | 0.645 |
| 78 | 0.290 | 0.156 | 0.290 | 0.156 | 0.290 | 0.156 | 0.290 | 0.156 | 0.290 | 0.579 |
| 79 | 0.093 | 0.218 | 0.126 | 0.192 | 0.126 | 0.192 | 0.126 | 0.641 | 0.126 | 0.808 |
| 80 | 0.186 | 0.141 | 0.180 | 0.139 | 0.180 | 0.139 | 0.180 | 0.147 | 0.180 | 0.558 |
| 81 | 0.093 | 0.086 | 0.093 | 0.100 | 0.093 | 0.100 | 0.093 | 0.714 | 0.093 | 0.800 |
| 82 | 0.132 | 0.049 | 0.140 | 0.217 | 0.140 | 0.217 | 0.140 | 0.505 | 0.140 | 0.606 |
| 83 | 0.073 | 0.114 | 0.073 | 0.114 | 0.073 | 0.114 | 0.073 | 0.114 | 0.073 | 0.527 |
| 84 | 0.181 | 0.123 | 0.181 | 0.123 | 0.181 | 0.123 | 0.181 | 0.123 | 0.181 | 0.534 |
| 85 | 0.102 | 0.062 | 0.102 | 0.062 | 0.102 | 0.062 | 0.102 | 0.062 | 0.102 | 0.619 |
| 86 | 0.109 | 0.444 | 0.112 | 0.499 | 0.112 | 0.499 | 0.112 | 0.499 | 0.112 | 0.657 |
| 87 | 0.240 | 0.065 | 0.238 | 0.217 | 0.238 | 0.217 | 0.238 | 0.432 | 0.238 | 0.591 |
| 88 | 0.201 | 0.211 | 0.201 | 0.388 | 0.201 | 0.388 | 0.201 | 0.388 | 0.201 | 0.799 |
| 89 | 0.220 | 0.032 | 0.207 | 0.031 | 0.207 | 0.031 | 0.207 | 0.031 | 0.207 | 0.304 |
| 90 | 0.112 | 0.122 | 0.099 | 0.134 | 0.099 | 0.134 | 0.099 | 0.423 | 0.099 | 0.662 |
| 91 | 0.259 | 0.105 | 0.272 | 0.220 | 0.272 | 0.220 | 0.272 | 0.454 | 0.272 | 0.773 |
| 92 | 0.032 | 0.050 | 0.053 | 0.050 | 0.053 | 0.050 | 0.053 | 0.550 | 0.053 | 0.550 |
| 93 | 0.049 | 0.169 | 0.049 | 0.169 | 0.049 | 0.169 | 0.049 | 0.271 | 0.049 | 0.699 |
| 94 | 0.161 | 0.054 | 0.155 | 0.054 | 0.155 | 0.054 | 0.155 | 0.056 | 0.155 | 0.522 |
| 95 | 0.117 | 0.449 | 0.117 | 0.449 | 0.117 | 0.449 | 0.117 | 0.449 | 0.117 | 0.464 |
| 96 | 0.199 | 0.672 | 0.199 | 0.601 | 0.199 | 0.601 | 0.199 | 0.751 | 0.199 | 0.763 |
| 97 | 0.206 | 0.373 | 0.192 | 0.400 | 0.192 | 0.400 | 0.192 | 0.494 | 0.192 | 0.726 |
| 98 | 0.122 | 0.050 | 0.122 | 0.050 | 0.122 | 0.050 | 0.122 | 0.050 | 0.122 | 0.538 |
| 99 | 0.155 | 0.058 | 0.155 | 0.059 | 0.155 | 0.059 | 0.155 | 0.075 | 0.155 | 0.539 |
| 100 | 0.047 | 0.140 | 0.047 | 0.140 | 0.047 | 0.140 | 0.047 | 0.140 | 0.047 | 0.805 |
| 101 | 0.078 | 0.091 | 0.078 | 0.091 | 0.078 | 0.091 | 0.078 | 0.108 | 0.078 | 0.804 |
| 102 | 0.079 | 0.079 | 0.079 | 0.081 | 0.079 | 0.081 | 0.079 | 0.205 | 0.079 | 0.657 |
| 103 | 0.027 | 0.152 | 0.027 | 0.152 | 0.027 | 0.152 | 0.027 | 0.152 | 0.027 | 0.548 |
| 104 | 0.060 | 0.207 | 0.060 | 0.207 | 0.060 | 0.207 | 0.060 | 0.207 | 0.060 | 0.563 |
| 105 | 0.173 | 0.598 | 0.173 | 0.598 | 0.173 | 0.598 | 0.173 | 0.598 | 0.173 | 0.812 |
| 106 | 0.196 | 0.125 | 0.196 | 0.125 | 0.196 | 0.125 | 0.196 | 0.125 | 0.196 | 0.803 |
| 107 | 0.142 | 0.157 | 0.142 | 0.157 | 0.142 | 0.157 | 0.142 | 0.157 | 0.142 | 0.689 |
| 108 | 0.049 | 0.125 | 0.049 | 0.137 | 0.049 | 0.137 | 0.049 | 0.799 | 0.049 | 0.799 |
| 109 | 0.177 | 0.105 | 0.177 | 0.105 | 0.177 | 0.105 | 0.177 | 0.105 | 0.177 | 0.729 |
| 110 | 0.034 | 0.664 | 0.034 | 0.664 | 0.034 | 0.664 | 0.034 | 0.665 | 0.034 | 0.669 |
| 111 | 0.125 | 0.116 | 0.125 | 0.116 | 0.125 | 0.116 | 0.125 | 0.116 | 0.125 | 0.802 |

| | March 2018 | | February 2020 | | March 2021 | | October 2022 | | Ultimate Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| URBS Subcatch ID | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious |
| 112 | 0.038 | 0.802 | 0.038 | 0.802 | 0.038 | 0.802 | 0.038 | 0.802 | 0.038 | 0.802 |
| 113 | 0.010 | 0.577 | 0.010 | 0.577 | 0.010 | 0.577 | 0.010 | 0.577 | 0.010 | 0.577 |
| 114 | 0.291 | 0.195 | 0.291 | 0.543 | 0.291 | 0.543 | 0.291 | 0.584 | 0.291 | 0.820 |
| 115 | 0.018 | 0.651 | 0.018 | 0.651 | 0.018 | 0.651 | 0.018 | 0.651 | 0.018 | 0.651 |
| 116 | 0.285 | 0.143 | 0.285 | 0.143 | 0.285 | 0.143 | 0.285 | 0.299 | 0.285 | 0.805 |
| 117 | 0.204 | 0.734 | 0.206 | 0.754 | 0.206 | 0.754 | 0.206 | 0.773 | 0.206 | 0.788 |
| 118 | 0.083 | 0.140 | 0.083 | 0.140 | 0.083 | 0.140 | 0.083 | 0.140 | 0.083 | 0.630 |
| 119 | 0.114 | 0.251 | 0.114 | 0.251 | 0.114 | 0.251 | 0.114 | 0.260 | 0.114 | 0.641 |
| 120 | 0.231 | 0.148 | 0.231 | 0.148 | 0.231 | 0.148 | 0.231 | 0.148 | 0.231 | 0.806 |
| 121 | 0.088 | 0.819 | 0.088 | 0.819 | 0.088 | 0.819 | 0.088 | 0.819 | 0.088 | 0.820 |
| 122 | 0.092 | 0.098 | 0.092 | 0.819 | 0.092 | 0.819 | 0.092 | 0.819 | 0.092 | 0.819 |
| 123 | 0.133 | 0.100 | 0.133 | 0.100 | 0.133 | 0.100 | 0.133 | 0.100 | 0.133 | 0.799 |
| 124 | 0.208 | 0.100 | 0.208 | 0.100 | 0.208 | 0.100 | 0.208 | 0.100 | 0.208 | 0.698 |
| 125 | 0.106 | 0.212 | 0.106 | 0.435 | 0.106 | 0.435 | 0.106 | 0.706 | 0.106 | 0.805 |
| 126 | 0.279 | 0.123 | 0.232 | 0.113 | 0.232 | 0.113 | 0.232 | 0.081 | 0.232 | 0.556 |
| 127 | 0.046 | 0.122 | 0.046 | 0.122 | 0.046 | 0.122 | 0.046 | 0.122 | 0.046 | 0.423 |
| 128 | 0.182 | 0.451 | 0.182 | 0.484 | 0.182 | 0.484 | 0.182 | 0.638 | 0.182 | 0.738 |
| 129 | 0.034 | 0.077 | 0.034 | 0.077 | 0.034 | 0.077 | 0.034 | 0.077 | 0.034 | 0.618 |
| 130 | 0.198 | 0.105 | 0.198 | 0.105 | 0.198 | 0.105 | 0.198 | 0.105 | 0.198 | 0.721 |
| 131 | 0.021 | 0.275 | 0.021 | 0.275 | 0.021 | 0.275 | 0.021 | 0.275 | 0.021 | 0.575 |
| 132 | 0.291 | 0.127 | 0.291 | 0.127 | 0.291 | 0.127 | 0.291 | 0.127 | 0.291 | 0.796 |
| 133 | 0.084 | 0.099 | 0.084 | 0.099 | 0.084 | 0.099 | 0.084 | 0.099 | 0.084 | 0.793 |
| 134 | 0.104 | 0.132 | 0.104 | 0.137 | 0.104 | 0.137 | 0.104 | 0.137 | 0.104 | 0.805 |
| 135 | 0.169 | 0.282 | 0.214 | 0.253 | 0.214 | 0.253 | 0.214 | 0.238 | 0.214 | 0.777 |
| 136 | 0.151 | 0.215 | 0.151 | 0.216 | 0.151 | 0.216 | 0.151 | 0.216 | 0.151 | 0.814 |
| 137 | 0.023 | 0.297 | 0.023 | 0.297 | 0.023 | 0.297 | 0.023 | 0.297 | 0.023 | 0.297 |
| 138 | 0.131 | 0.134 | 0.131 | 0.134 | 0.131 | 0.134 | 0.131 | 0.134 | 0.131 | 0.745 |
| 139 | 0.025 | 0.190 | 0.025 | 0.190 | 0.025 | 0.190 | 0.025 | 0.190 | 0.025 | 0.190 |
| 140 | 0.153 | 0.136 | 0.153 | 0.136 | 0.153 | 0.136 | 0.153 | 0.136 | 0.153 | 0.758 |
| 141 | 0.041 | 0.807 | 0.041 | 0.807 | 0.041 | 0.807 | 0.041 | 0.807 | 0.041 | 0.808 |
| 142 | 0.050 | 0.717 | 0.050 | 0.724 | 0.050 | 0.724 | 0.050 | 0.812 | 0.050 | 0.814 |
| 143 | 0.140 | 0.099 | 0.140 | 0.099 | 0.140 | 0.099 | 0.140 | 0.099 | 0.140 | 0.794 |
| 144 | 0.038 | 0.282 | 0.038 | 0.313 | 0.038 | 0.313 | 0.038 | 0.764 | 0.038 | 0.764 |
| 145 | 0.039 | 0.155 | 0.039 | 0.155 | 0.039 | 0.155 | 0.039 | 0.155 | 0.039 | 0.807 |
| 146 | 0.074 | 0.173 | 0.074 | 0.357 | 0.074 | 0.357 | 0.074 | 0.357 | 0.074 | 0.591 |
| 147 | 0.067 | 0.300 | 0.067 | 0.308 | 0.067 | 0.308 | 0.067 | 0.764 | 0.067 | 0.774 |
| 148 | 0.038 | 0.145 | 0.038 | 0.146 | 0.038 | 0.146 | 0.038 | 0.671 | 0.038 | 0.744 |

| | March 2018 | | February 2020 | | March 2021 | | October 2022 | | Ultimate Conditions | |
|---|---|---|---|---|---|---|---|---|---|---|
| URBS Subcatch ID | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious | Area ($km^2$) | Fraction Impervious |
| 149 | 0.031 | 0.076 | 0.031 | 0.076 | 0.031 | 0.076 | 0.031 | 0.076 | 0.031 | 0.076 |
| 150 | 0.014 | 0.077 | 0.014 | 0.079 | 0.014 | 0.079 | 0.014 | 0.079 | 0.014 | 0.450 |
| 151 | 0.038 | 0.594 | 0.038 | 0.642 | 0.038 | 0.642 | 0.038 | 0.702 | 0.038 | 0.720 |
| 152 | 0.012 | 0.386 | 0.012 | 0.386 | 0.012 | 0.386 | 0.012 | 0.386 | 0.012 | 0.688 |
| 153 | 0.018 | 0.344 | 0.018 | 0.418 | 0.018 | 0.418 | 0.018 | 0.696 | 0.018 | 0.696 |
| 154 | 0.043 | 0.832 | 0.043 | 0.833 | 0.043 | 0.833 | 0.043 | 0.833 | 0.043 | 0.833 |
| 155 | 0.118 | 0.315 | 0.118 | 0.315 | 0.118 | 0.315 | 0.118 | 0.315 | 0.118 | 0.394 |
| 156 | 0.078 | 0.308 | 0.078 | 0.308 | 0.078 | 0.308 | 0.078 | 0.308 | 0.078 | 0.366 |
| 157 | 0.123 | 0.042 | 0.123 | 0.042 | 0.123 | 0.042 | 0.123 | 0.042 | 0.123 | 0.654 |

# Appendix B: Hydraulic Structures Details

Hydraulic Structures in TUFLOW model

**Table B1: Culvert and pipe configurations in the TUFLOW model**

| ID | Culvert Type | US Invert (mAHD) | DS Invert (mAHD) | Width/ Diameter (m) | Height (m) | No. of barrels | Comments |
|---|---|---|---|---|---|---|---|
| 08Pipe_1 | C | 15.274 | 15.189 | 0.375 | 0 | 1 | LCC Site Survey |
| 08Pipe_2 | C | 14.96 | 14.9 | 0.65 | 0 | 3 | LCC Site Survey |
| 0Pipe | C | 27.683 | 27.178 | 0.75 | 0 | 1 | LCC Site Survey |
| 10Pipe_3 | C | 13.346 | 13.231 | 1.4 | 0 | 4 | LCC Site Survey |
| 13Pipe_1 | C | 4.2 | 3.84 | 0.3 | 0 | 1 | LCC Site Survey |
| 14Pipe_1 | C | 3.35 | 3.216 | 0.9 | 0 | 2 | LCC Site Survey |
| 16Pipe_1 | C | 18.16 | 17.555 | 0.375 | 0 | 1 | LCC database; LCC Site Survey |
| 17Pipe_1 | C | 3.41 | 3.31 | 0.375 | 0 | 1 | LCC Site Survey |
| 19Pipe_1 | C | 9.366 | 9.318 | 0.675 | 0 | 1 | LCC Site Survey |
| 1Cul_3 | R | 21.655 | 21.58 | 1.6 | 1 | 3 | LCC Site Survey |
| 21Pipe_2 | C | 14.3 | 14.2 | 0.525 | 0 | 3 | LCC Site Survey |
| 22Pipe_1 | C | 20.35 | 20.33 | 0.525 | 0 | 1 | LCC Site Survey |
| 22Pipe_2 | C | 20.03 | 19.91 | 0.75 | 0 | 1 | LCC Site Survey |
| 23Pipe_1 | C | 24.342 | 24.303 | 0.6 | 0 | 1 | LCC Site Survey |
| 23Pipe_2 | C | 24.357 | 24.325 | 0.75 | 0 | 1 | LCC Site Survey |
| 24Pipe_2 | C | 12.133 | 12.131 | 0.6 | 0 | 2 | LCC Site Survey |
| 26Pipe_1 | C | 5.69 | 5.589 | 1.375 | 0 | 1 | LCC Site Survey |
| 27Pipe_1 | C | 4.59 | 4.526 | 0.6 | 0 | 1 | LCC Site Survey |
| 29Pipe_2 | C | 4.56 | 4.42 | 0.45 | 0 | 2 | LCC Site Survey |
| 2Pipe | C | 23.75 | 23.729 | 0.6 | 0 | 2 | LCC Site Survey |
| 2Pipe_2 | C | 24.345 | 24.304 | 0.6 | 0 | 2 | LCC Site Survey |
| 31 Pipe | C | 16.445 | 16.359 | 0.6 | 0 | 1 | LCC Site Survey |
| 31Cul_1 | R | 16.624 | 16.464 | 0.6 | 0.6 | 1 | LCC database; LCC Site Survey |
| 31Culv_2 | R | 16.613 | 16.415 | 0.6 | 0.45 | 1 | LCC database; LCC Site Survey |
| 31Pipe_3 | C | 16.31 | 16.27 | 0.525 | 0 | 4 | LCC Site Survey |
| 32Pipe_2 | C | 15.95 | 15.941 | 0.525 | 0 | 2 | LCC Site Survey |
| 32Pipe_4 | C | 16.048 | 16 | 0.45 | 0 | 2 | LCC Site Survey |
| 33Pipe_2 | C | 15.699 | 15.62 | 0.375 | 0 | 4 | LCC Site Survey |
| 35Pipe_2 | C | 17.356 | 17.356 | 0.75 | 0 | 4 | LCC Site Survey |
| 35Pipe_2_I | C | 18.25 | 18.2 | 0.75 | 0 | 4 | Estimated culverts |
| 36Pipe_3 | C | 16.5 | 16.464 | 0.45 | 0 | 5 | LCC Site Survey |
| 3Pipe_2 | C | 24.98 | 24.68 | 0.6 | 0 | 2 | LCC Site Survey |
| 3Pipe_3 | C | 25.09 | 24.66 | 0.9 | 0 | 2 | LCC Site Survey |
| 4Cul | R | 25.104 | 25.053 | 1.1 | 0.4 | 2 | LCC Site Survey |
| 5Pipe | C | 17.79 | 17.6 | 0.675 | 0 | 1 | LCC Site Survey |
| 5Pipe_2 | C | 17.79 | 17.6 | 0.6 | 0 | 1 | LCC Site Survey |
| 6Cul_2 | R | 17.495 | 17.445 | 0.3 | 0.12 | 3 | LCC Site Survey |

| ID | Culvert Type | US Invert (mAHD) | DS Invert (mAHD) | Width/ Diameter (m) | Height (m) | No. of barrels | Comments |
|---|---|---|---|---|---|---|---|
| 6Pipe | C | 17.18 | 17.17 | 0.675 | 0 | 2 | LCC Site Survey |
| 7Pipe_2 | C | 16.84 | 16.83 | 0.525 | 0 | 2 | LCC Site Survey |
| 9Pipe_1 | C | 12.706 | 12.501 | 0.75 | 0 | 2 | LCC Site Survey |
| Est1 | C | 15.4 | 15.2 | 0.65 | 0 | 3 | Estimated culverts; Street View and current LCC database |
| Est2 | C | 16.11 | 16.1 | 0.6 | 0 | 2 | Estimated culverts; Street View and current LCC database |
| Est3 | C | 15.3 | 15.2 | 0.6 | 0 | 3 | Estimated culverts; Street View and current LCC database |
| Est4 | R | 13.35 | 13.15 | 1.8 | 0.6 | 2 | Estimated culverts; Street View and current LCC database |
| Est5 | C | 10.7 | 10.4 | 0.9 | 0 | 3 | Estimated culverts; Street View and current LCC database |
| Est6 | C | 9.85 | 9.7 | 0.9 | 0 | 3 | Estimated culverts; Street View and current LCC database |
| SC234 | R | 5.46 | 5.35 | 3.6 | 2.37 | 2 | LCC database; LCC Site Survey |
| SC235 | R | 5.46 | 5.35 | 3.6 | 2.1 | 3 | LCC database; LCC Site Survey |
| SC236 | R | 16.91 | 16.8 | 1.2 | 0.9 | 4 | LCC database |
| SC266 | R | 9.1 | 8.95 | 3.3 | 2.1 | 7 | LCC database; invert levels estimated |
| SC346 | R | 9.6 | 9.57 | 1.2 | 0.3 | 1 | LCC database |
| SC493785 | R | 11.49 | 11.08 | 0.9 | 0.3 | 1 | LCC database |
| SC499332 | R | 28.84 | 28.78 | 0.9 | 0.3 | 2 | LCC database |
| SC499335 | R | 27.81 | 27.74 | 1.8 | 0.9 | 4 | LCC database |
| SC500910 | R | 15.98 | 15.76 | 1.8 | 0.9 | 2 | LCC database |
| SC506592 | R | 16.18 | 16.17 | 0.8 | 0.2 | 2 | LCC database |
| SC506593 | R | 16.91 | 16.8 | 1.5 | 0.86 | 3 | LCC database; invert levels estimated |
| SC521021 | R | 18.56 | 18.53 | 1.5 | 0.6 | 5 | LCC database; invert levels estimated |
| SC521039 | R | 22.29 | 22.19 | 1.2 | 0.9 | 3 | LCC database; invert levels estimated |
| SC605918 | R | 2.45 | 2.4 | 2.1 | 1.8 | 1 | LCC database; invert levels estimated |
| SC605919 | R | 2.45 | 2.4 | 2.1 | 1.5 | 2 | LCC database; invert levels estimated |
| SC714 | R | 11.8 | 11.75 | 1.2 | 0.6 | 2 | LCC database; invert levels estimated |
| SC857 | R | 18.15 | 17.75 | 1.2 | 0.6 | 2 | LCC database; invert levels estimated |
| SC859 | R | 14.959 | 14.95 | 1.2 | 0.6 | 3 | LCC database; invert levels estimated |
| SD14427 | C | 20.6 | 20.5 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD14428 | C | 19.87 | 18.82 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD14429 | C | 18.82 | 18.48 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD15491 | C | 18.48 | 17.9 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD15492 | C | 17.9 | 17.71 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD15493 | C | 17.71 | 16.71 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD15494 | C | 16.71 | 15.81 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD15665 | C | 13.005 | 13 | 0.45 | 0 | 1 | LCC database; invert levels estimated |
| SD15666 | C | 13 | 12.95 | 0.825 | 0 | 1 | LCC database; invert levels estimated |

| ID | Culvert Type | US Invert (mAHD) | DS Invert (mAHD) | Width/ Diameter (m) | Height (m) | No. of barrels | Comments |
|---|---|---|---|---|---|---|---|
| SD15667 | C | 12.95 | 12.9 | 0.825 | 0 | 1 | LCC database; invert levels estimated |
| SD15669 | C | 13.98 | 13.91 | 0.3 | 0 | 1 | LCC database; invert levels estimated |
| SD20762 | C | 14.5 | 14.1 | 1.35 | 0 | 3 | LCC database; invert levels estimated |
| SD20768 | C | 15.1 | 14.9 | 1.35 | 0 | 3 | LCC database; invert levels estimated |
| SD21822 | C | 6.3 | 6.2 | 1.05 | 0 | 2 | LCC database; invert levels estimated |
| SD23047 | C | 1.75 | 1.65 | 2.7 | 0 | 9 | LCC database; invert levels estimated |
| SD23056 | C | 1.44 | 1.38 | 2.7 | 0 | 9 | LCC database |
| SD23263 | C | 3.3 | 1.95 | 0.525 | 0 | 1 | LCC database |
| SD23264 | C | 1.95 | 1.94 | 0.375 | 0 | 2 | LCC database |
| SD23266 | C | 3.72 | 3.56 | 0.525 | 0 | 1 | LCC database |
| SD23267 | C | 3.4 | 3.24 | 0.525 | 0 | 1 | LCC database |
| SD23268 | C | 1.67 | 1.6 | 2.1 | 0 | 3 | LCC database |
| SD23518 | C | 15.7 | 14.5 | 0.75 | 0 | 2 | LCC database; invert levels estimated |
| SD37778 | C | 18.55 | 18.45 | 0.75 | 0 | 3 | LCC database; invert levels estimated |
| SD37924 | C | 12.8 | 12.4 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD39422 | C | 28.95 | 28.9 | 1.2 | 0 | 1 | LCC database; invert levels estimated |
| SD39760 | C | 34.8 | 34.4 | 0.75 | 0 | 1 | LCC database; invert levels estimated |
| SD41598 | C | 13.24 | 13.16 | 0.45 | 0 | 1 | LCC database |
| SD41599 | C | 12.25 | 12.1 | 0.6 | 0 | 1 | LCC database |
| SD42887 | C | 4 | 3.98 | 1.05 | 0 | 2 | LCC database; invert levels estimated |
| SD42887_I | C | 4.2 | 4.1 | 1.05 | 0 | 2 | Estimated culvert |
| SD42888 | C | 4.3 | 4.2 | 0.375 | 0 | 2 | LCC database; invert levels estimated |
| SD42890 | C | 3.69 | 3.65 | 0.375 | 0 | 4 | LCC database; invert levels estimated |
| SD43498 | C | 14.2 | 13.3 | 0.6 | 0 | 1 | LCC database; invert levels estimated |
| SD43499 | C | 12.91 | 12.84 | 0.525 | 0 | 1 | LCC database |
| SD45649 | C | 11.58 | 11.21 | 0.525 | 0 | 1 | LCC database |
| SD45650 | C | 11.58 | 11.21 | 0.6 | 0 | 1 | LCC database |
| SD490066 | C | 1.36 | 1.32 | 1.65 | 0 | 2 | LCC database; invert levels estimated; From site visit 2no. 1.65m |
| SD495240 | C | 11.15 | 10.98 | 0.75 | 0 | 1 | LCC database |
| SD495241 | C | 10.7 | 10.21 | 0.525 | 0 | 1 | LCC database |
| SD495242 | C | 10.19 | 9.67 | 0.525 | 0 | 1 | LCC database |
| SD496116 | C | 10.68 | 10.55 | 0.525 | 0 | 6 | LCC database |
| SD496118 | C | 10.16 | 10.03 | 0.525 | 0 | 3 | LCC database |
| SD499312 | C | 28.53 | 28.23 | 0.45 | 0 | 1 | LCC database |
| SD499322 | C | 27.85 | 27.73 | 0.3 | 0 | 1 | LCC database |
| SD501856 | C | 23.24 | 22.57 | 0.375 | 0 | 4 | LCC database |
| SD508965 | C | 11.48 | 11.01 | 0.6 | 0 | 1 | LCC database |

| ID | Culvert Type | US Invert (mAHD) | DS Invert (mAHD) | Width/ Diameter (m) | Height (m) | No. of barrels | Comments |
|---|---|---|---|---|---|---|---|
| SD536442 | C | 10.4 | 10.32 | 0.3 | 0 | 1 | LCC database |
| SD536452 | C | 10.27 | 10.19 | 0.3 | 0 | 1 | LCC database |
| SD53727 | C | 10.3 | 10.23 | 0.6 | 0 | 2 | LCC database |
| SD537961 | C | 23.2 | 22.81 | 0.675 | 0 | 1 | LCC database |
| SD596584 | C | 35.6 | 35.5 | 0.6 | 0 | 1 | LCC database; inverts estimated |
| SD596973 | C | 33.8 | 33.5 | 0.47 | 0 | 1 | LCC database; inverts estimated |
| SD597045 | C | 43.1 | 43 | 0.65 | 0 | 3 | LCC database; inverts estimated |
| SD597216 | C | 28.247 | 27.6 | 0.6 | 0 | 1 | LCC database; inverts estimated |
| SD59857 | C | 10.83 | 10.45 | 0.45 | 0 | 1 | LCC database |
| SD59890 | C | 11.21 | 11.03 | 0.3 | 0 | 1 | LCC database |
| SD61875 | C | 11.11 | 11 | 0.6 | 0 | 1 | LCC database |
| SD61876 | C | 11.18 | 11.11 | 0.6 | 0 | 1 | LCC database |
| SD7977 | C | 20.5 | 19.87 | 0.6 | 0 | 1 | LCC database; inverts estimated |
| SD8043 | C | 15.81 | 13.55 | 0.375 | 0 | 1 | LCC database |
| SiteV19 | C | 6.05 | 6 | 0.6 | 0 | 2 | KBR Site Visit; invert levels estimated |
| Sitev47 | R | 26.6 | 26.5 | 2.7 | 1 | 5 | KBR Site Visit; invert levels estimated |
| SiteV48 | R | 26.85 | 26.8 | 2.4 | 0.9 | 3 | KBR Site Visit; invert levels estimated |
| SiteV49 | R | 27.8 | 27.7 | 2.2 | 0.7 | 3 | KBR Site Visit; invert levels estimated |

**Table B2: Pit configurations in the TUFLOW model**

| Pit ID | Pit Type | Surface Level (mAHD) | Invert level (mAHD) | Size (m) | No. of pits | Comments |
|---|---|---|---|---|---|---|
| 16_Pipe_1_P | R | From DEM | Pipe Invert | 0.9 x 0.6 | 1 | LCC Site Visit |
| SD14427_P | R | From DEM | Pipe Invert | 3.6 x 0.1 | 1 | KBR Site Visit |
| SD499322_P | C | From DEM | Pipe Invert | 0.6 Dia | 1 | LCC Database |
| SP13983 | C | From DEM | Pipe Invert | 1.05 Dia | 1 | LCC Database |
| SP13984 | C | From DEM | Pipe Invert | 1.05 Dia | 1 | LCC Database |
| SP15025 | C | From DEM | Pipe Invert | 1.05 Dia | 1 | LCC Database |
| SP15026 | C | From DEM | Pipe Invert | 1.05 Dia | 1 | LCC Database |
| SP21855 | C | From DEM | Pipe Invert | 0.6 Dia | 1 | LCC Database |
| SP495209 | C | From DEM | Pipe Invert | 0.6 Dia | 1 | LCC Database |
| SP495210 | C | From DEM | Pipe Invert | 0.6 Dia | 1 | LCC Database |
| SP495211 | C | From DEM | Pipe Invert | 0.6 Dia | 1 | LCC Database |
| SP499289 | C | From DEM | Pipe Invert | 0.9 Dia | 1 | LCC Database |
| SP508934 | C | From DEM | Pipe Invert | 0.9 Dia | 1 | LCC Database |
| SP536413 | C | From DEM | Pipe Invert | 0.9 Dia | 1 | LCC Database; size estimated |
| SP536414 | C | From DEM | Pipe Invert | 0.9 Dia | 1 | LCC Database; size estimated |
| SP537942 | C | From DEM | Pipe Invert | 0.6 Dia | 1 | LCC Database; size estimated |
| SP59543 | C | From DEM | Pipe Invert | 0.9 Dia | 1 | LCC Database |
| SP8012 | C | From DEM | Pipe Invert | 1.05 Dia | 1 | LCC Database |

**Table B3: Bridge configurations in the TUFLOW model**

| Invert (mAHD) | Shape Width (m) | L1 Obvert (mAHD) | L1 Block (%) | L1 FLC | L2 Depth (m) | L2 Block (%) | L2 FLC | L3 Depth (m) | L3 Block (%) | L3 FLC | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| From DEM | 3 | 13.0 | 0 | 0 | 0.4 | 100 | 0.378 | 1.2 | 30 | 0 | Steel Bridge DS of Pony Club; hB/T=2.6 |
| From DEM | 5 | 13.9 | 0 | 0 | 0.4 | 100 | 0.368 | 1.1 | 30 | 0 | Wooden Bridge near PCYC; hB/T =0.42 |
| From DEM | 3 | 11.5 | 4 | 0.1 | 0.3 | 100 | 0.42 | 0 | 0 | 0 | Wooden Bridge Stoneleigh Park; hB/T=1.67 |
| From DEM | 3 | 11.2 | 0 | 0 | 0.2 | 100 | 0.2 | 0 | 0 | 0 | Bridge - Survey no. 11; hB/T=6.5 |
| From DEM | 3 | 10.65 | 0 | 0 | 0.4 | 100 | 0.42 | 0 | 0 | 0 | Bridge - Survey no. 12; hB/T=1.88 |

**Modelling of Bridges:**

- Layered FLC Default Approach == METHOD C; recommended approach in TUFLOW 2020-10-AF release notes.
- Layer 1 FLC – single span footbridges, FLC=0; nominal piers, FLC=0.1
- Layer 2 FLC from hB/T and FLC relationship Table outlined in https://wiki.tuflow.com/TUFLOW_2D_Hydraulic_Structures
- Layer 3 FLC=0 and blockage of 30% (where railings are present) from Transport and Main Roads Hydraulics and Hydrology (2019) guideline on Bridge modelling

## Photos of modelled bridges

***Steel Bridge DS of Pony Club***

***Wooden Bridge near PCYC***

***Wooden Bridge Stoneleigh Park***

***Bridge - Survey no. 11***

*Bridge - Survey no. 12*

# Appendix C: Box Plots

Box Plots of Design Events at Key Locations

## 1% AEP Box Plots

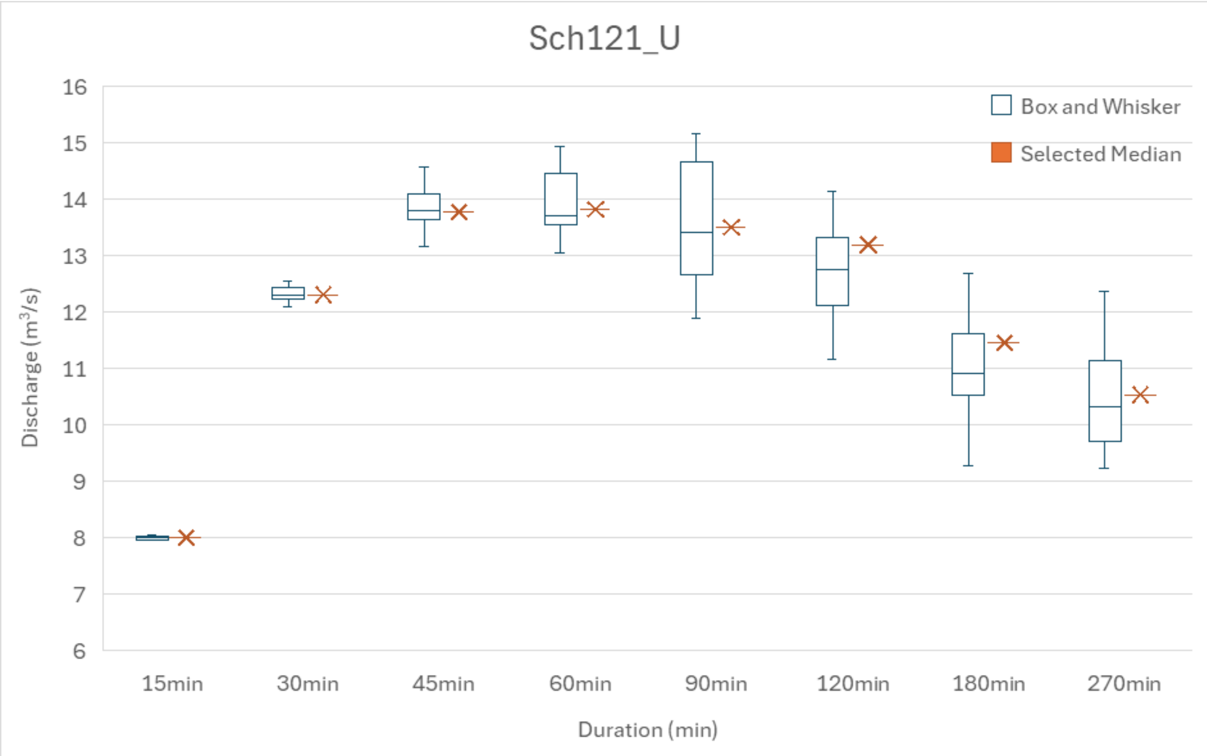



**Figure C1 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Northern Arm) at Mt Huntley Street**

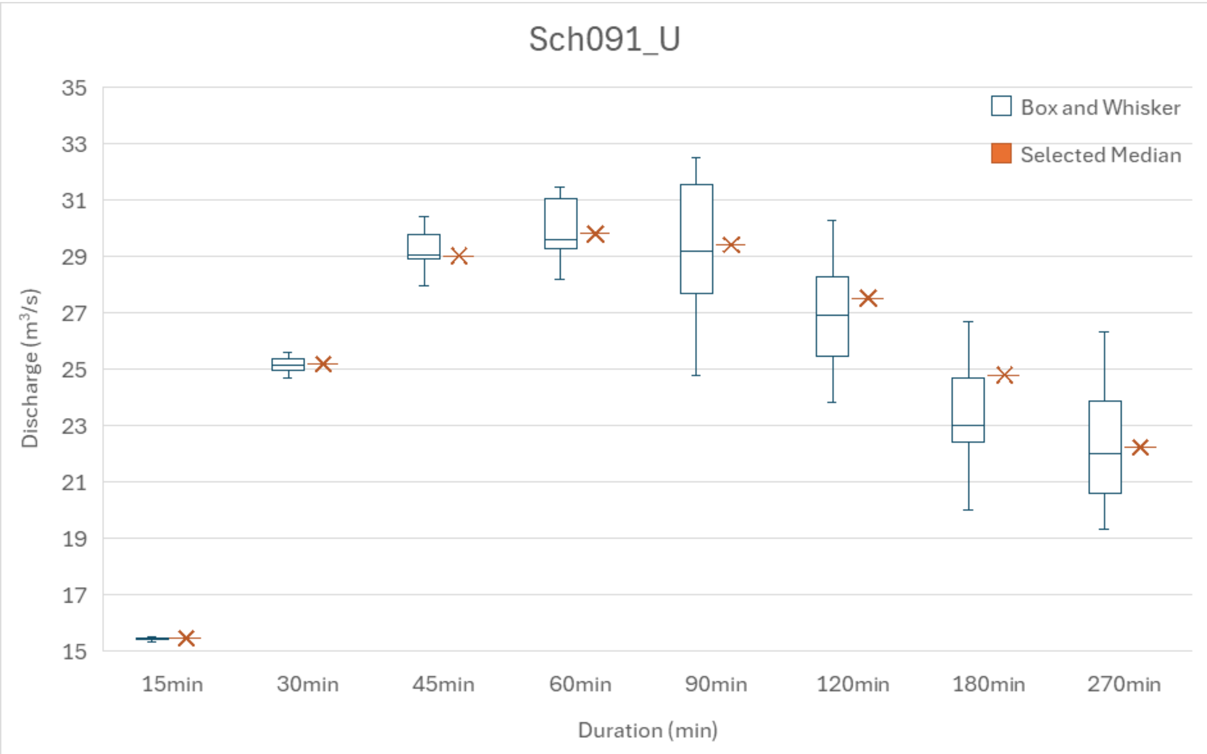



**Figure C2 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Northern Arm) at Park Ridge Road**

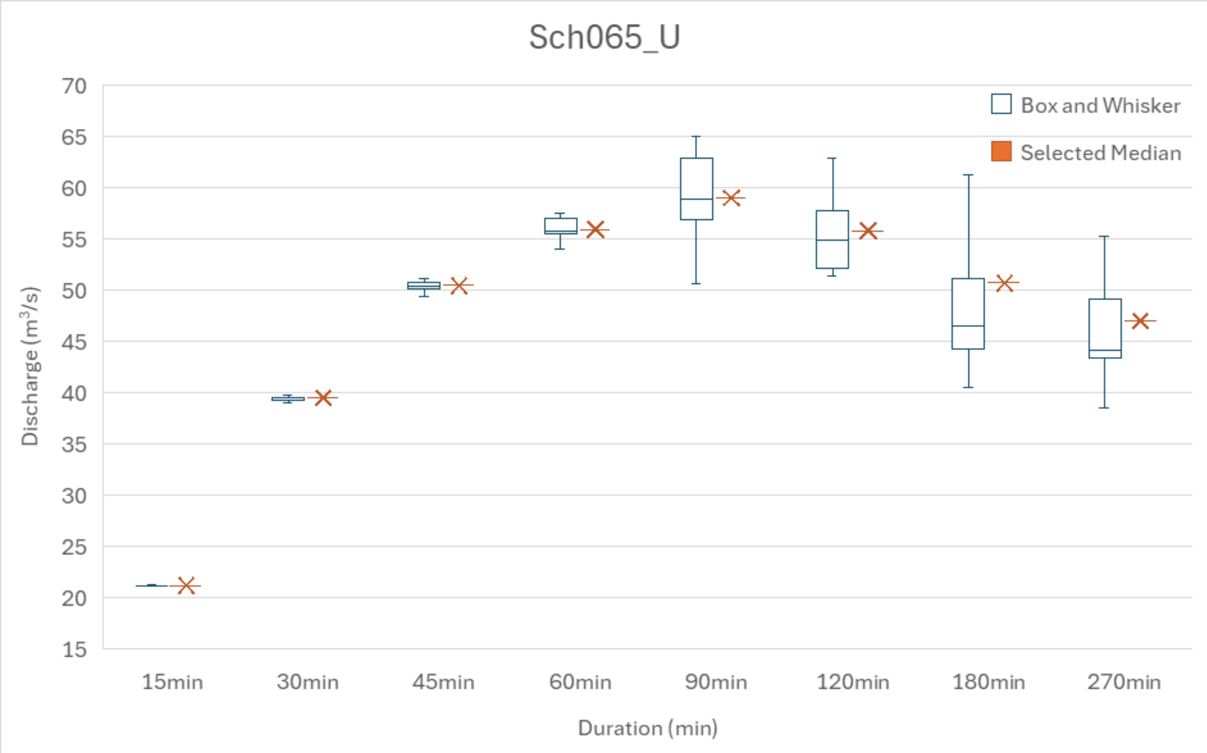



**Figure C3 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Northern Arm) at Burnstead Road**

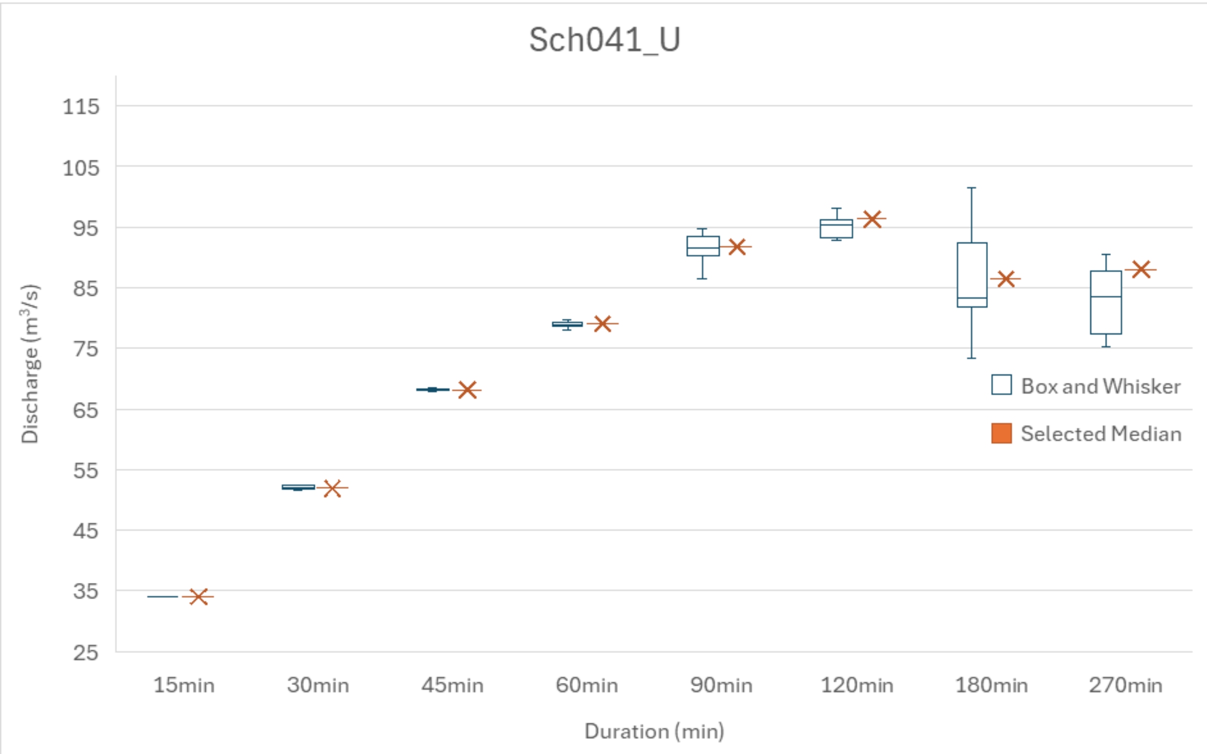



**Figure C4 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Northern Arm) at Chambers Flat Road**

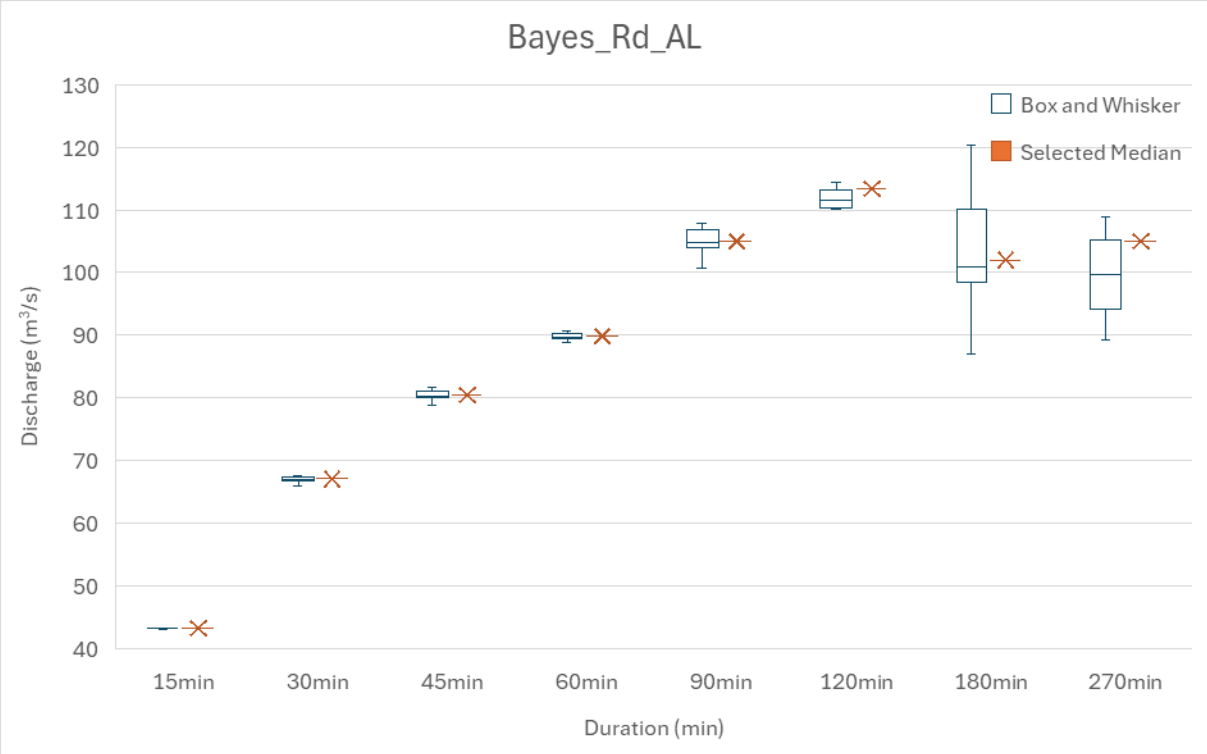



**Figure C5 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Northern Arm) at Bayes Road Alert**

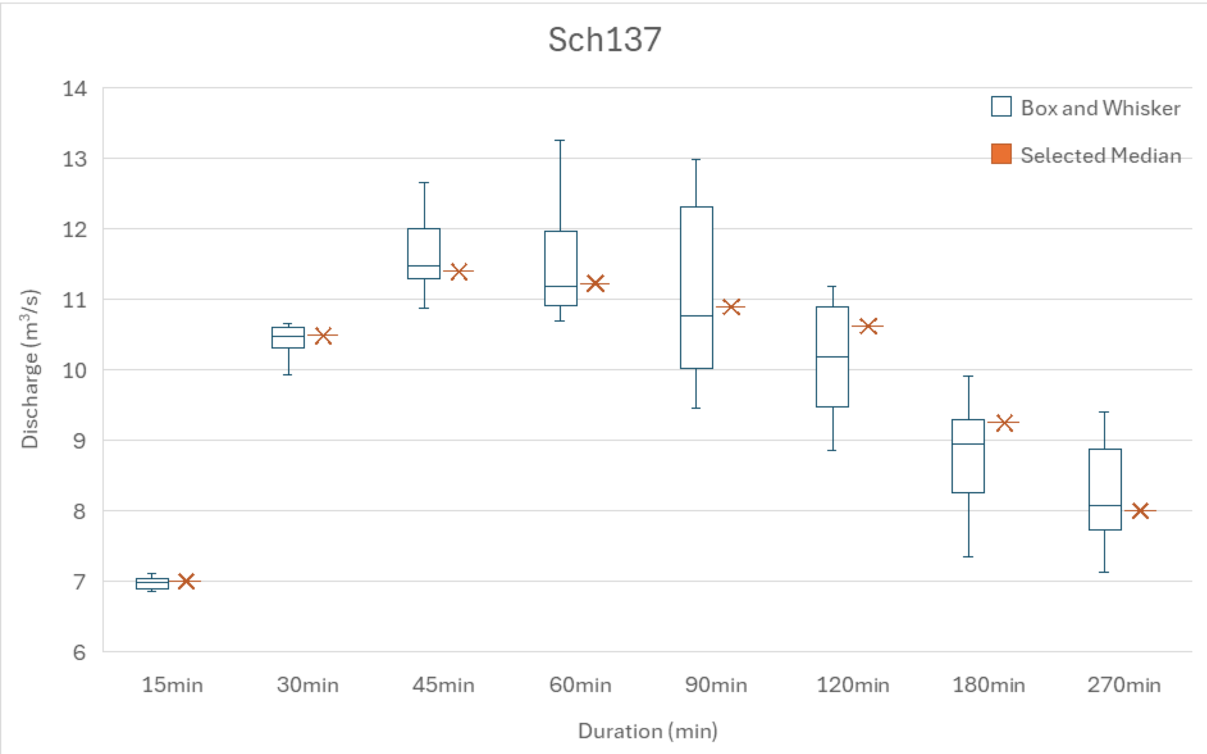



**Figure C6 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Southern Arm) at Chambers Flat Road**

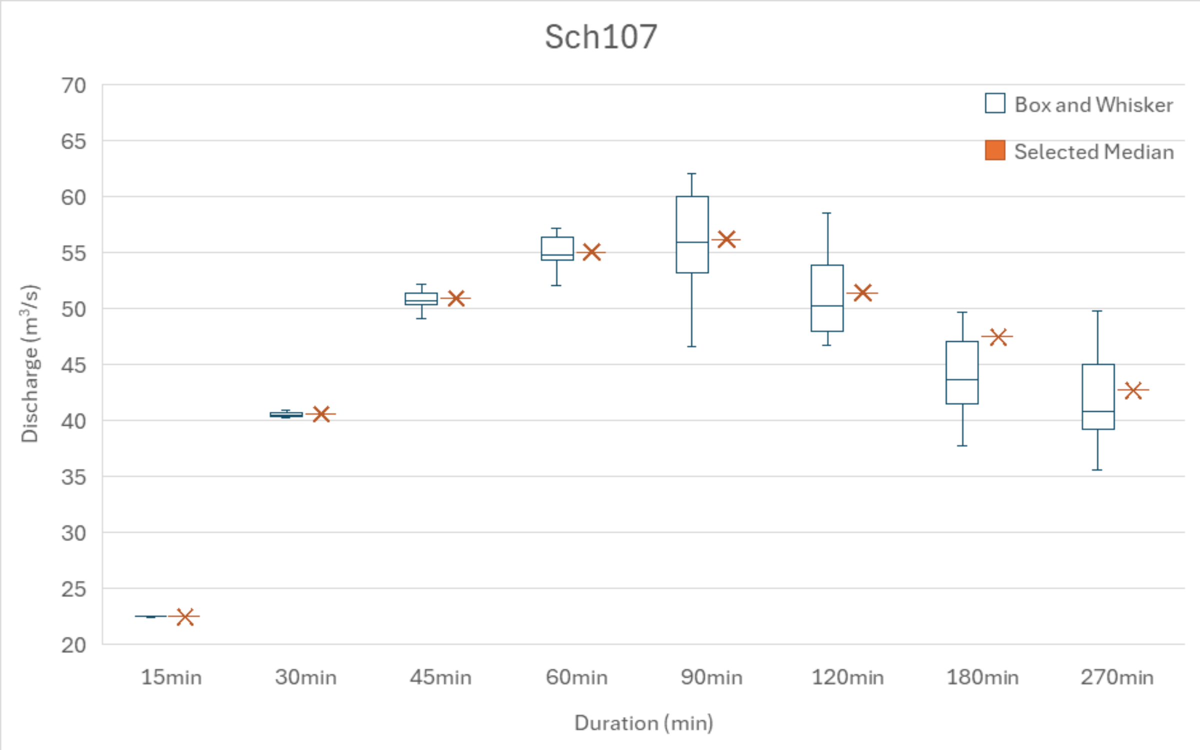



**Figure C7 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Southern Arm) at School Road**

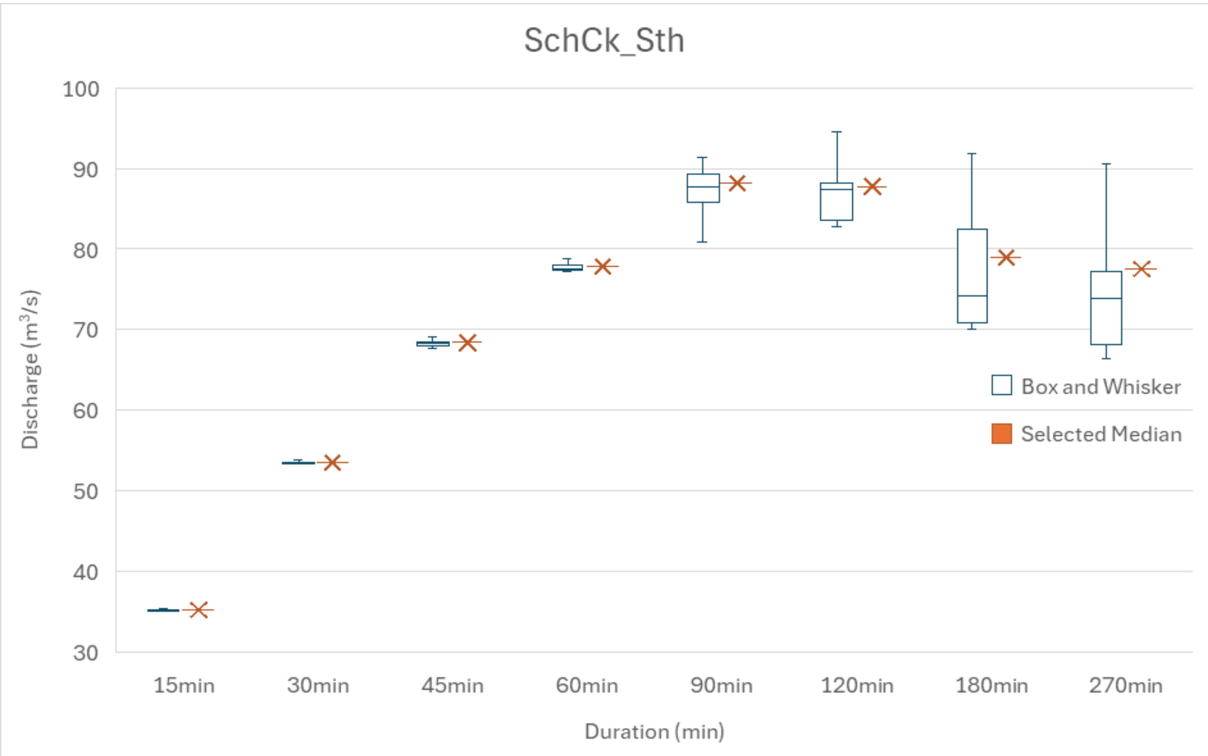



**Figure C8 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek (Southern Arm) at Logan Reserve Road**

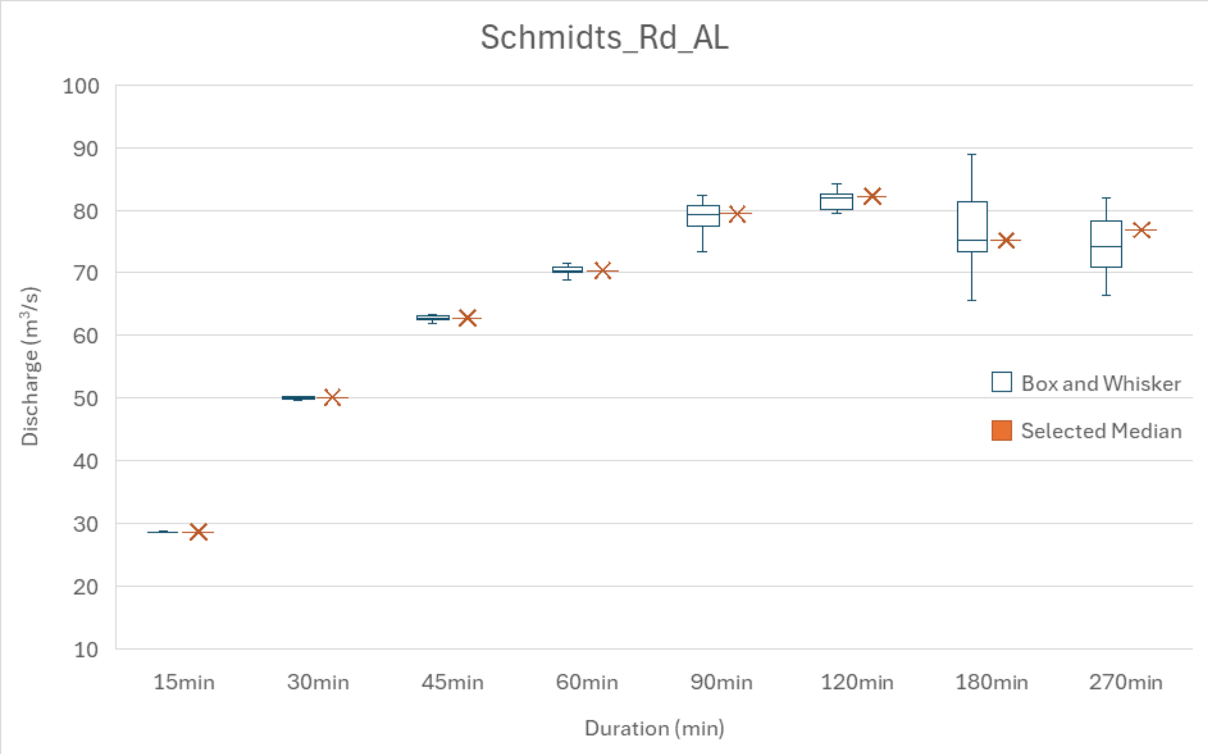



**Figure C9 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek at Schmidt's Road Alert**

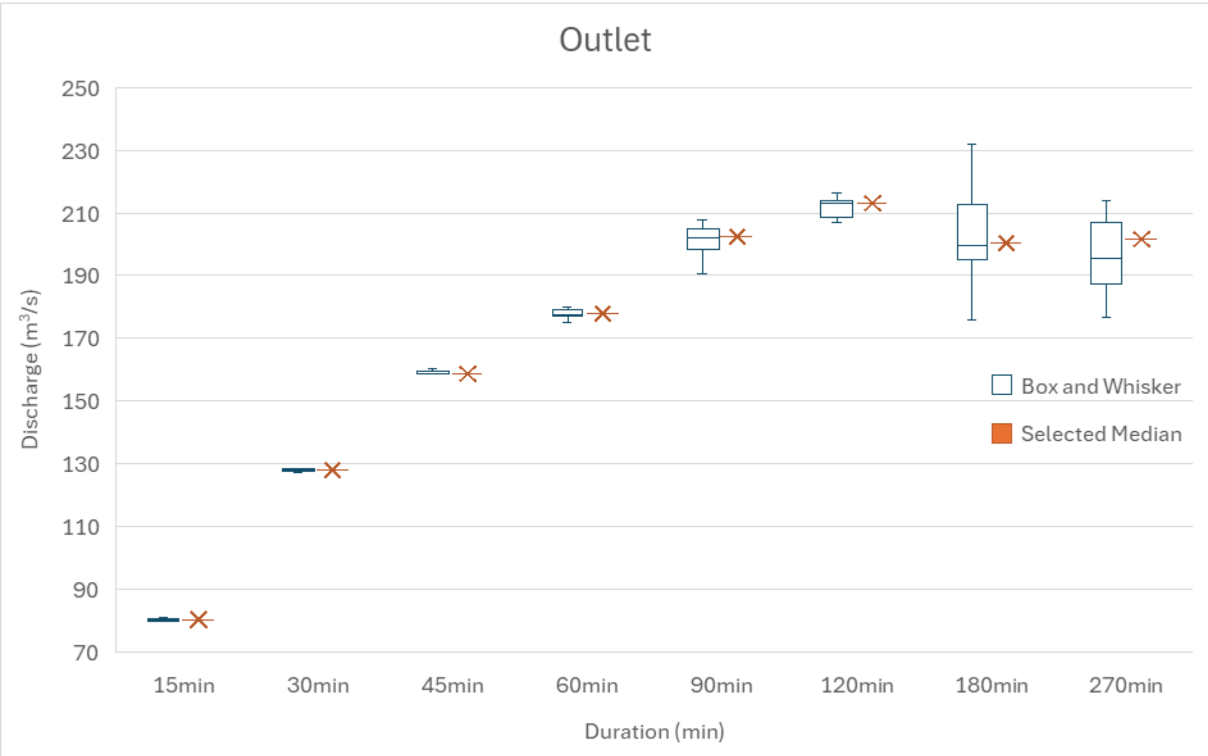



**Figure C10 Box plot showing the ensemble of TUFLOW model predicted 1% AEP design peak flows, Schmidt's Creek at Schmidt's Outlet**

## 5% AEP Box Plots

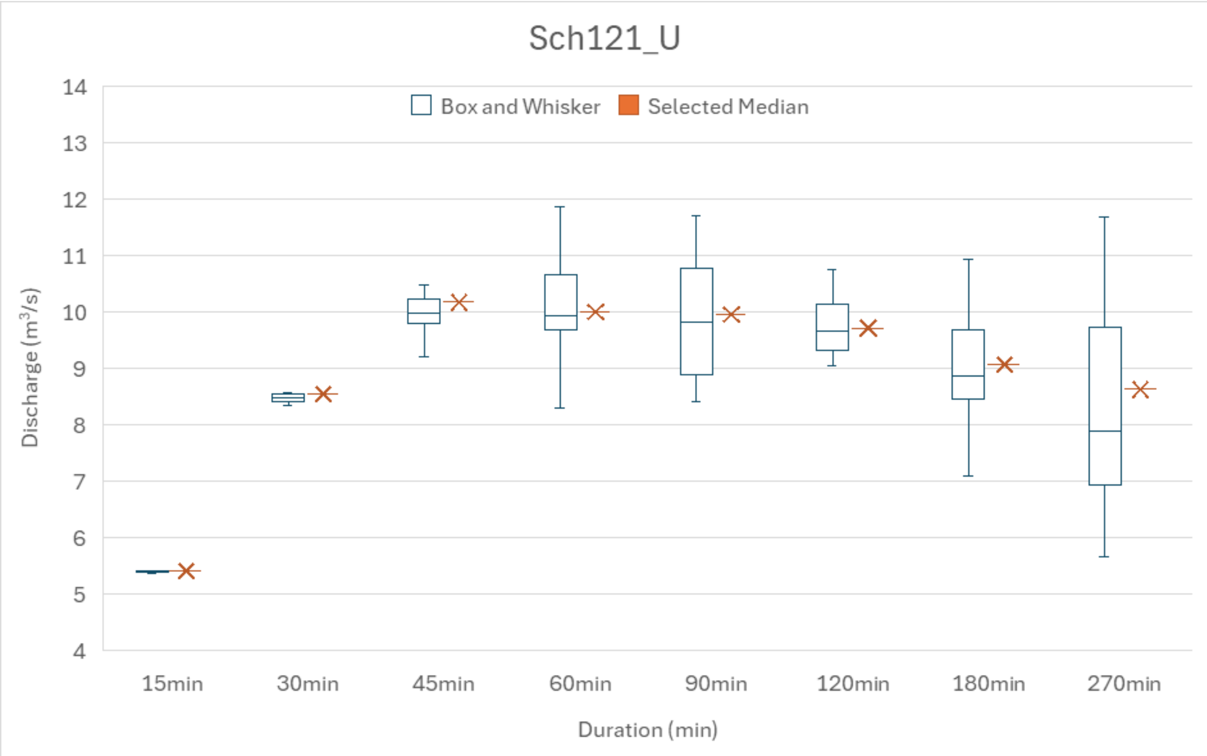



**Figure C11 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Northern Arm) at Mt Huntley Street**

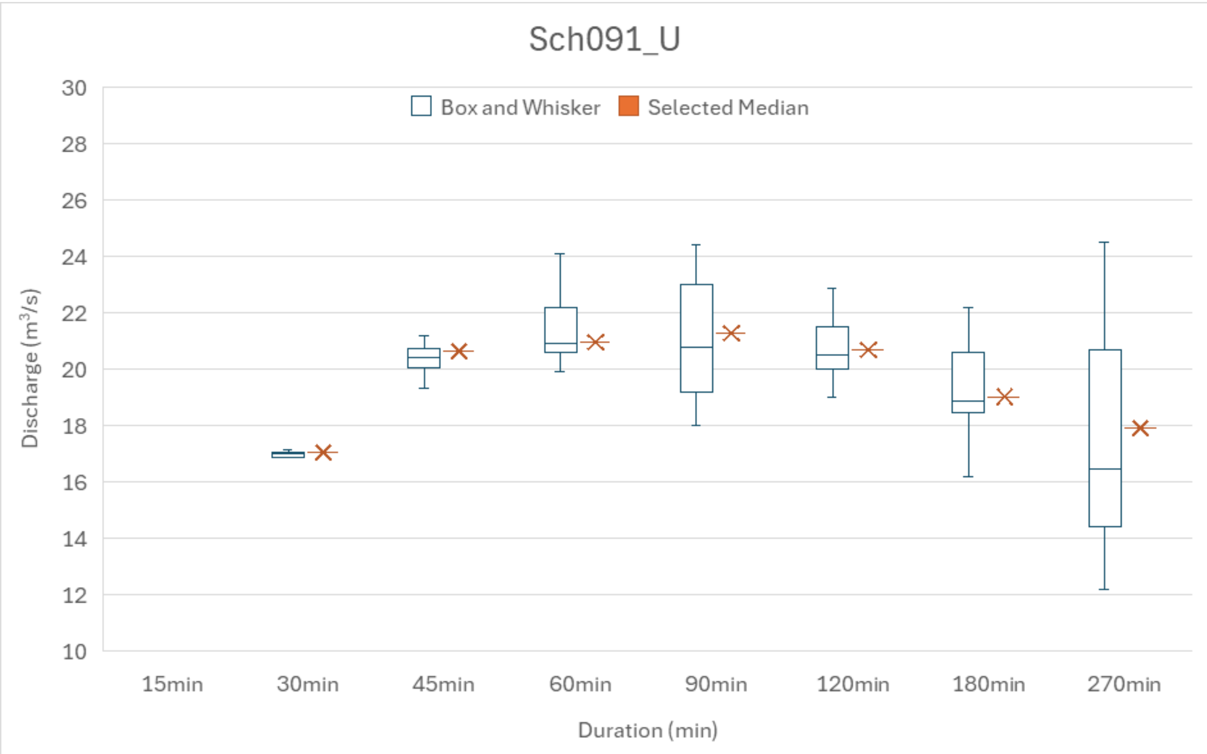



**Figure C12 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Northern Arm) at Park Ridge Road**

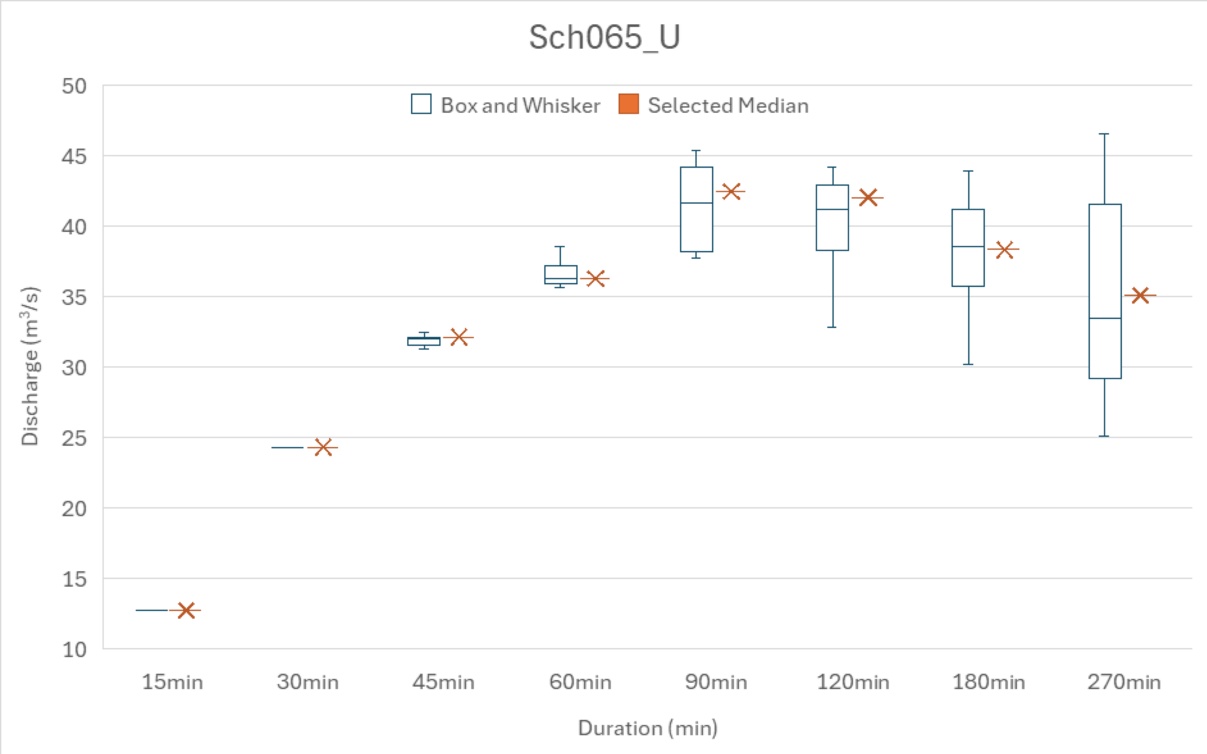



**Figure C13 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Northern Arm) at Burnstead Road**

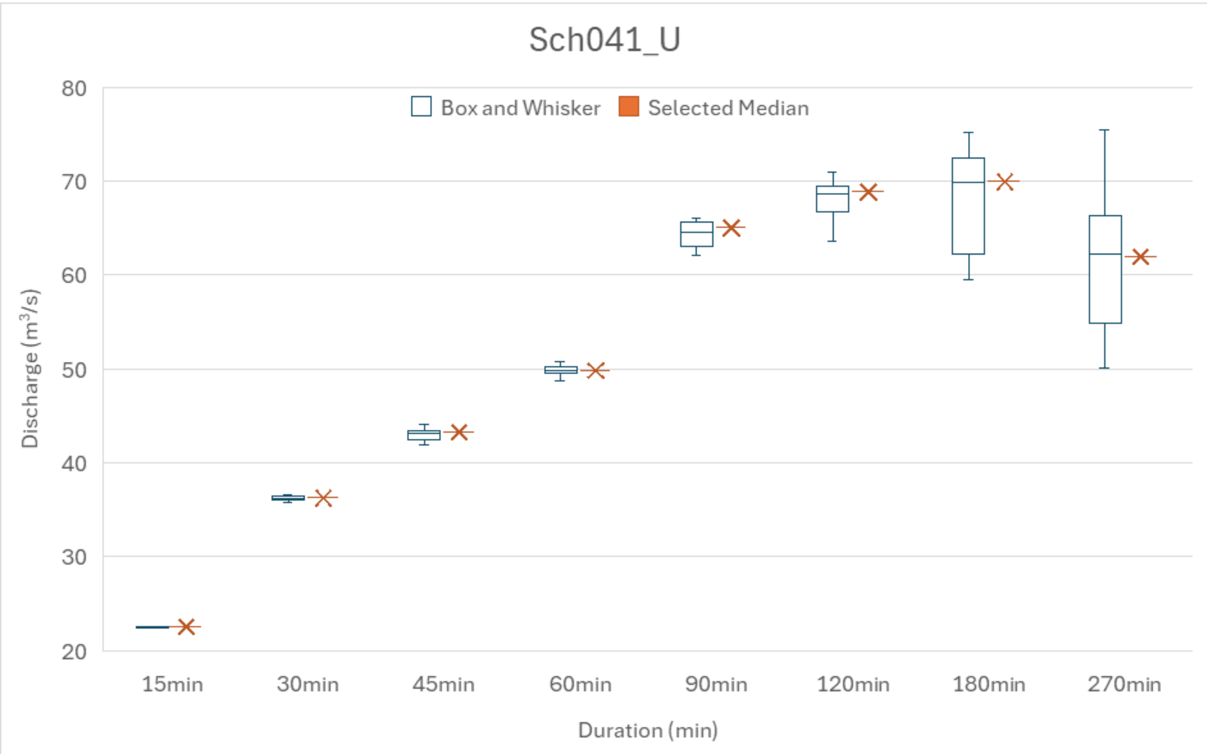



**Figure C14 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Northern Arm) at Chambers Flat Road**

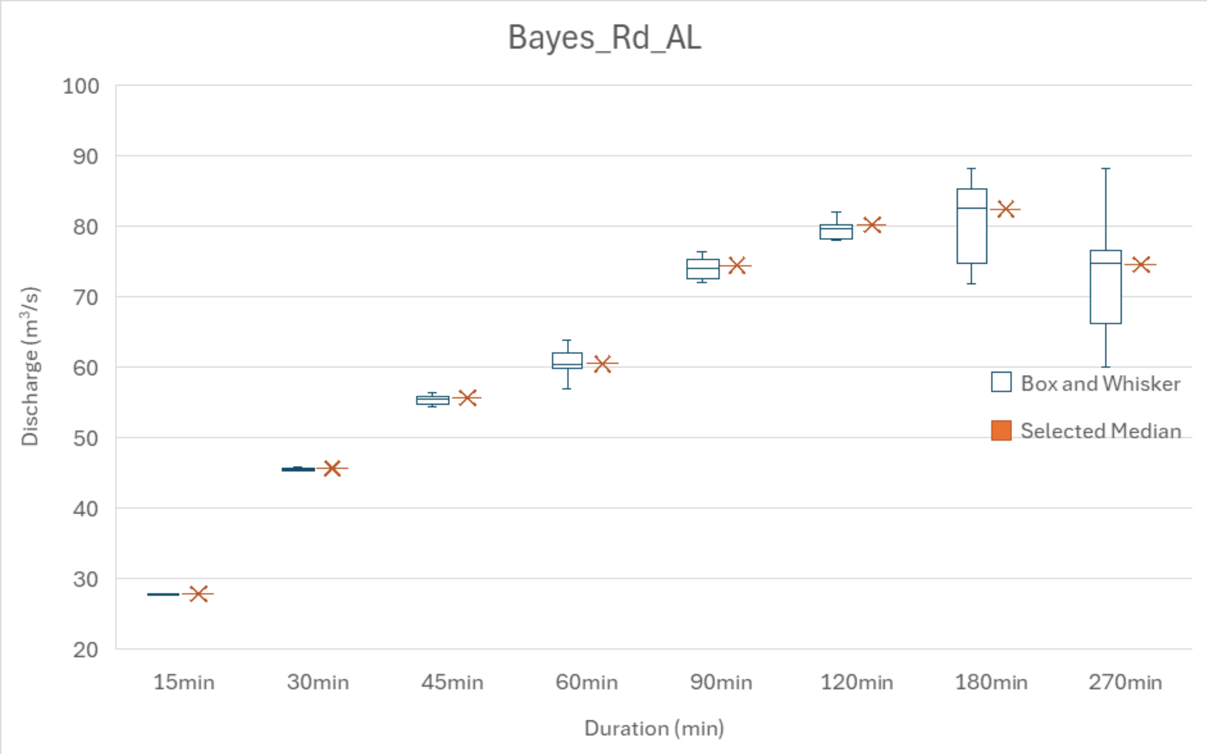



**Figure C15 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Northern Arm) at Bayes Road Alert**

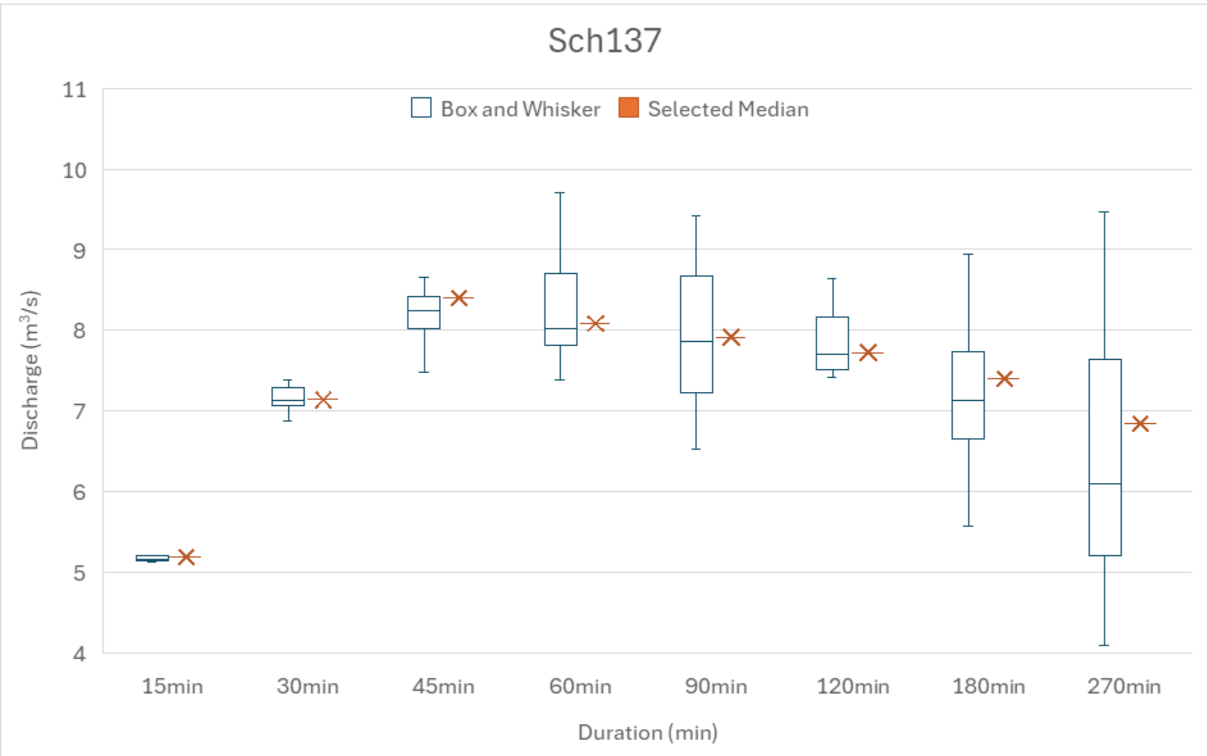



**Figure C16 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Southern Arm) at Chambers Flat Road**

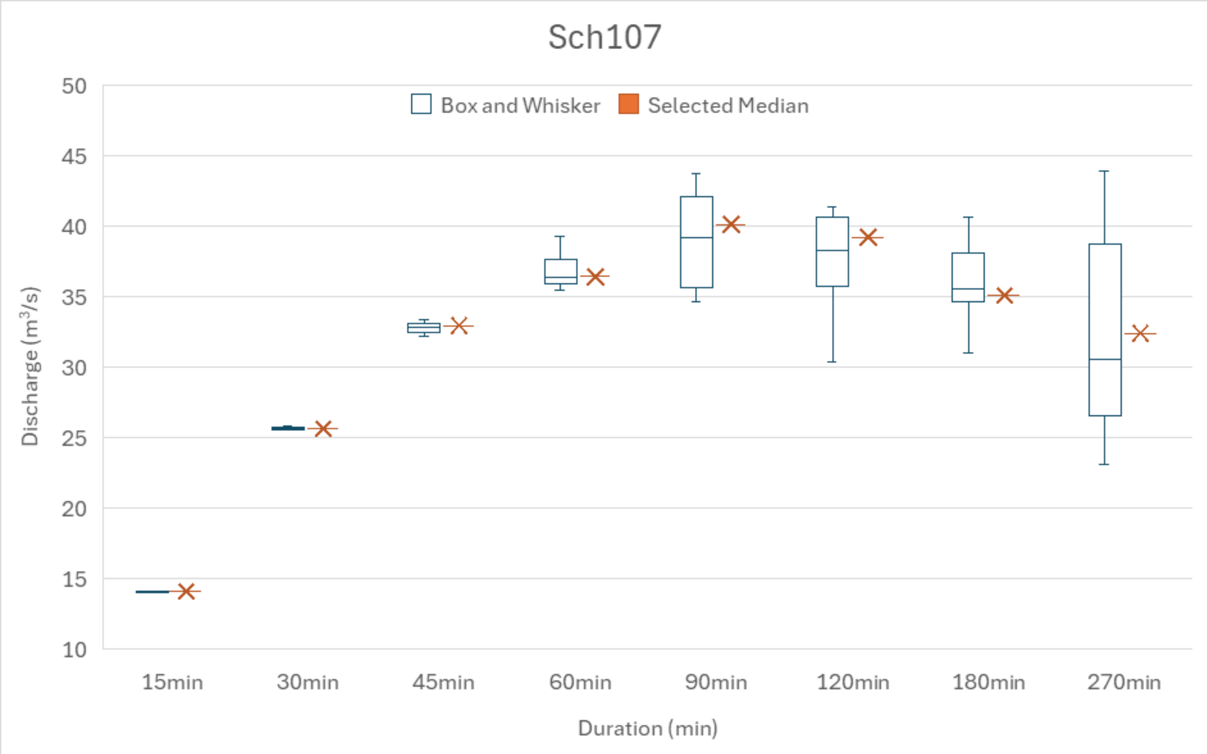



**Figure C17 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Southern Arm) at School Road**

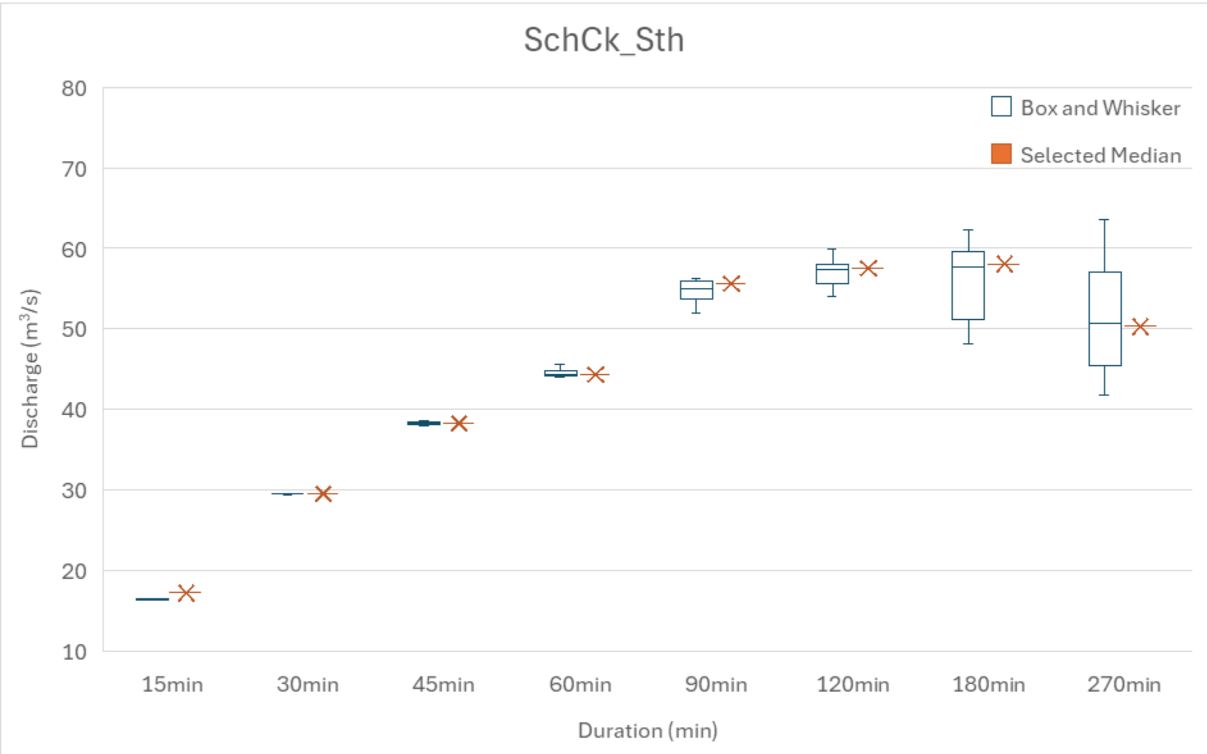



**Figure C18 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek (Southern Arm) at Logan Reserve Road**

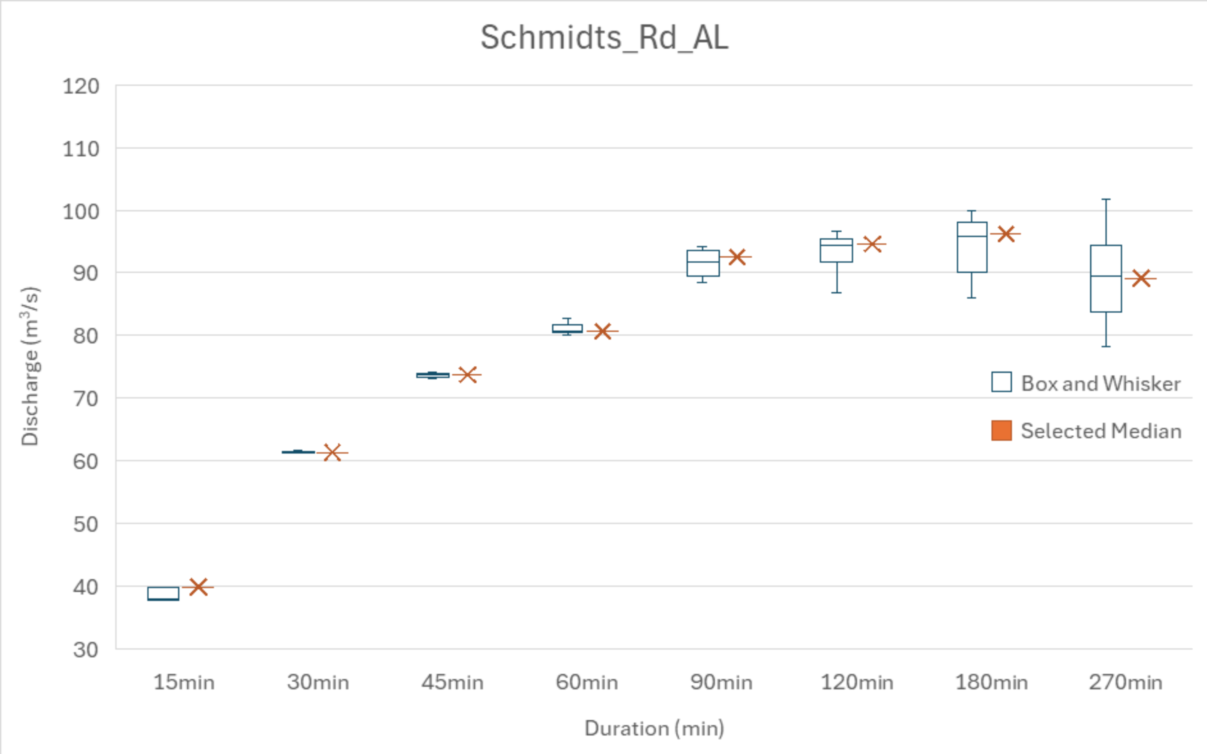



**Figure C19 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek at Schmidt's Road Alert**

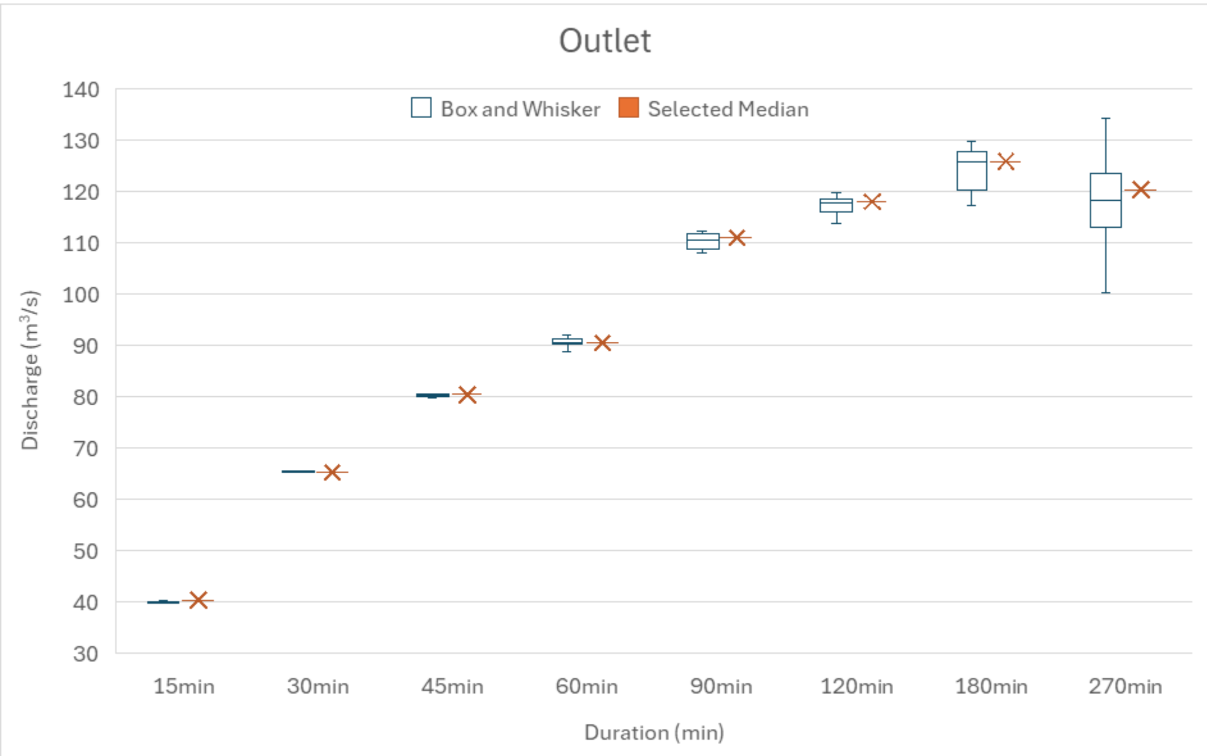



**Figure C20 Box plot showing the ensemble of TUFLOW model predicted 5% AEP design peak flows, Schmidt's Creek at Schmidt's Outlet**

## 20% AEP Box Plots

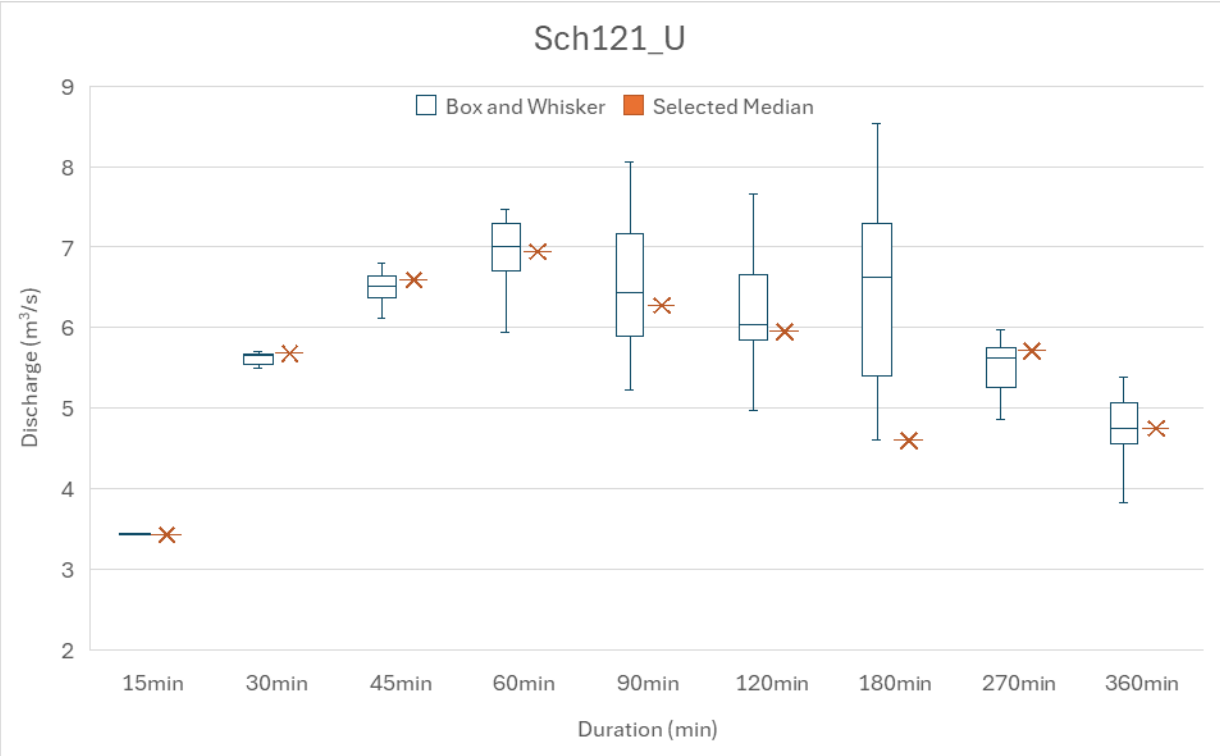



**Figure C21 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Northern Arm) at Mt Huntley Street**

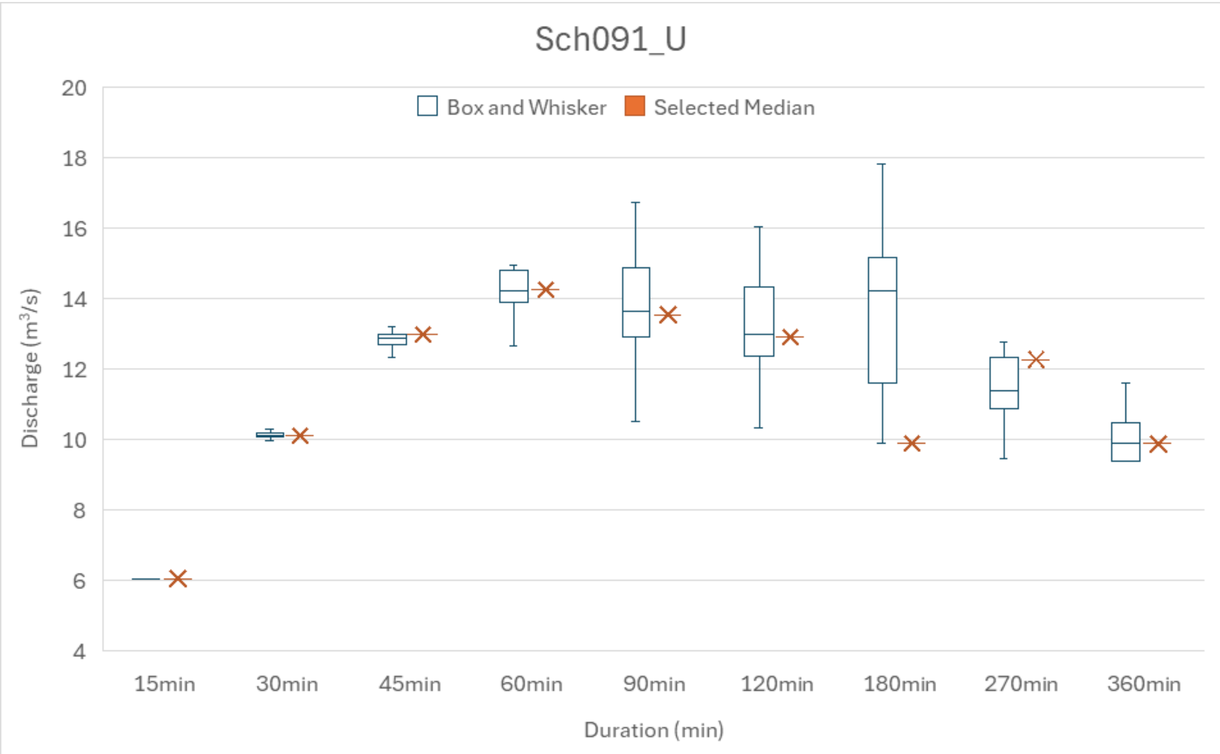



**Figure C22 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Northern Arm) at Park Ridge Road**

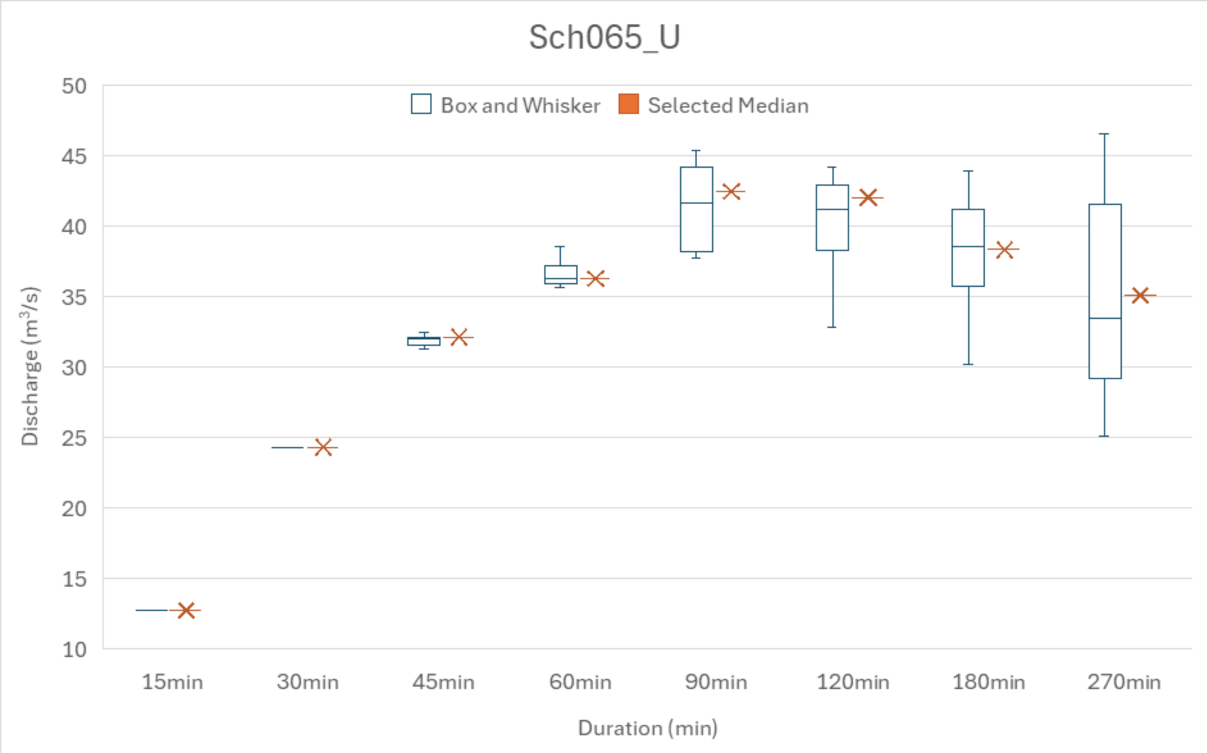



**Figure C23 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Northern Arm) at Burnstead Road**

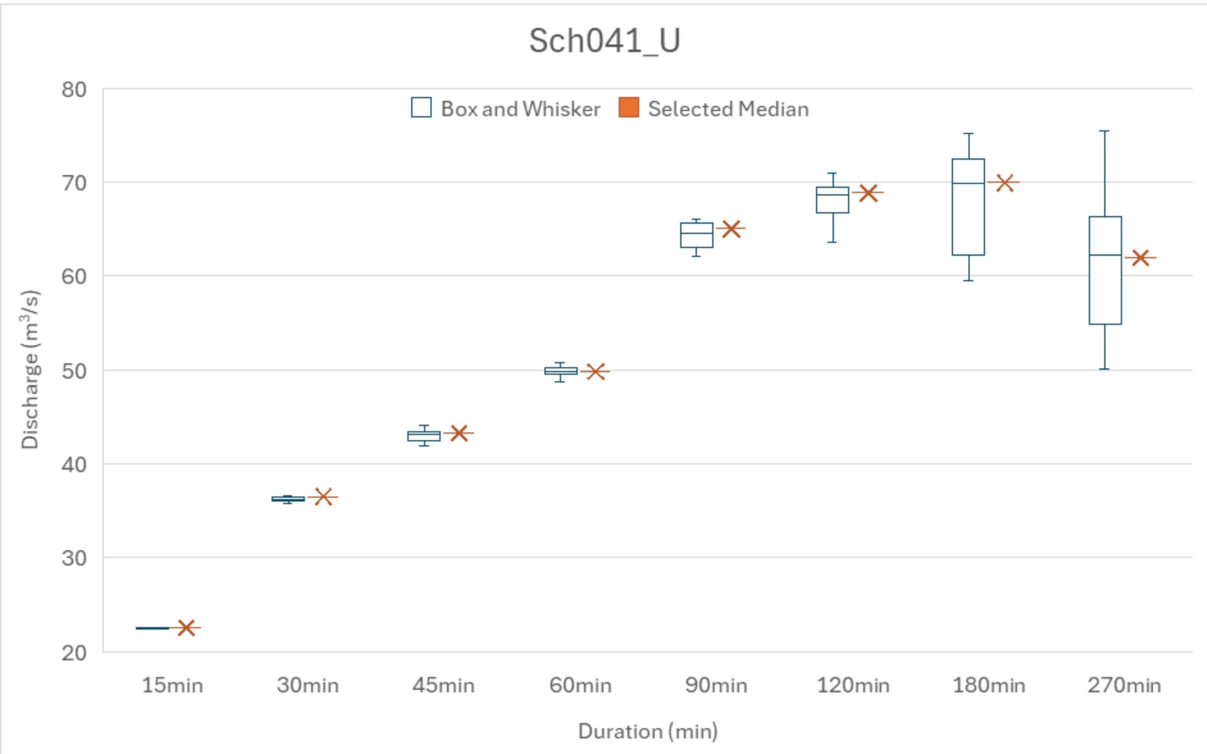



**Figure C24 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Northern Arm) at Chambers Flat Road**

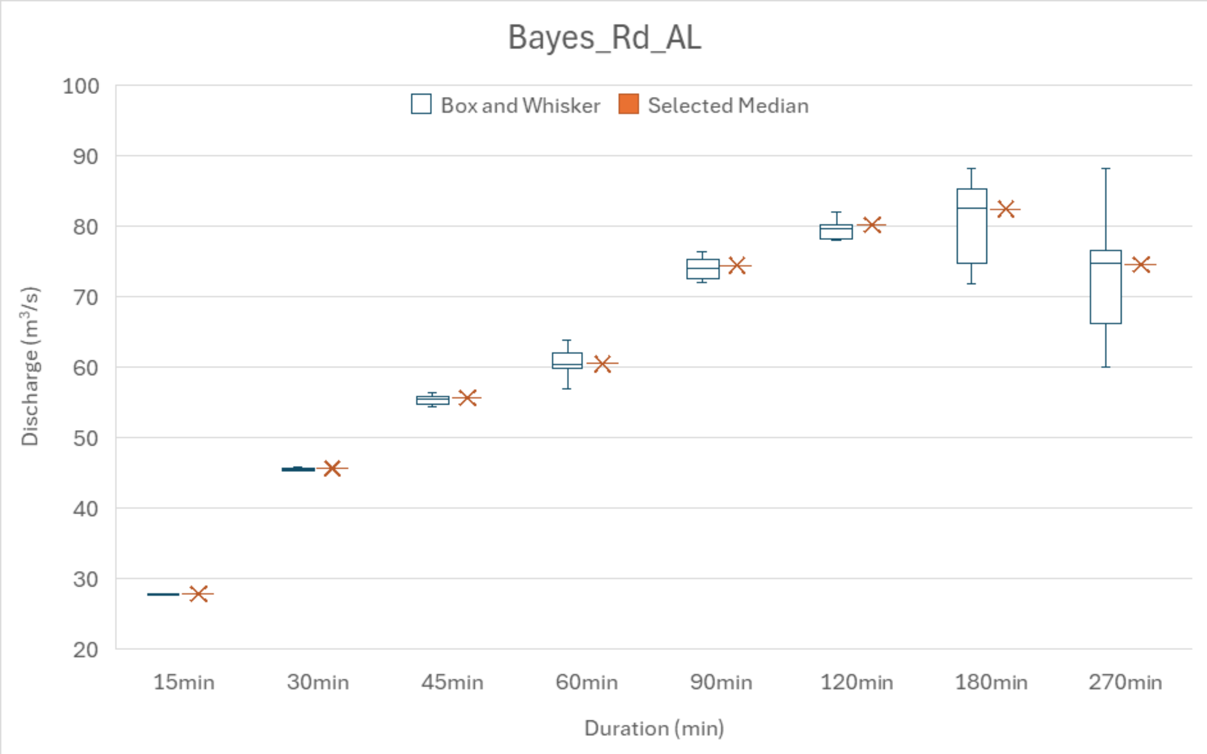



**Figure C25 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Northern Arm) at Bayes Road Alert**

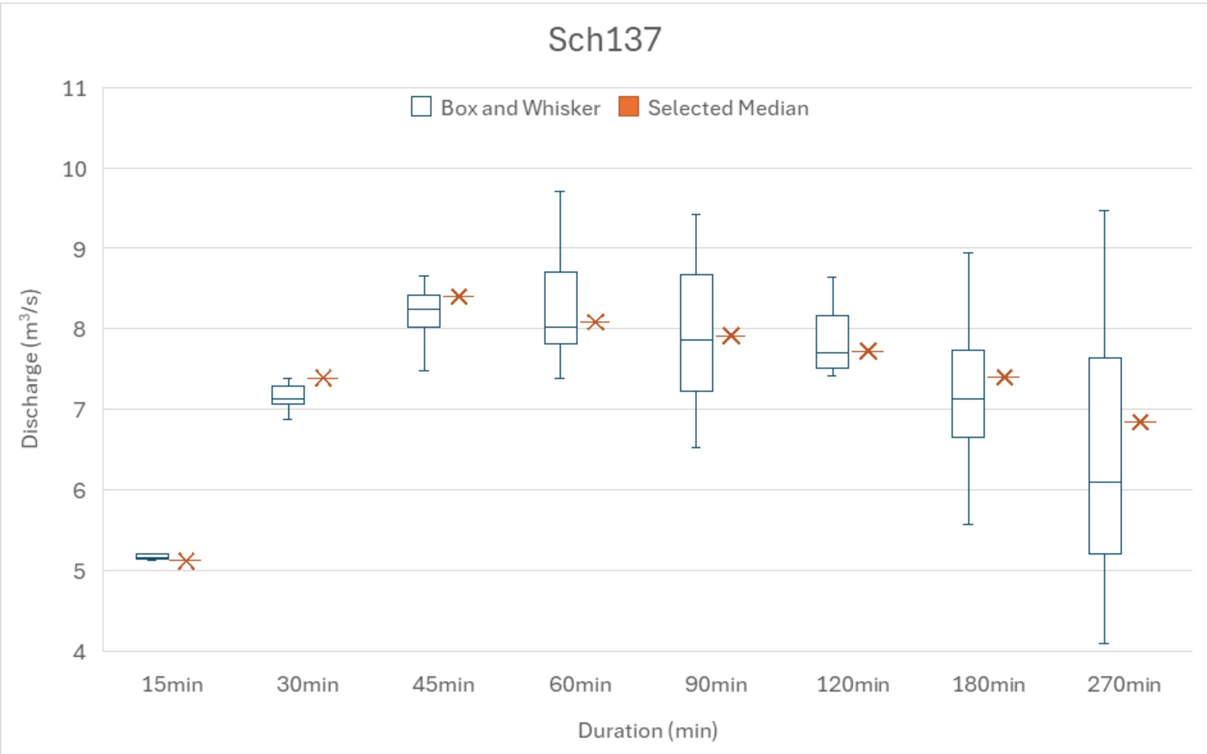



**Figure C26 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Southern Arm) at Chambers Flat Road**

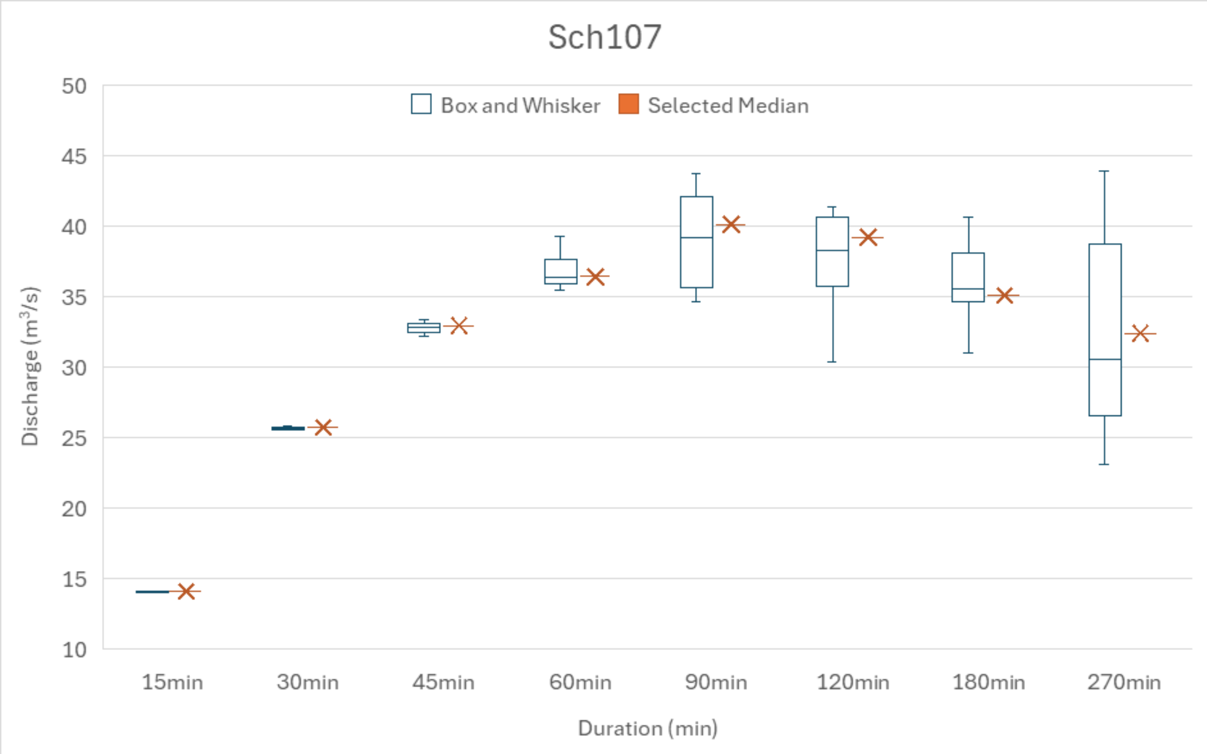



**Figure C27 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Southern Arm) at School Road**

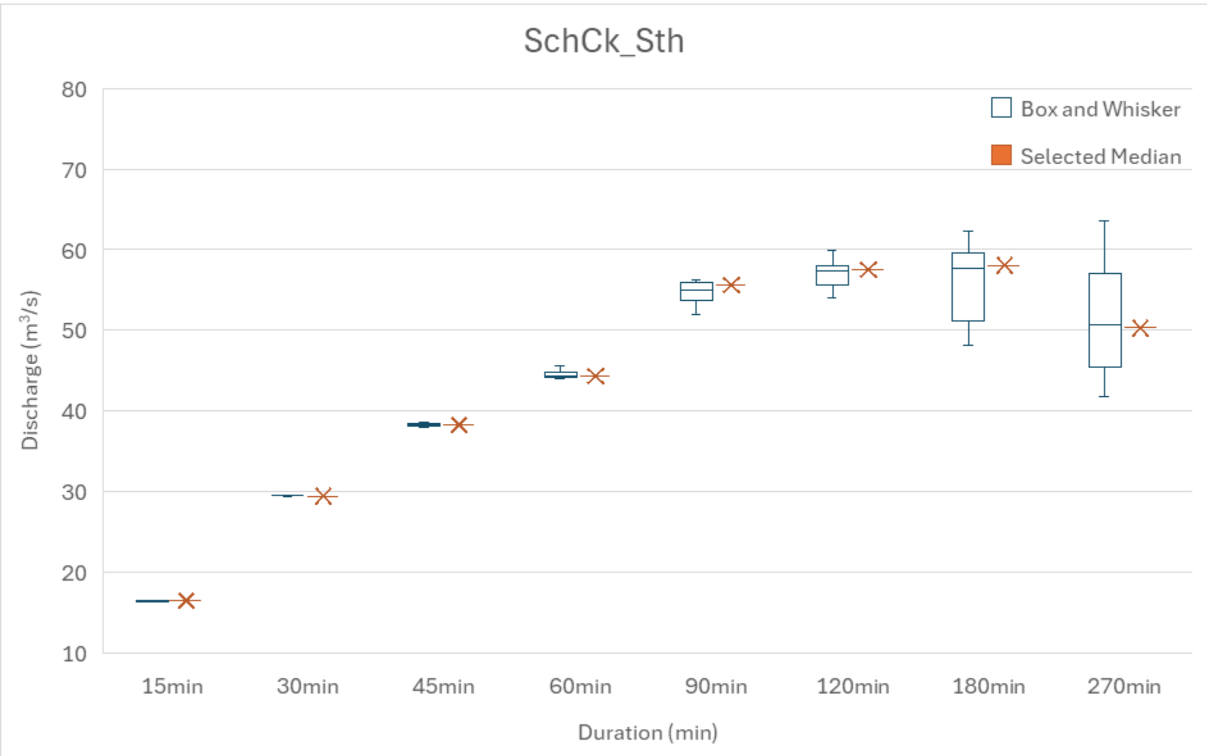



**Figure C28 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek (Southern Arm) at Logan Reserve Road**

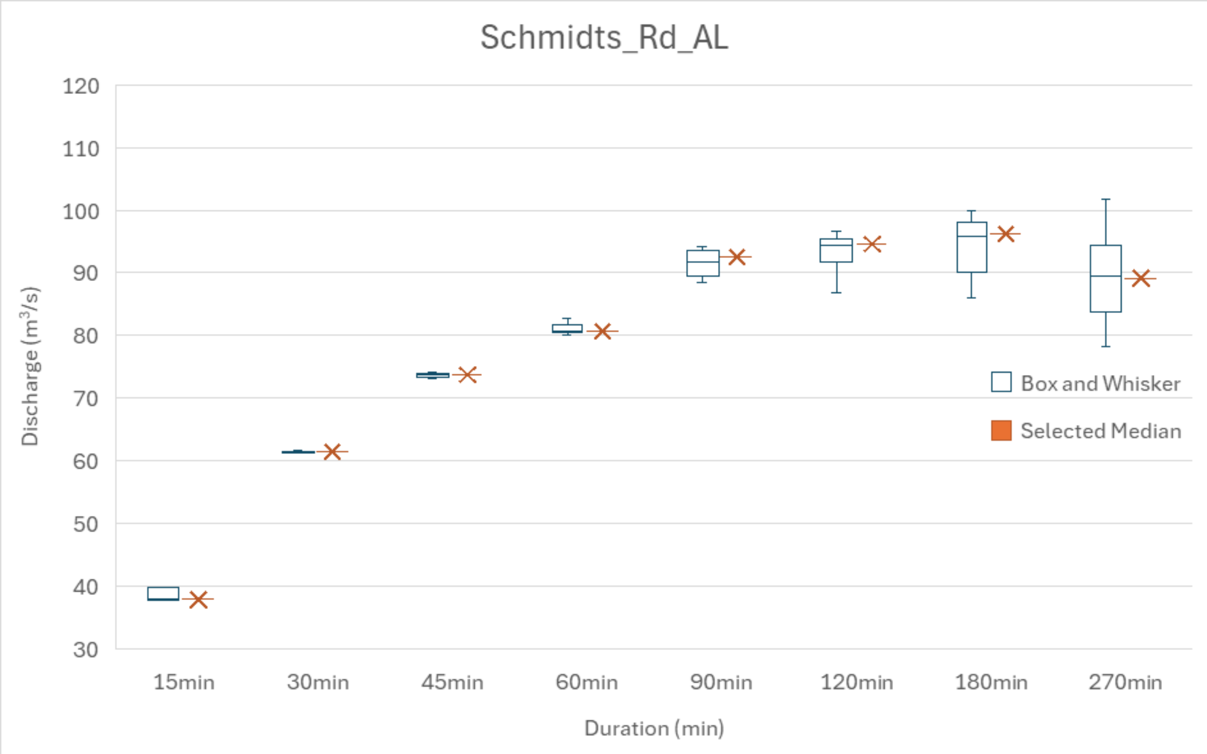



**Figure C29 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek at Schmidt's Road Alert**

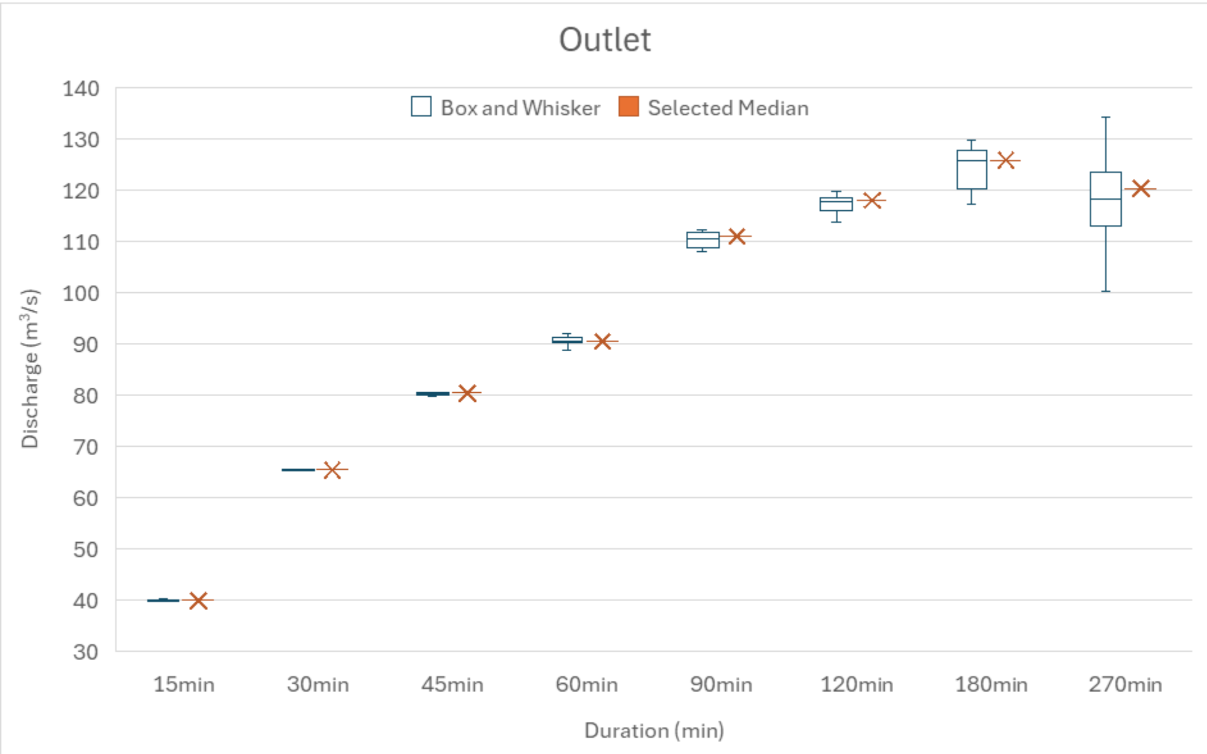
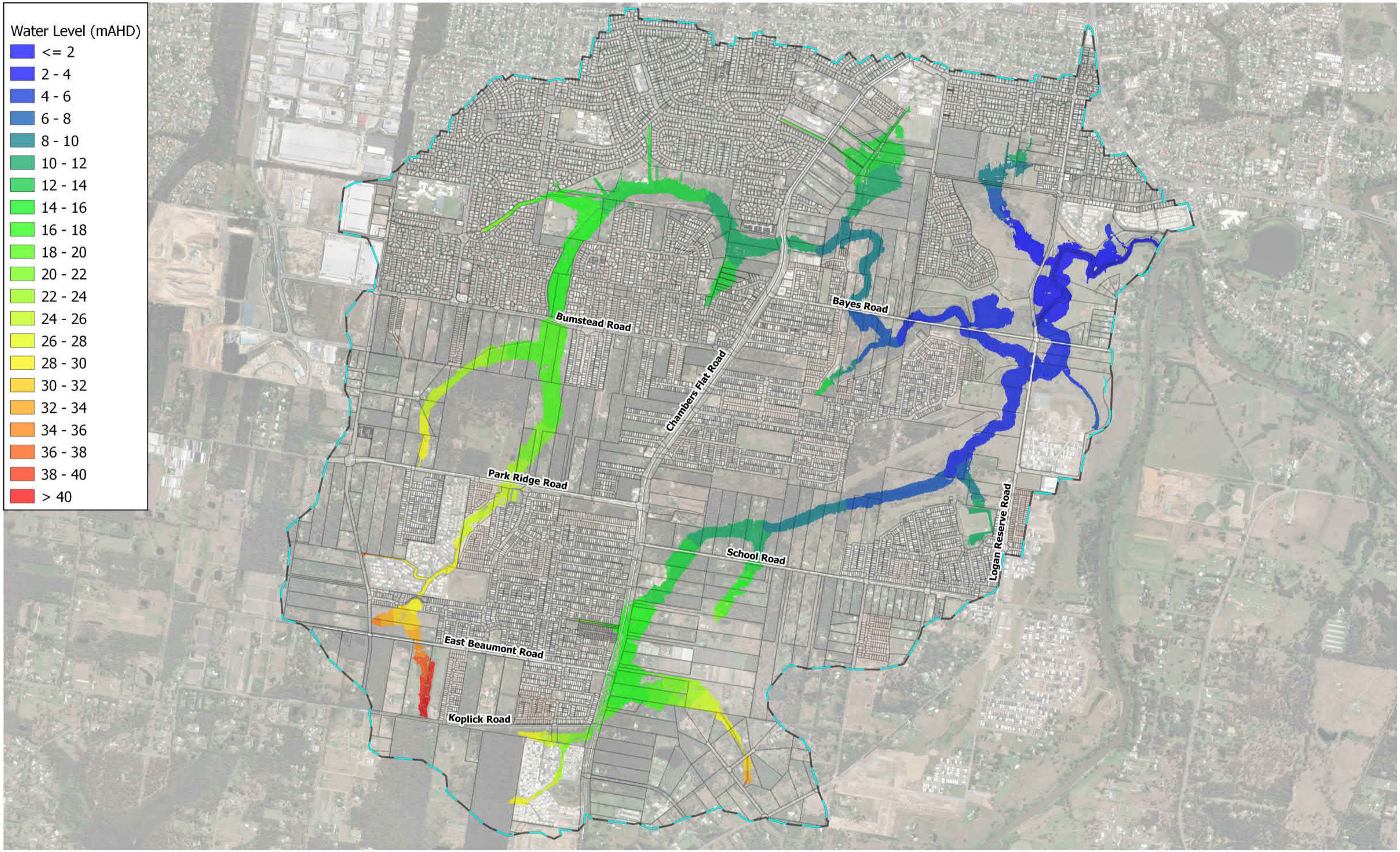



**Figure C20 Box plot showing the ensemble of TUFLOW model predicted 20% AEP design peak flows, Schmidt's Creek at Schmidt's Outlet**

# Appendix D: Design Event Mapping

Design Event Mapping




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Water Surface Level - 50% AEP

Figure: D1

Rev: 0

Scale at A3 1:21000
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While effort has been made to ensure the accuracy and completeness of the information presented, no guarantee is given, nor responsibility taken by KBR for any errors or omission.

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Scale:

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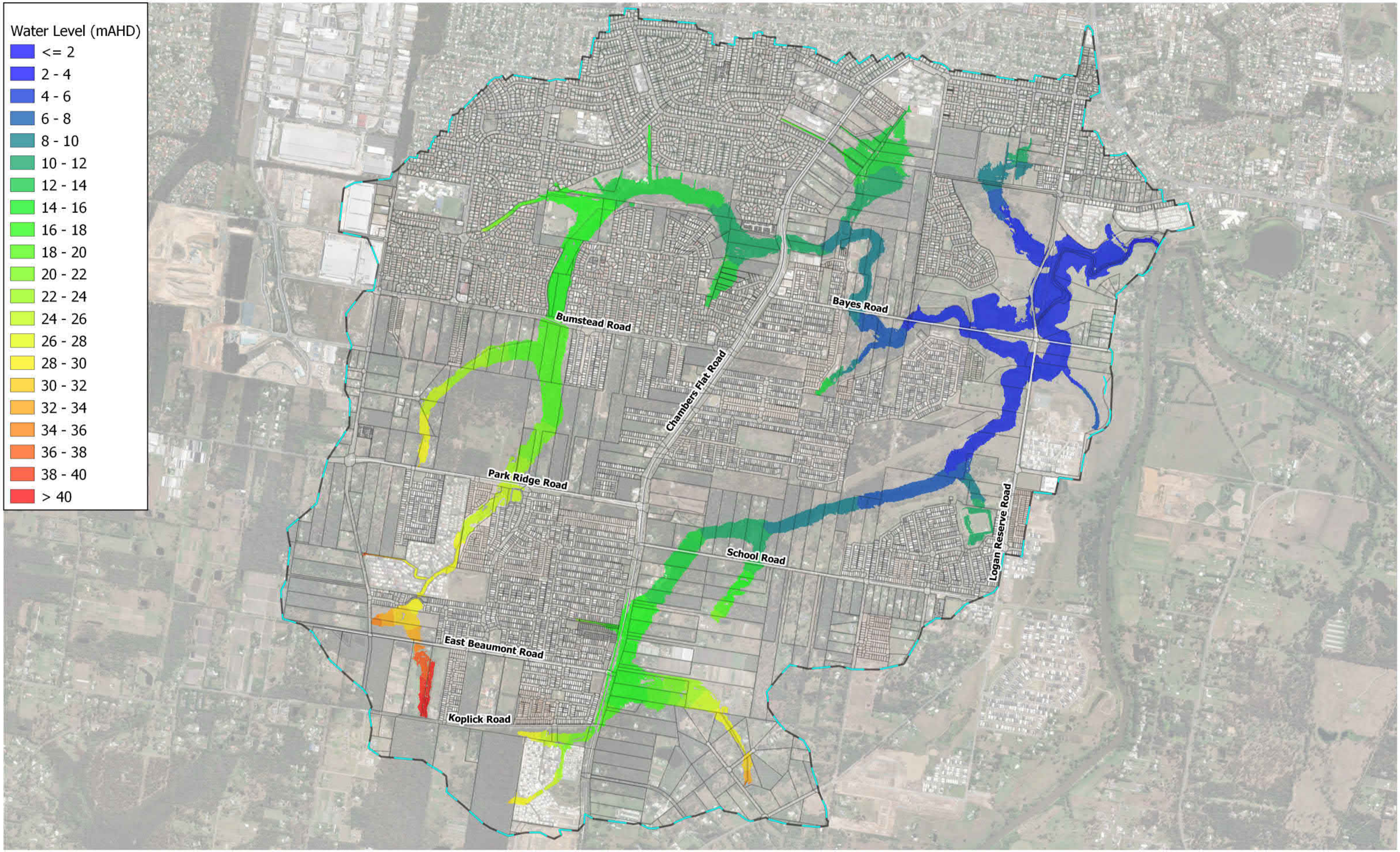
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

## Schmidt's Creek Flood Study - Design Event Mapping
## Water Surface Level - 20% AEP

Scale at A3 1:21000


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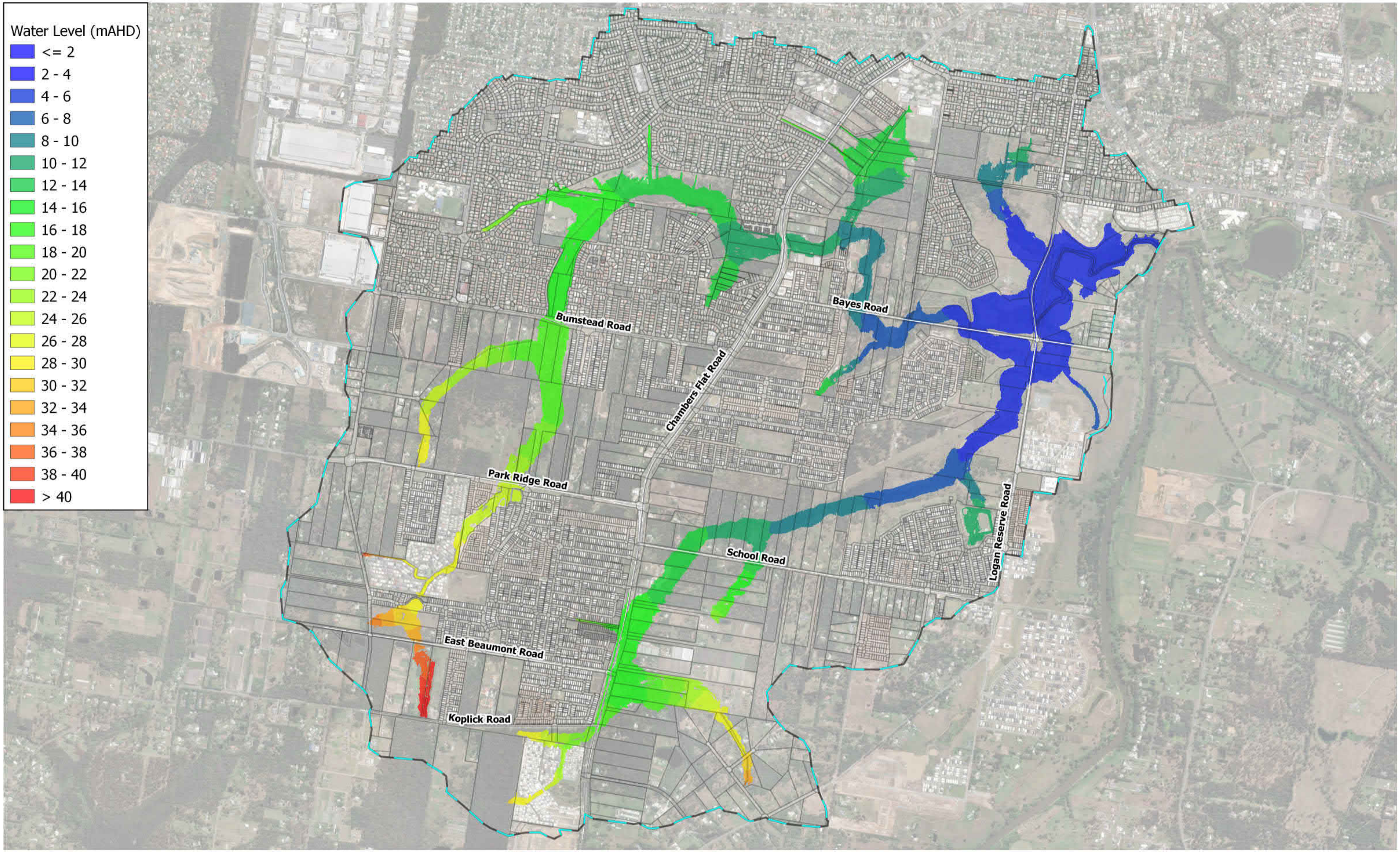
Figure: D2

Rev: 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
## Water Surface Level - 10% AEP

Figure: D3

Rev: 0

Scale at A3 1:21000



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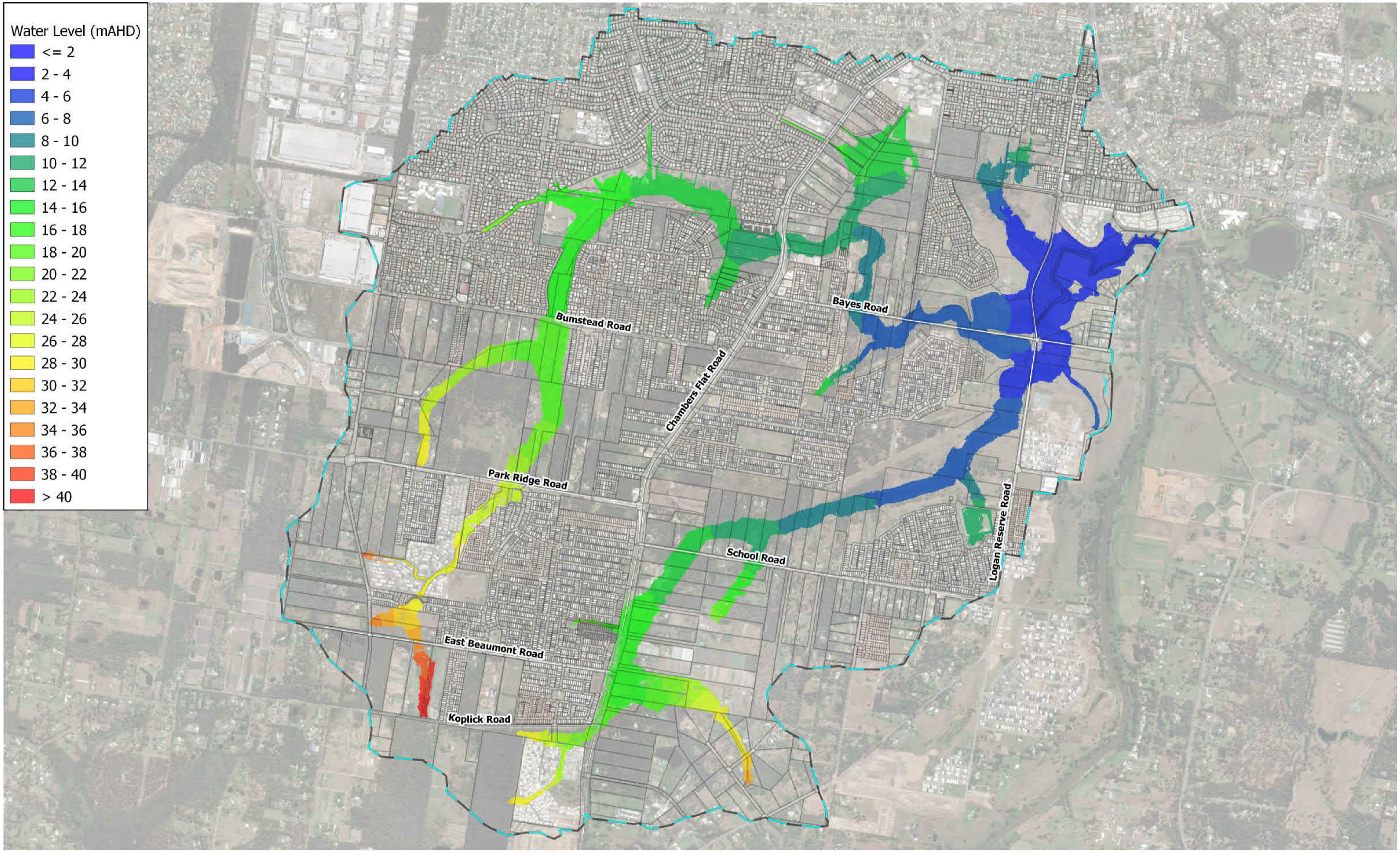


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Water Surface Level - 5% AEP**

Scale at A3 1:21000
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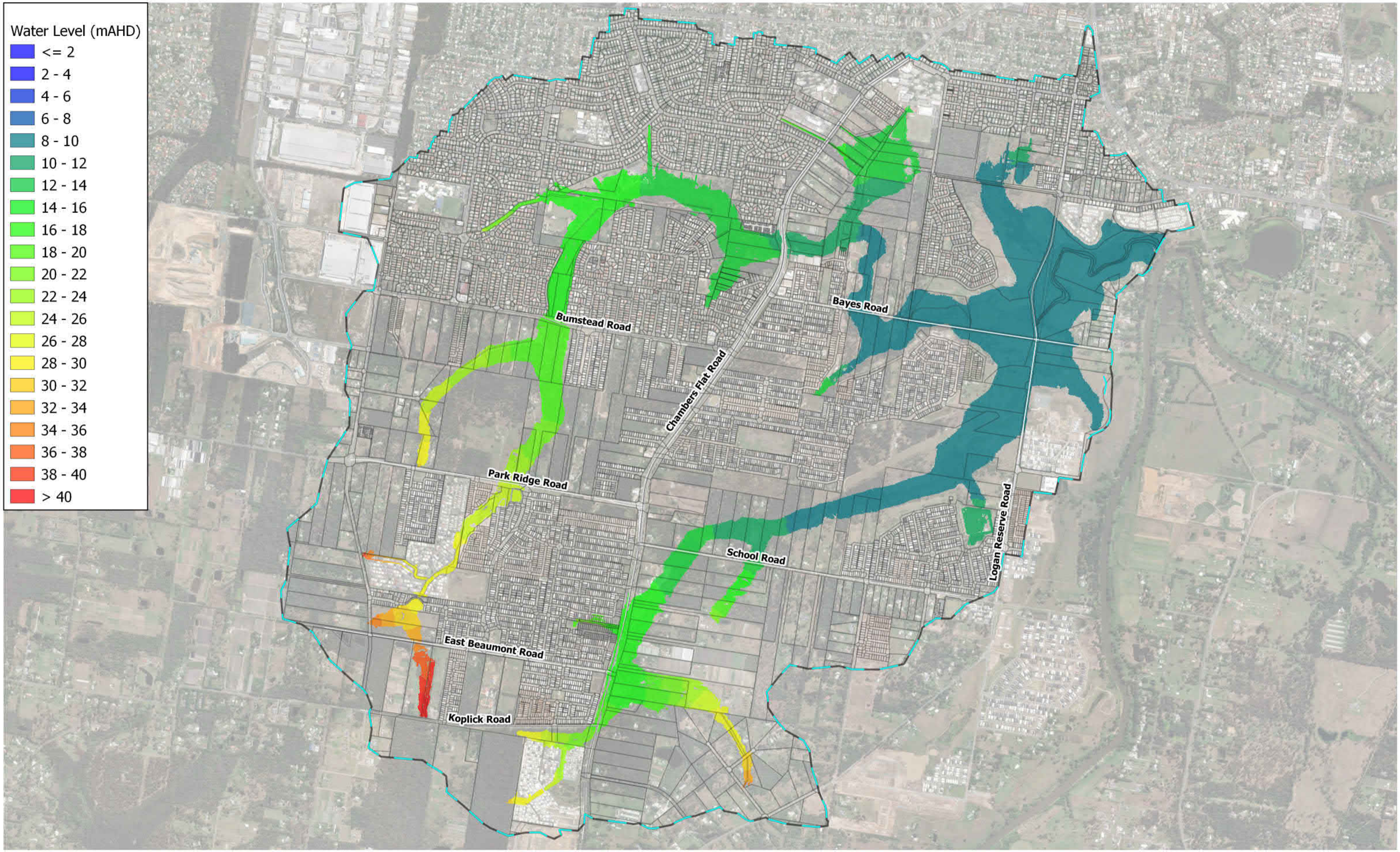
Figure: D4

Rev: 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Water Surface Level - 2% AEP

Scale at A3 1:21000
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Scale:

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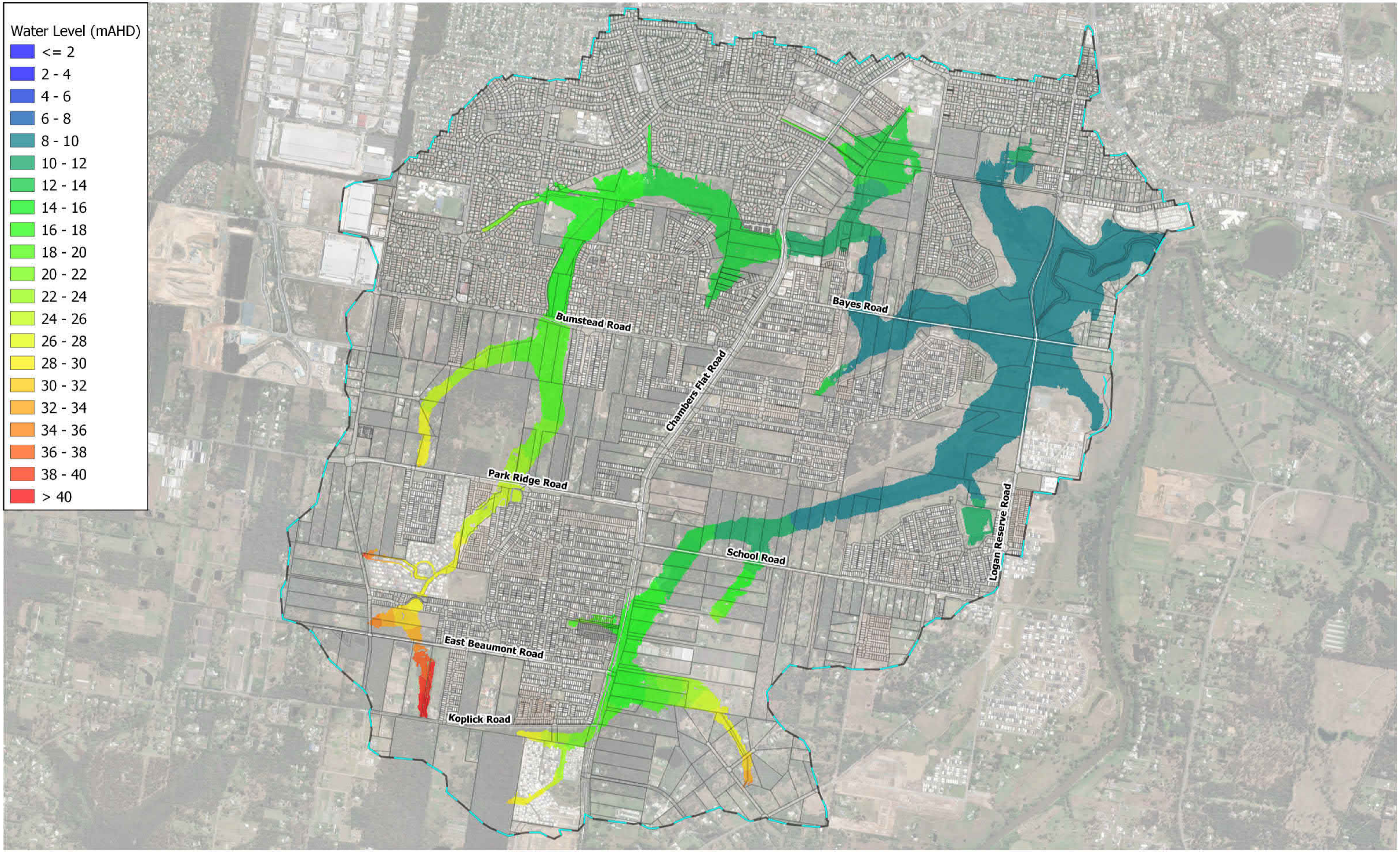
1:21,000

Figure

D5

Rev

0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Water Surface Level - 1% AEP

Scale at A3 1:21000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Scale:

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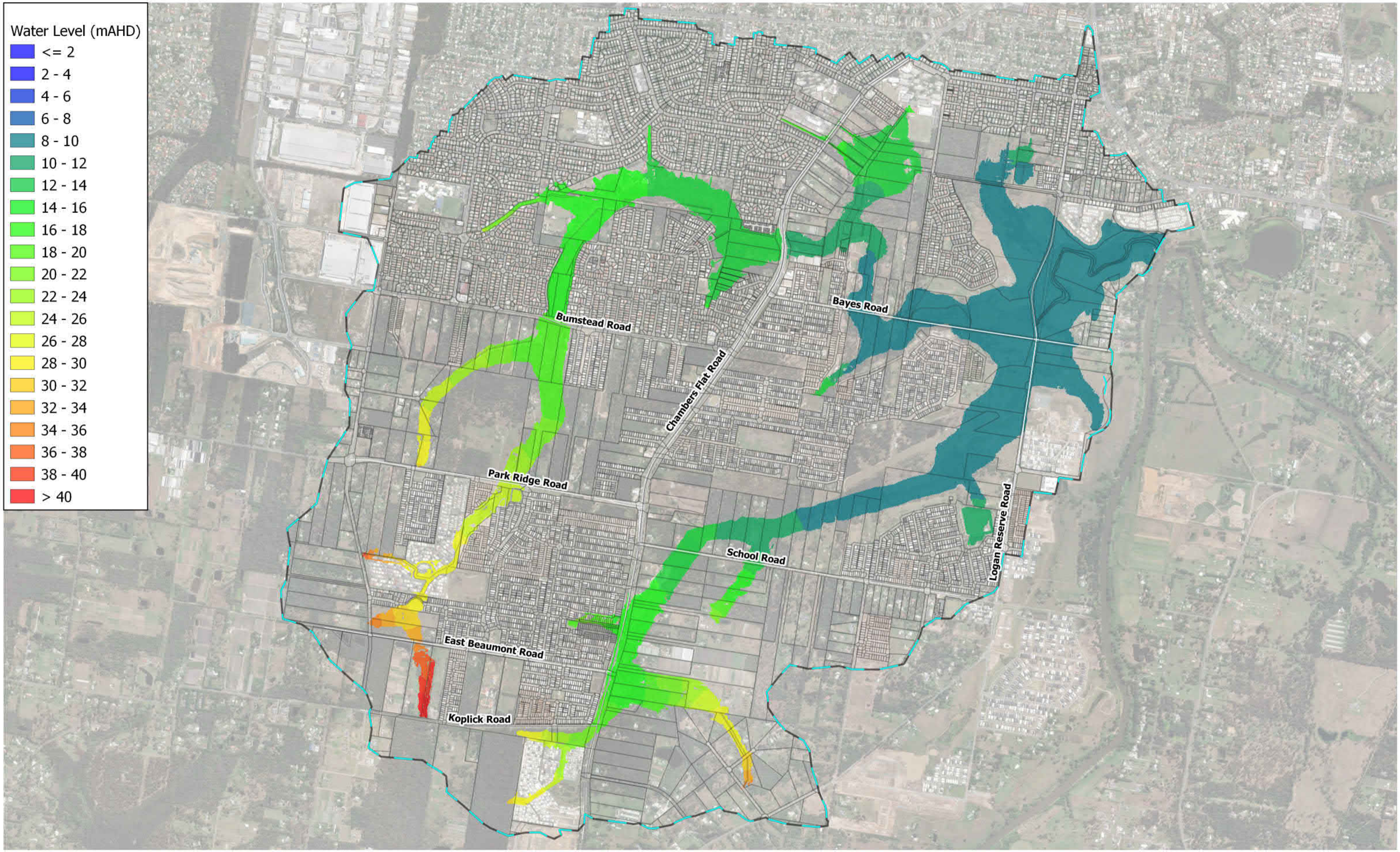
Figure D6

Rev 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
## Water Surface Level - 0.5% AEP

Scale at A3 1:21000



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Scale:

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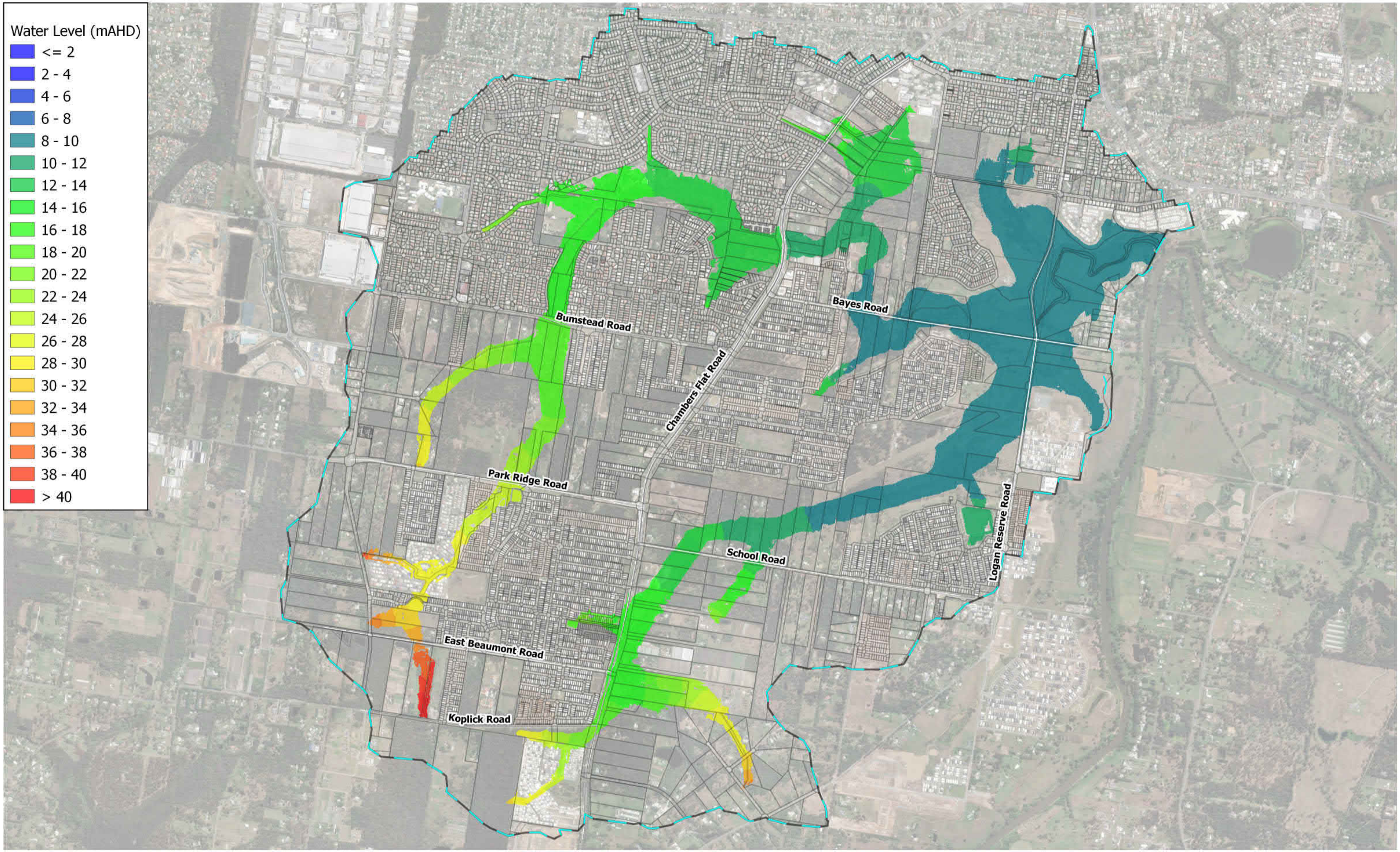
Figure D7

Rev 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Water Surface Level - 0.2% AEP**

Figure **D8** Rev **0**

Scale at A3 1:21000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Scale:

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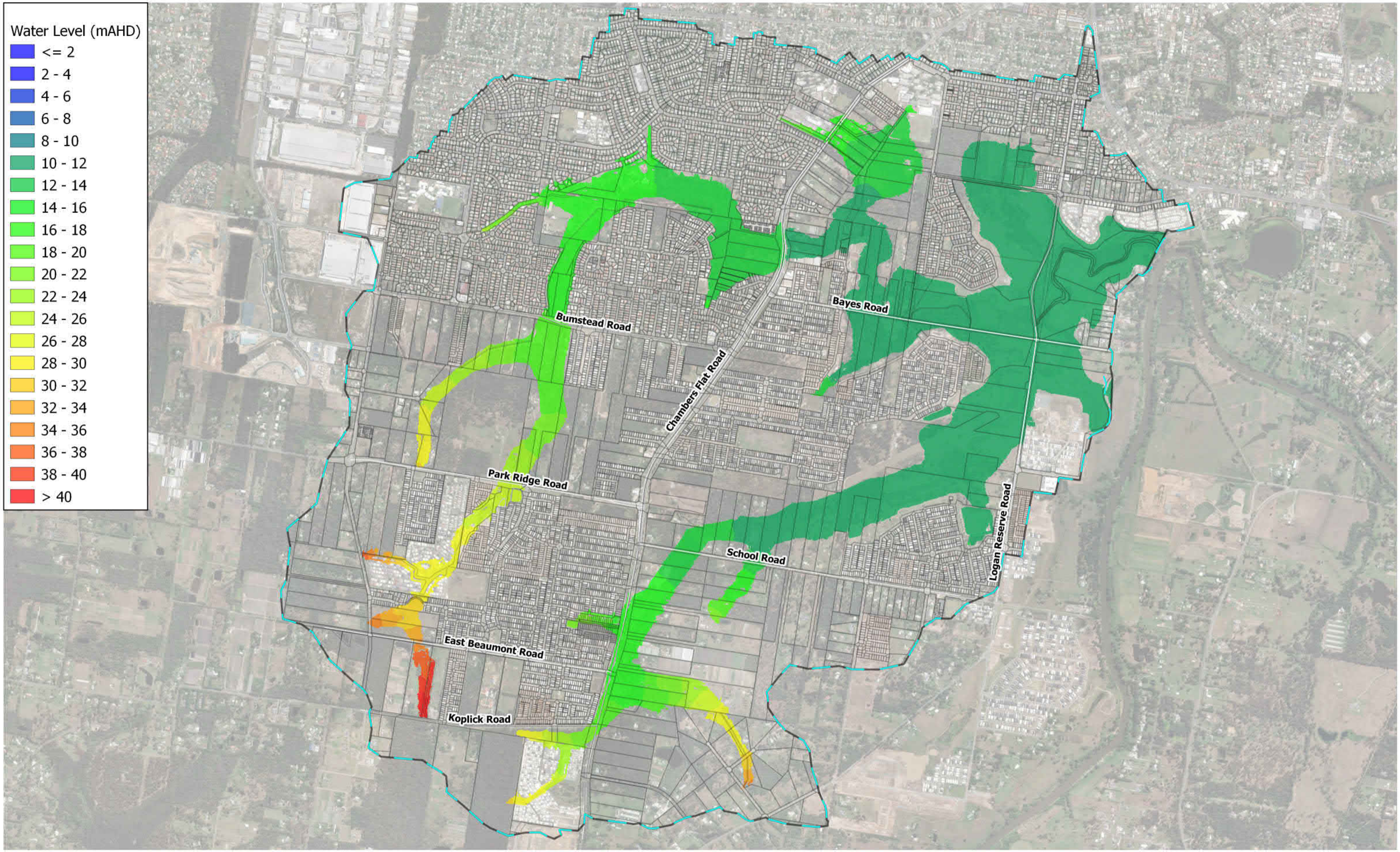


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Water Surface Level - 0.05% AEP**

Figure **D9**

Rev **0**

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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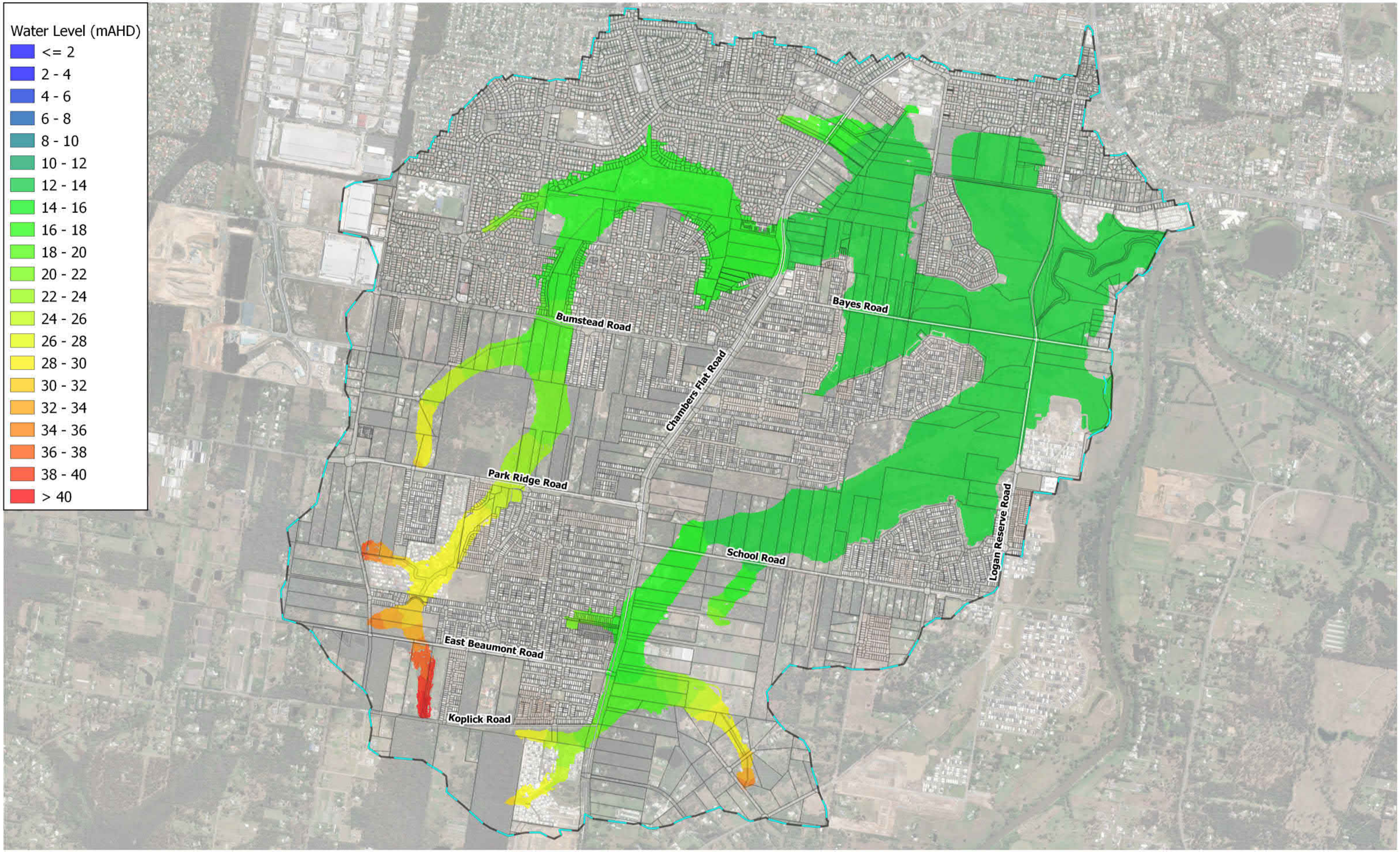


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Water Surface Level - PMP**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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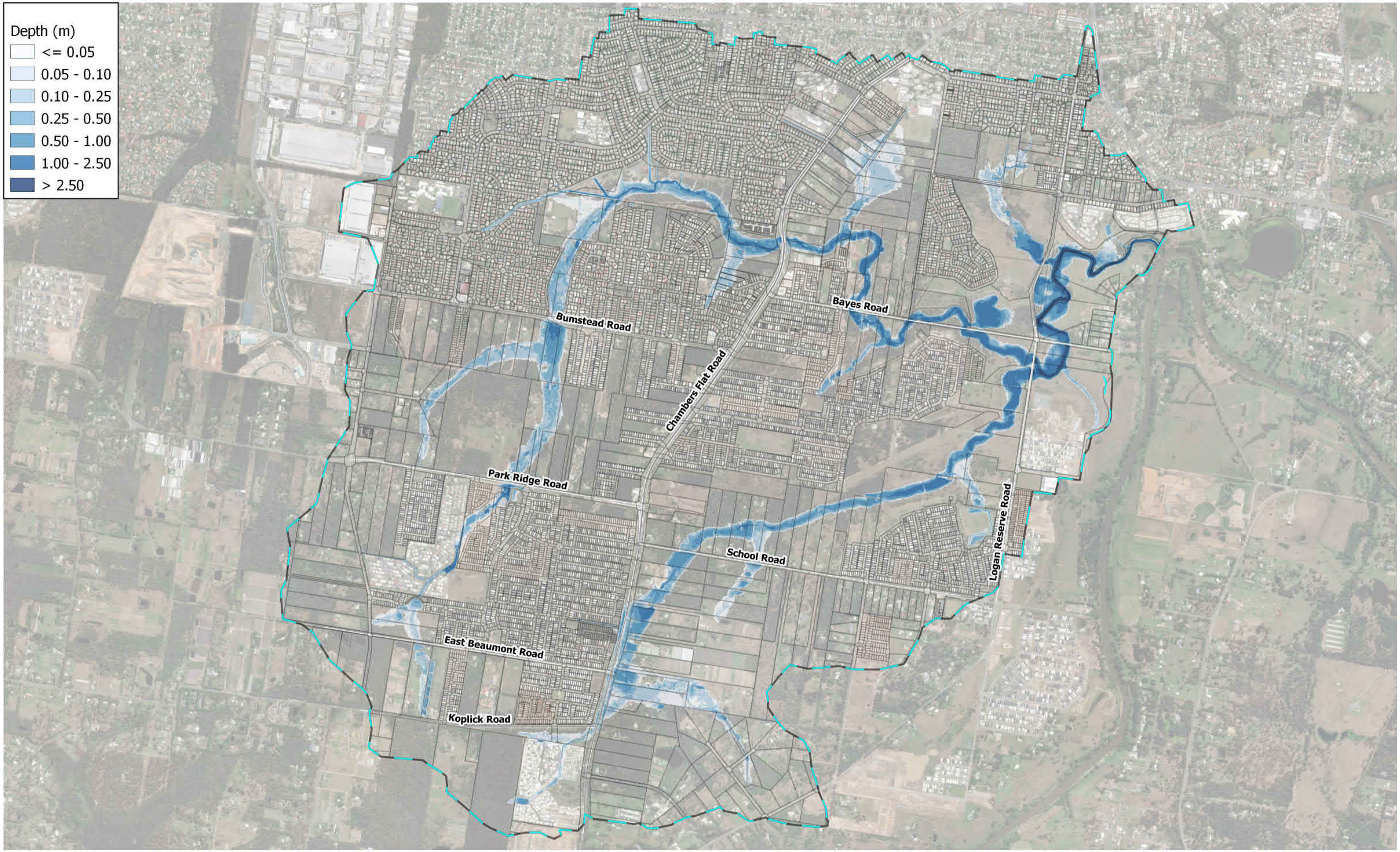
1:21,000

Figure

D10

Rev

0




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Depth - 50% AEP**

Scale at A3 1:21000
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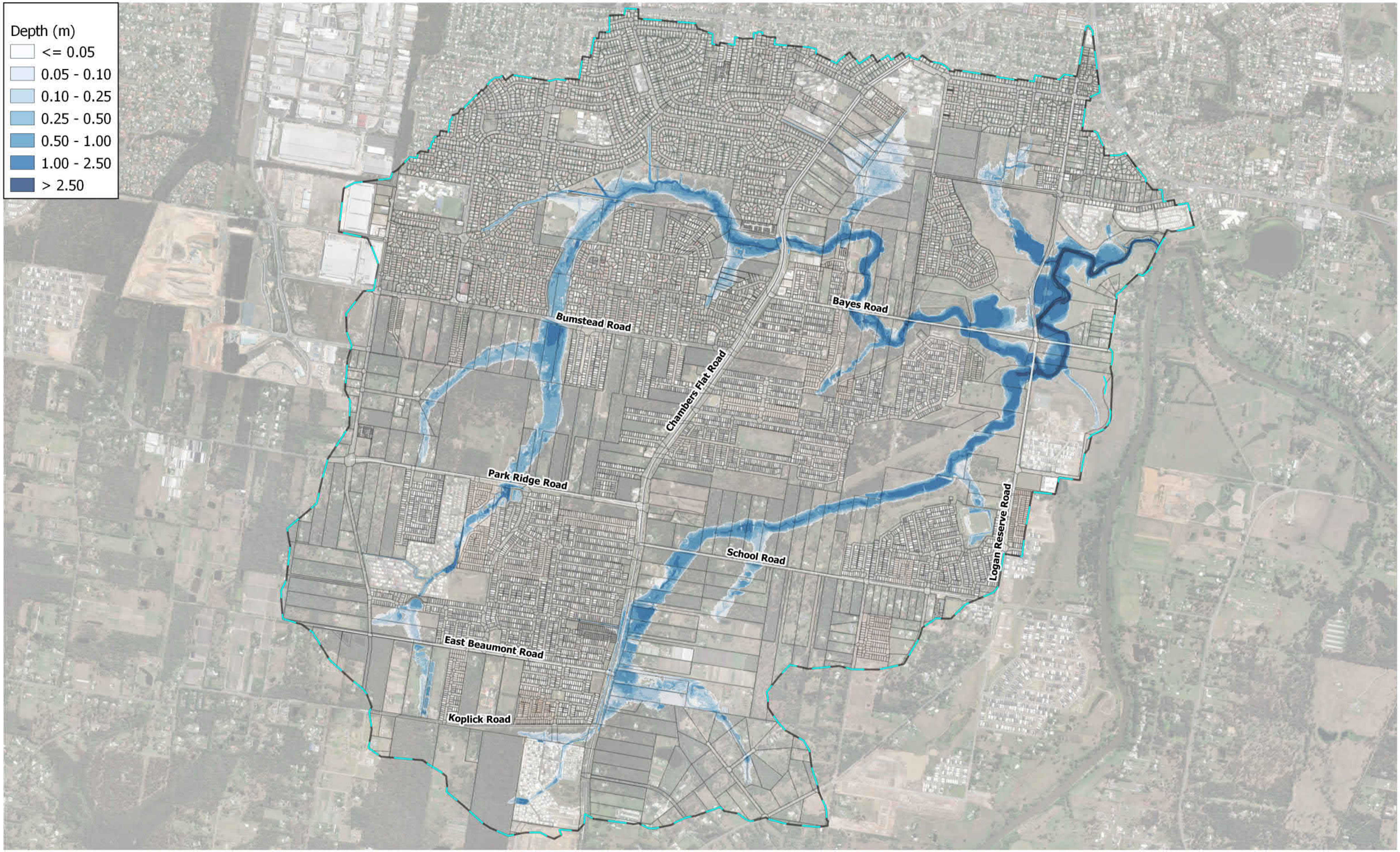
Scale:

0 200 400 600 800 m

1:21,000

Figure: D11

Rev: 0




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Depth - 20% AEP**

Figure: **D12**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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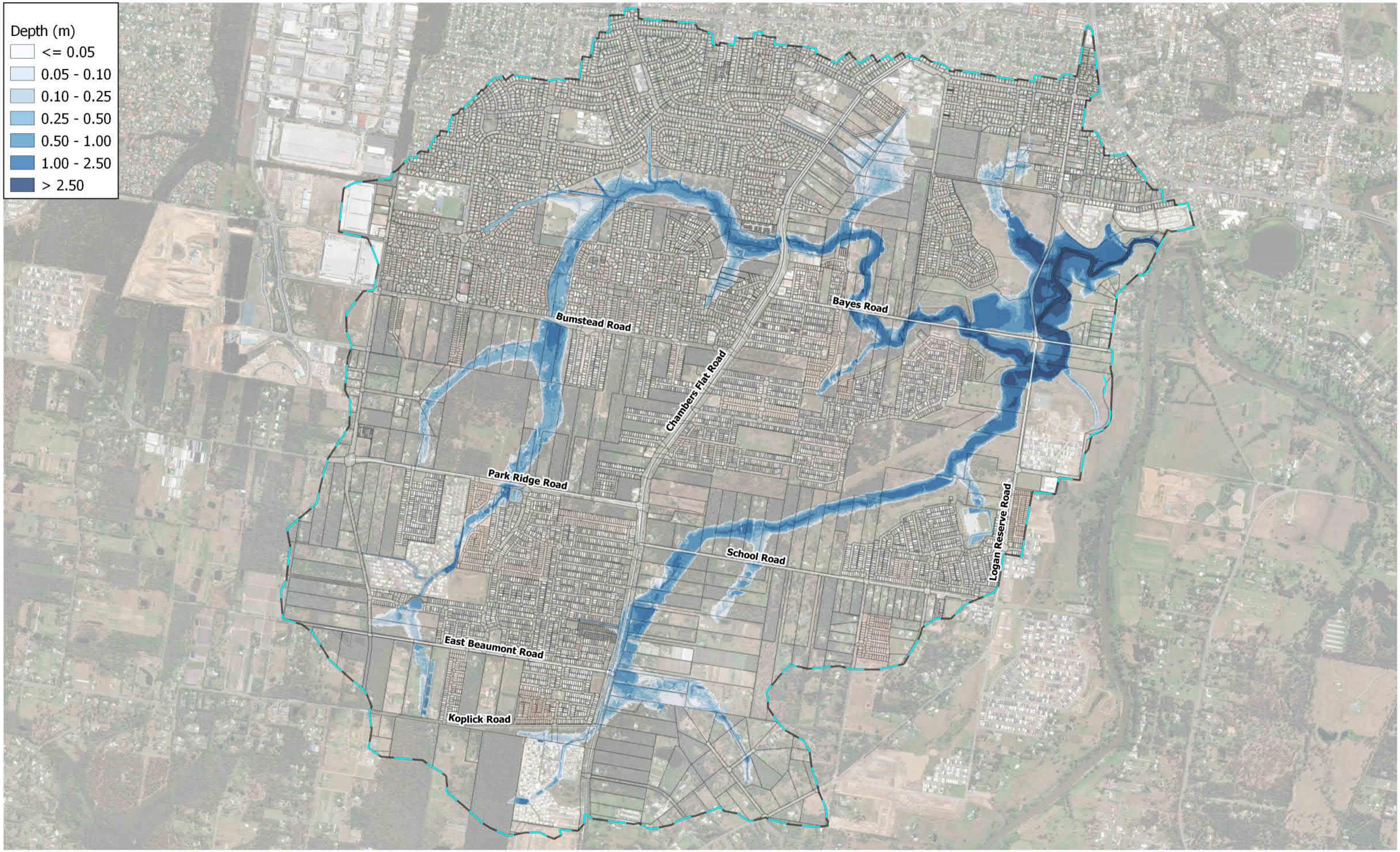
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Depth - 10% AEP

Figure: D13

Rev: 0

Scale at A3 1:21000



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File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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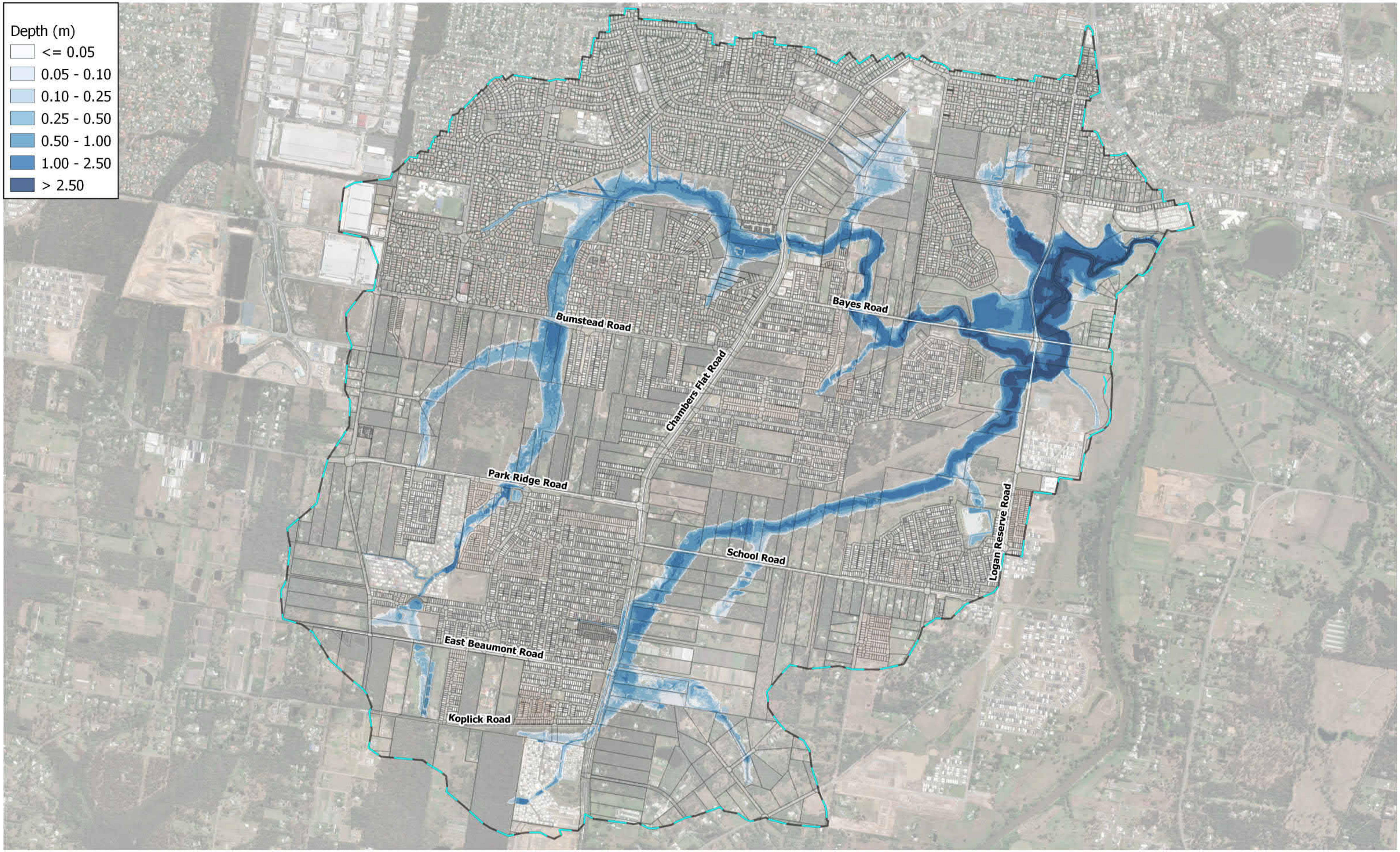


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Depth - 5% AEP

Figure: D14

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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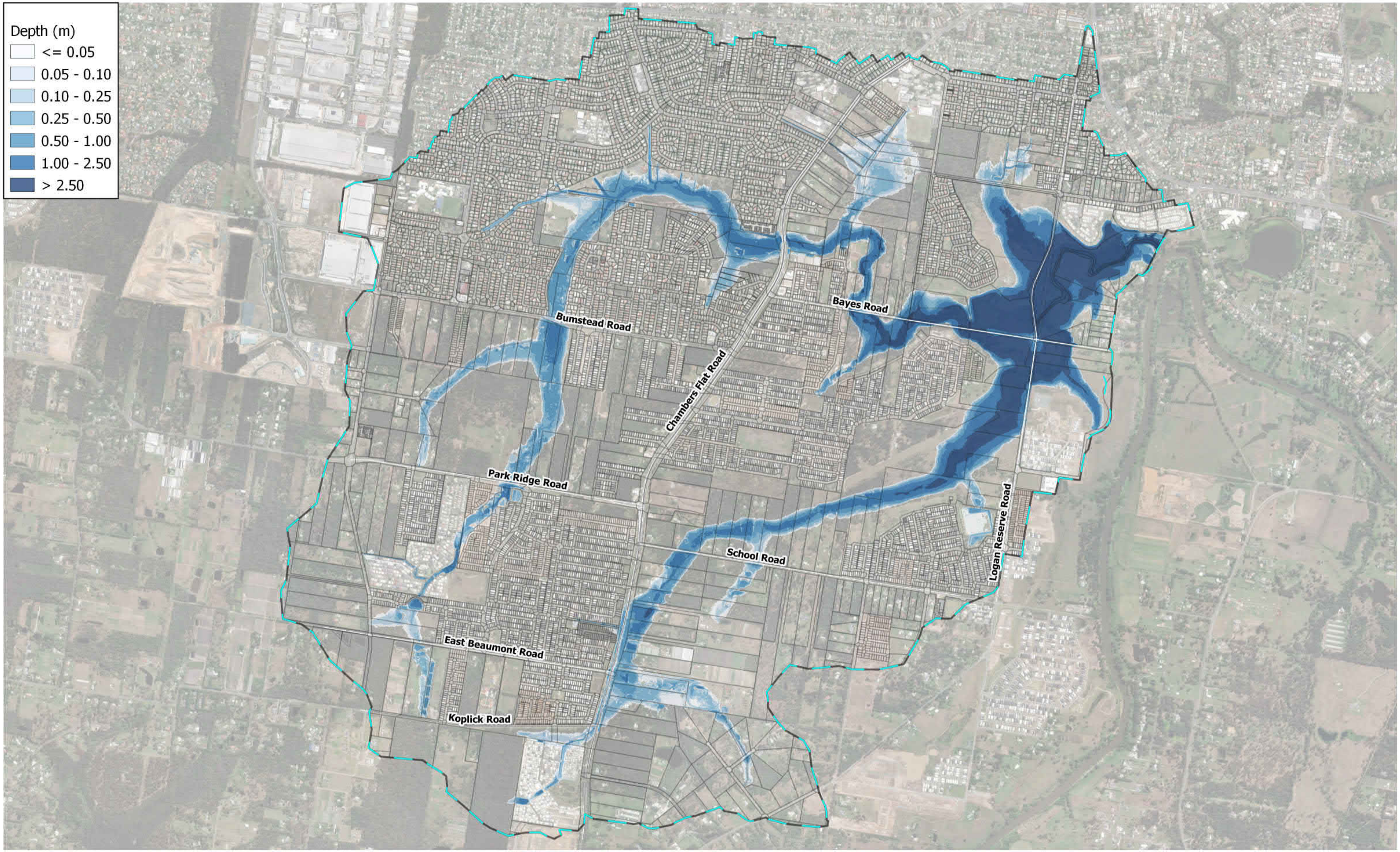


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Depth - 2% AEP

Figure: D15

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FSG - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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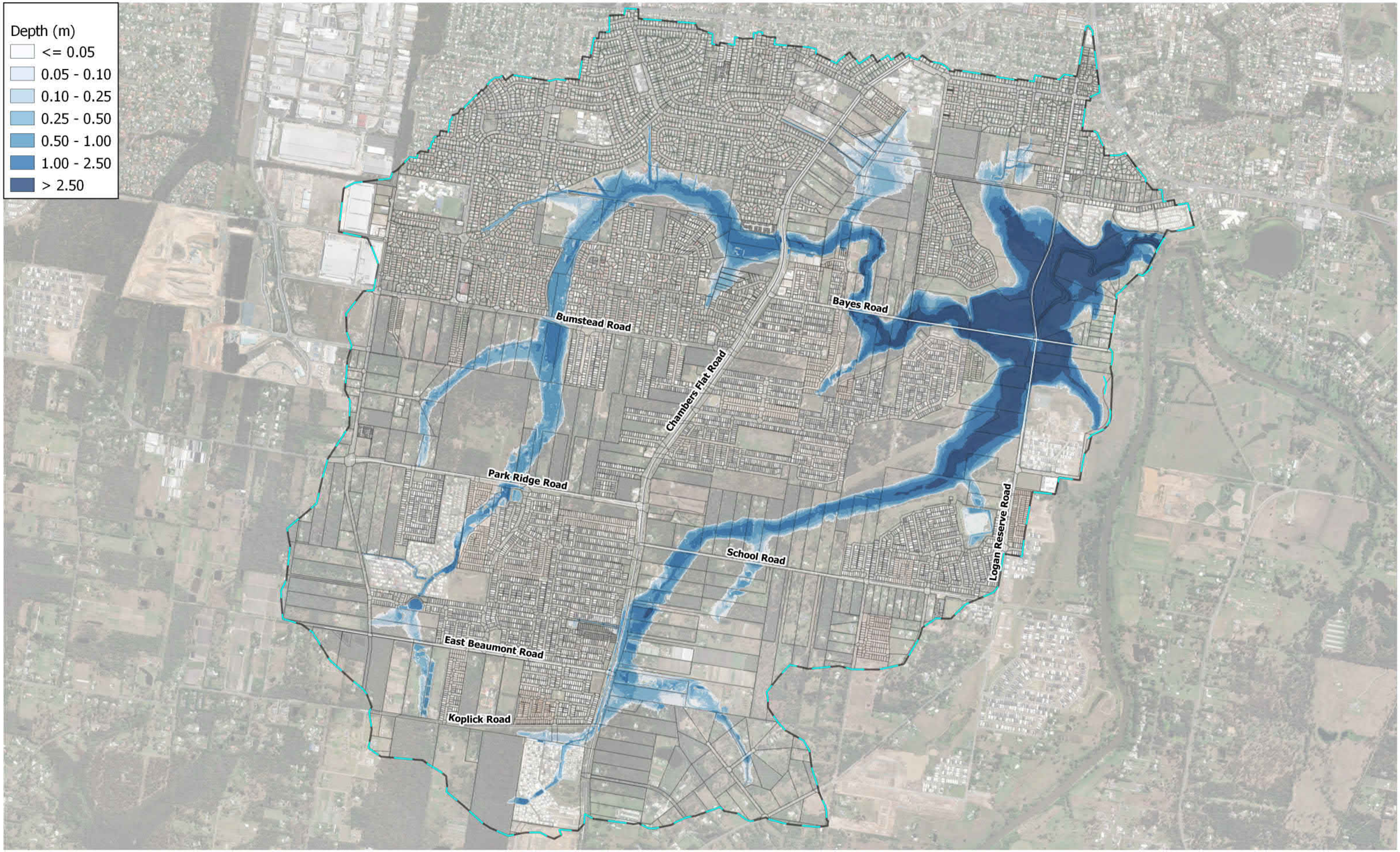


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Depth - 1% AEP**

Figure: **D16**

Rev: **0**



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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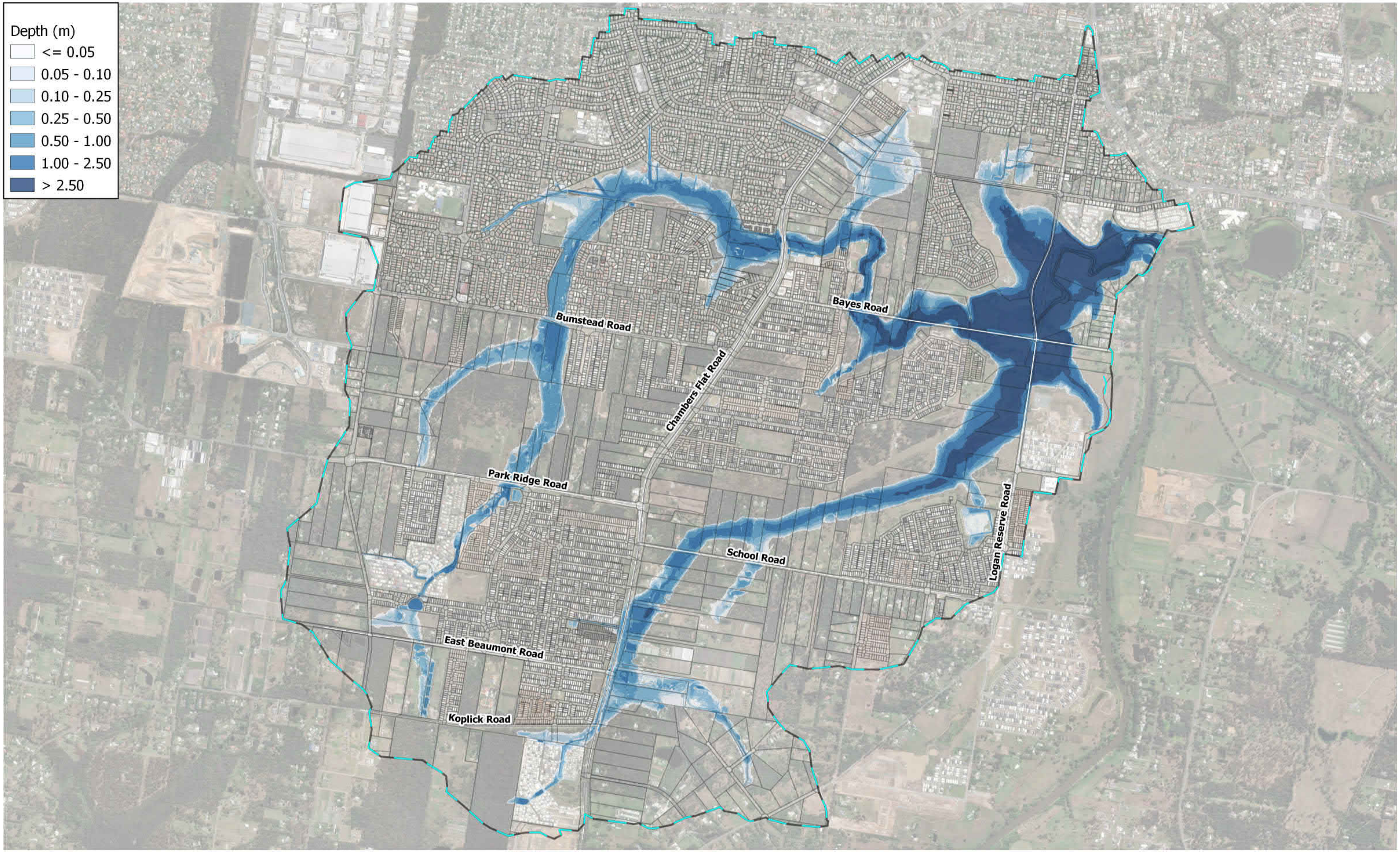



**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Depth - 0.5% AEP**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

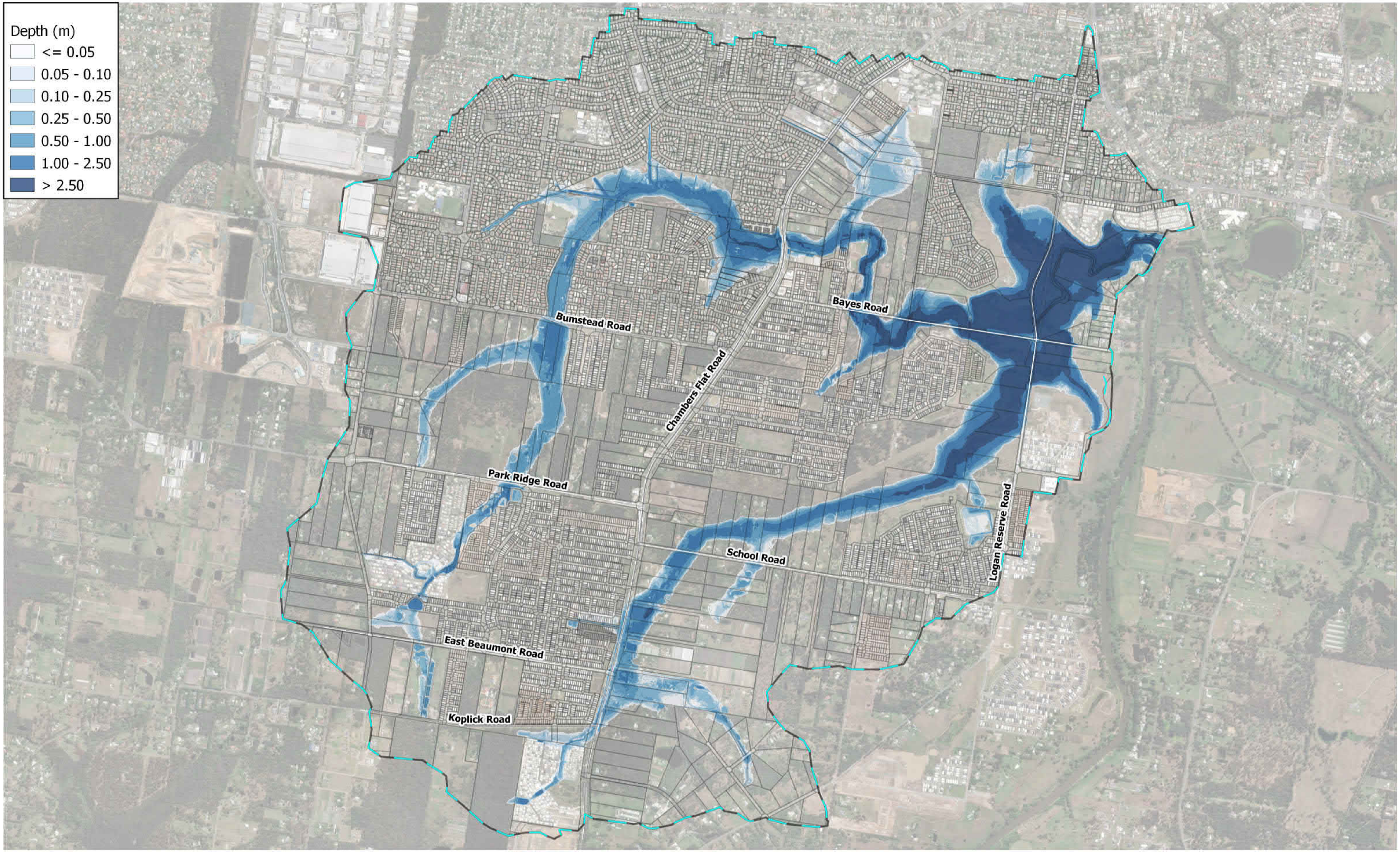
Scale:

0 200 400 600 800 m

1:21,000

Figure: D17

Rev: 0




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

## Schmidt's Creek Flood Study - Design Event Mapping
## Flood Depth - 0.2% AEP

Figure: D18

Rev: 0

Scale at A3 1:21000
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Scale:

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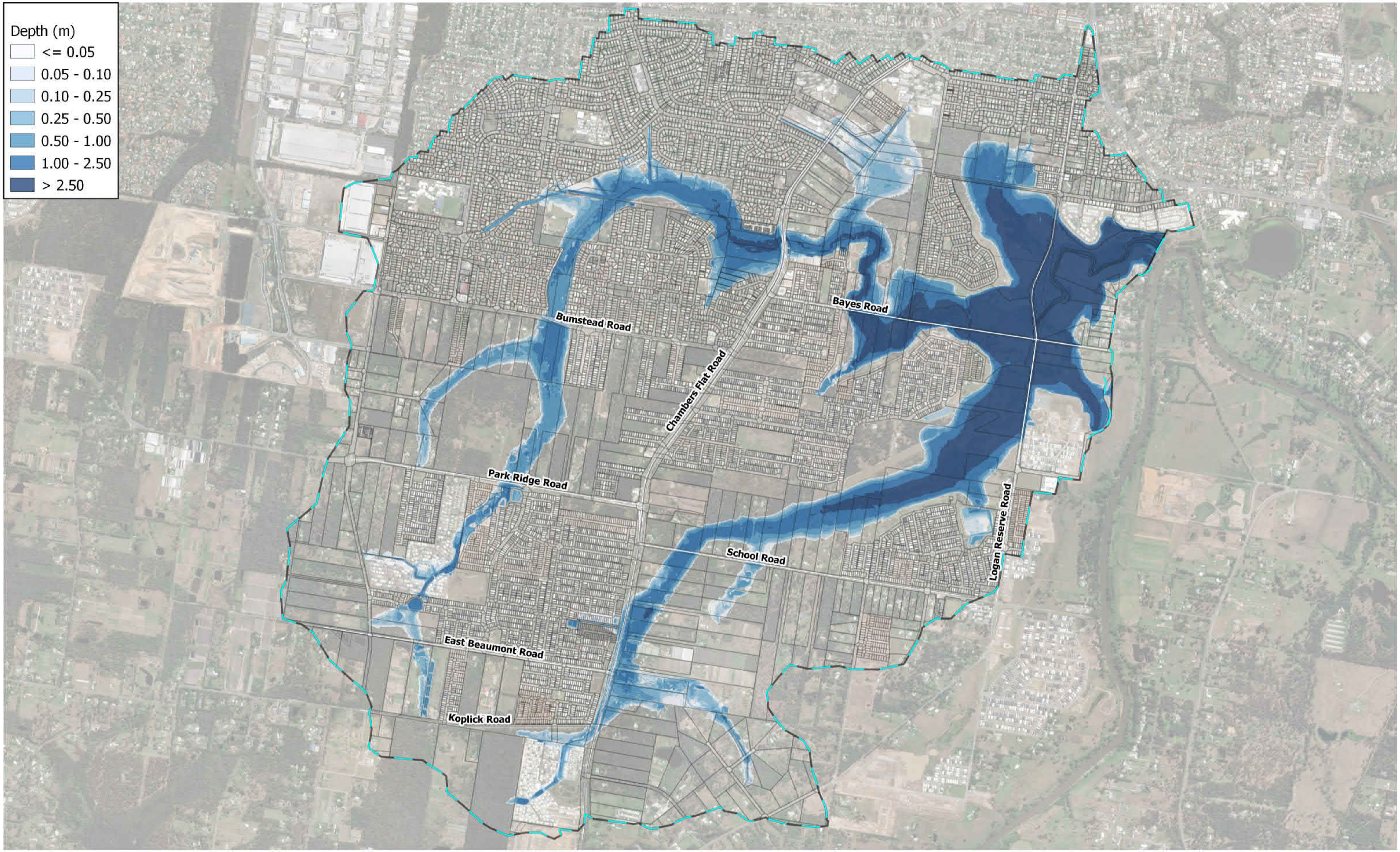
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Depth - 0.05% AEP**

Figure: **D19**

Rev: **0**

Scale at A3 1:21000
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Scale:

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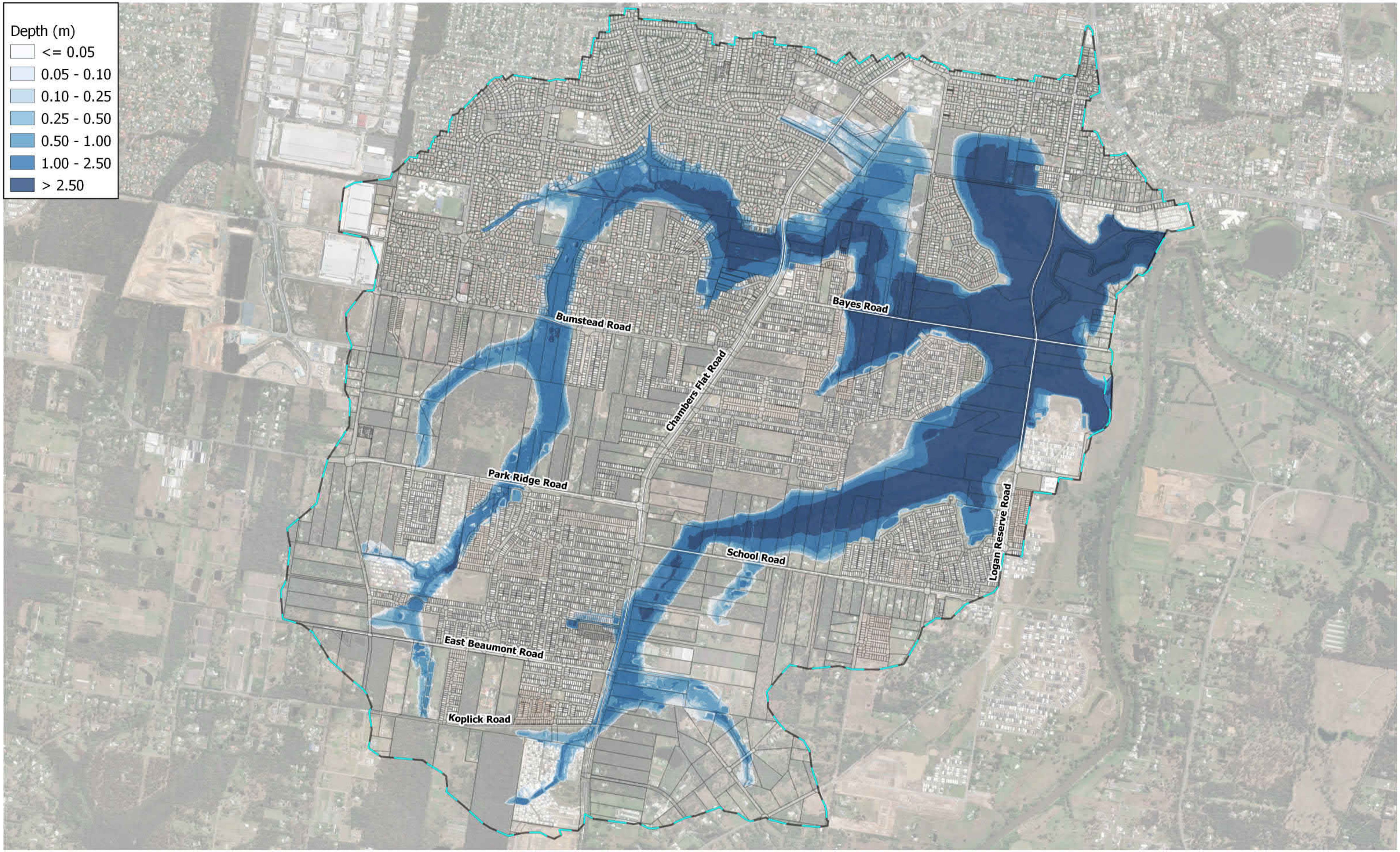
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Depth - PMP

Scale at A3 1:21000

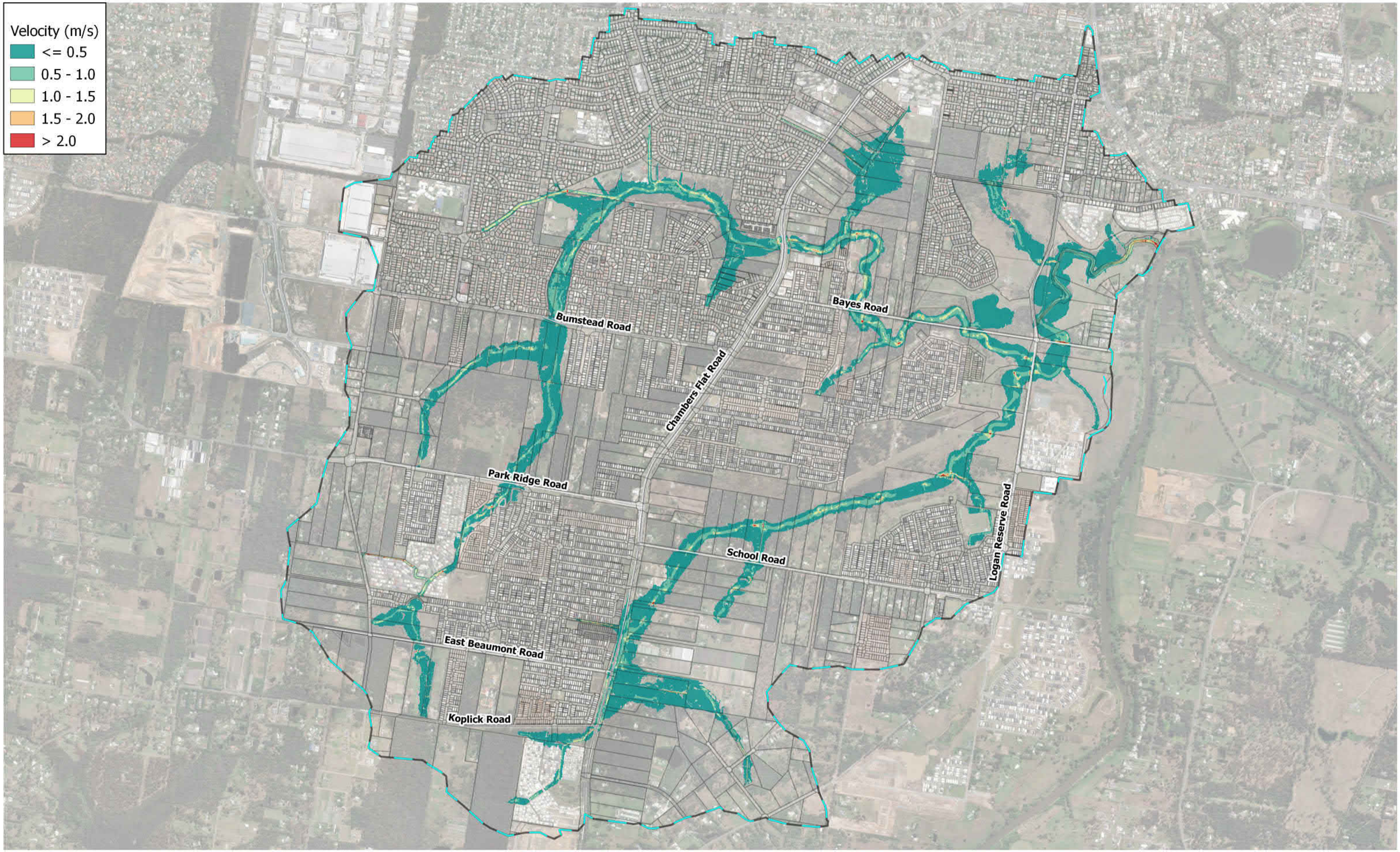


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale: 0 200 400 600 800 m

1:21,000

| Figure | Rev |
|---|---|
| D20 | 0 |




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Velocity - 50% AEP

Figure: **D21**

Rev: **0**

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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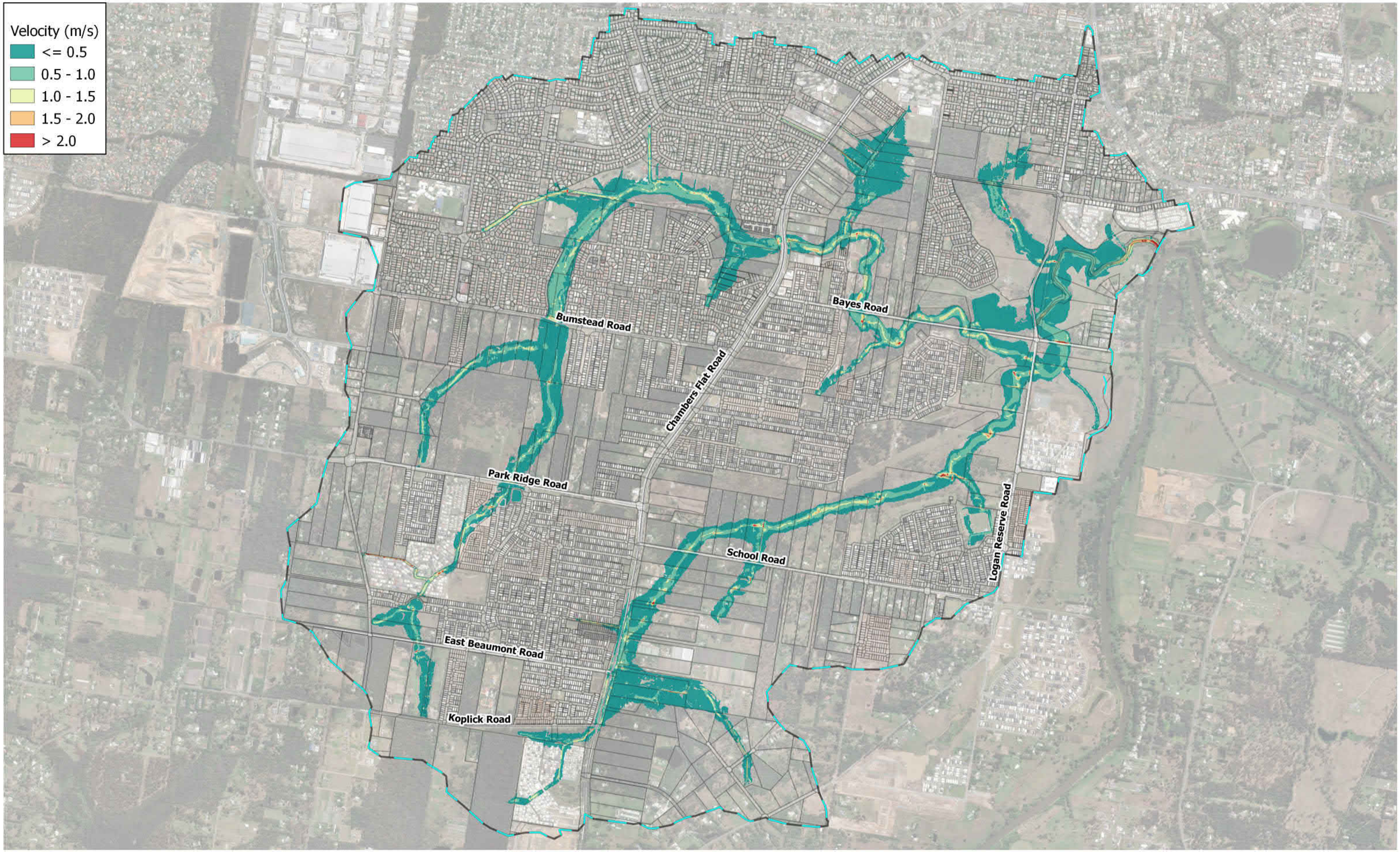
1:21,000




**LEGEND**

Cadastre
TUFLOW model extent
Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Velocity - 20% AEP**

Figure: **D22**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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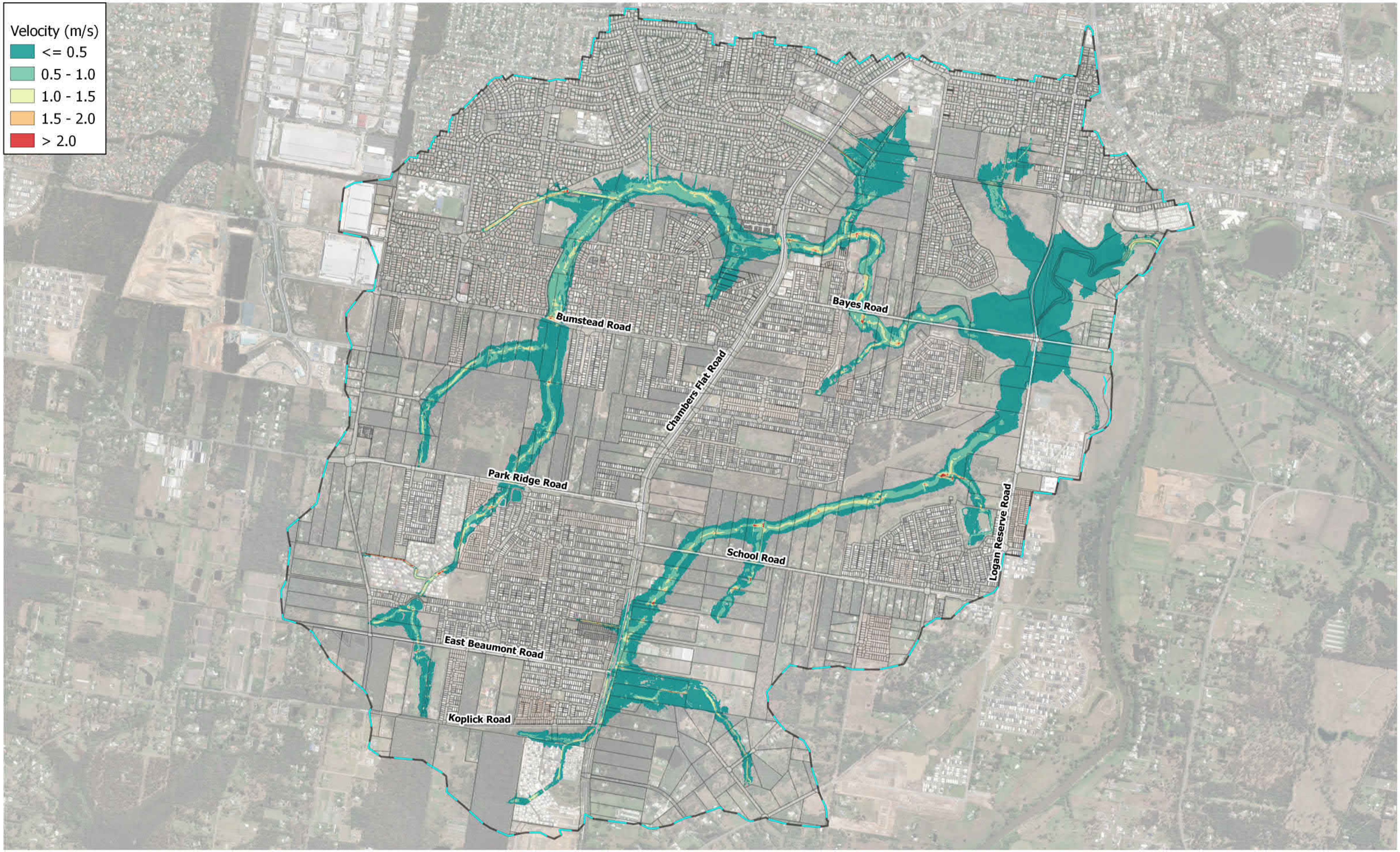
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Velocity - 10% AEP

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale

0 200 400 600 800 m

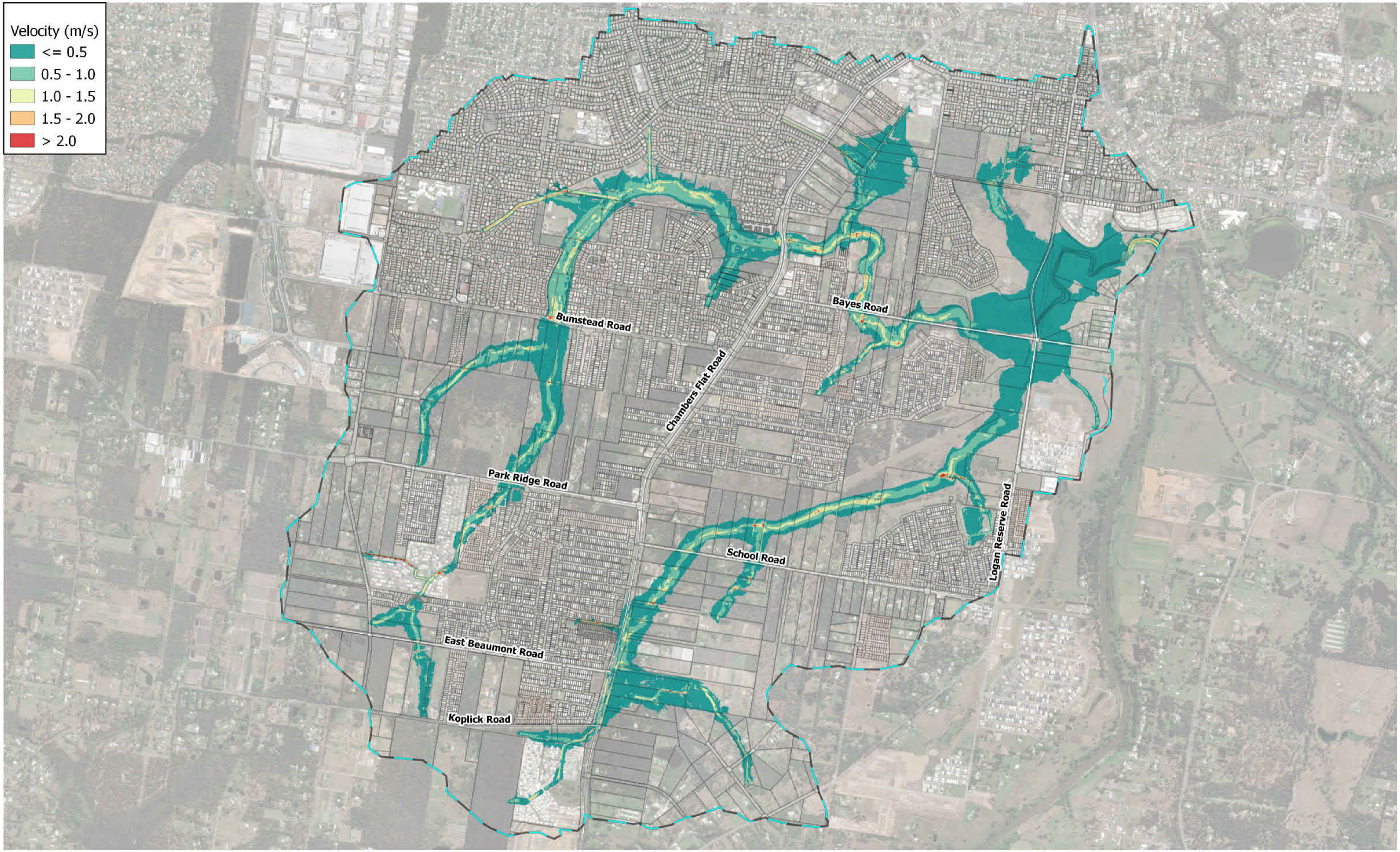
1:21,000

Figure

D23

Rev

0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt’s Creek Flood Study - Design Event Mapping Flood Velocity - 5% AEP

Figure: D24

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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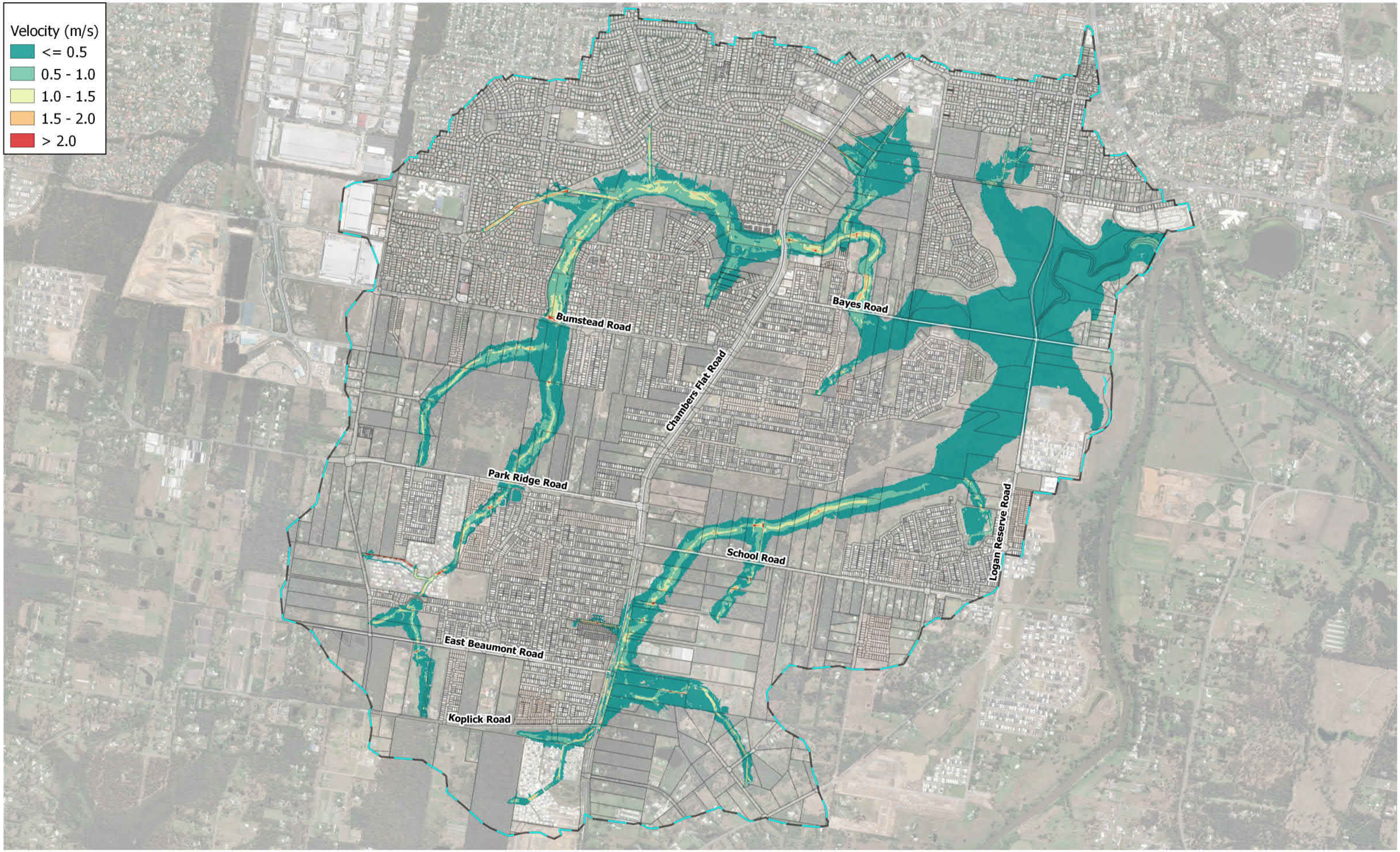
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Velocity - 2% AEP

Figure: D25

Rev: 0



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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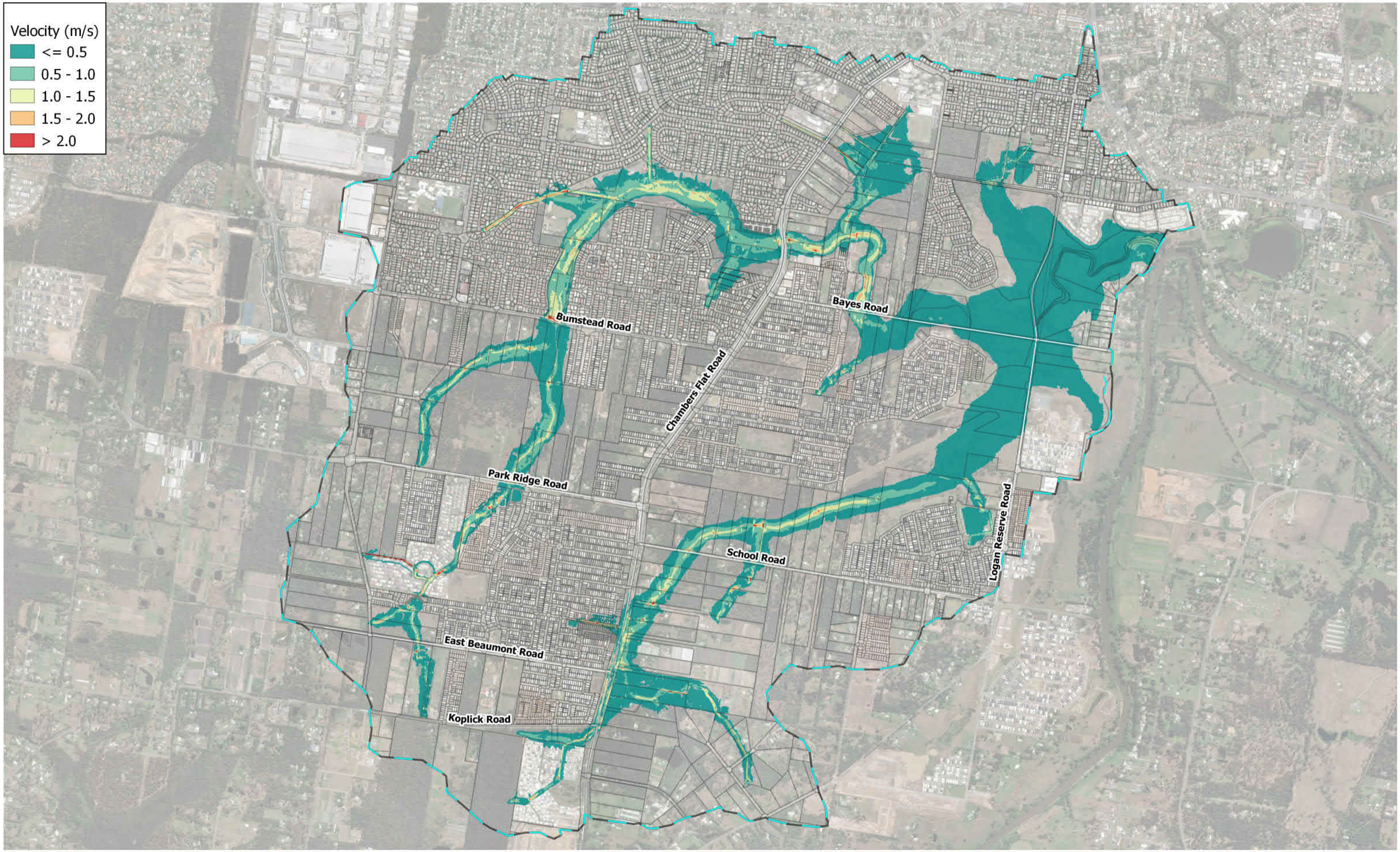
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Velocity - 1% AEP

Figure: D26

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wig\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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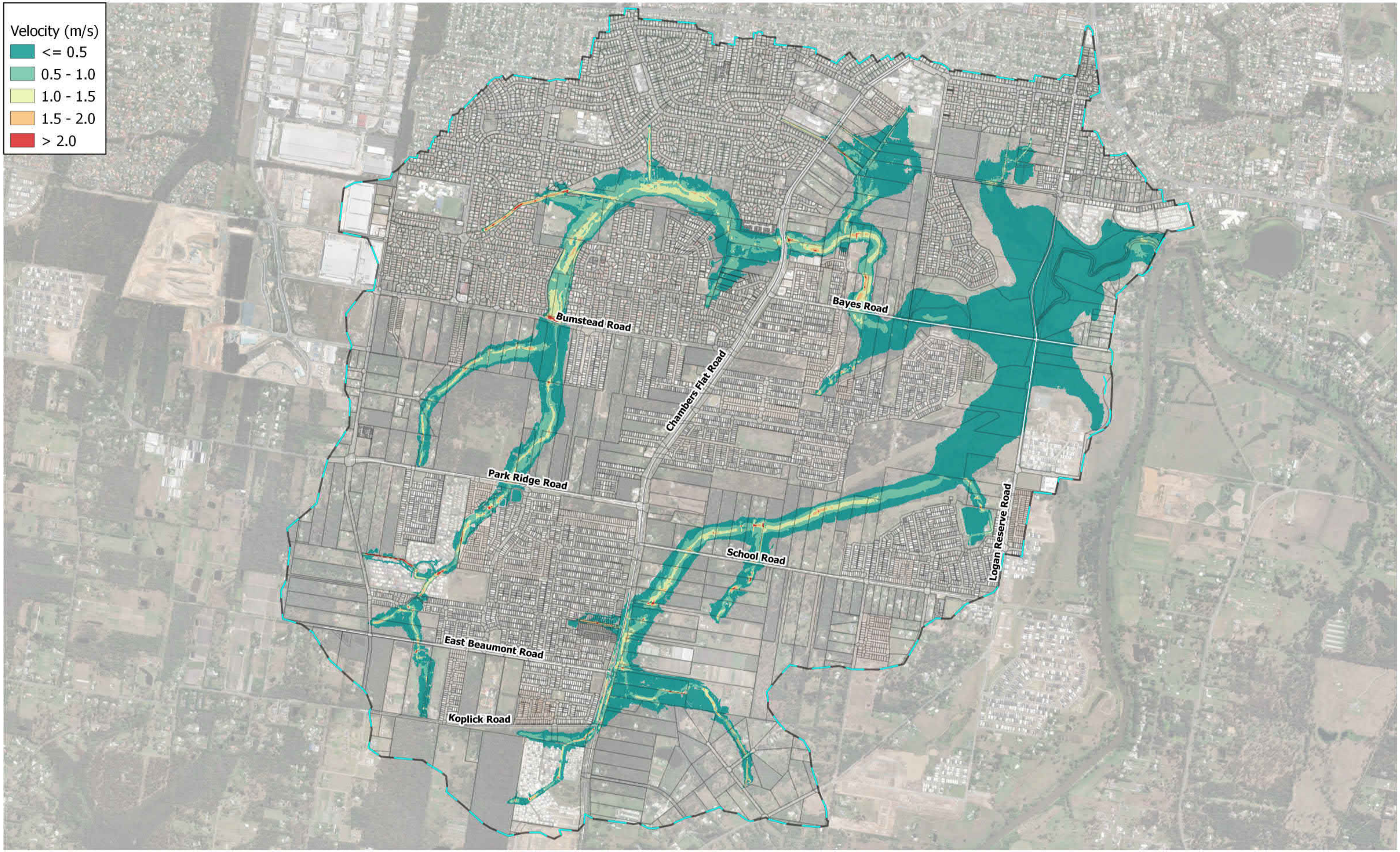
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Velocity - 0.5% AEP

Figure: D27

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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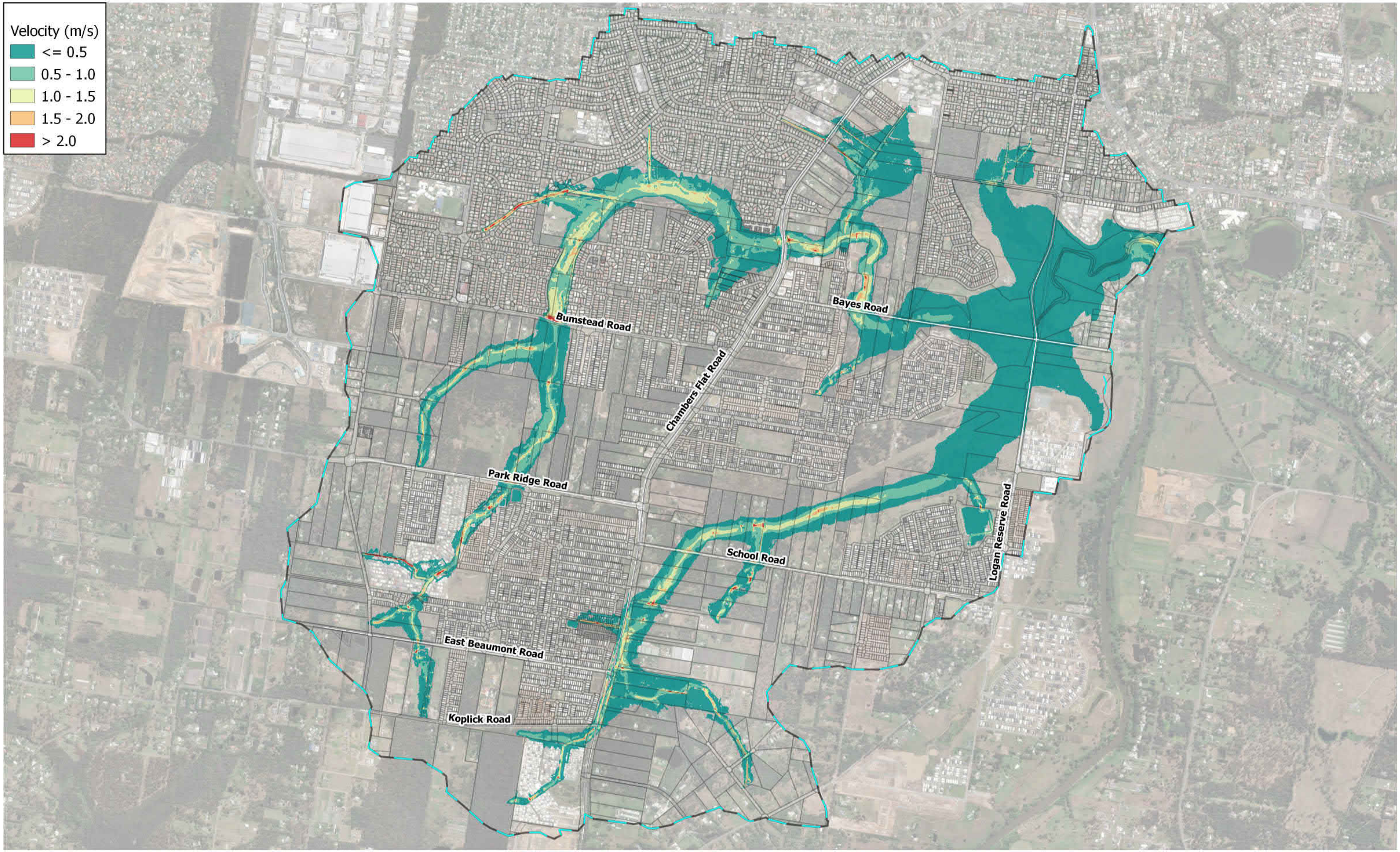
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Velocity - 0.2% AEP

Figure: D28

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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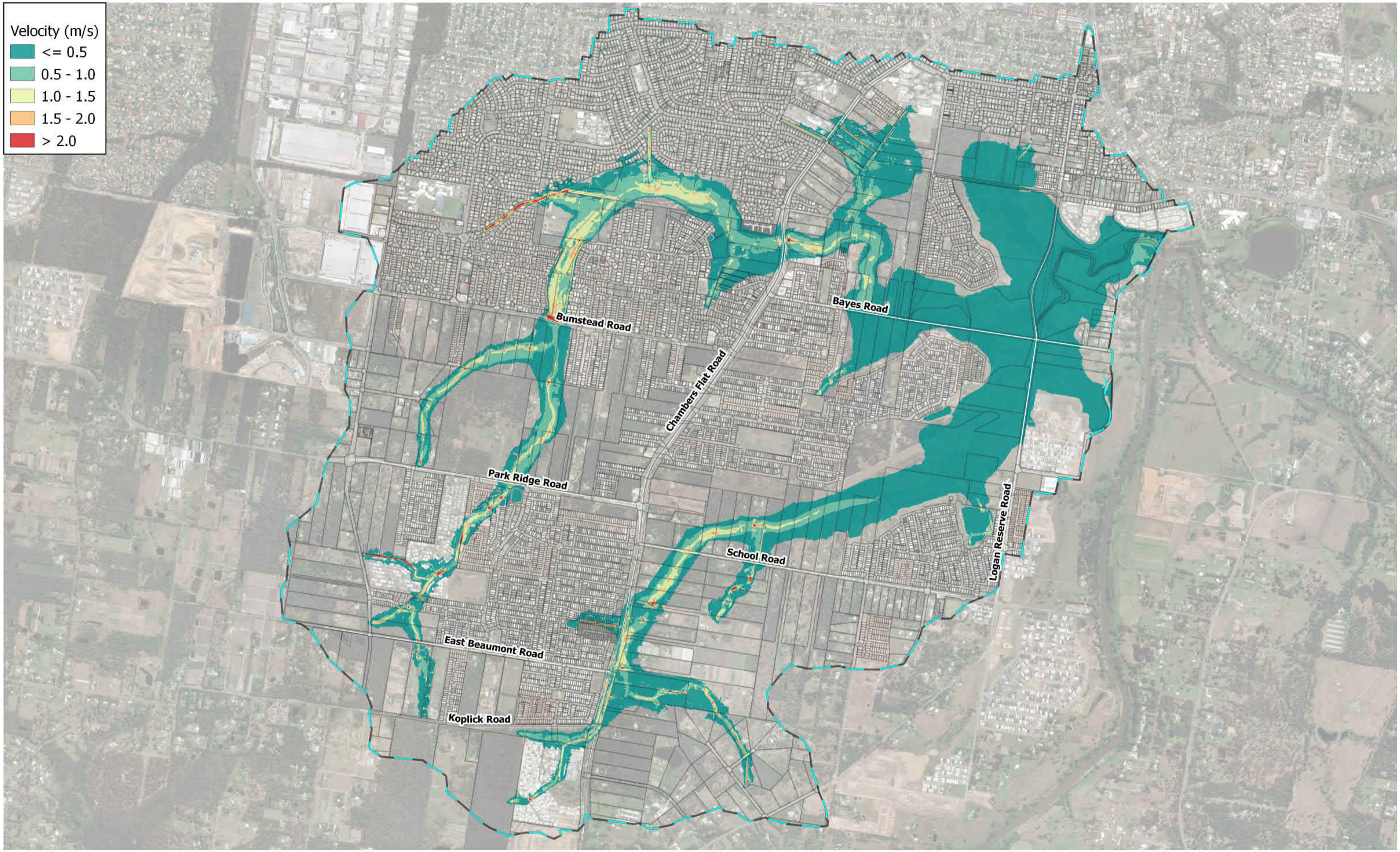
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Velocity - 0.05% AEP

Figure D29

Rev 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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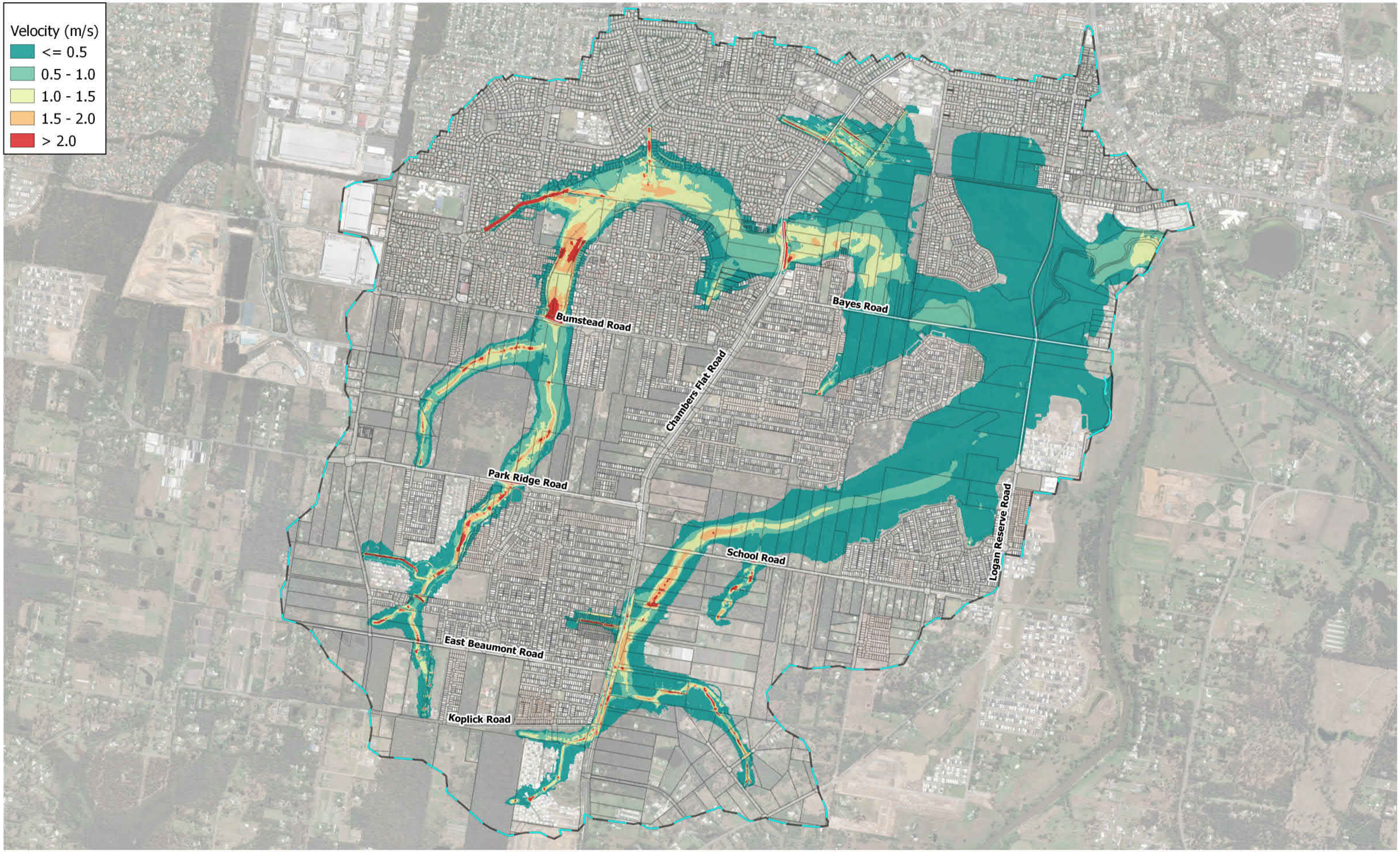
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Velocity - PMP

Figure: D30

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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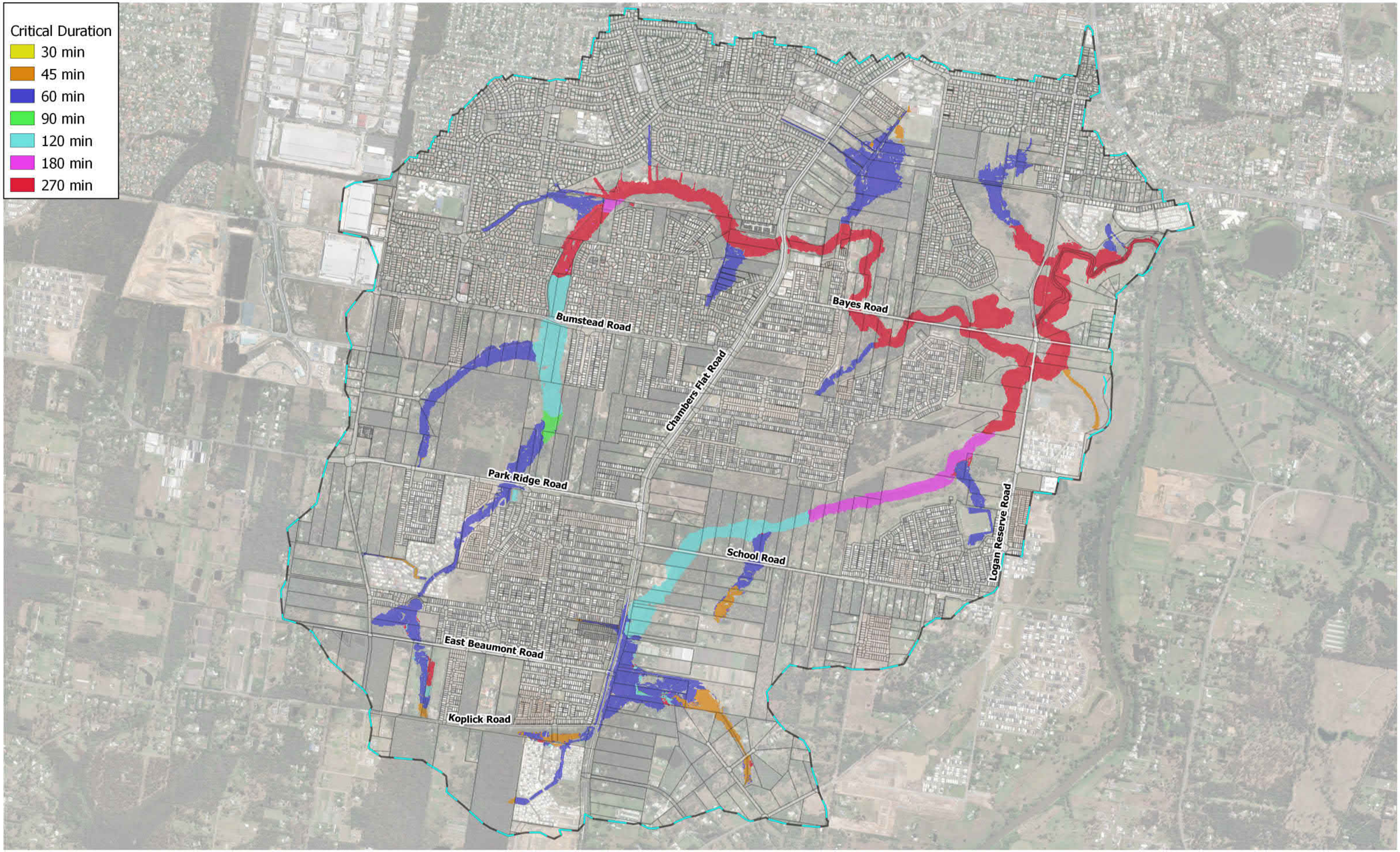
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title:

# Schmidt's Creek Flood Study - Design Event Mapping
# Critical Duration - 50% AEP

Figure: D31

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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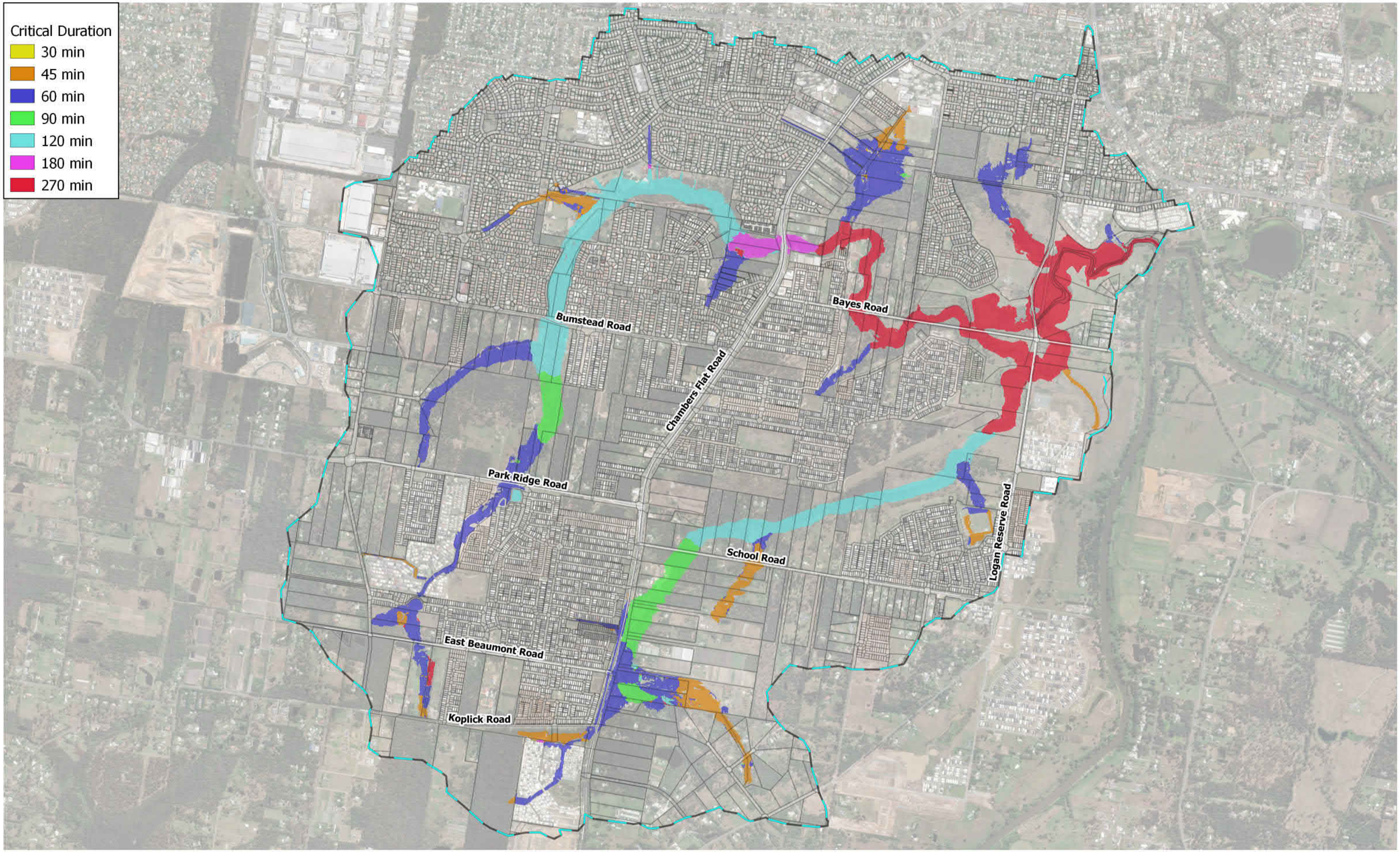
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Critical Duration - 20% AEP

Figure: D32

Rev: 0

Scale at A3 1:21000

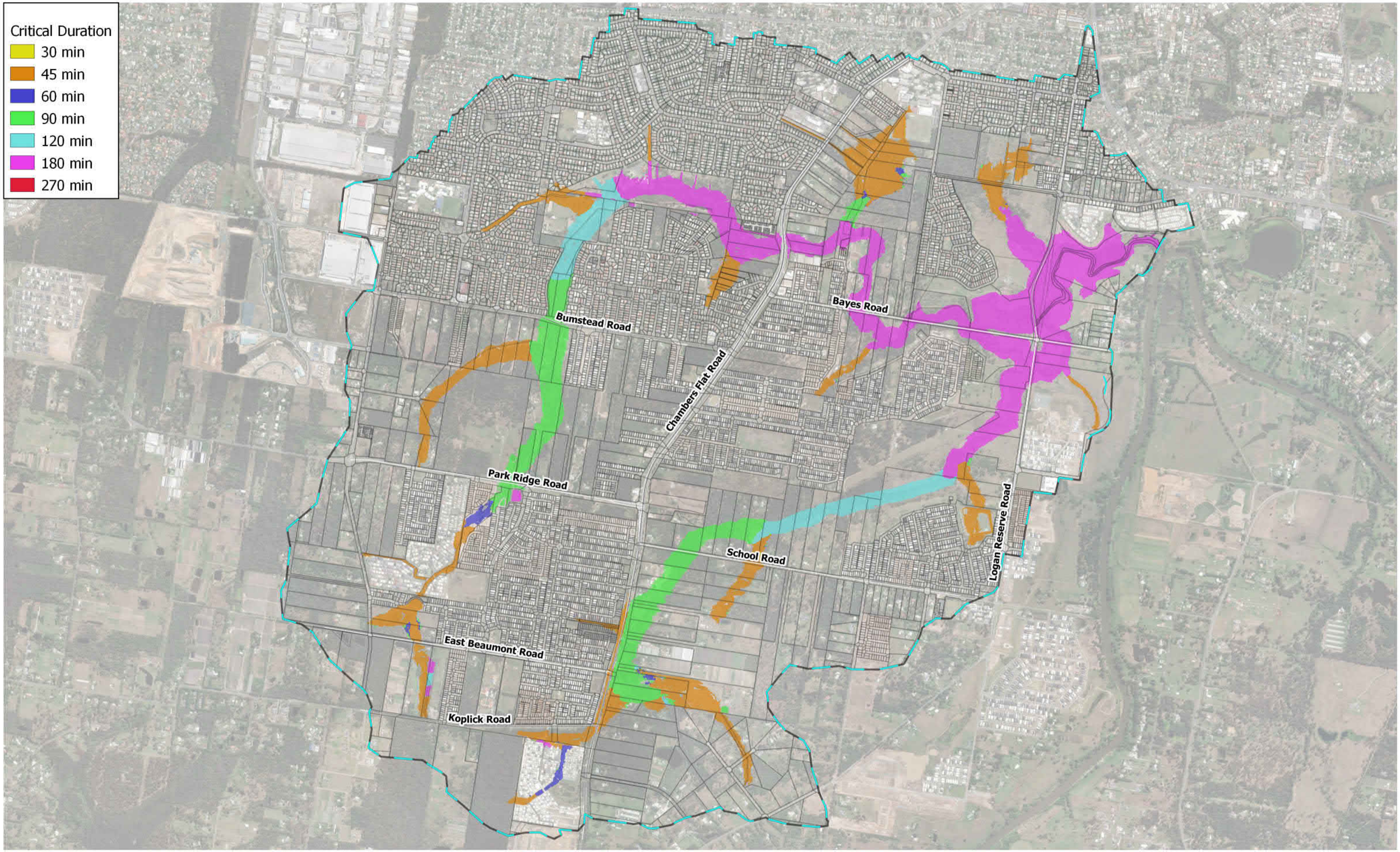


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Critical Duration - 10% AEP**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale

0 200 400 600 800 m

1:21,000

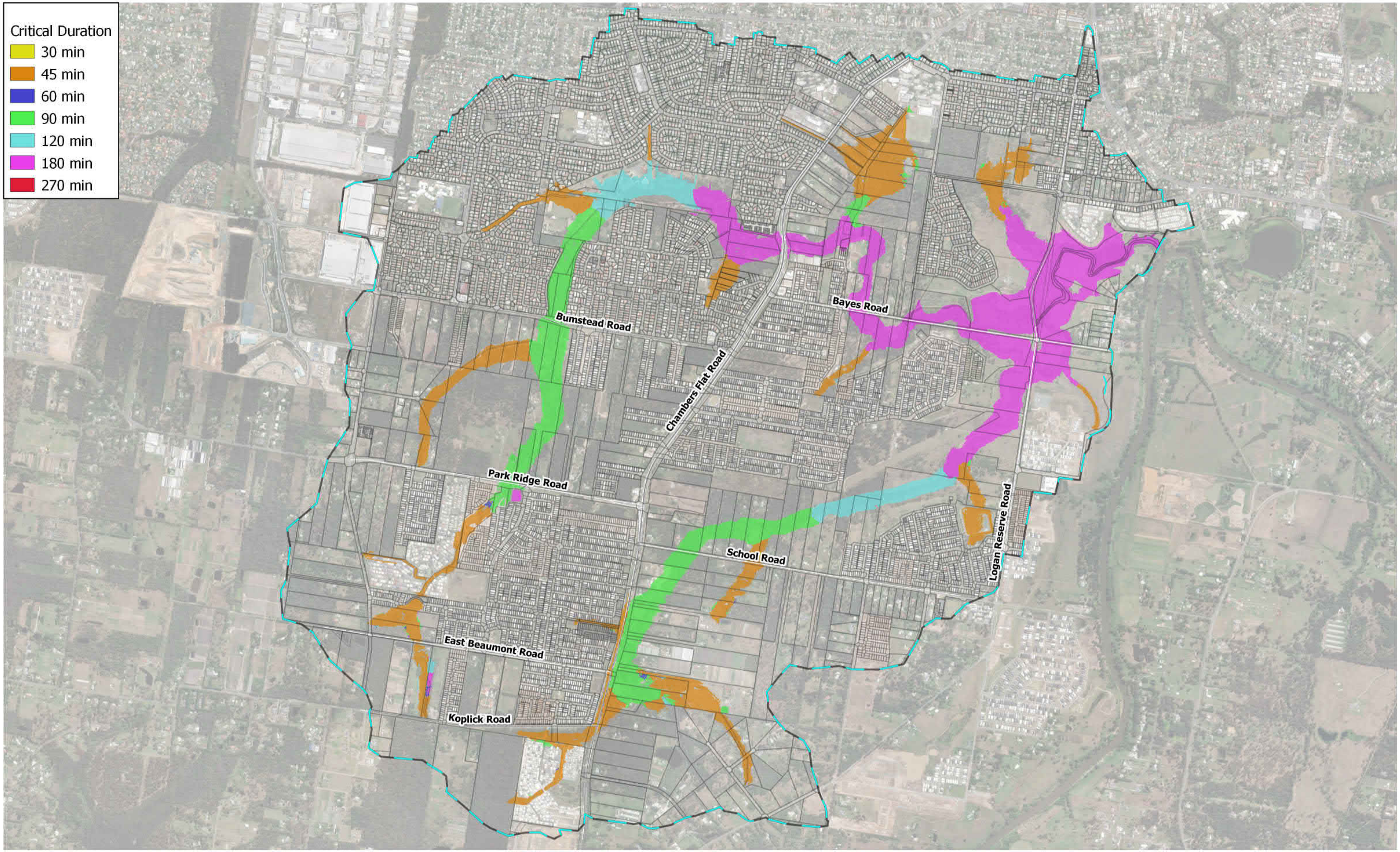
Figure

D33

Rev

0

KBR




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title:

**Schmidt's Creek Flood Study - Design Event Mapping Critical Duration - 5% AEP**

Figure: **D34**

Rev: **0**

Scale at A3 1:21000

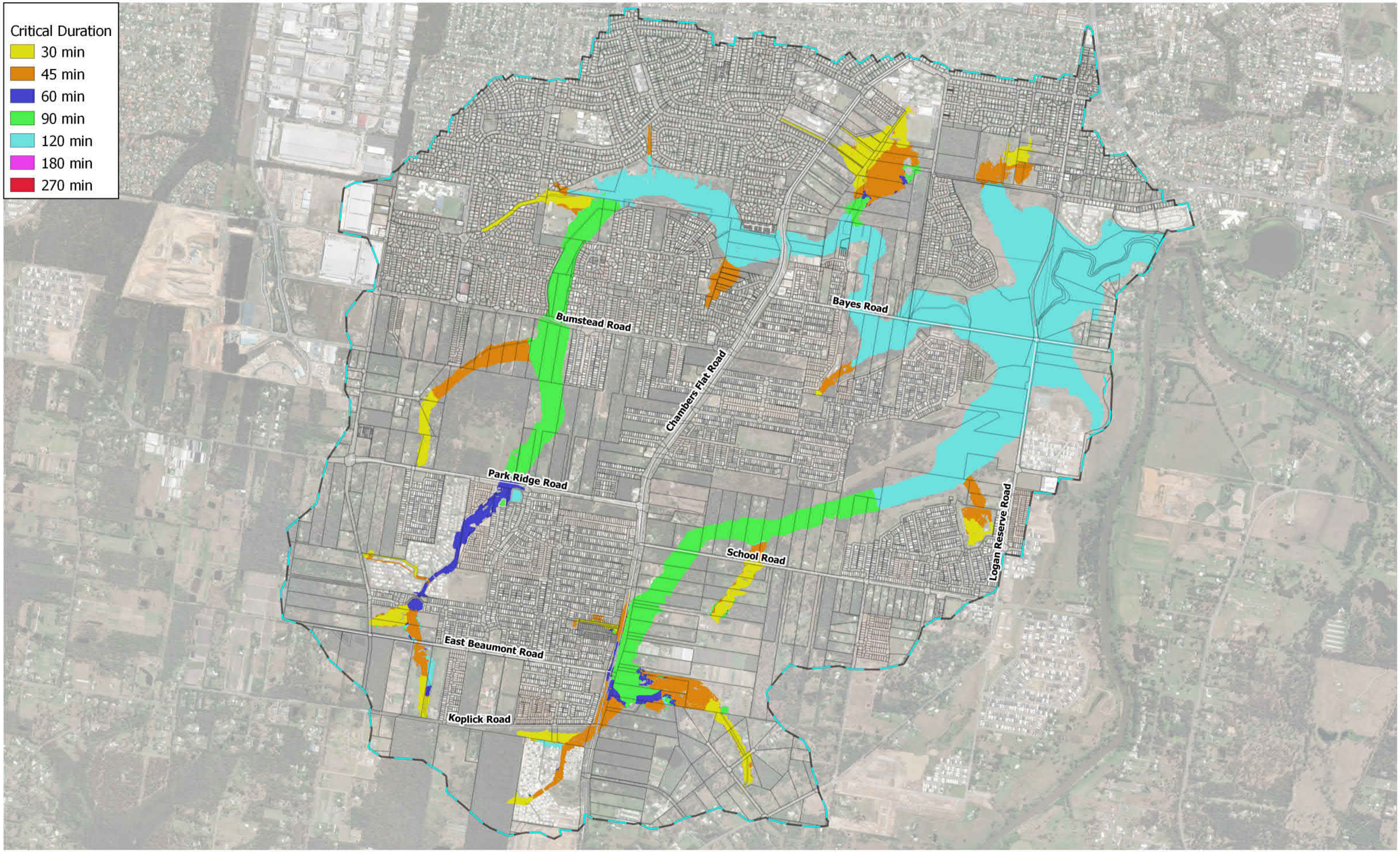


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Critical Duration - 2% AEP

Figure: D35

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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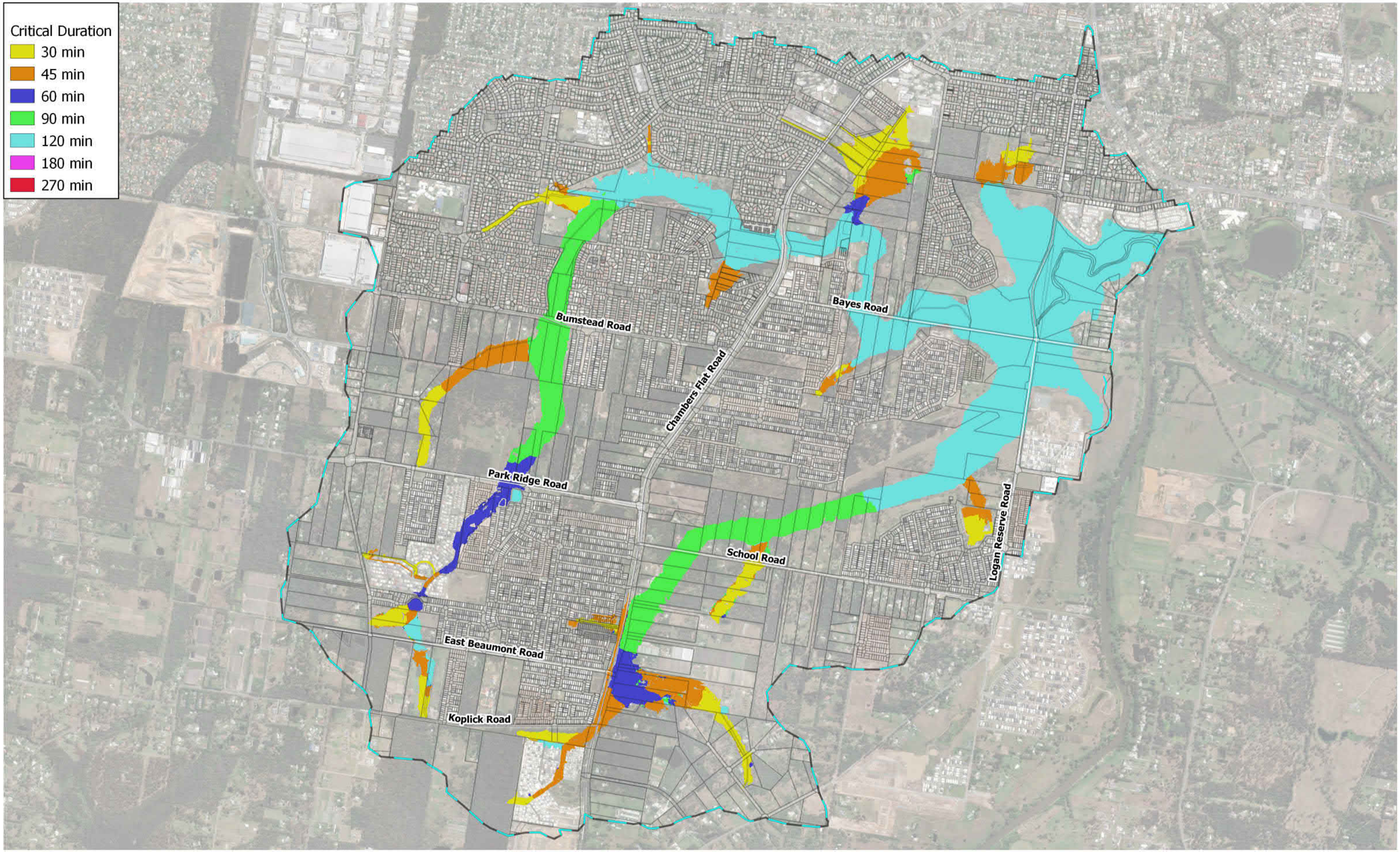


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Critical Duration - 1% AEP

Figure: D36

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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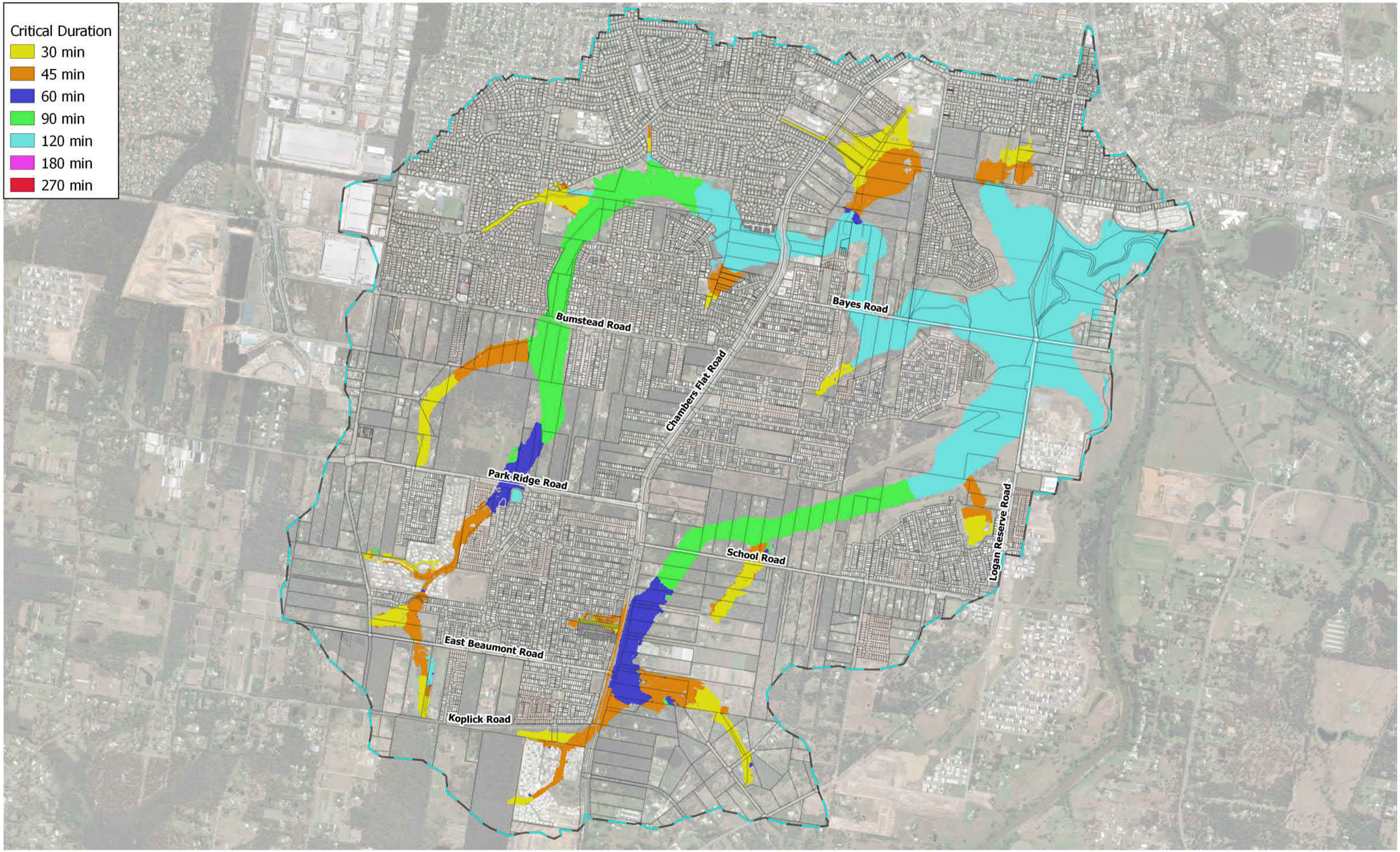


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Critical Duration - 0.5% AEP

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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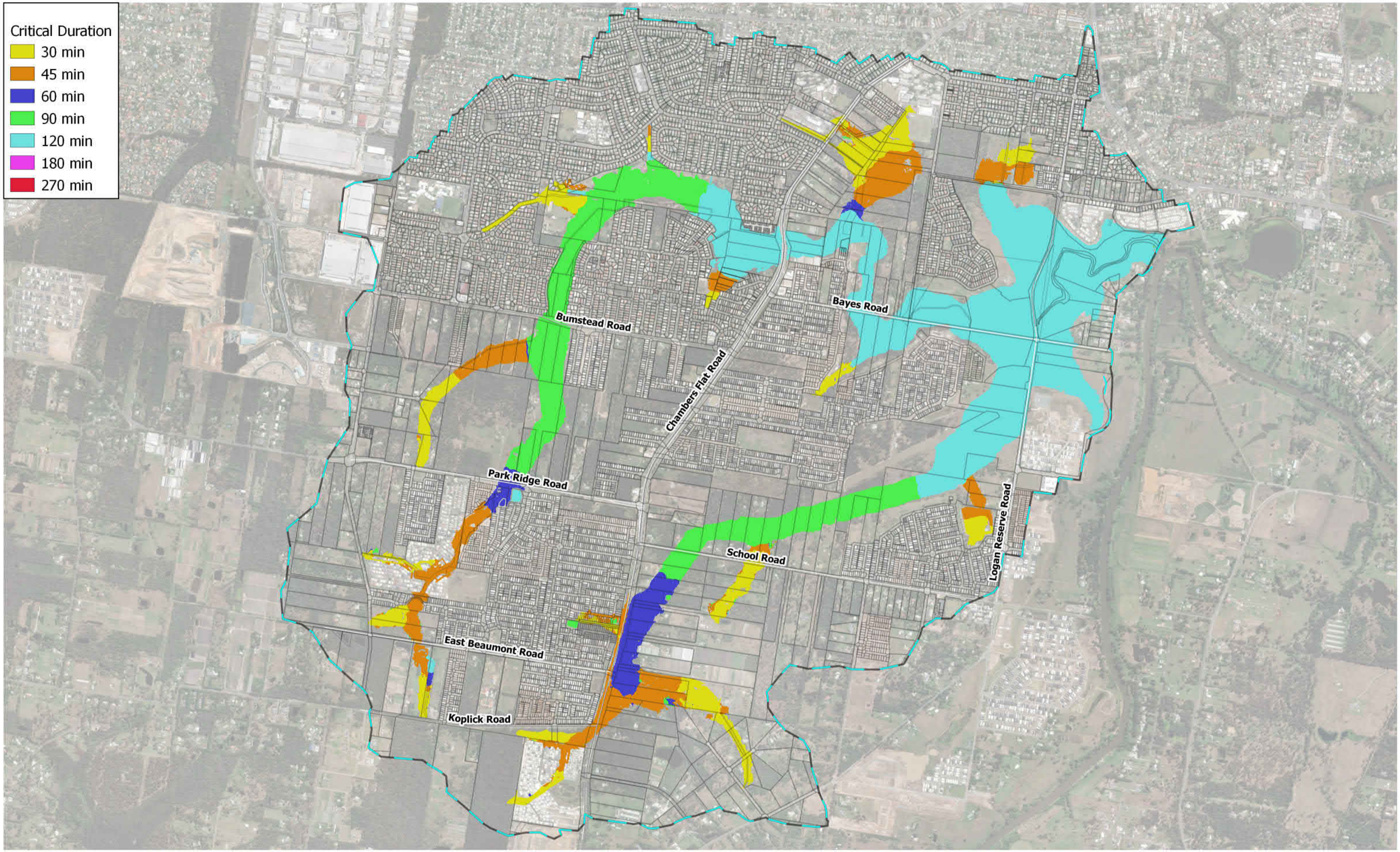
1:21,000

Figure

D37

Rev

0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title:

# Schmidt's Creek Flood Study - Design Event Mapping Critical Duration - 0.2% AEP

Figure: **D38**

Rev: **0**

Scale at A3 1:21000

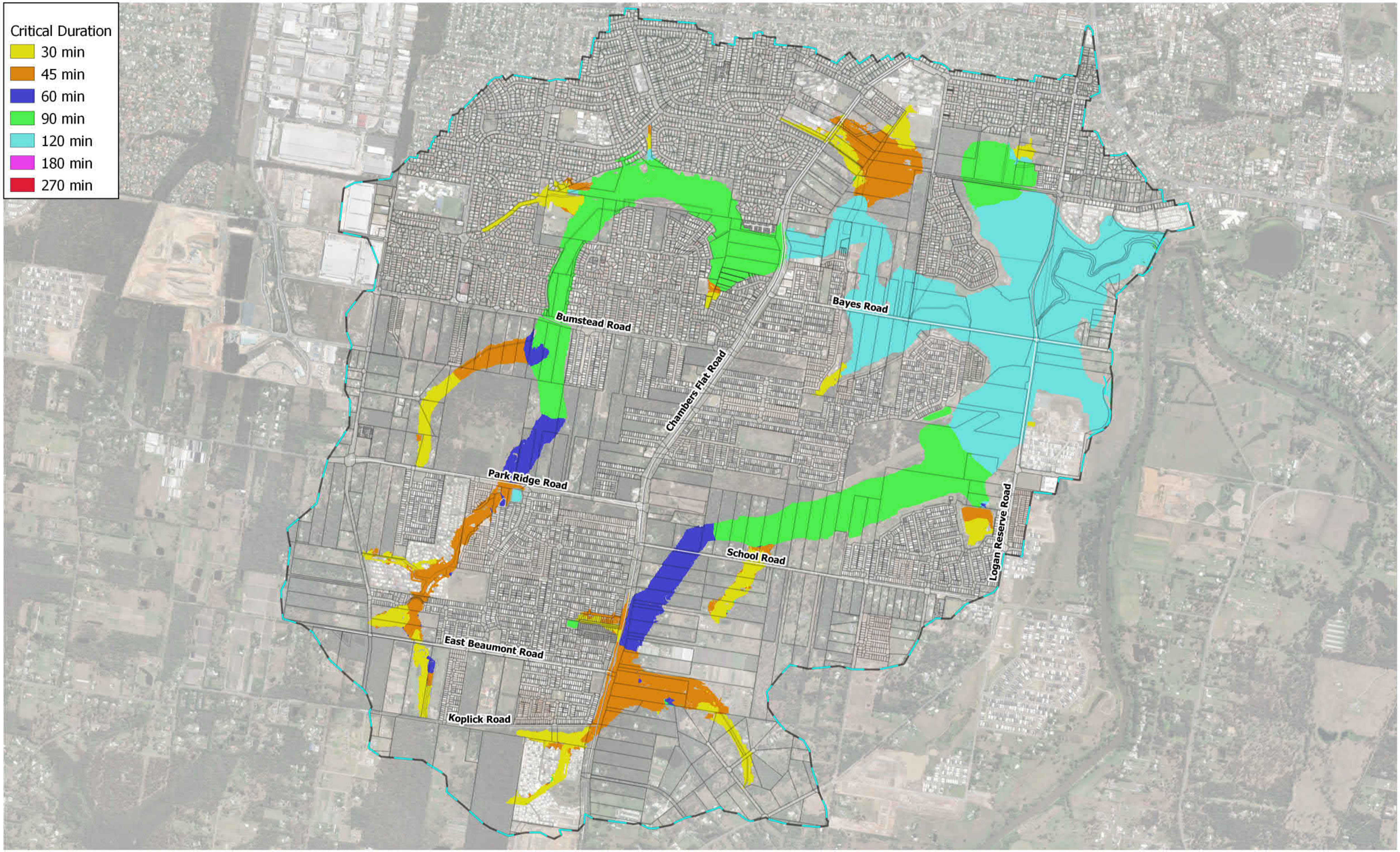

File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000

KBR




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Critical Duration - 0.05% AEP

Figure: D39

Rev: 0

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

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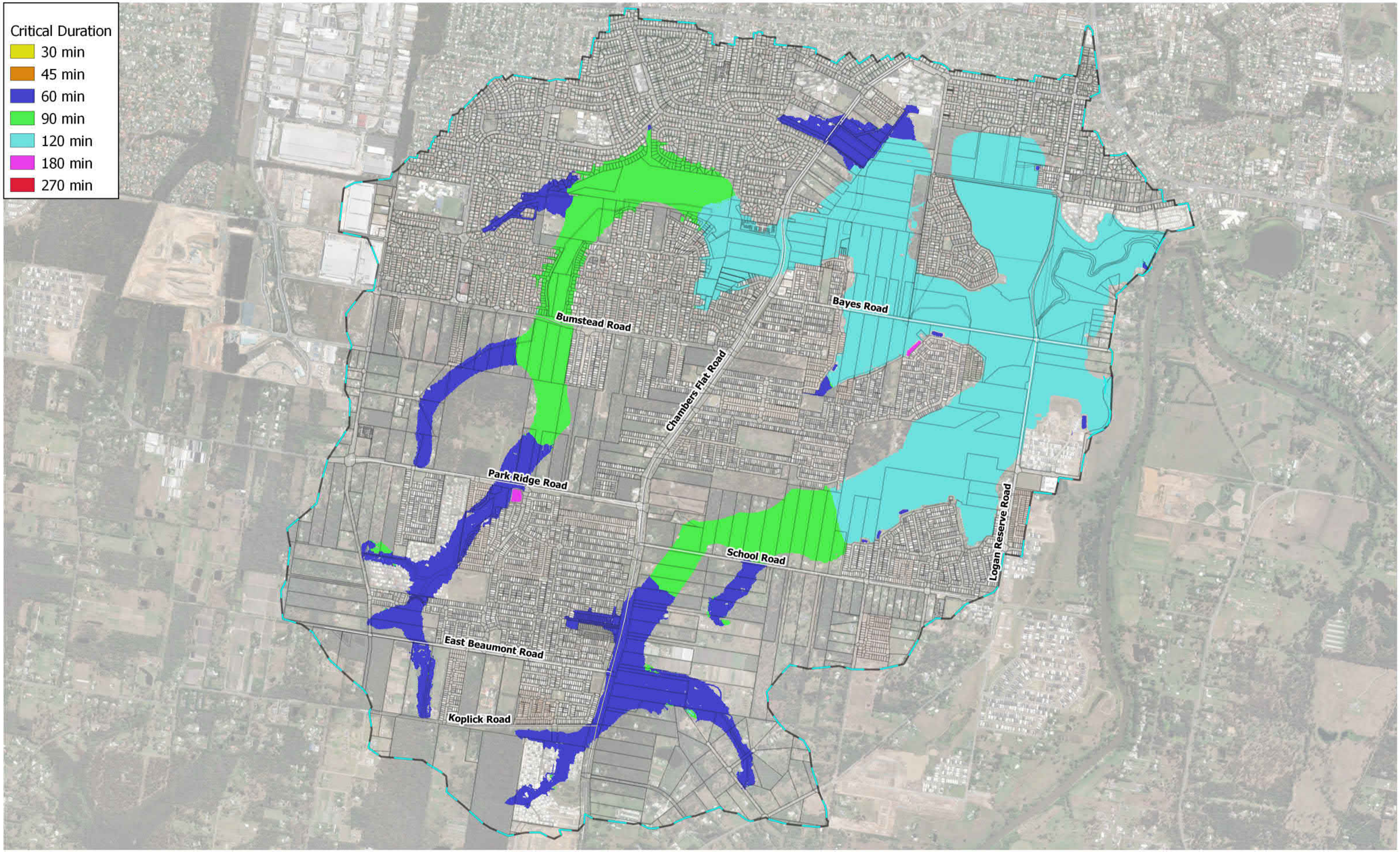


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Critical Duration - PMP

Figure: **D40**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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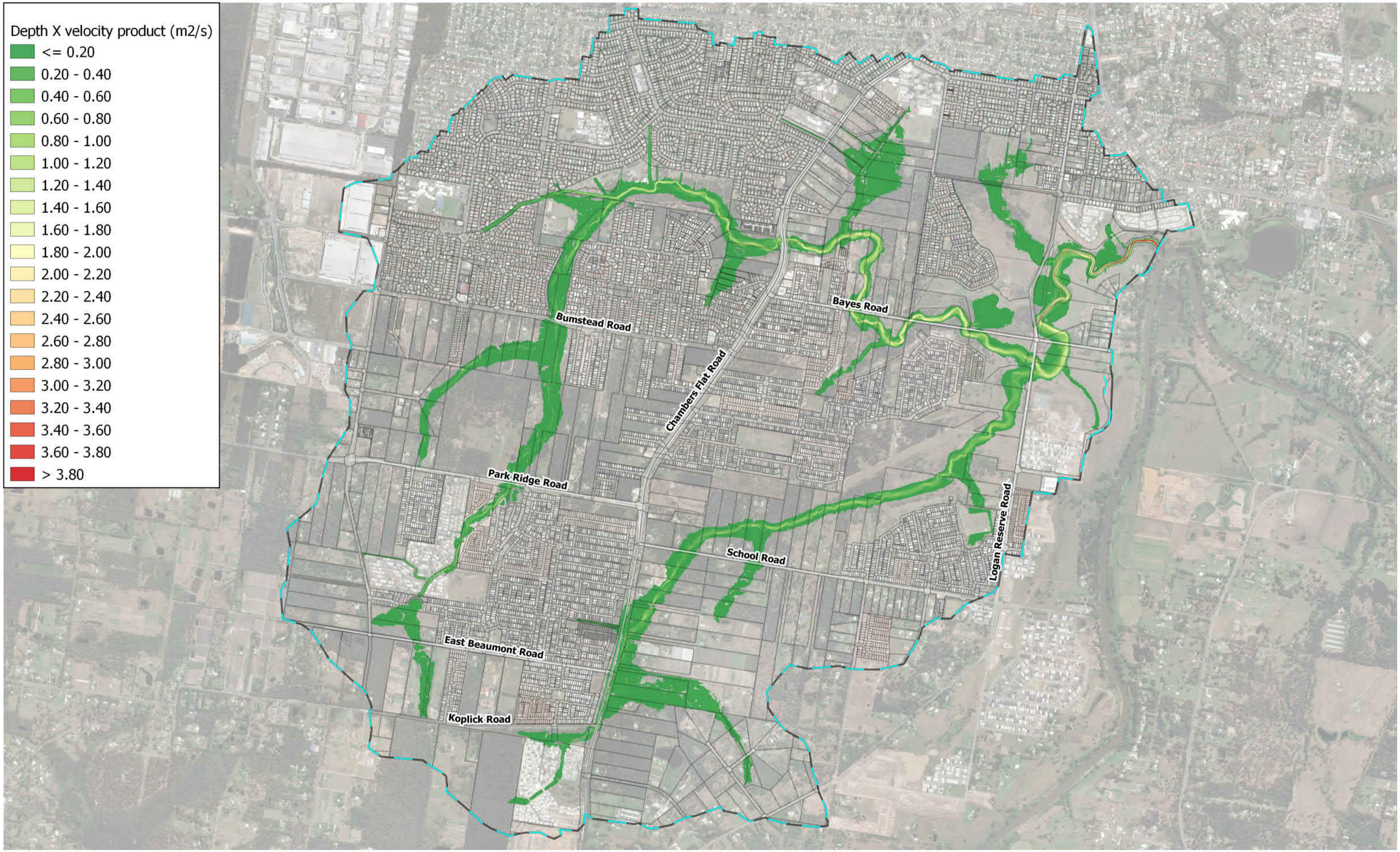


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (D x V) - 50% AEP**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000

Figure

D41

Rev

0


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (D x V) - 20% AEP**

Figure **D42** | Rev **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FSG - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:
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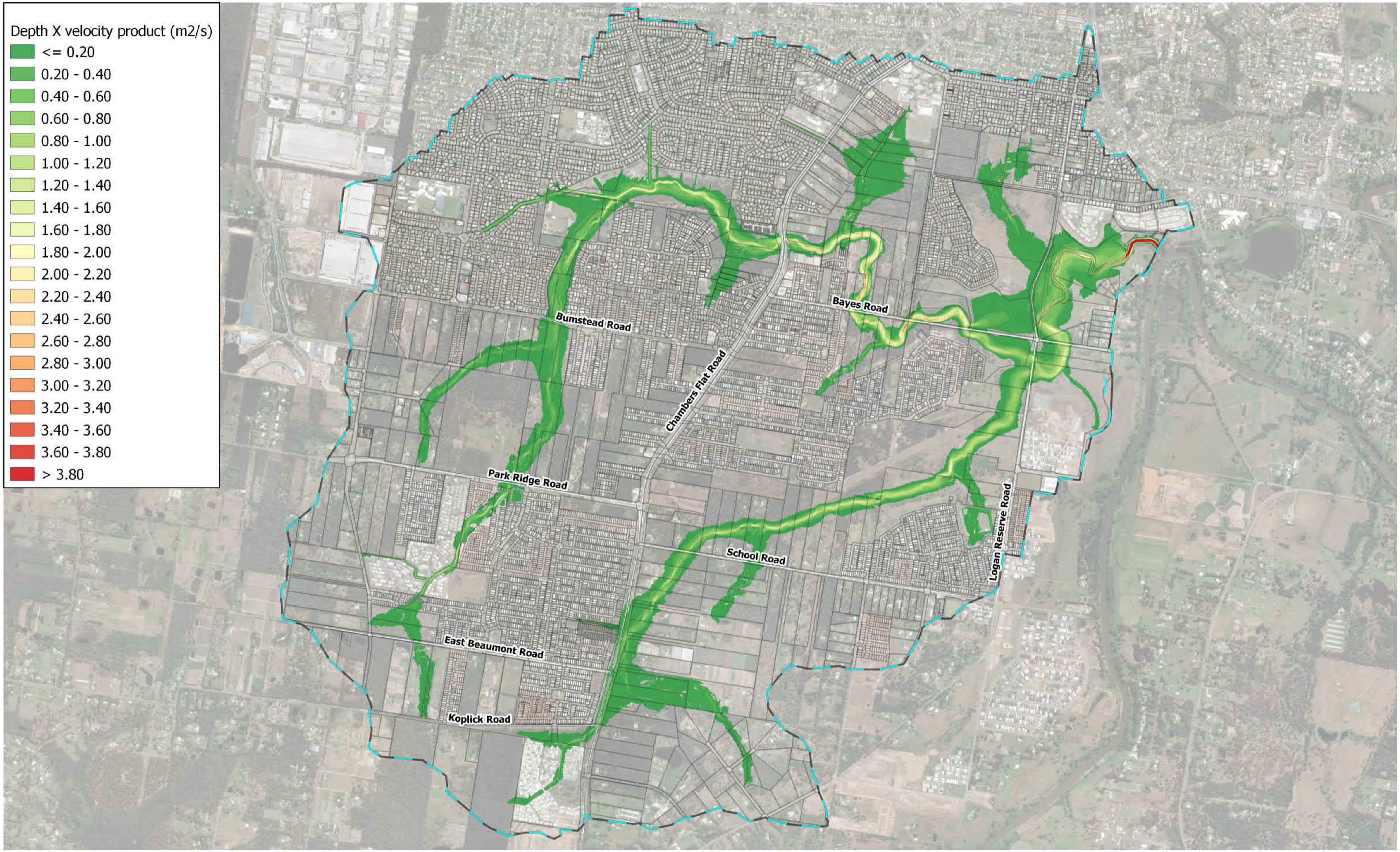
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt’s Creek Flood Study - Design Event Mapping**
**Flood Hazard (D x V) - 10% AEP**

Figure **D43**

Rev **0**

Scale at A3 1:21000
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Scale:

0 200 400 600 800 m

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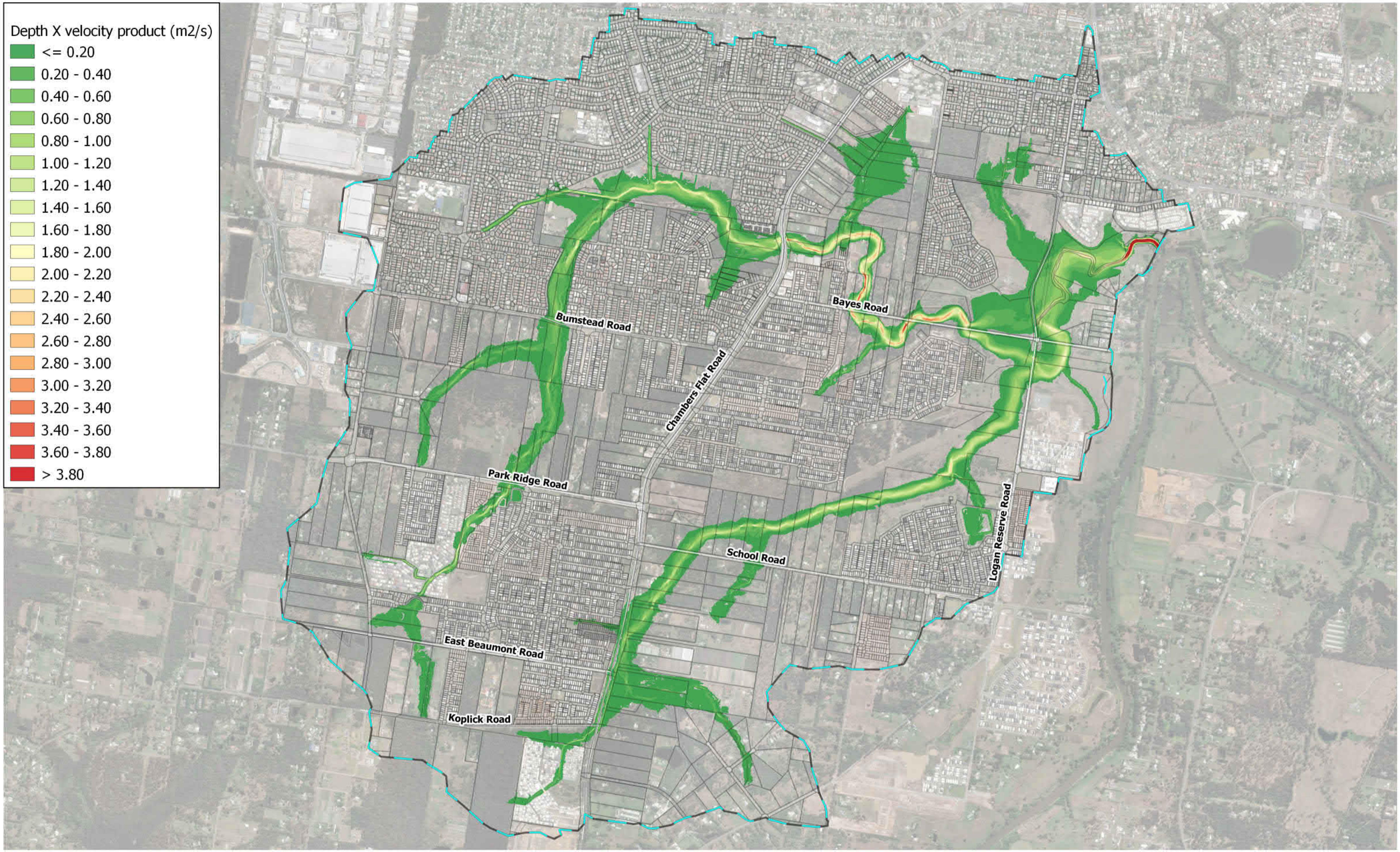



**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt’s Creek Flood Study - Design Event Mapping
# Flood Hazard (D x V) - 5% AEP

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

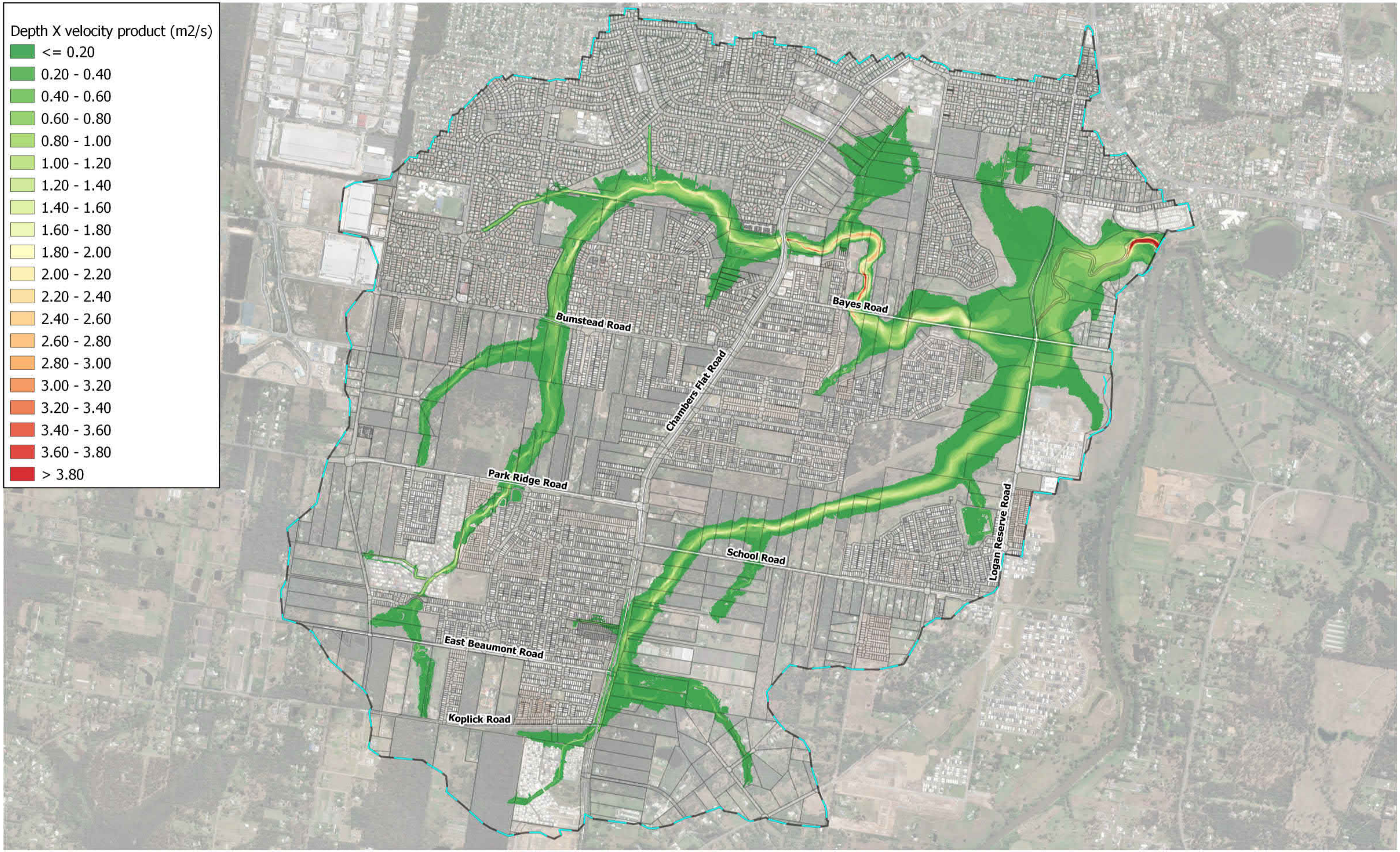
Scale

0 200 400 600 800 m

1:21,000

Figure D44

Rev 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Hazard (D x V) - 2% AEP

Scale at A3 1:21000
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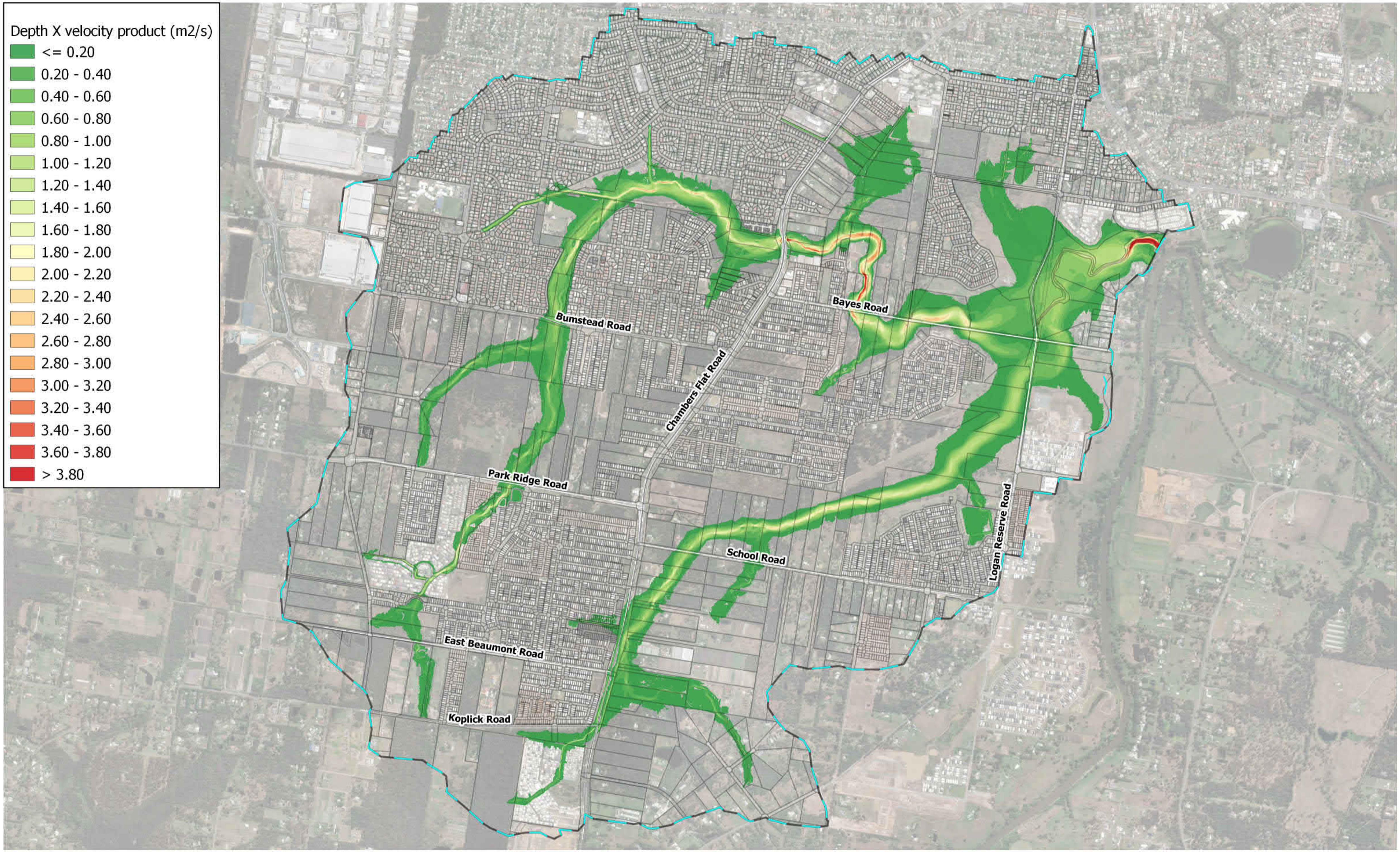
Scale:

0 200 400 600 800 m

1:21,000

Figure D45

Rev 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (D x V) - 1% AEP**

Scale at A3 1:21000
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Scale

0 200 400 600 800 m

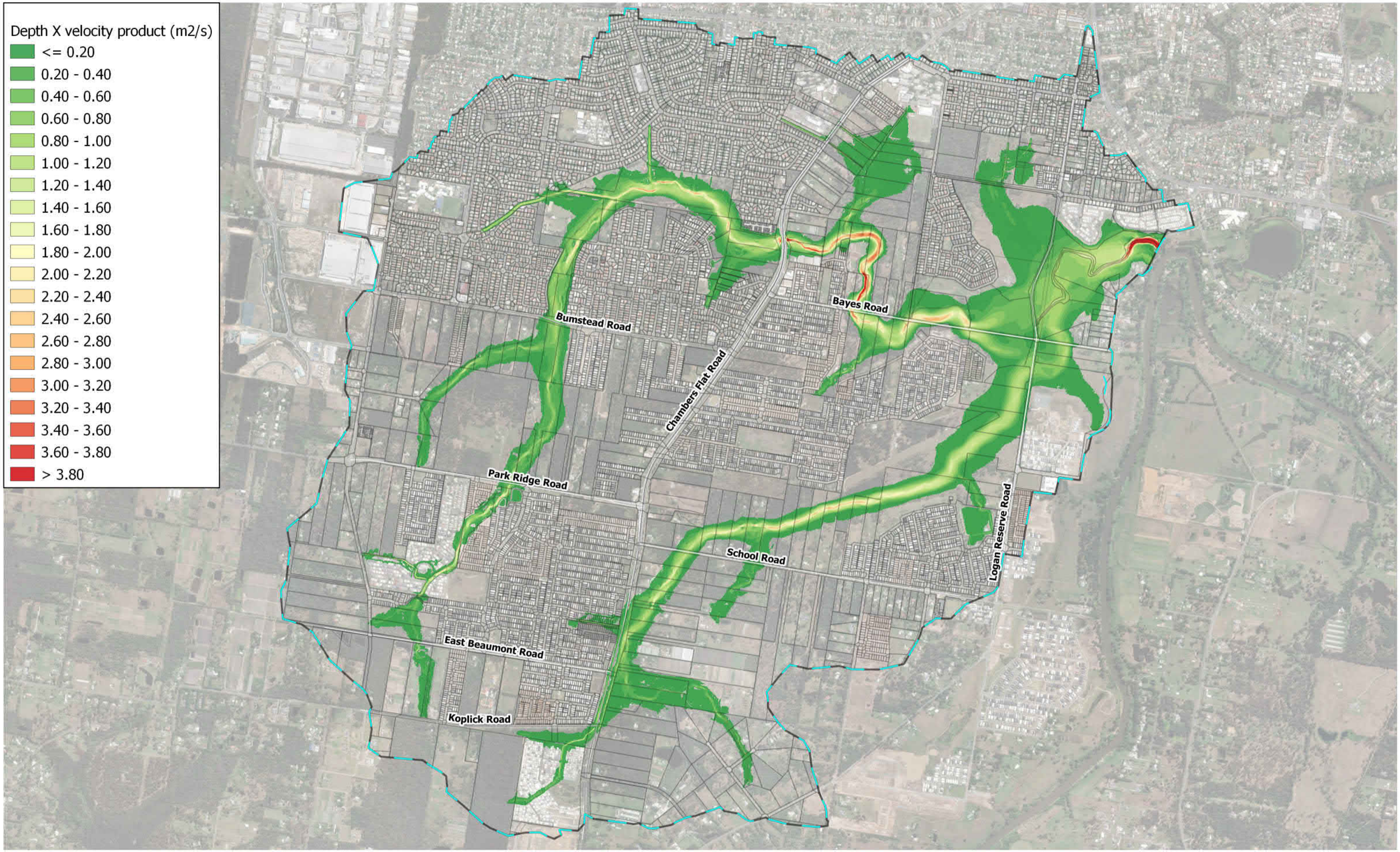
1:21,000

Figure

D46

Rev

0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Hazard (D x V) - 0.5% AEP

Figure: D47

Rev: 0

Scale at A3 1:21000

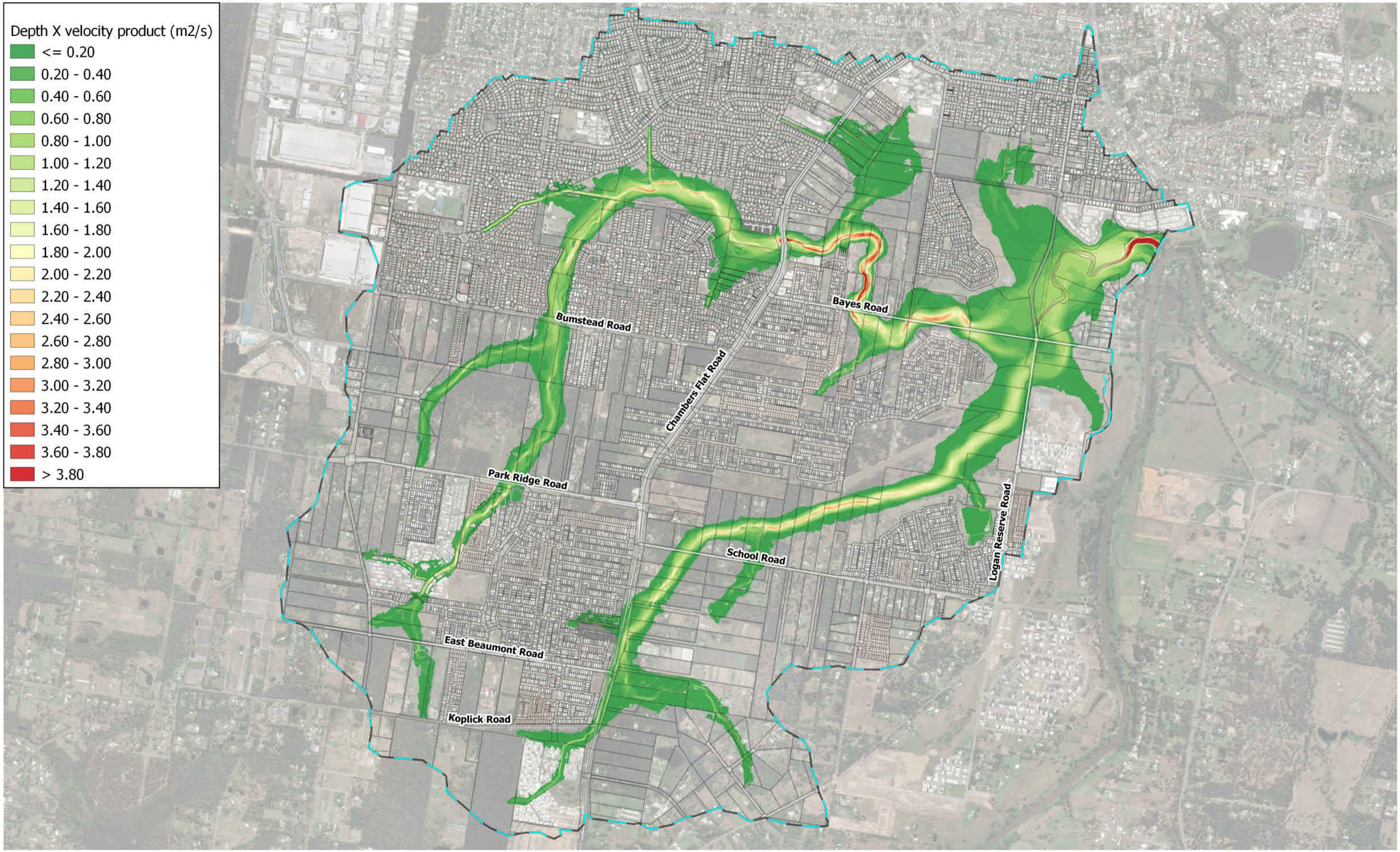


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (D x V) - 0.2% AEP**

Figure **D48**

Rev **0**

Scale at A3 1:21000

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Scale:

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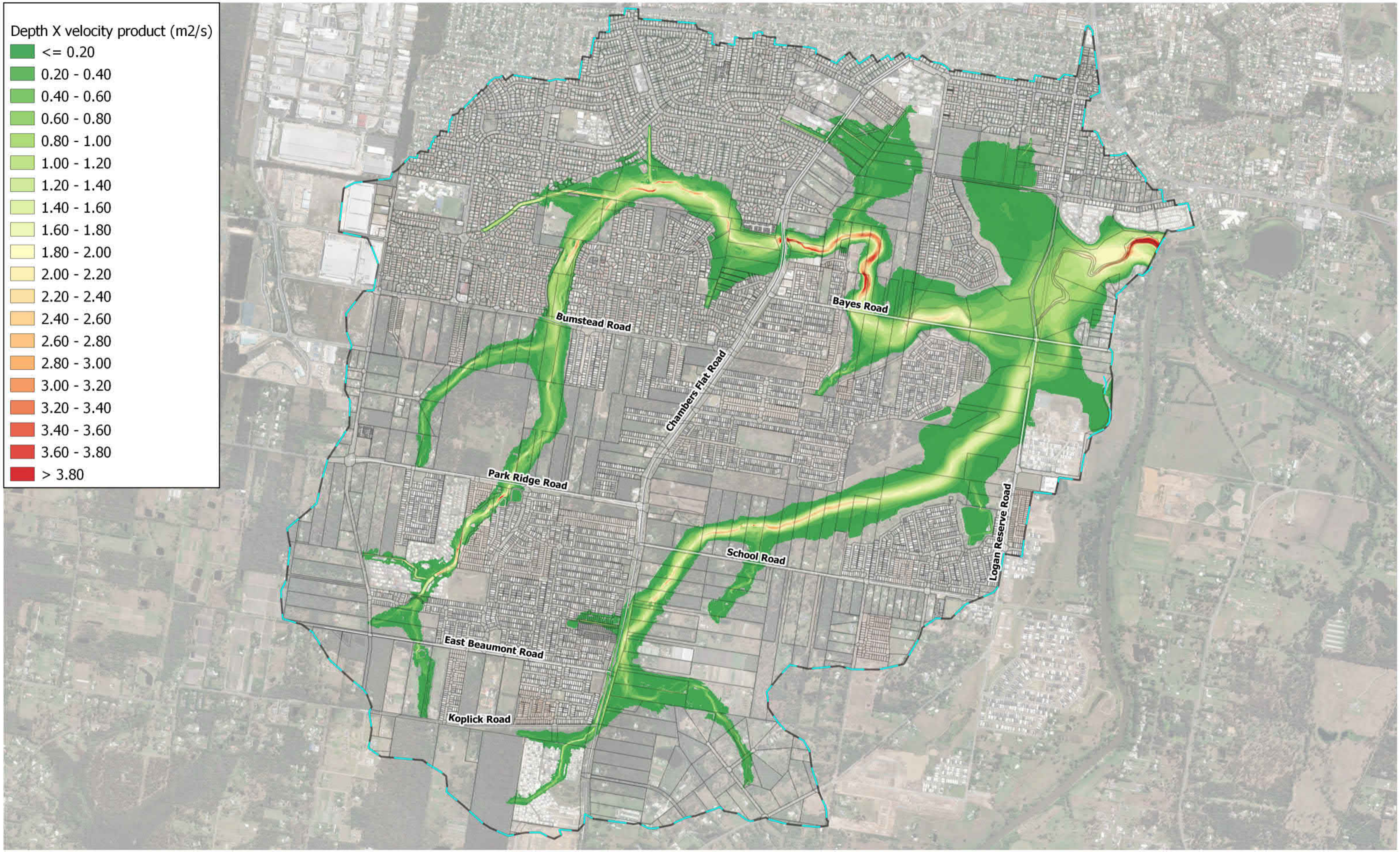



**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Hazard (D x V) - 0.05% AEP

Figure: **D49**

Rev: **0**

Scale at A3 1:21000

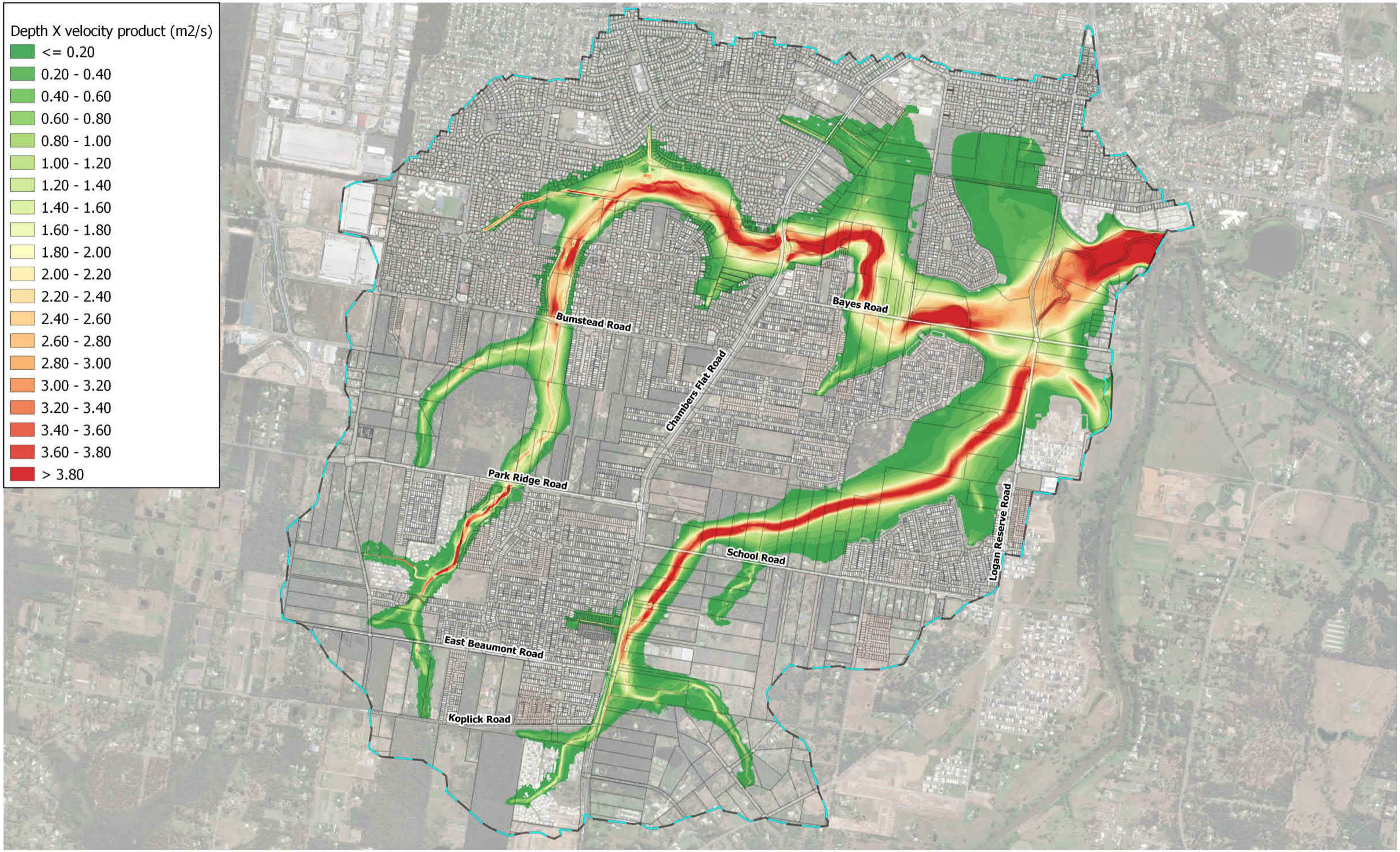


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wig\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

## Schmidt's Creek Flood Study - Design Event Mapping
## Flood Hazard (D x V) - PMP

Scale at A3 1:21000

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File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

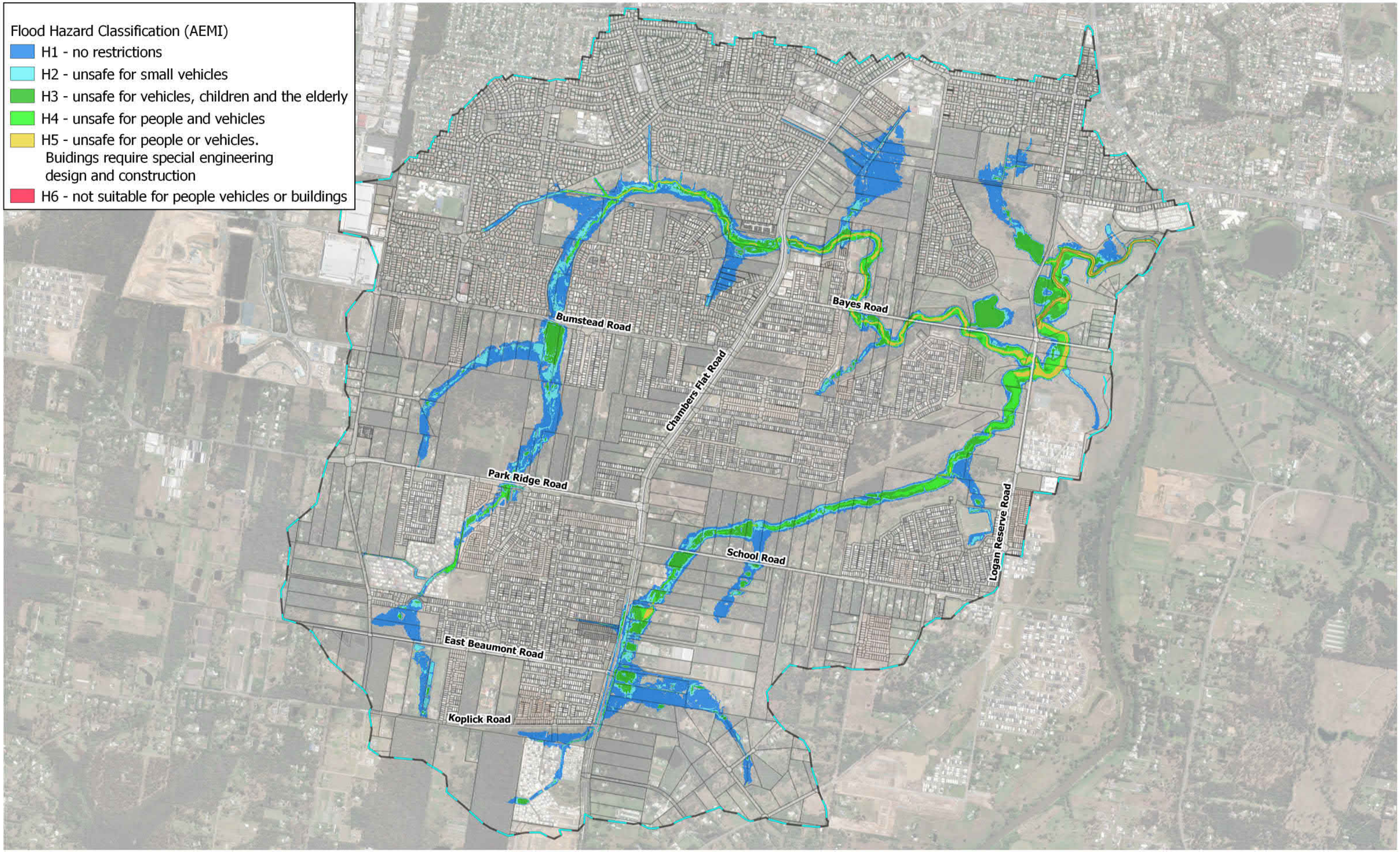
1:21,000

Figure

D50

Rev

0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt’s Creek Flood Study - Design Event Mapping
# Flood Hazard (ZAEM1) - 50% AEP

Figure D51

Rev 0

Scale at A3 1:21000
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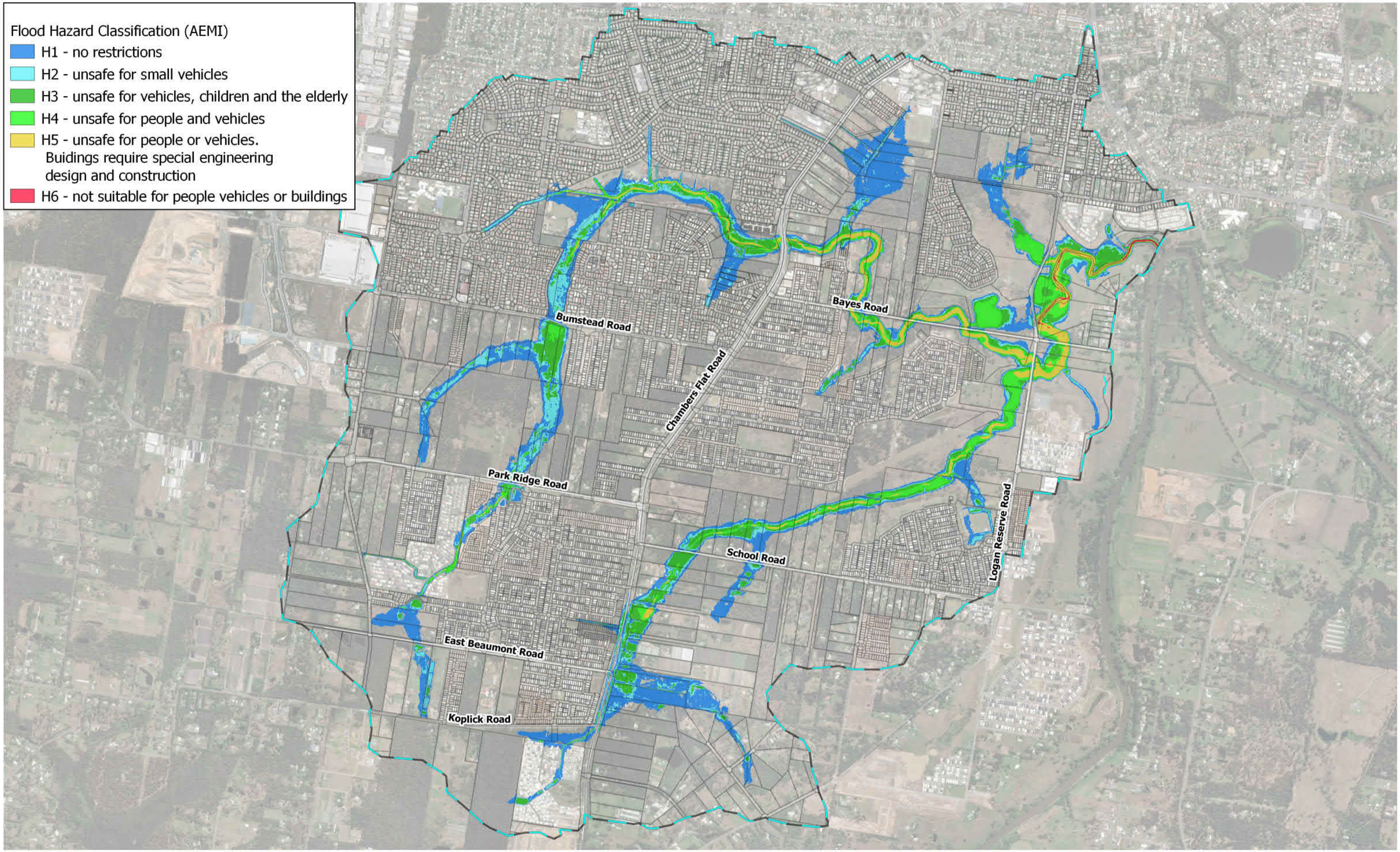
Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (ZAEM1) - 20% AEP**

Scale at A3 1:21000
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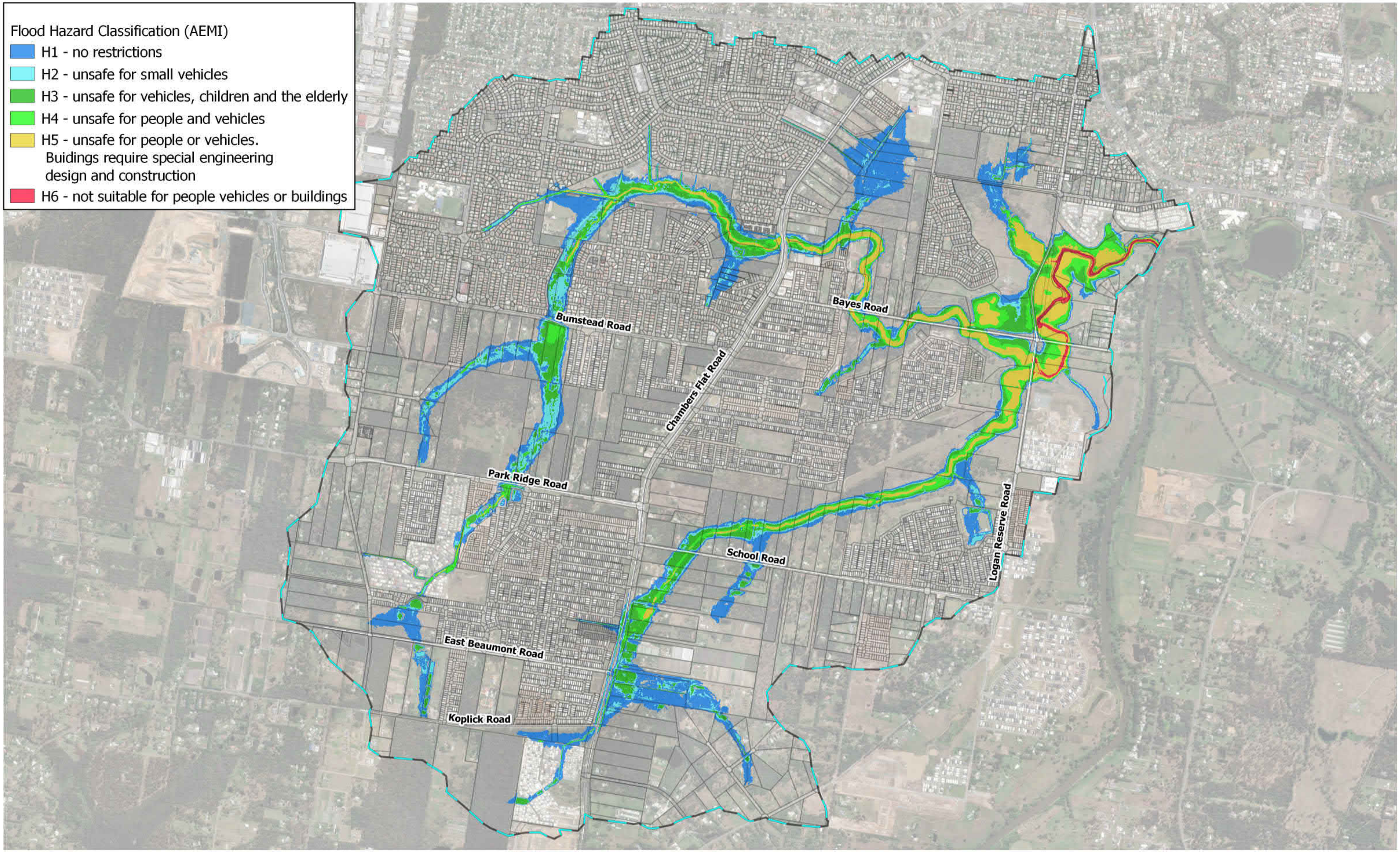
Scale:

0 200 400 600 800 m

1:21,000

Figure: D52

Rev: 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (ZAEM1) - 10% AEP**

Figure: **D53**

Rev: **0**

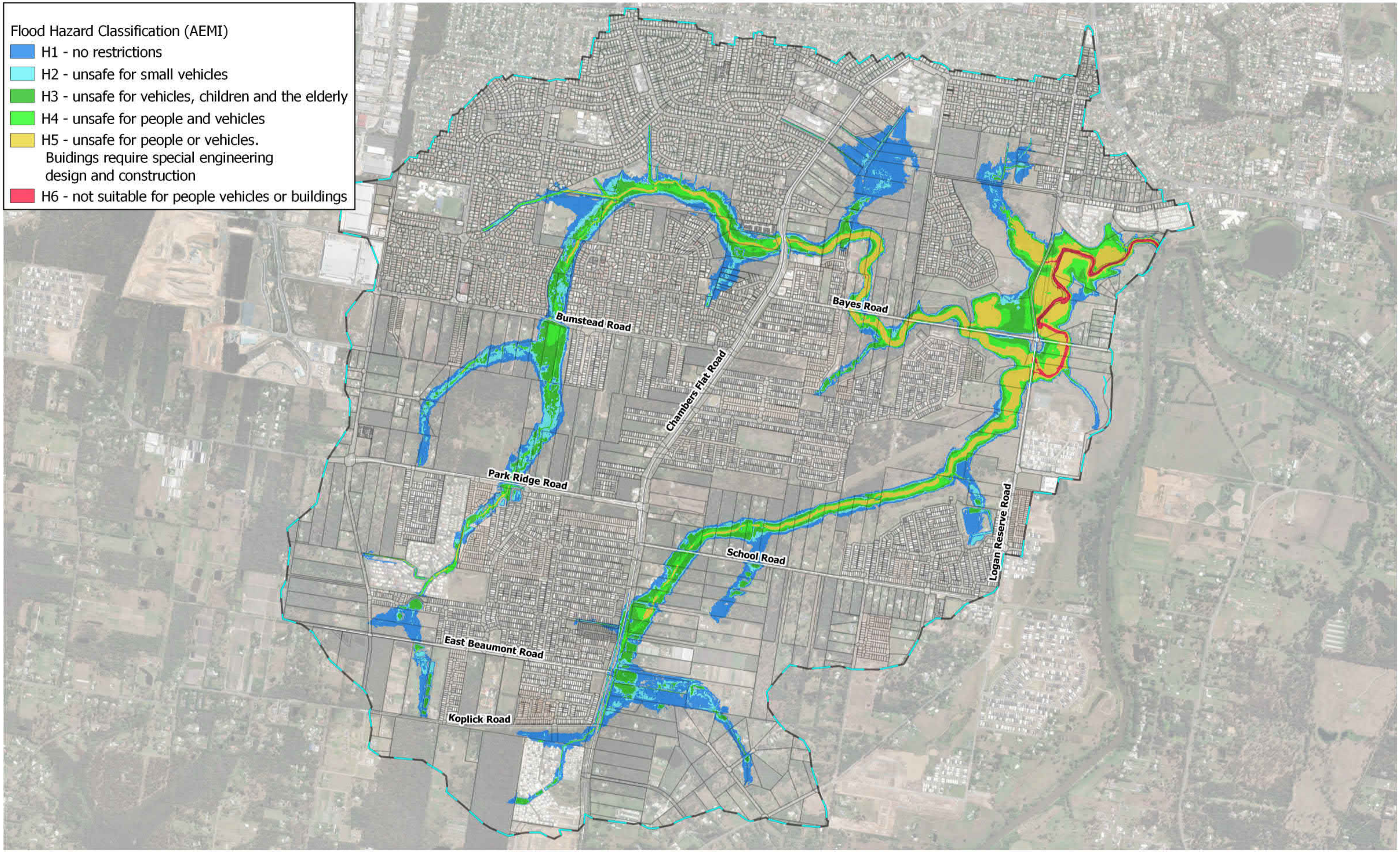
Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Hazard (ZAEM1) - 5% AEP

Scale at A3 1:21000
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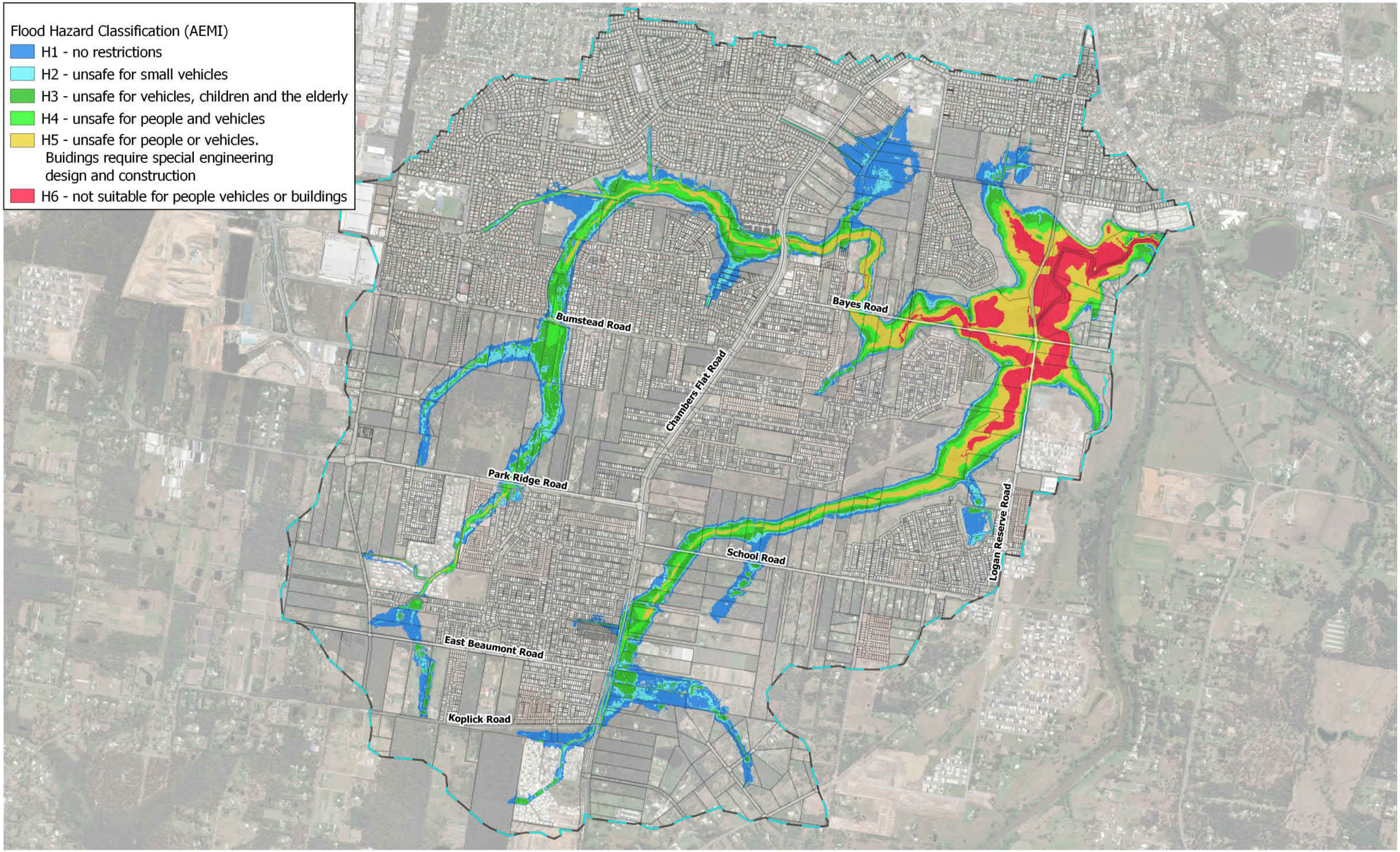
Scale

0 200 400 600 800 m

1:21,000

Figure D54

Rev 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Hazard (ZAEM1) - 2% AEP

Figure D55

Rev 0

Scale at A3 1:21000
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Scale:

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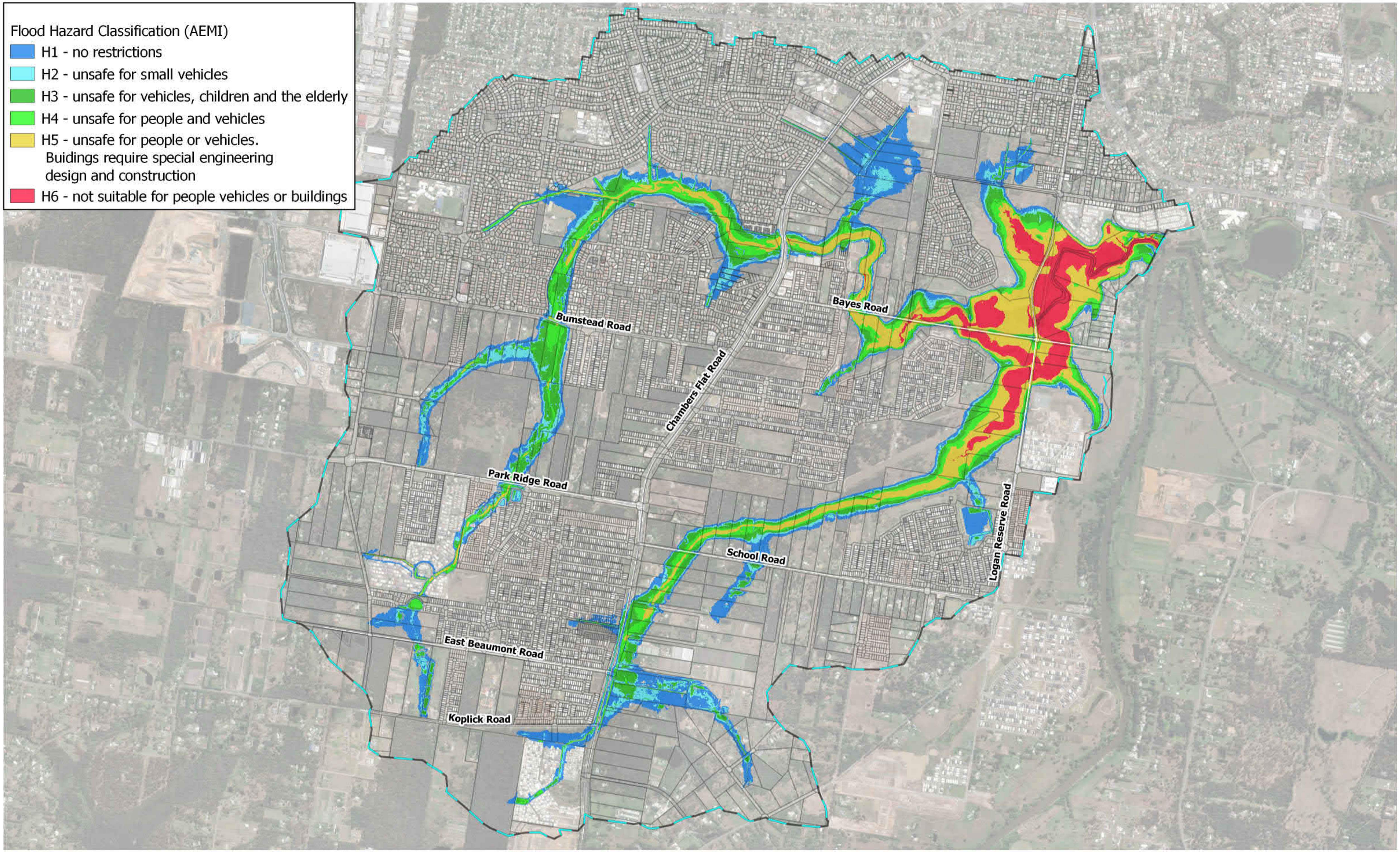
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Hazard (ZAEM1) - 1% AEP

Figure: D56

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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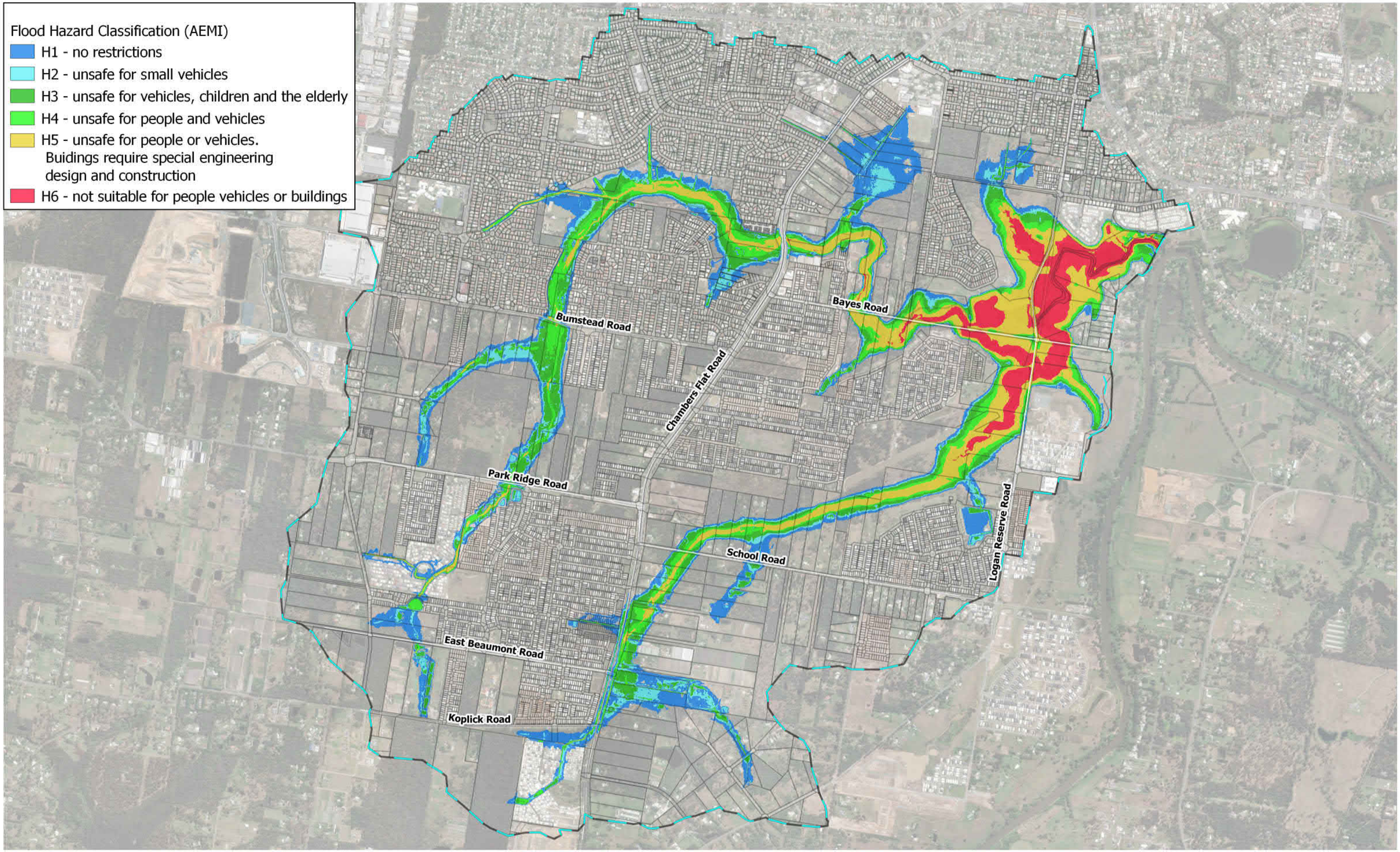
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Hazard (ZAEM1) - 0.5% AEP

Figure: D57

Rev: 0

Scale at A3 1:21000

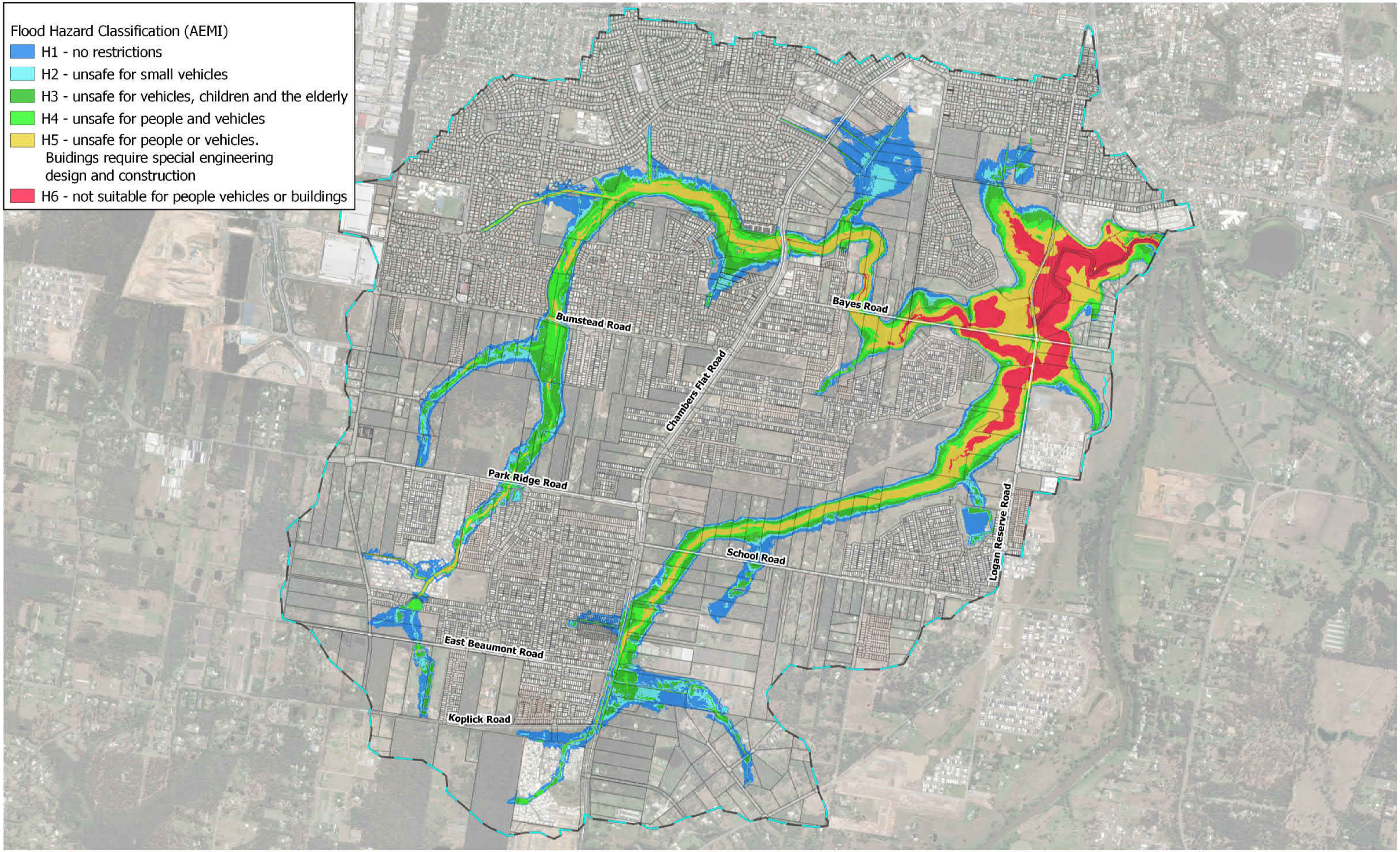


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (ZAEM1) - 0.2% AEP**

Figure: D58 | Rev: 0

Scale at A3 1:21000
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Scale: 0 200 400 600 800 m

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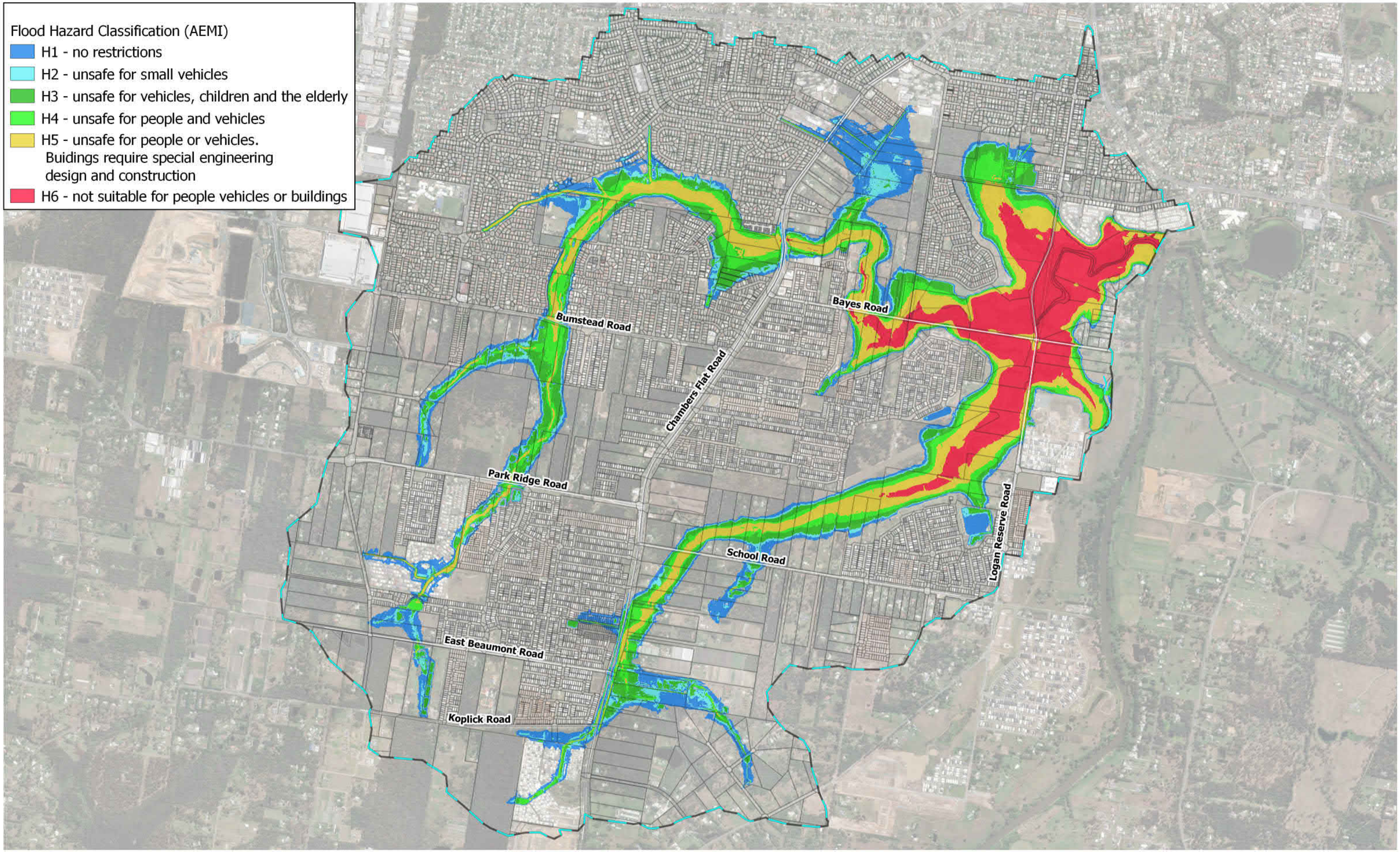



**LEGEND**

Cadastre
TUFLOW model extent
Catchment boundary

Title
## Schmidt's Creek Flood Study - Design Event Mapping
## Flood Hazard (ZAEM1) - 0.05% AEP

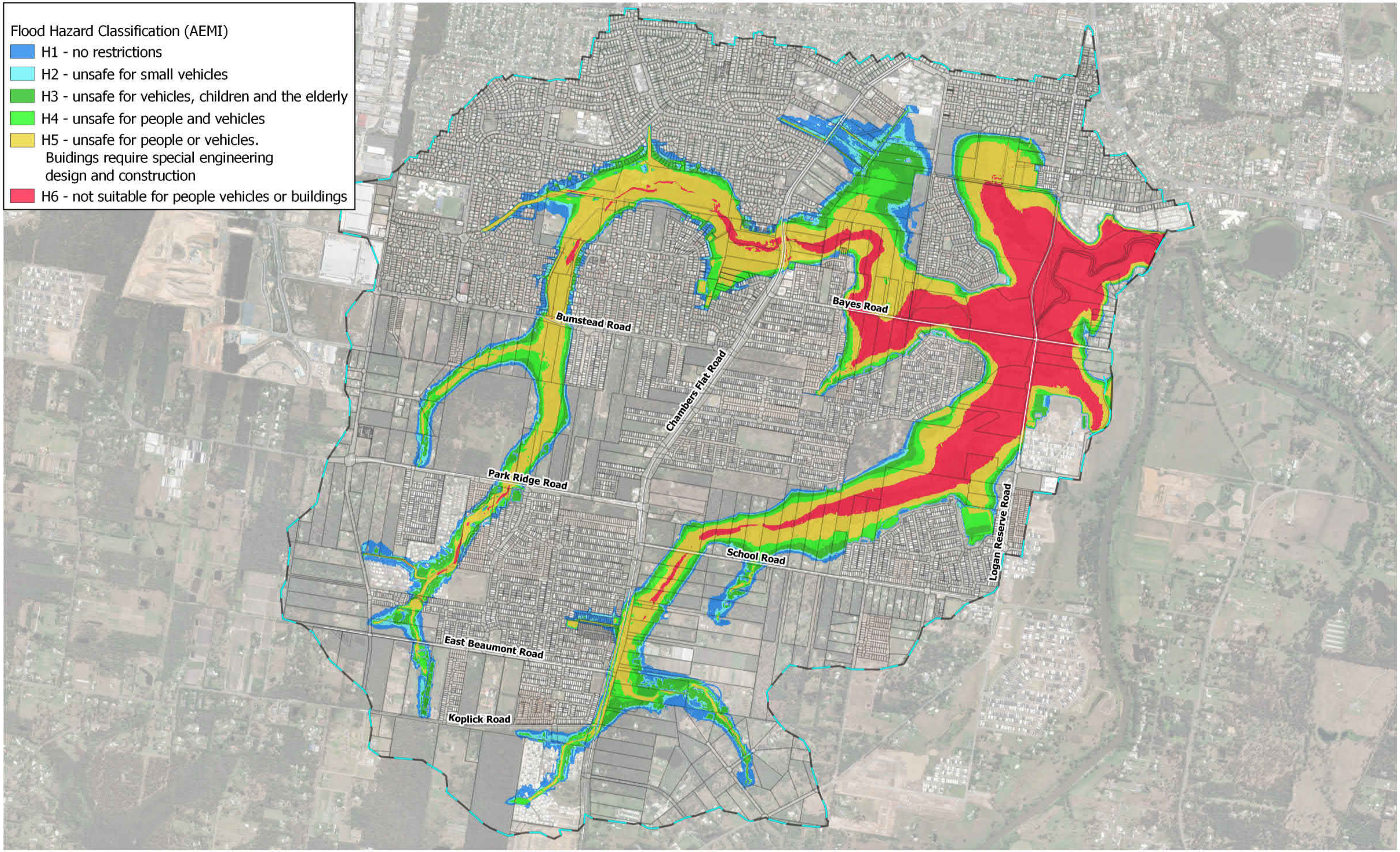
Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:
0 200 400 600 800 m
1:21,000

Figure
D59

Rev
0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping Flood Hazard (ZAEM1) - PMP

Figure D60

Rev 0

Scale at A3 1:21000

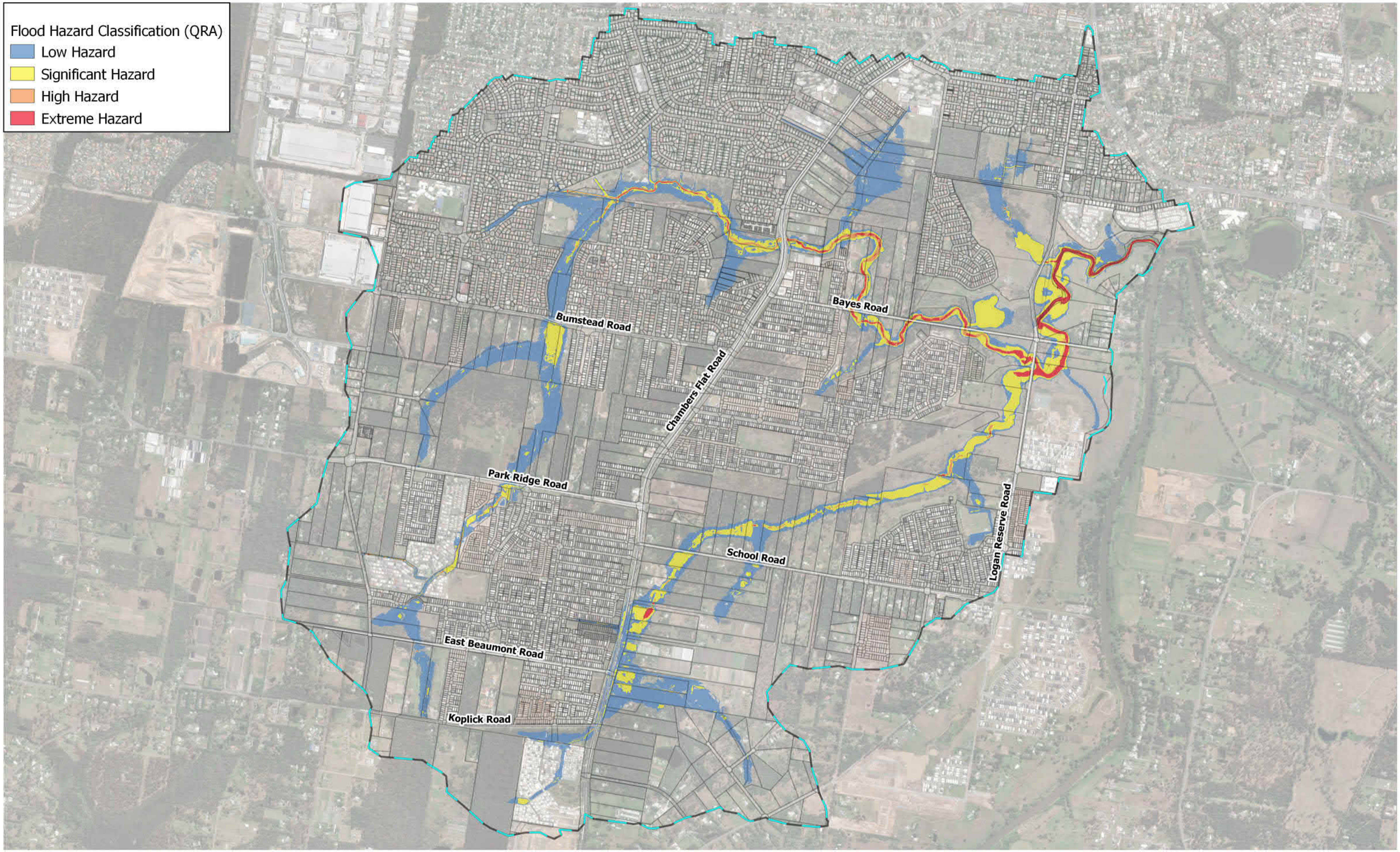


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Hazard (QRA) - 50% AEP

Figure: D61

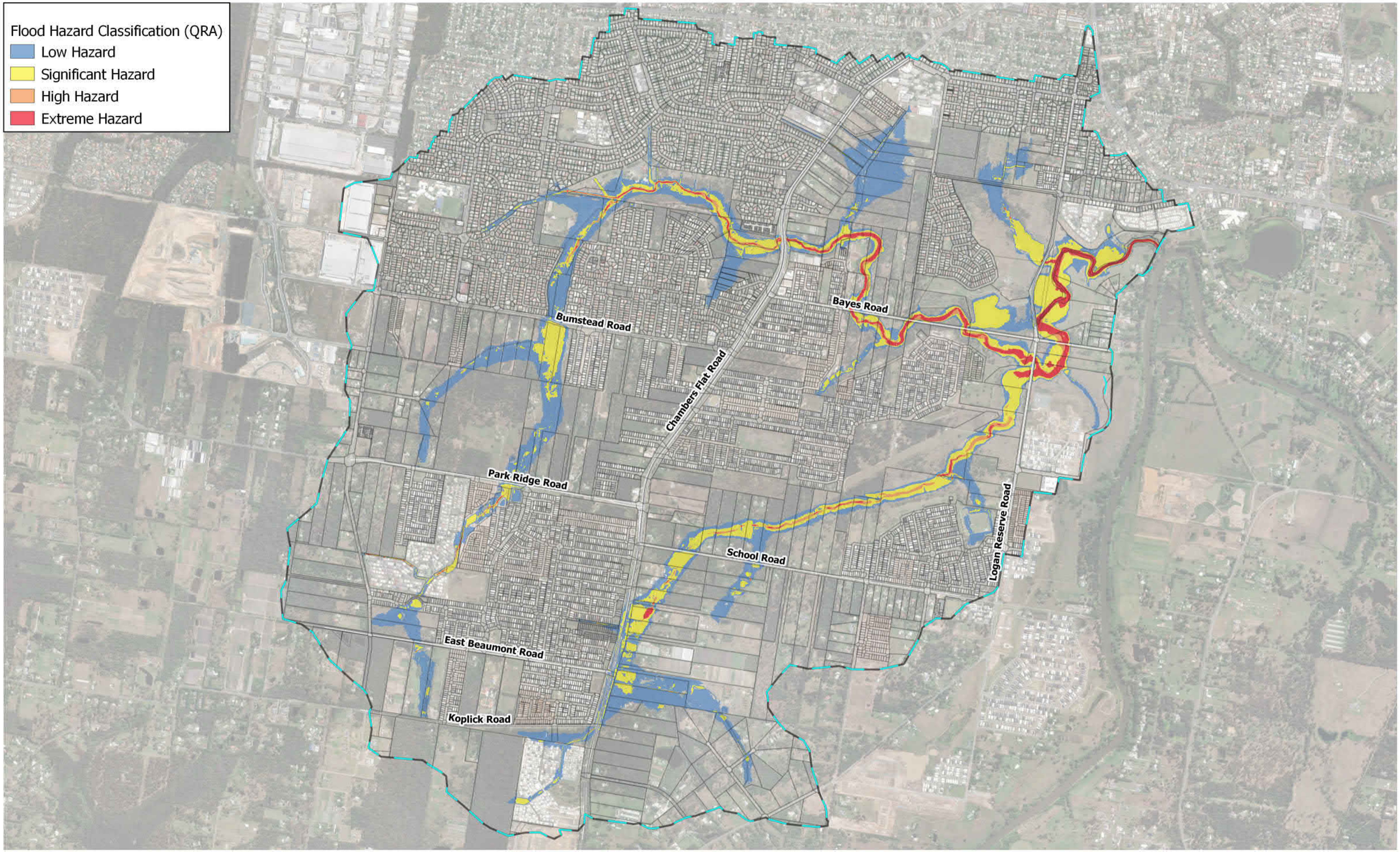
Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale: 0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Hazard (QRA) - 20% AEP

Figure: D62

Rev: 0

Scale at A3 1:21000

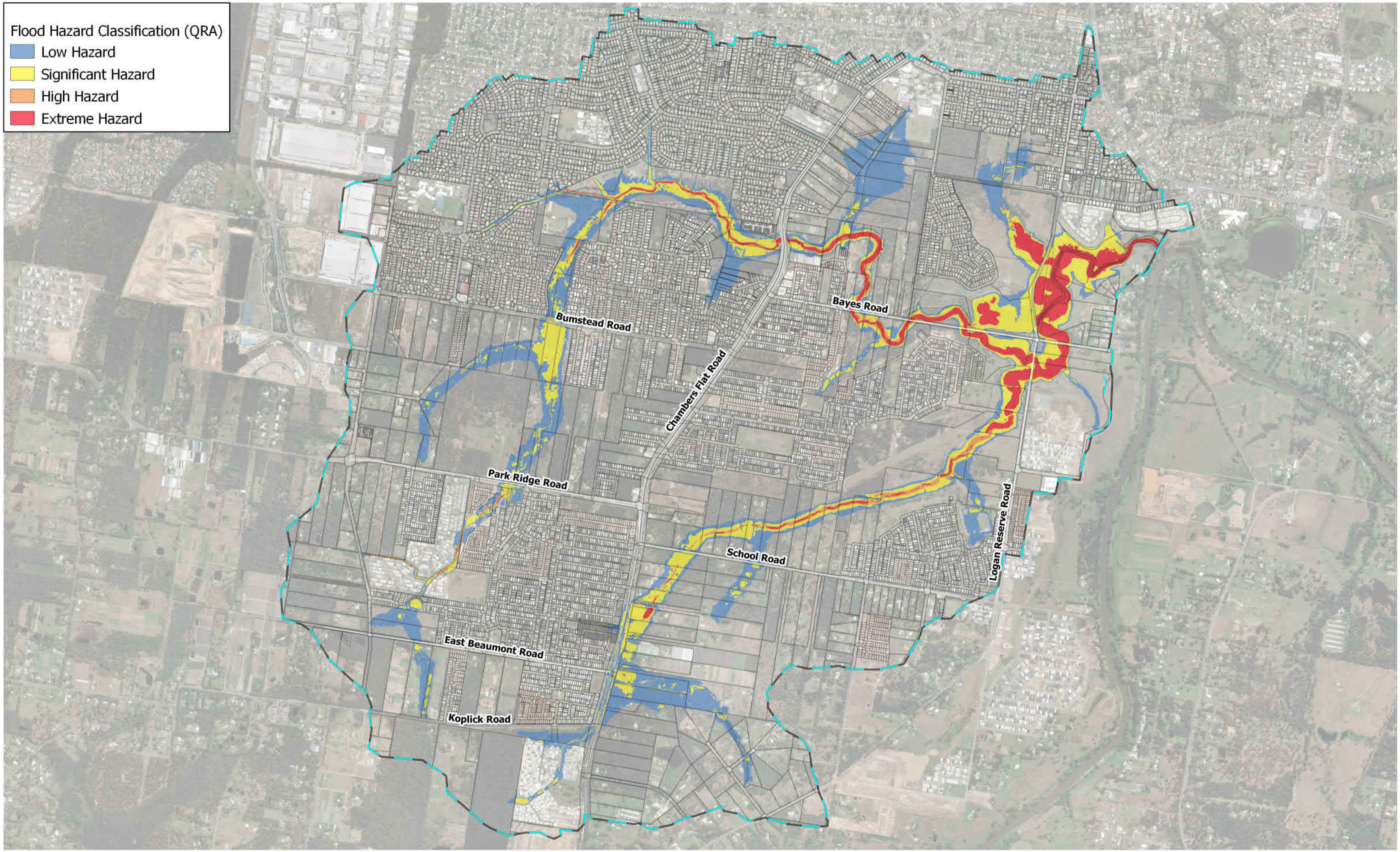


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (QRA) - 10% AEP**

Figure: **D63**

Rev: **0**

Scale at A3 1:21000
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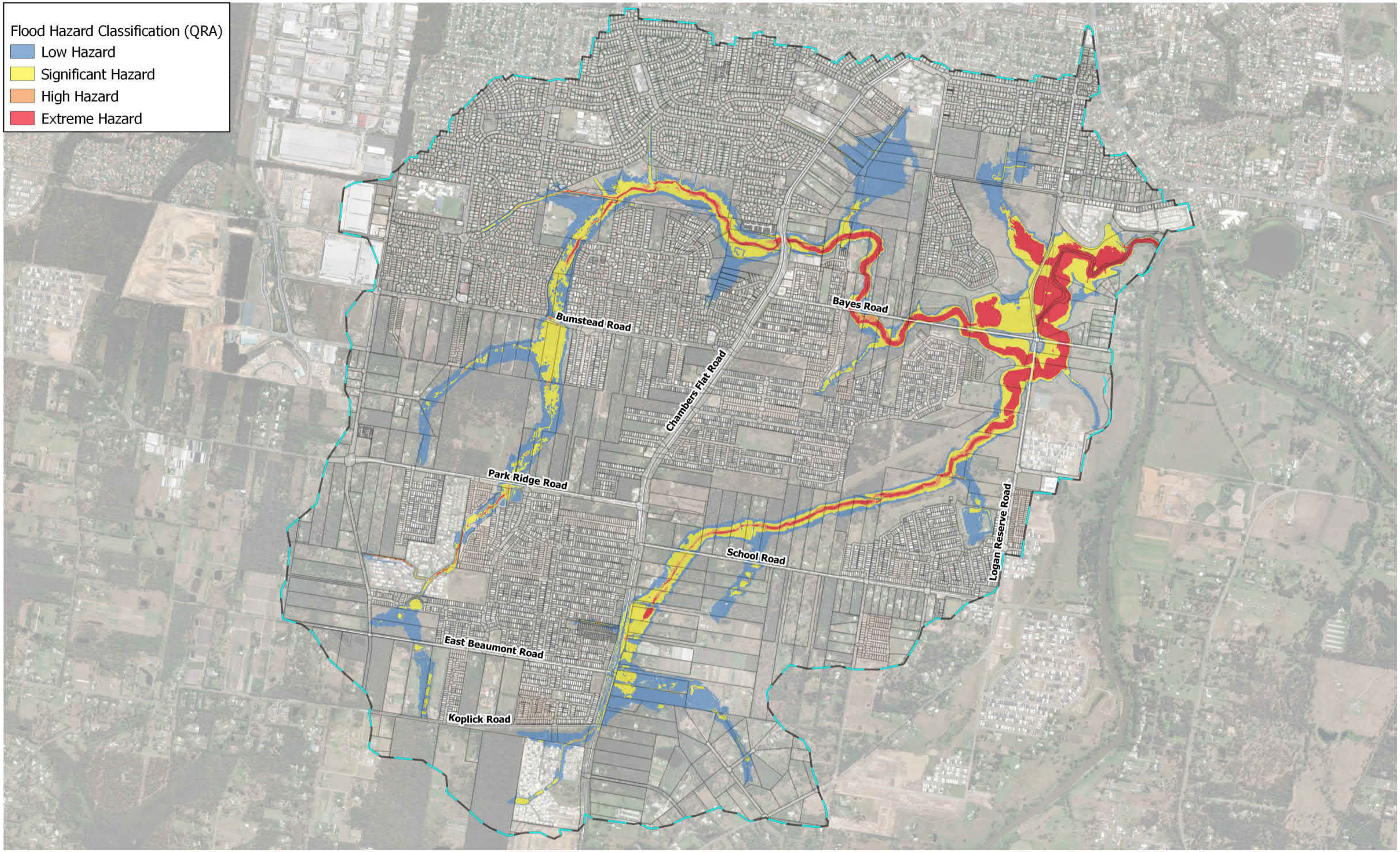
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (QRA) - 5% AEP**

Figure: **D64**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FSG - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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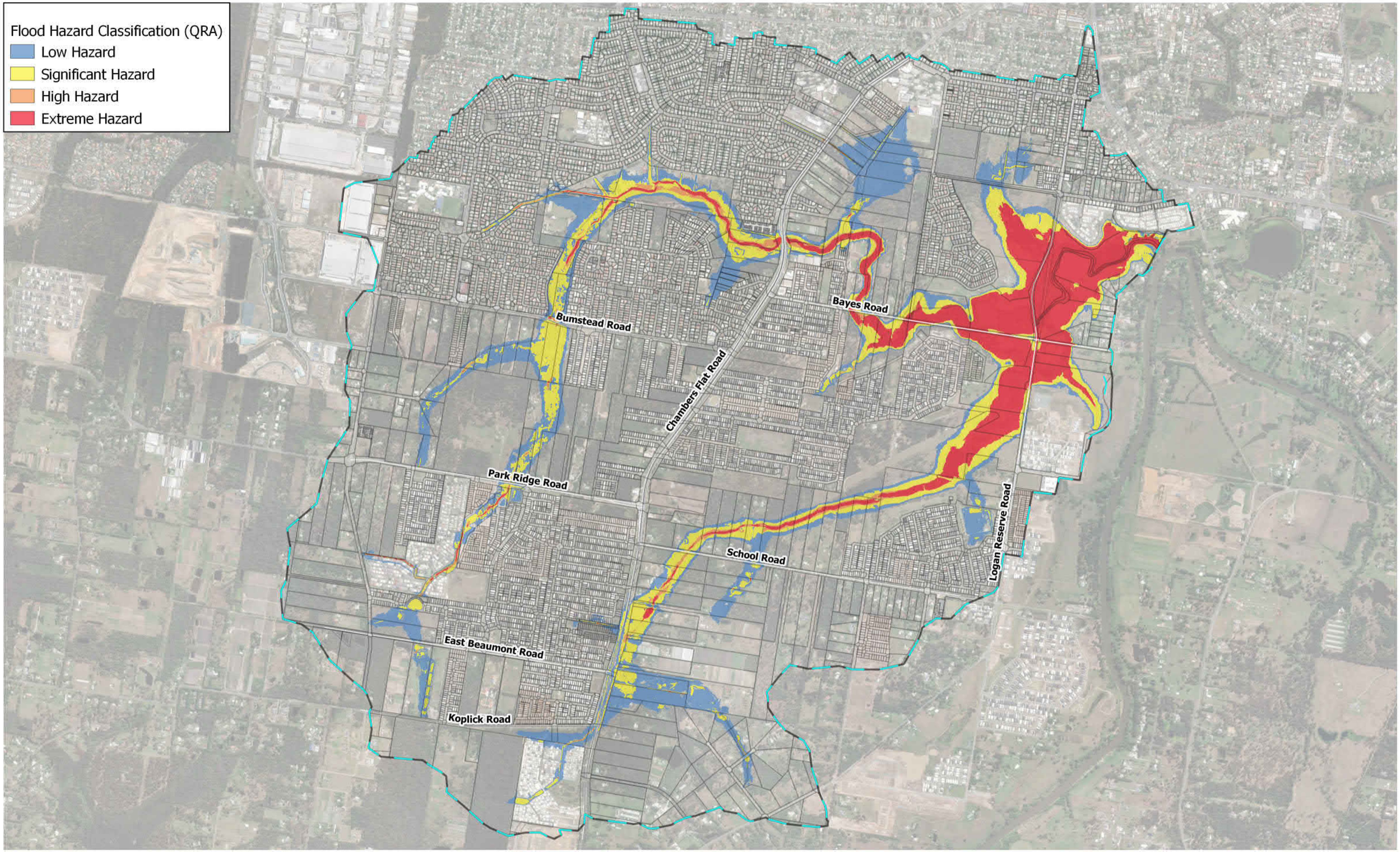
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (QRA) - 2% AEP**

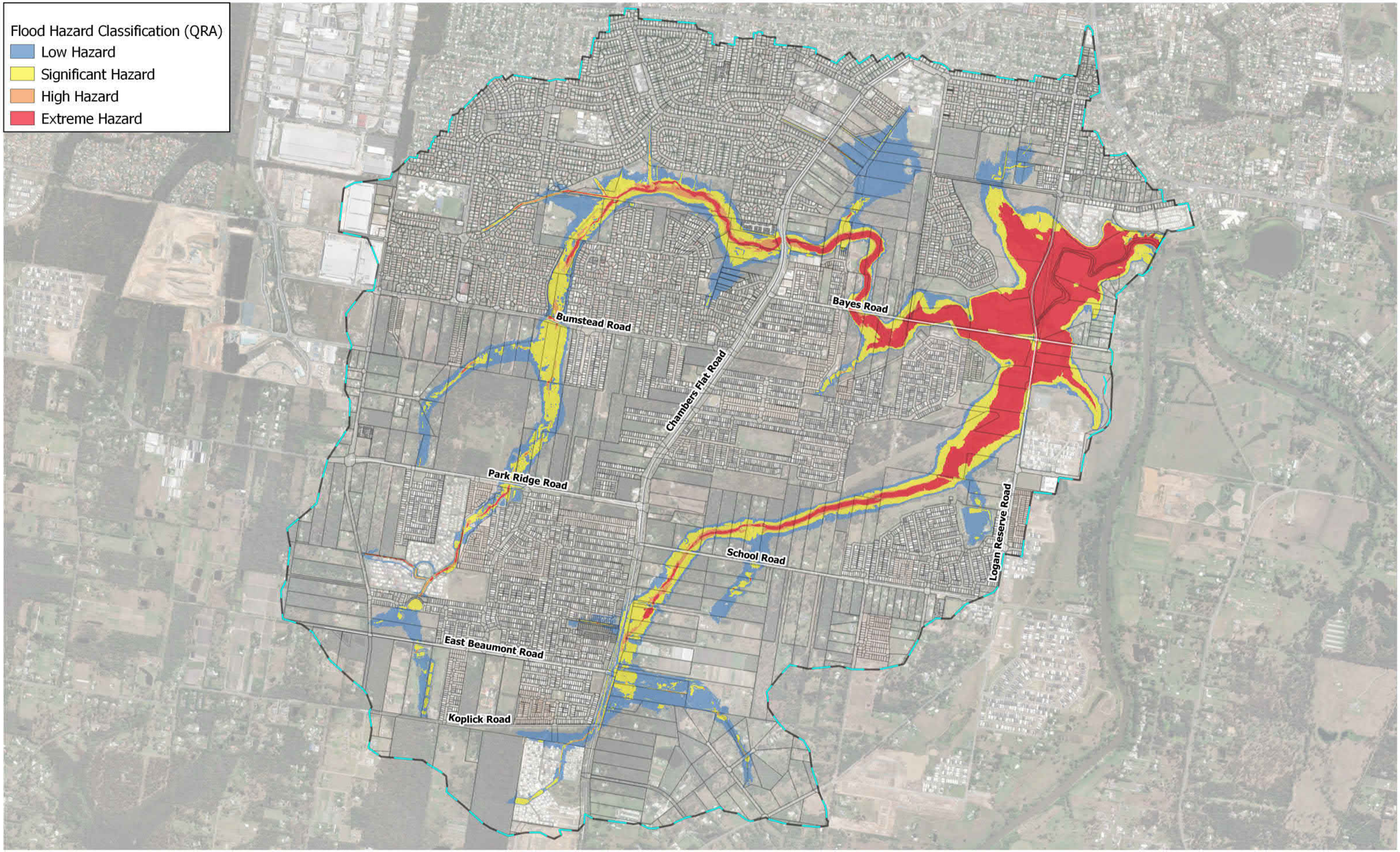
Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:
0 200 400 600 800 m
1:21,000

Figure: D65

Rev: 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

## Schmidt's Creek Flood Study - Design Event Mapping Flood Hazard (QRA) - 1% AEP

Figure: D66

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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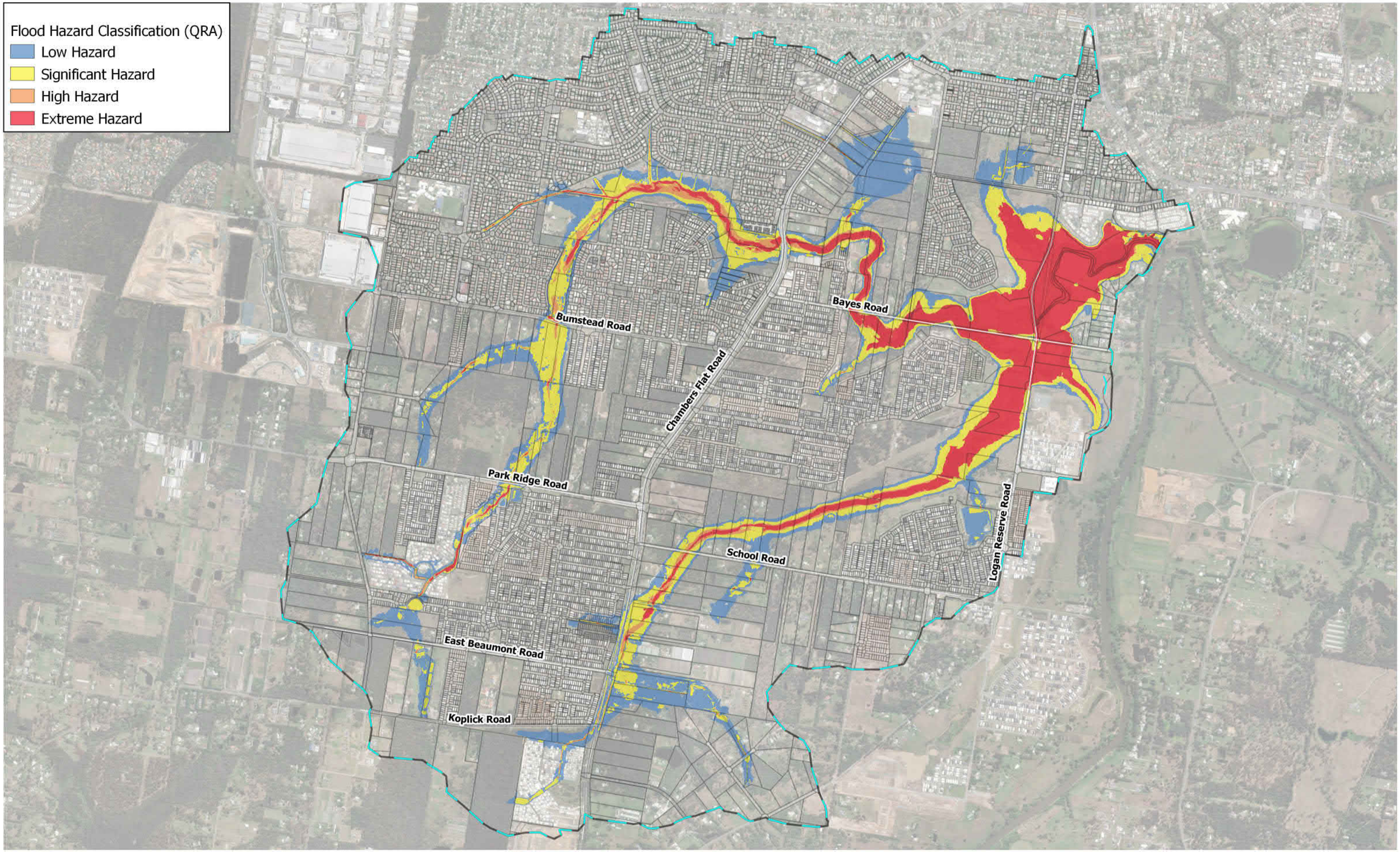


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Design Event Mapping
# Flood Hazard (QRA) - 0.5% AEP

Figure: D67

Rev: 0

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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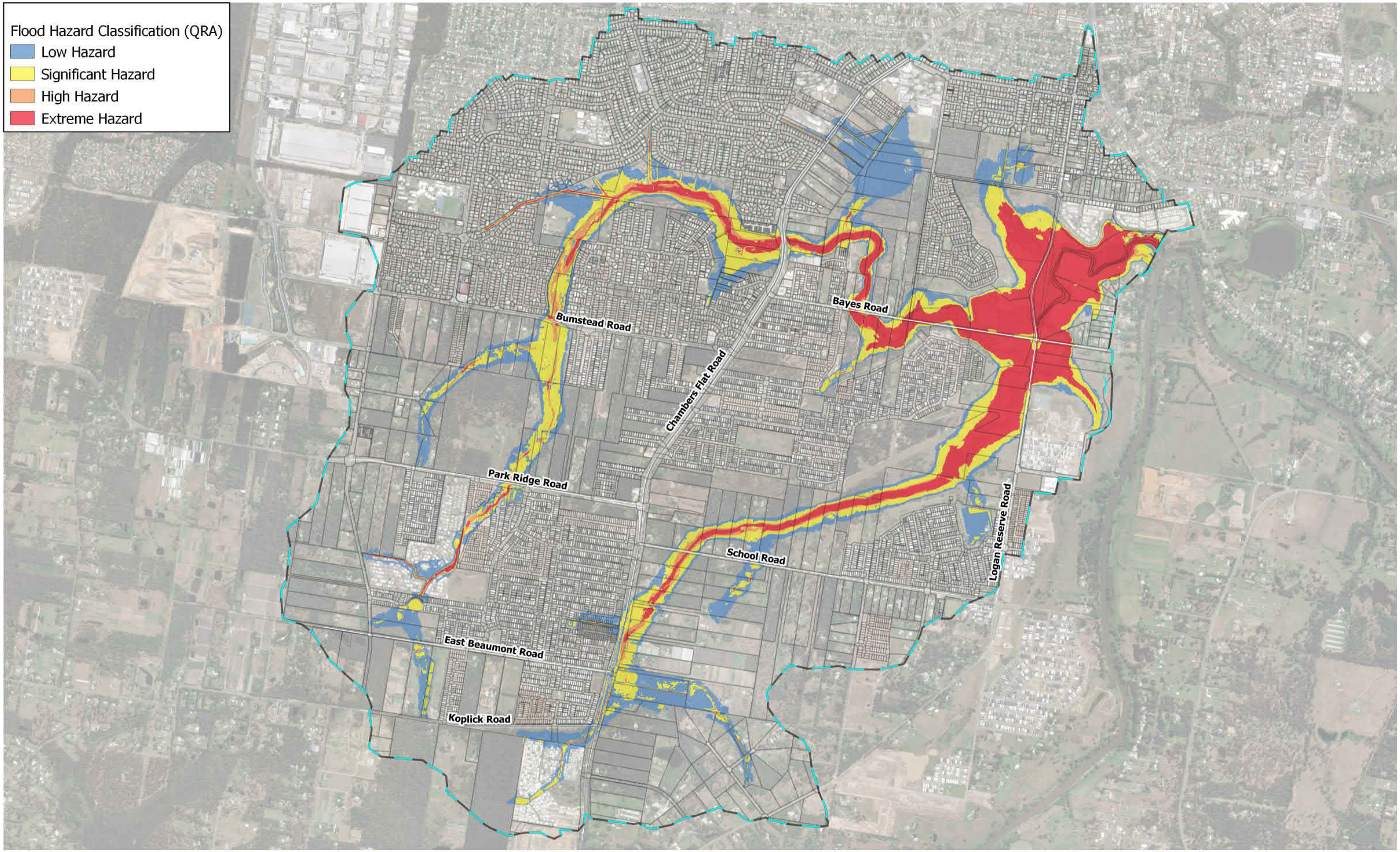


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

## Schmidt's Creek Flood Study - Design Event Mapping
## Flood Hazard (QRA) - 0.2% AEP

Figure: D68

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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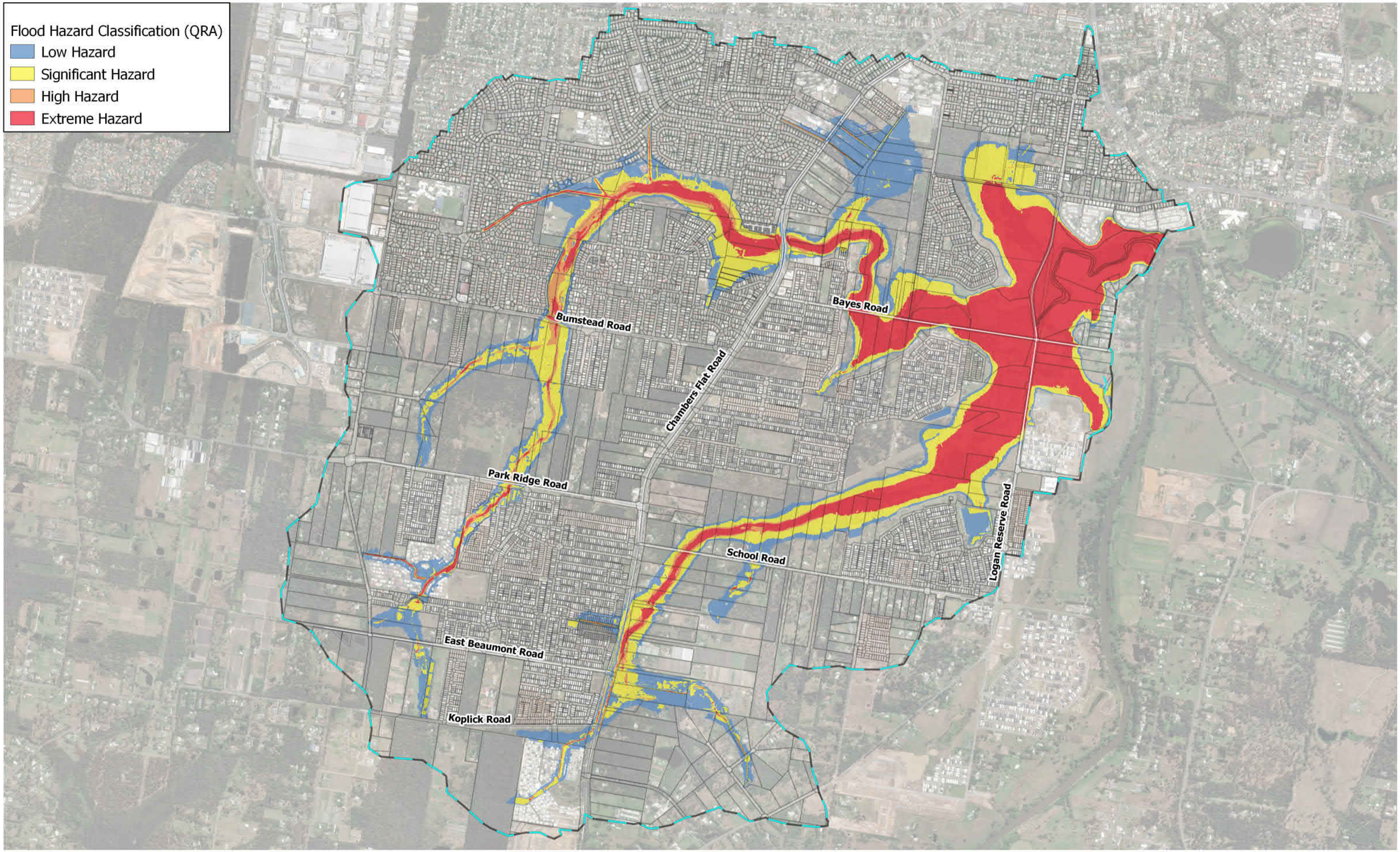


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

## Schmidt’s Creek Flood Study - Design Event Mapping
## Flood Hazard (QRA) - 0.05% AEP

Figure **D69**

Rev **0**

Scale at A3 1:21000
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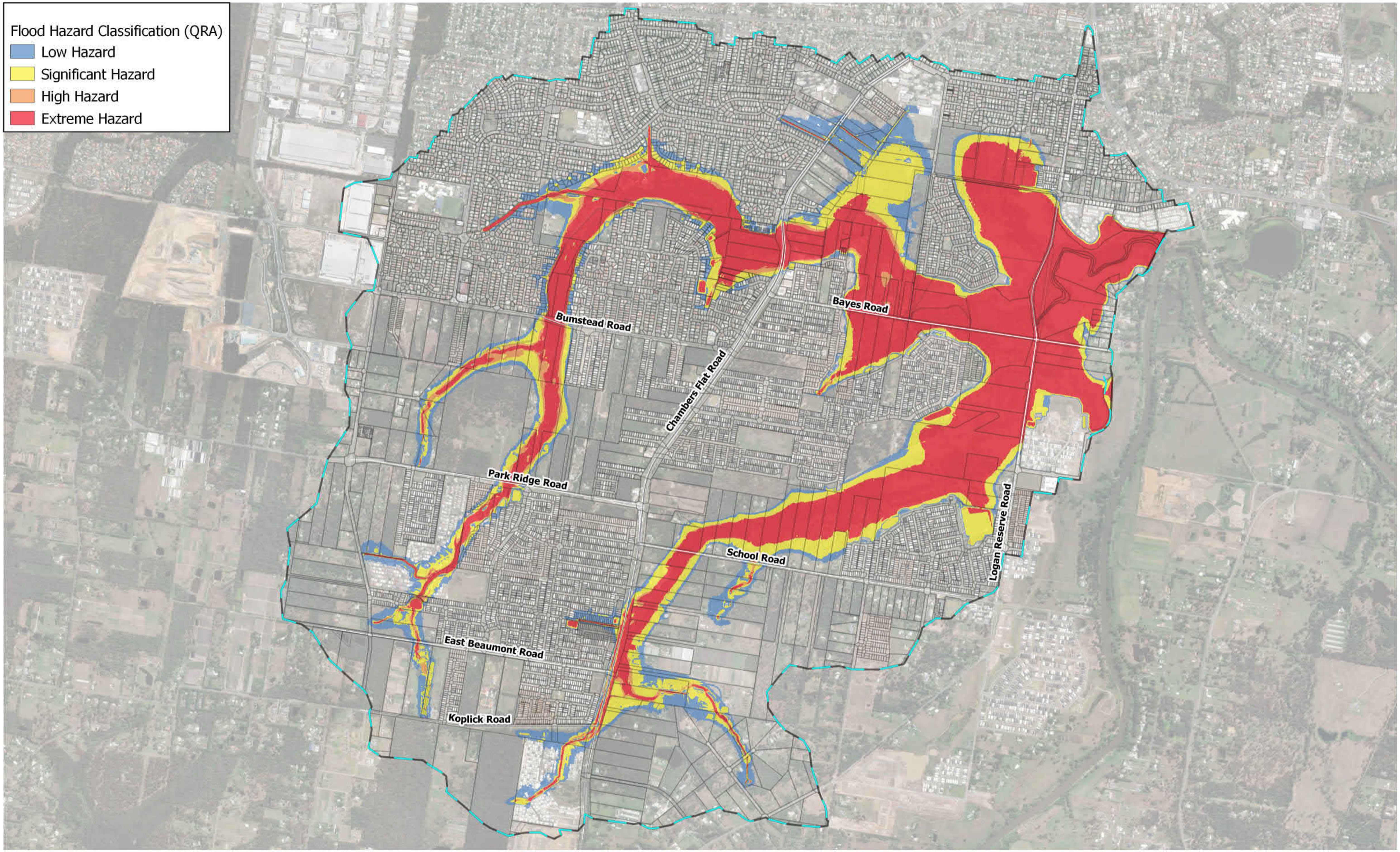


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Design Event Mapping**
**Flood Hazard (QRA) - PMP**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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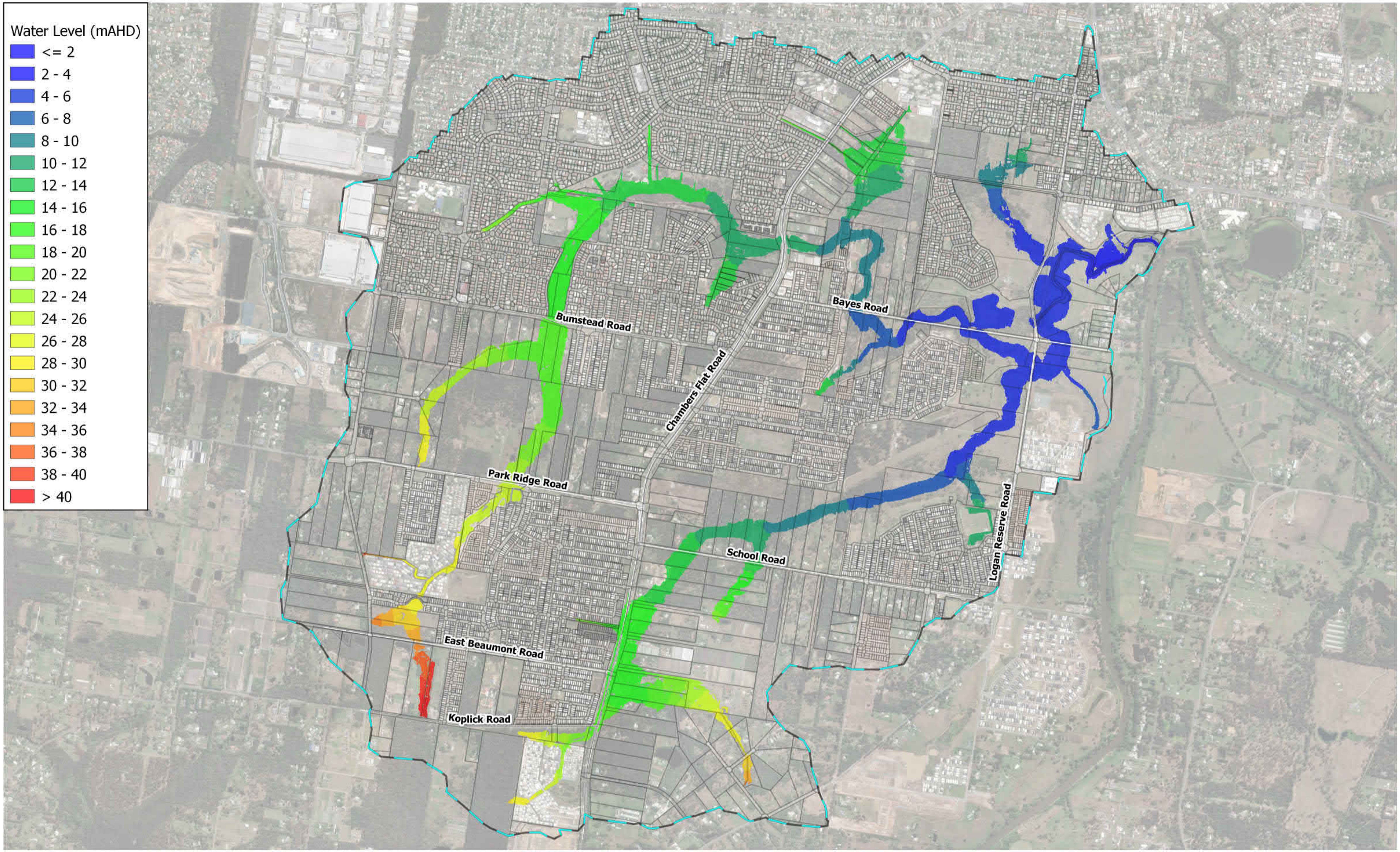
1:21,000

Figure: D70

Rev: 0

# Appendix E: Climate Change Event Mapping

Climate Change Event Mapping




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Water Surface Level - 50% AEP with Climate Change (RCP4.5)**

Figure: **E1**

Rev: **0**

Scale at A3 1:21000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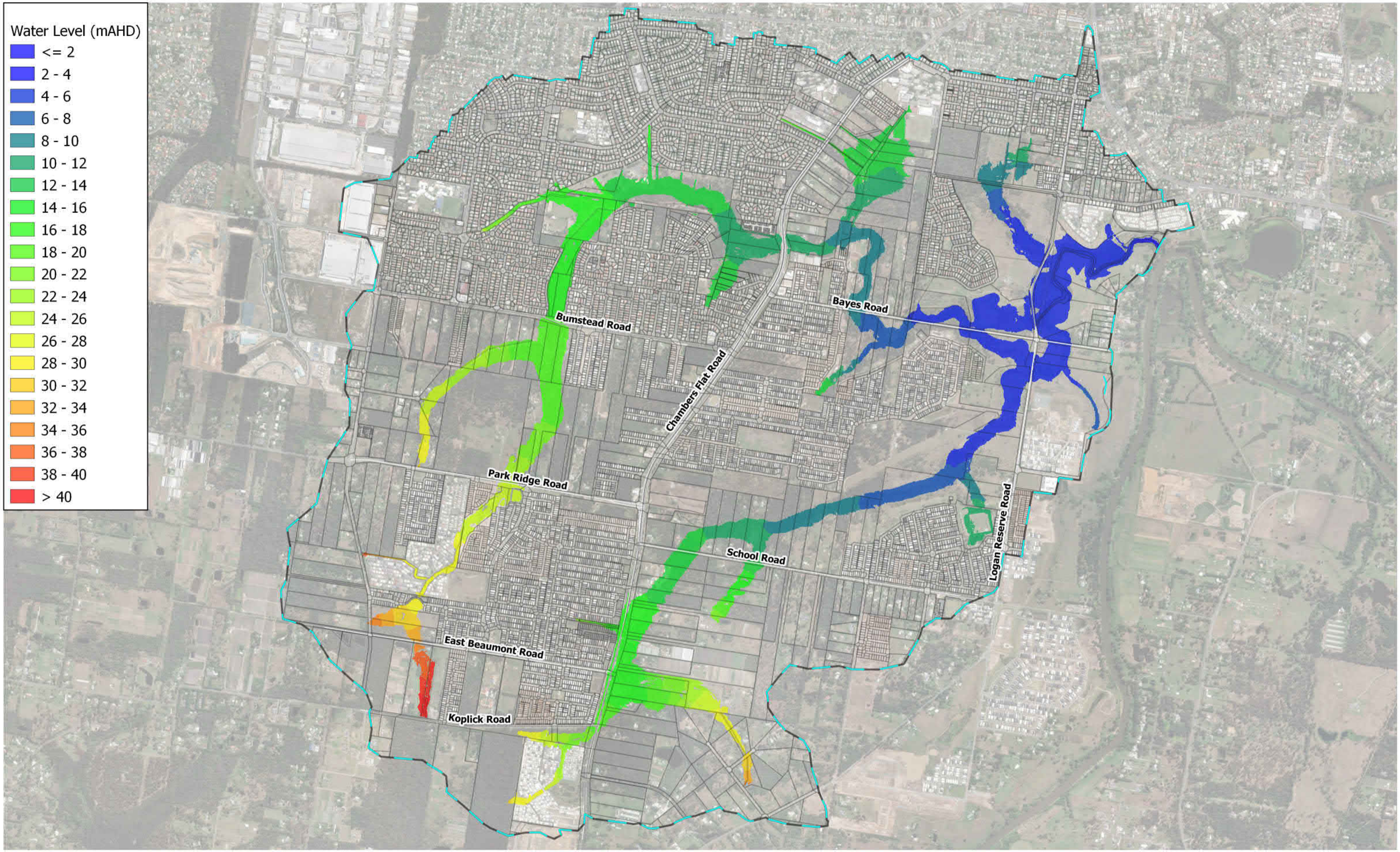


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping
# Water Surface Level - 20% AEP with Climate Change (RCP4.5)

Figure: E2

Rev: 0

Scale at A3 1:21000


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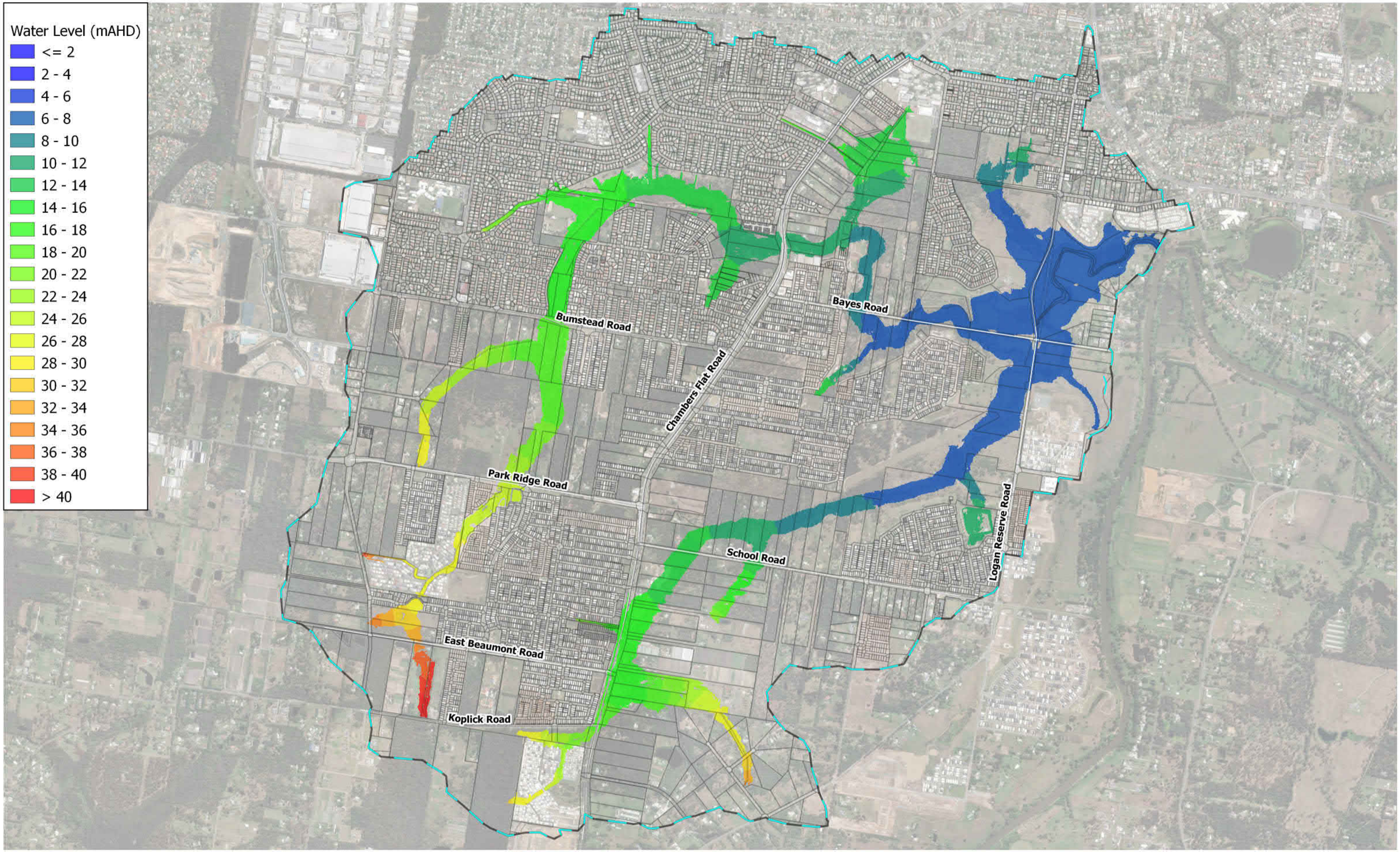


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping
# Water Surface Level - 10% AEP with Climate Change (RCP4.5)

Figure: E3

Rev: 0

Scale at A3 1:21000







File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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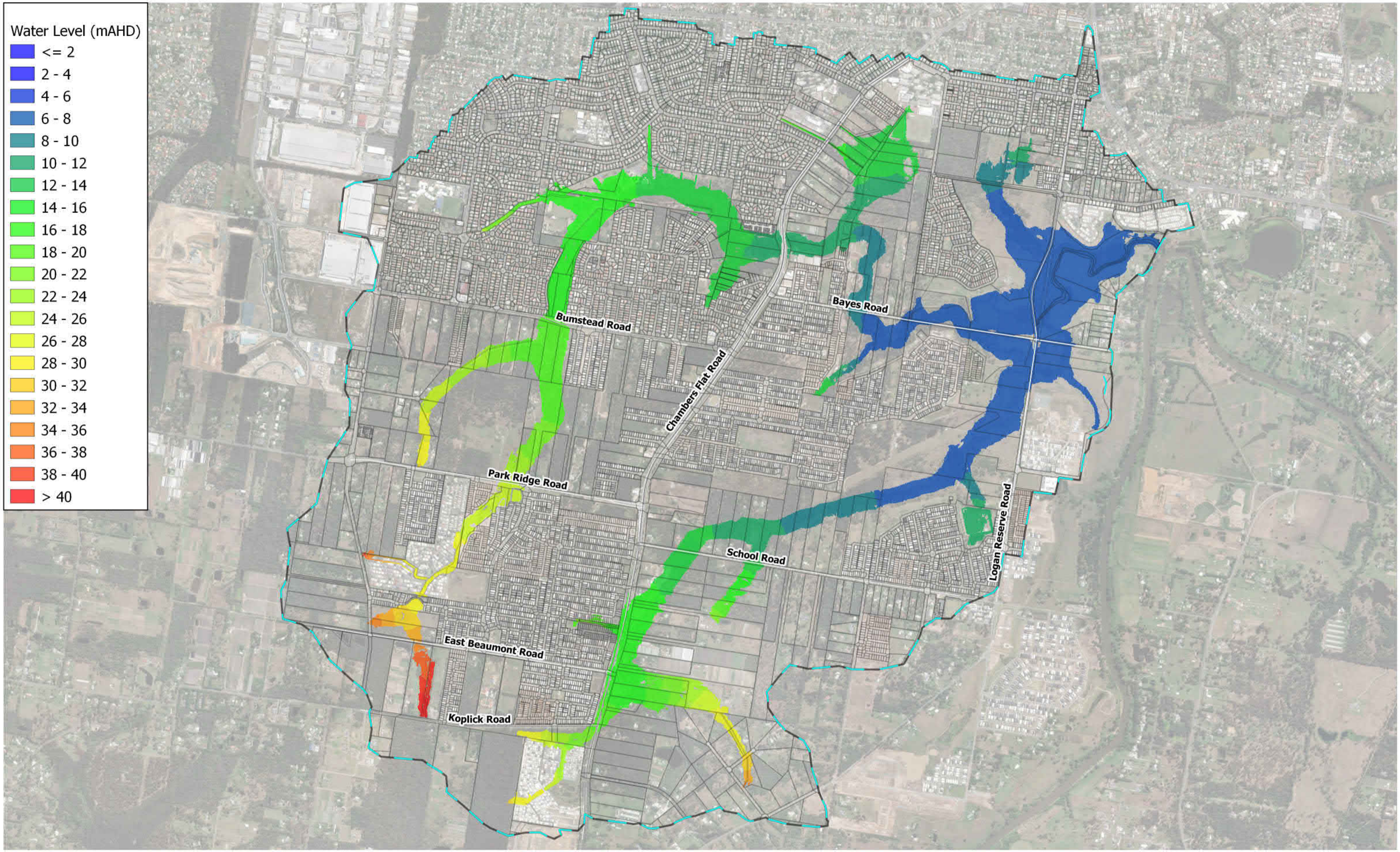


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Water Surface Level - 5% AEP with Climate Change (RCP4.5)**

Figure: E4

Rev: 0

Scale at A3 1:21000
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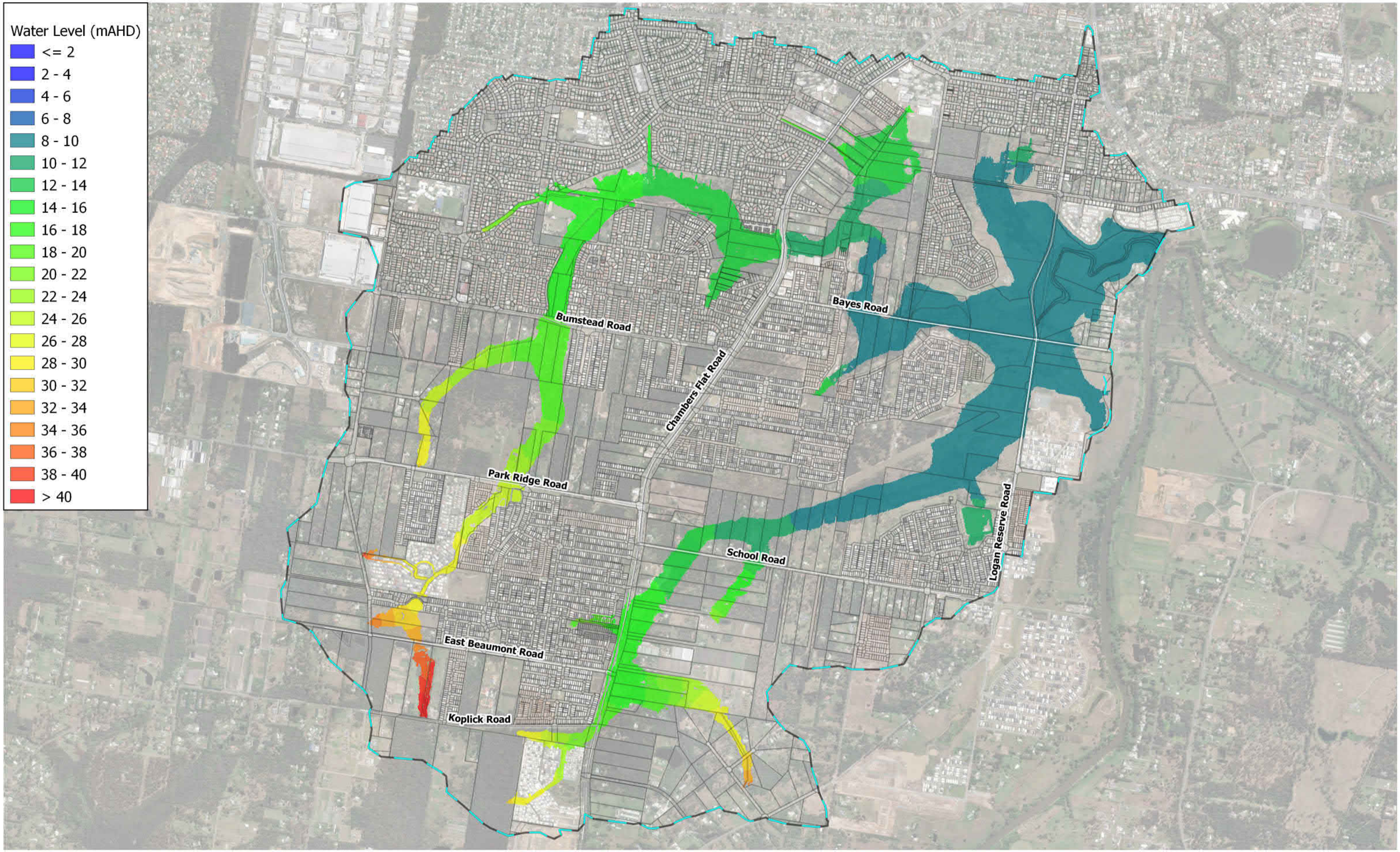


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Water Surface Level - 2% AEP with Climate Change (RCP4.5)**

Figure: **E5** Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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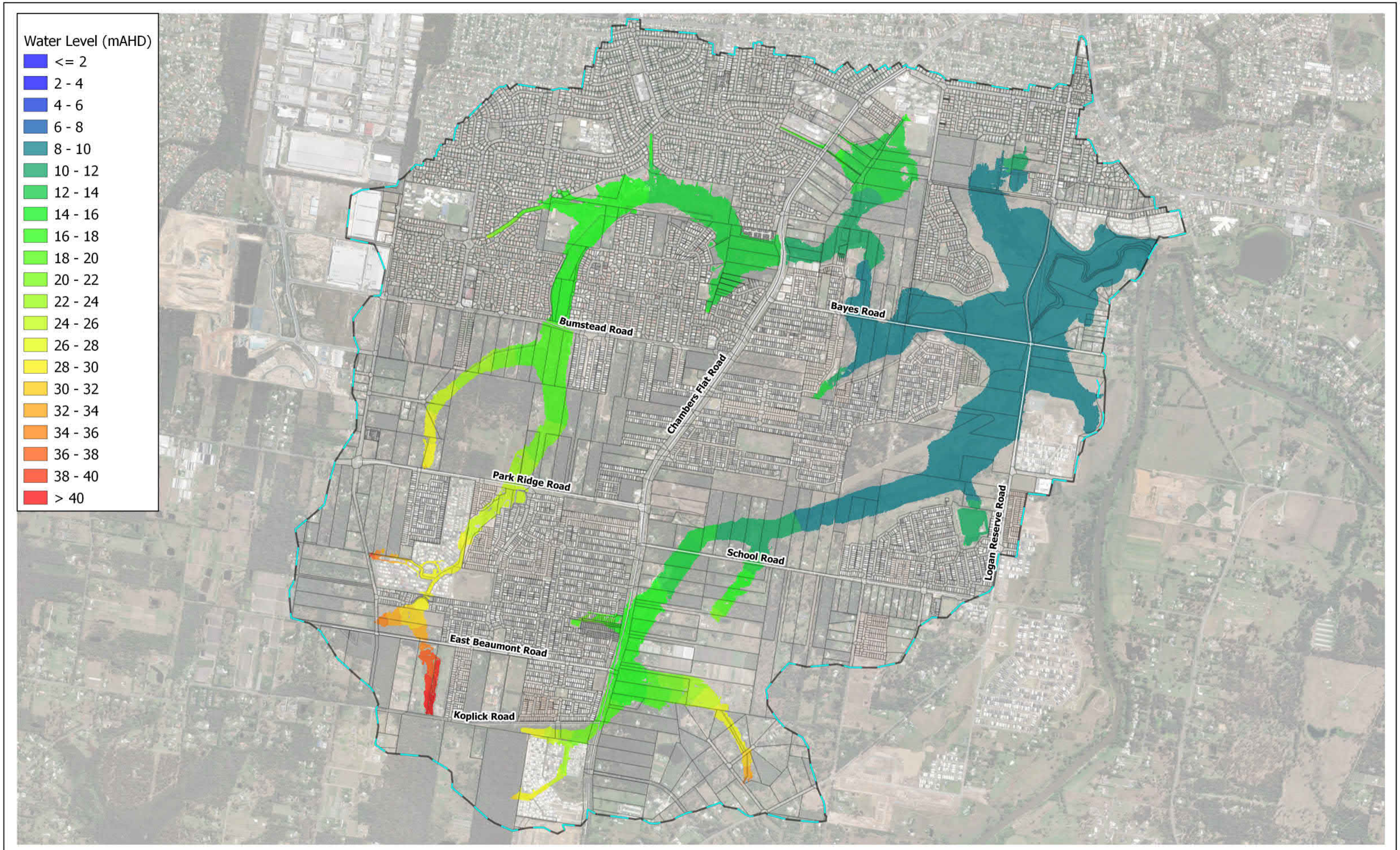


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Water Surface Level - 1% AEP with Climate Change (RCP4.5)**

Figure: **E6**

Rev: **0**

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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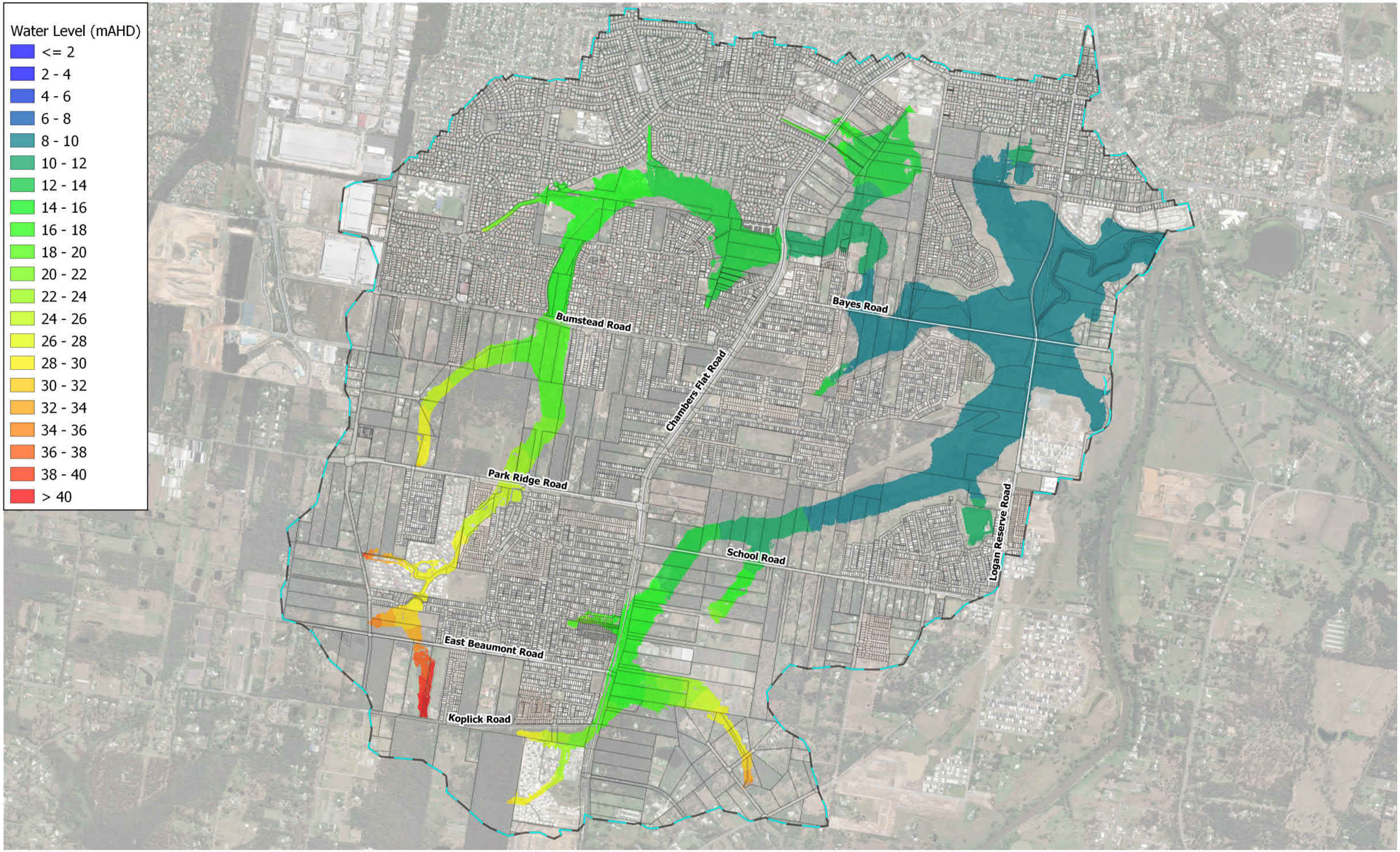


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt’s Creek Flood Study - Climate Change Mapping**
**Water Surface Level - 0.5% AEP with Climate Change (RCP4.5)**

Figure: E7

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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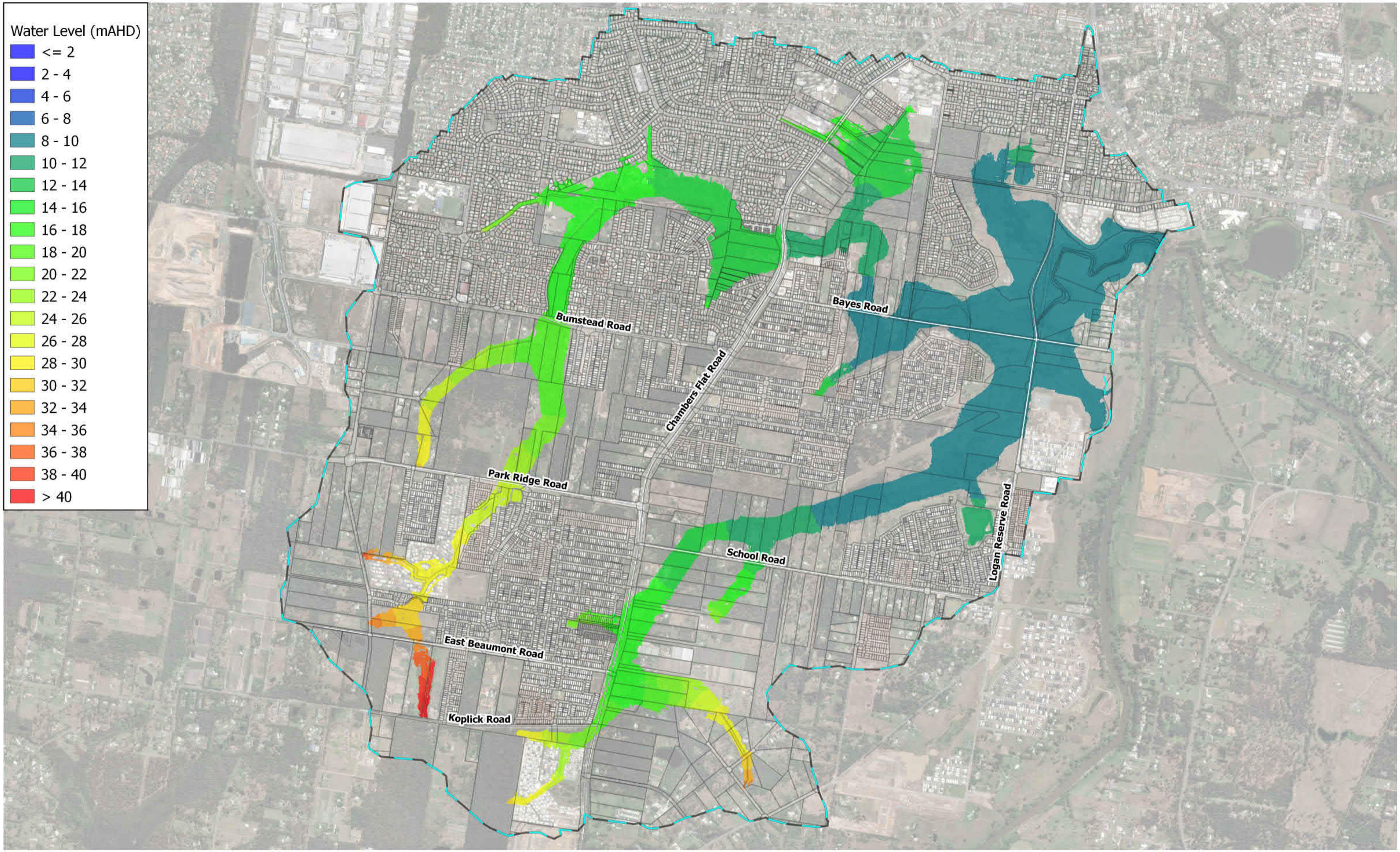


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Water Surface Level - 0.2% AEP with Climate Change (RCP4.5)**

Figure: E8

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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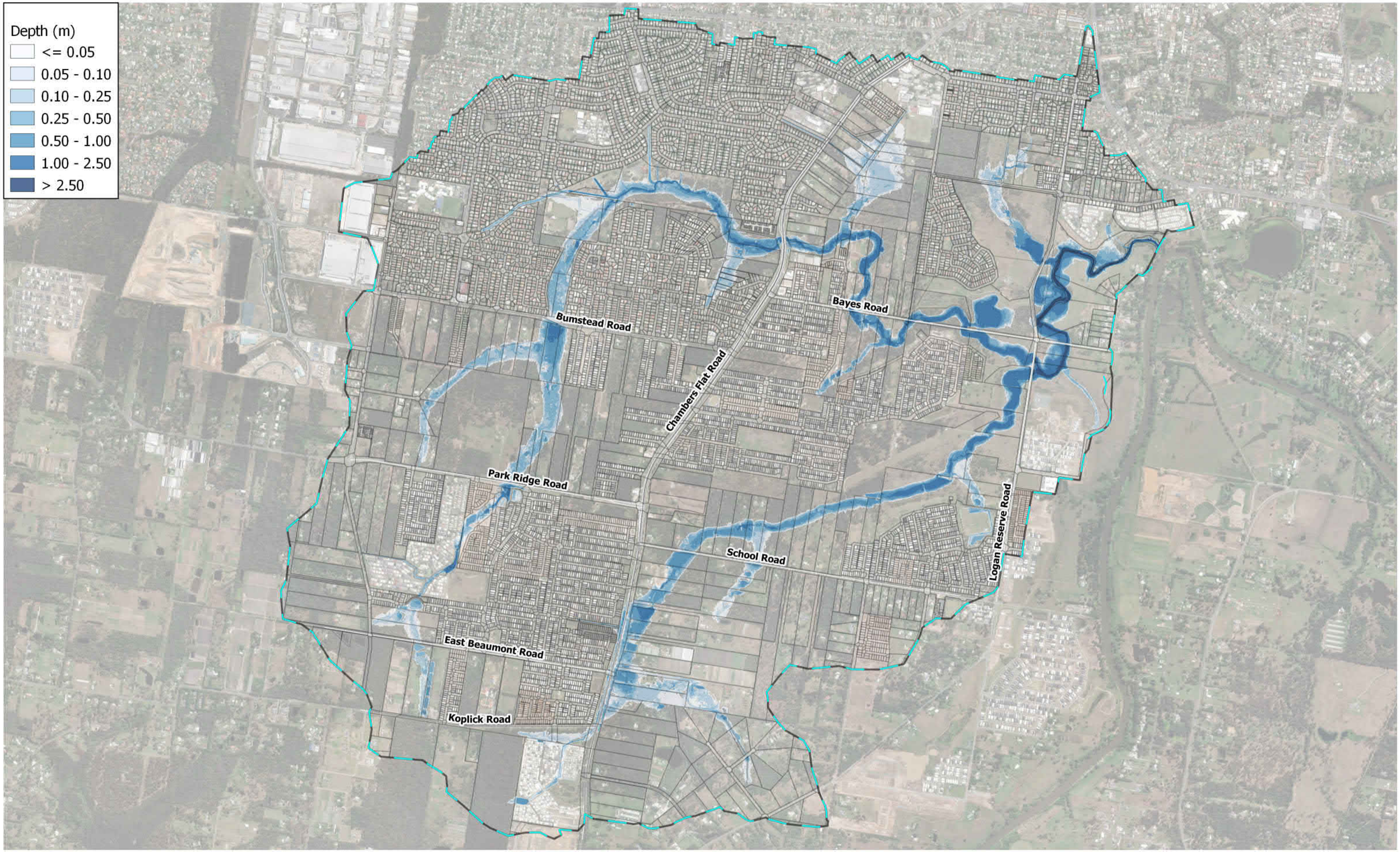


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 50% AEP with Climate Change (RCP4.5)**

| Figure | Rev |
|---|---|
| E9 | 0 |

Scale at A3 1:21000


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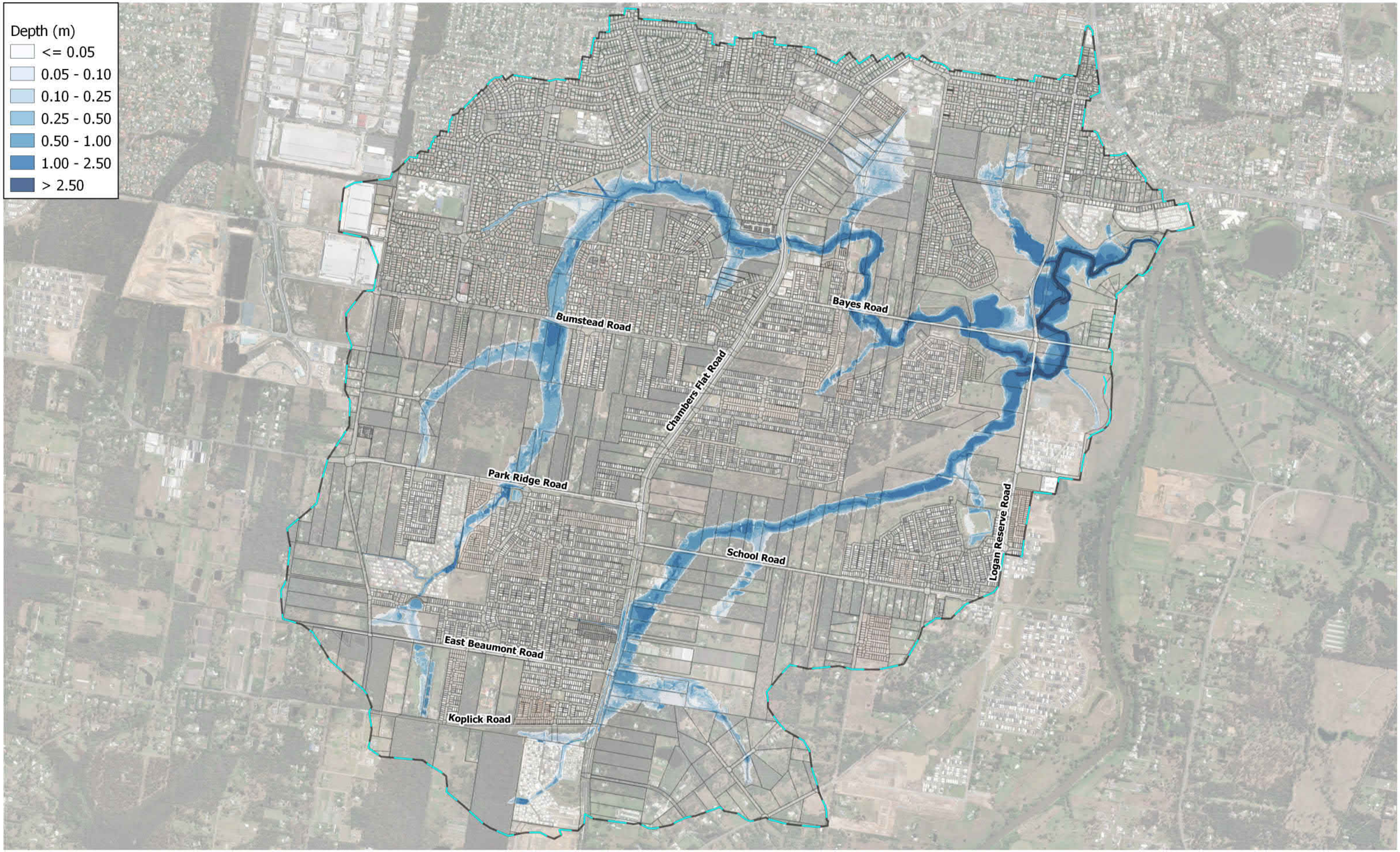


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 20% AEP with Climate Change (RCP4.5)**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale

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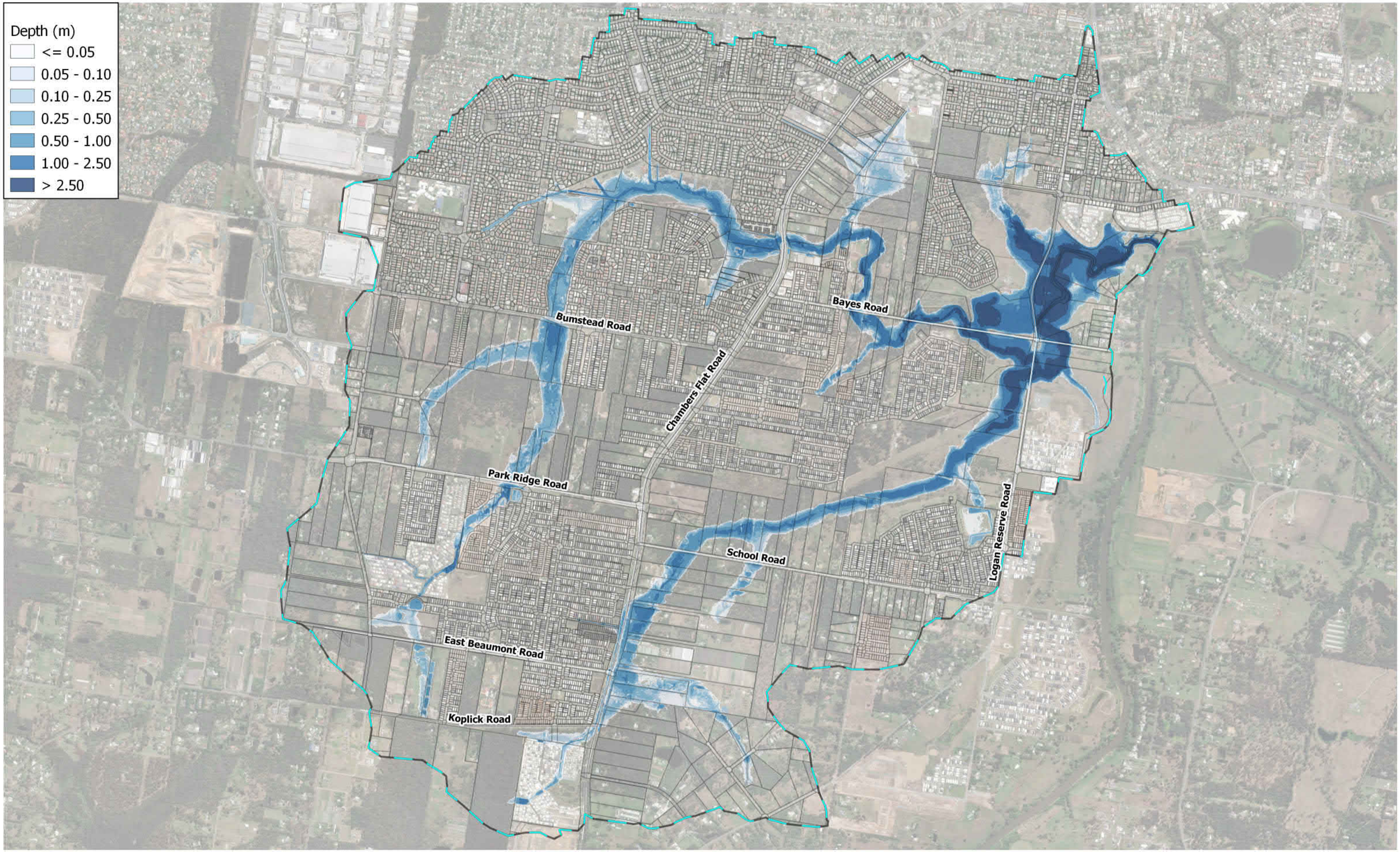
Figure

E10

Rev

0




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title:

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 10% AEP with Climate Change (RCP4.5)**

Figure: **E11**

Rev: **0**

Scale at A3 1:21000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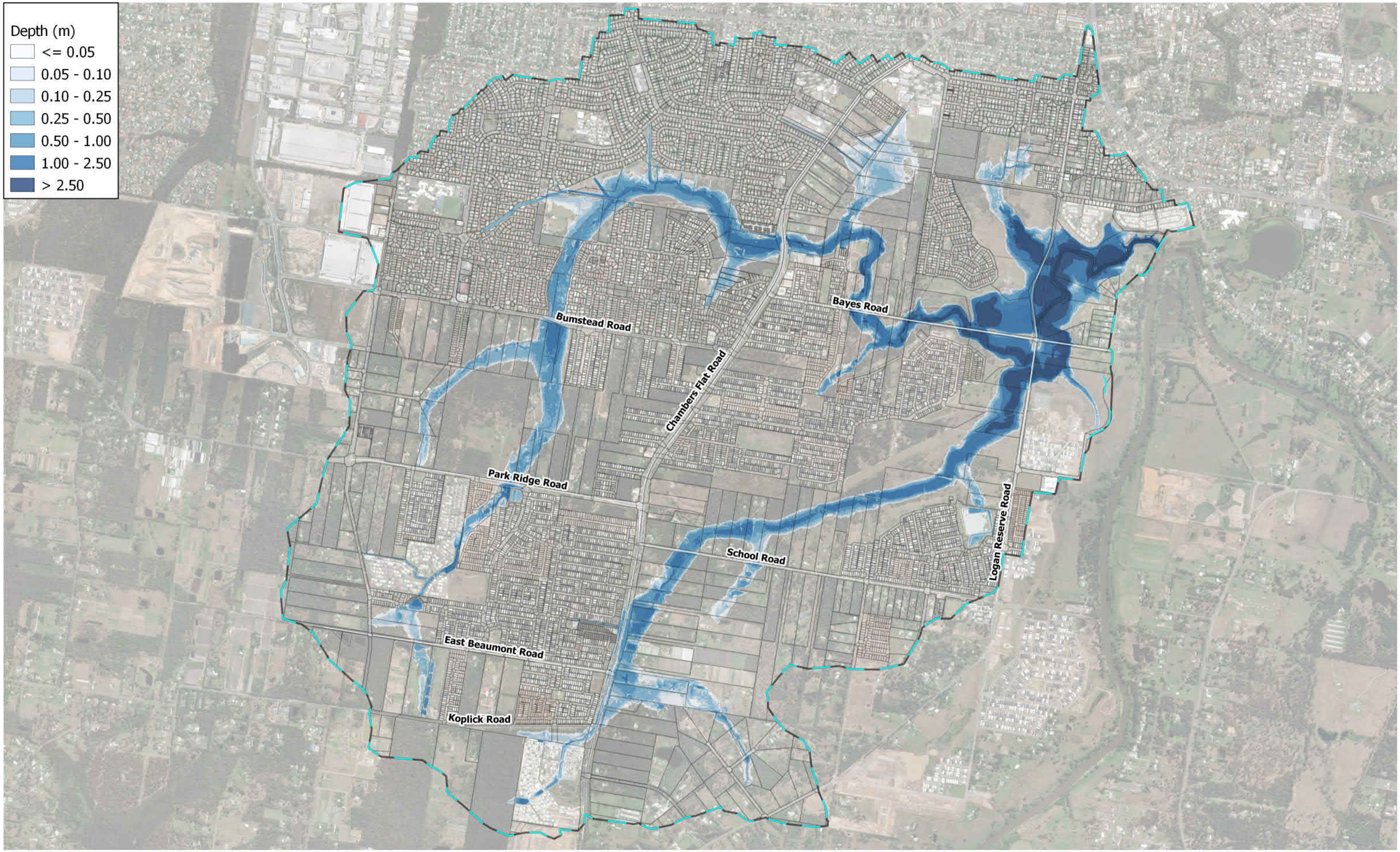


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping
# Flood Depth - 5% AEP with Climate Change (RCP4.5)

Figure: **E12**

Rev: **0**

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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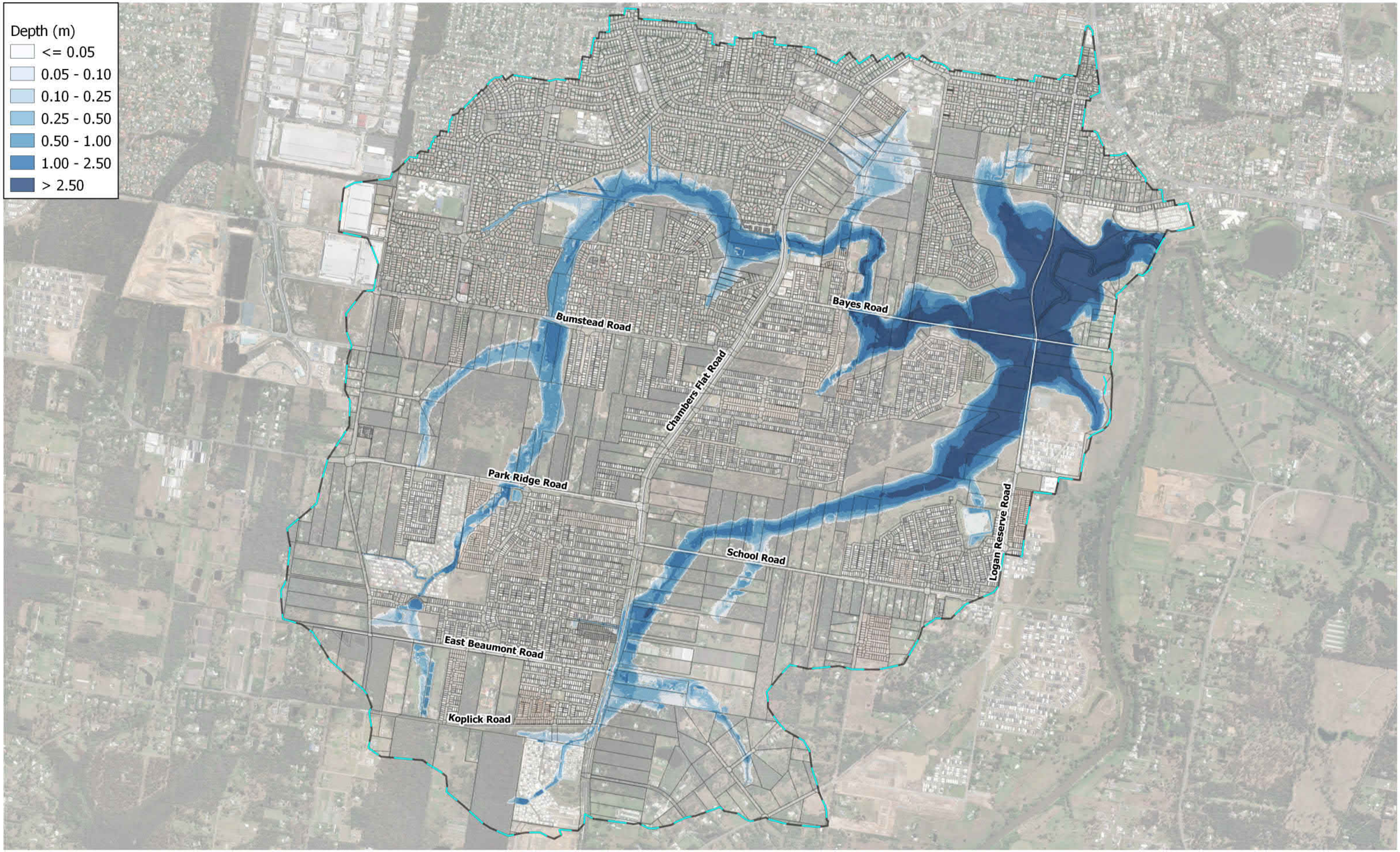


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 2% AEP with Climate Change (RCP4.5)**

Figure **E13**

Rev **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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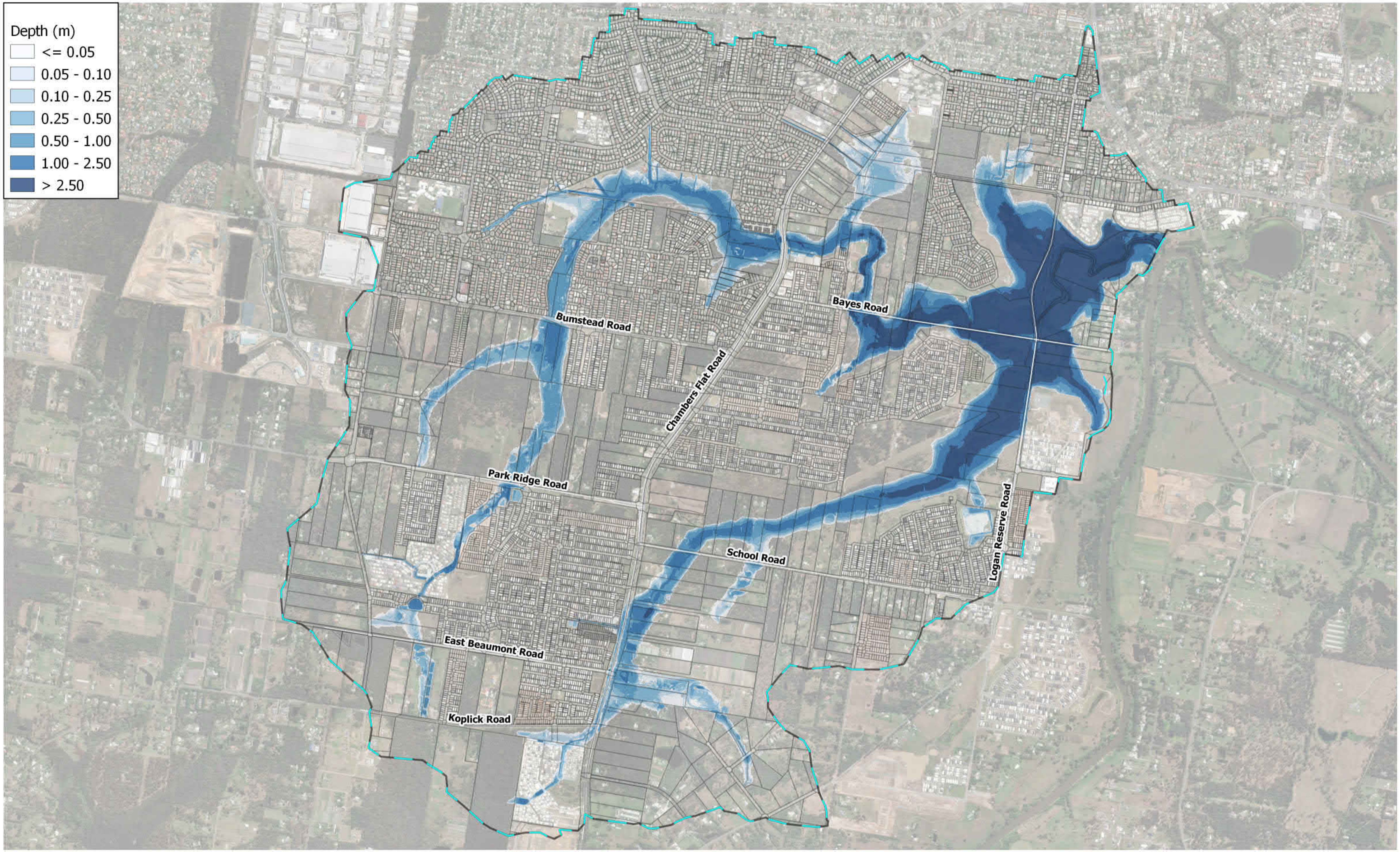


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 1% AEP with Climate Change (RCP4.5)**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FSG - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale: 0 200 400 600 800 m
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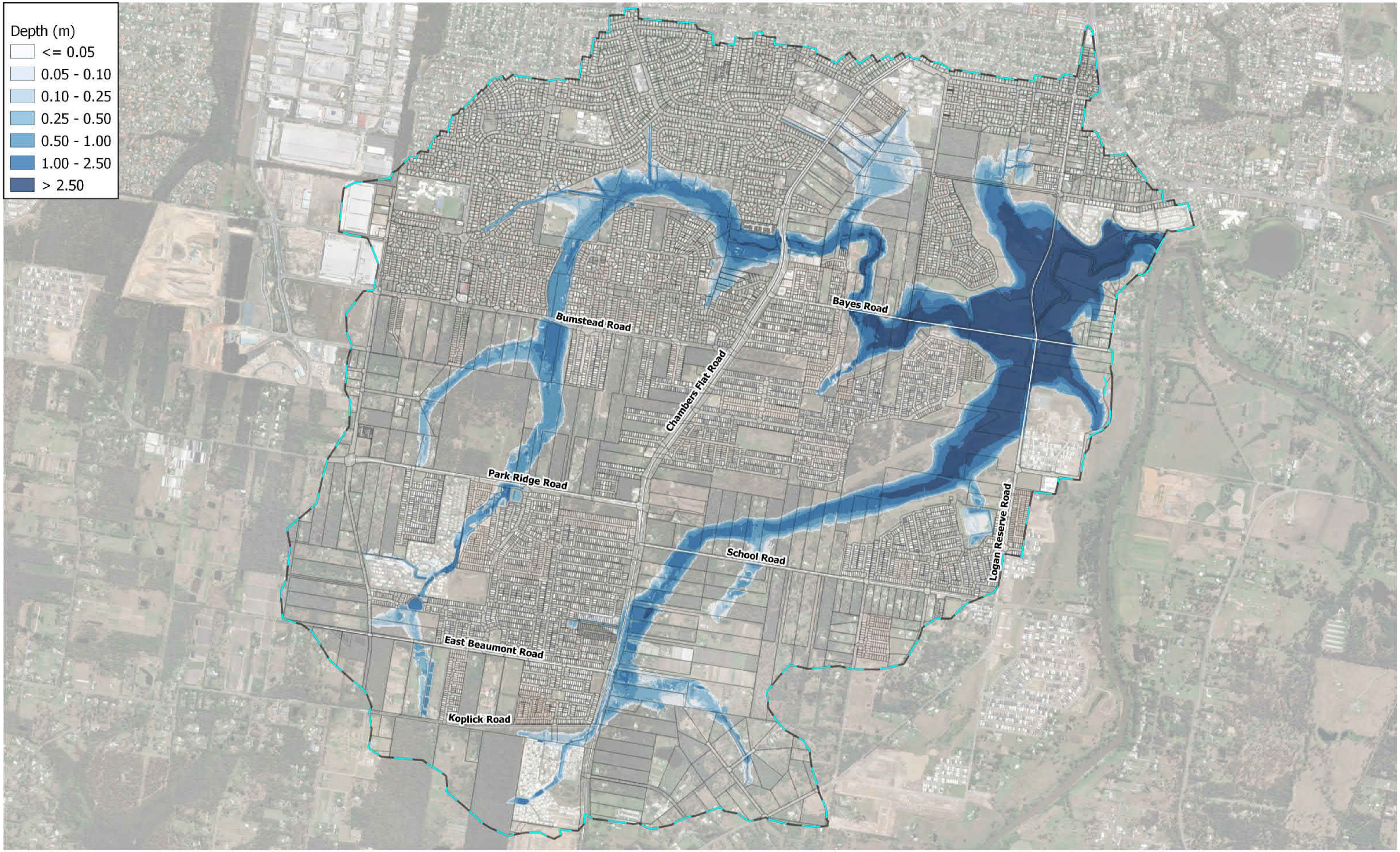
Figure E14

Rev 0




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 0.5% AEP with Climate Change (RCP4.5)**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale

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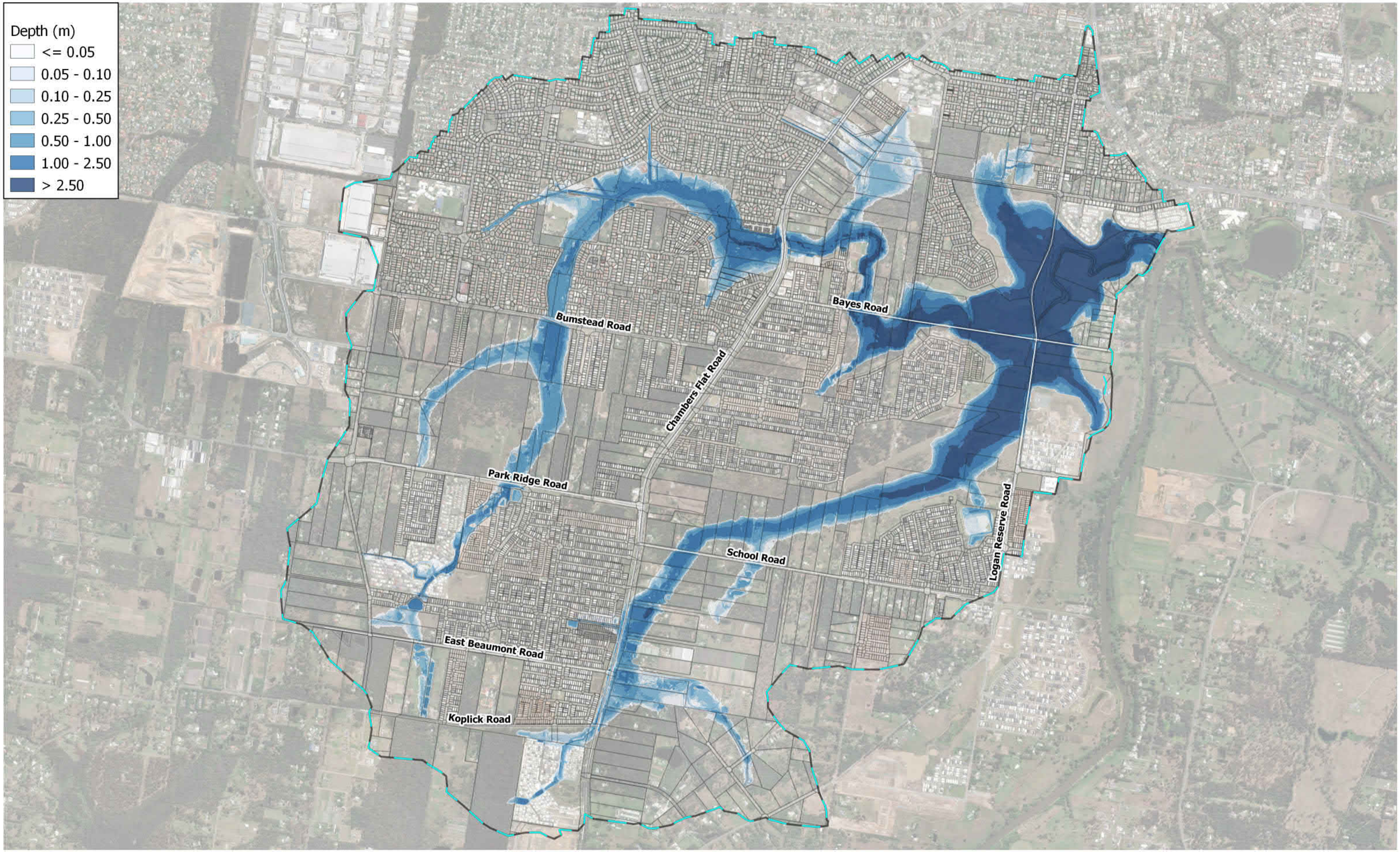
Figure

**E15**

Rev

**0**




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Depth - 0.2% AEP with Climate Change (RCP4.5)**

Figure: **E16**

Rev: **0**

Scale at A3 1:21000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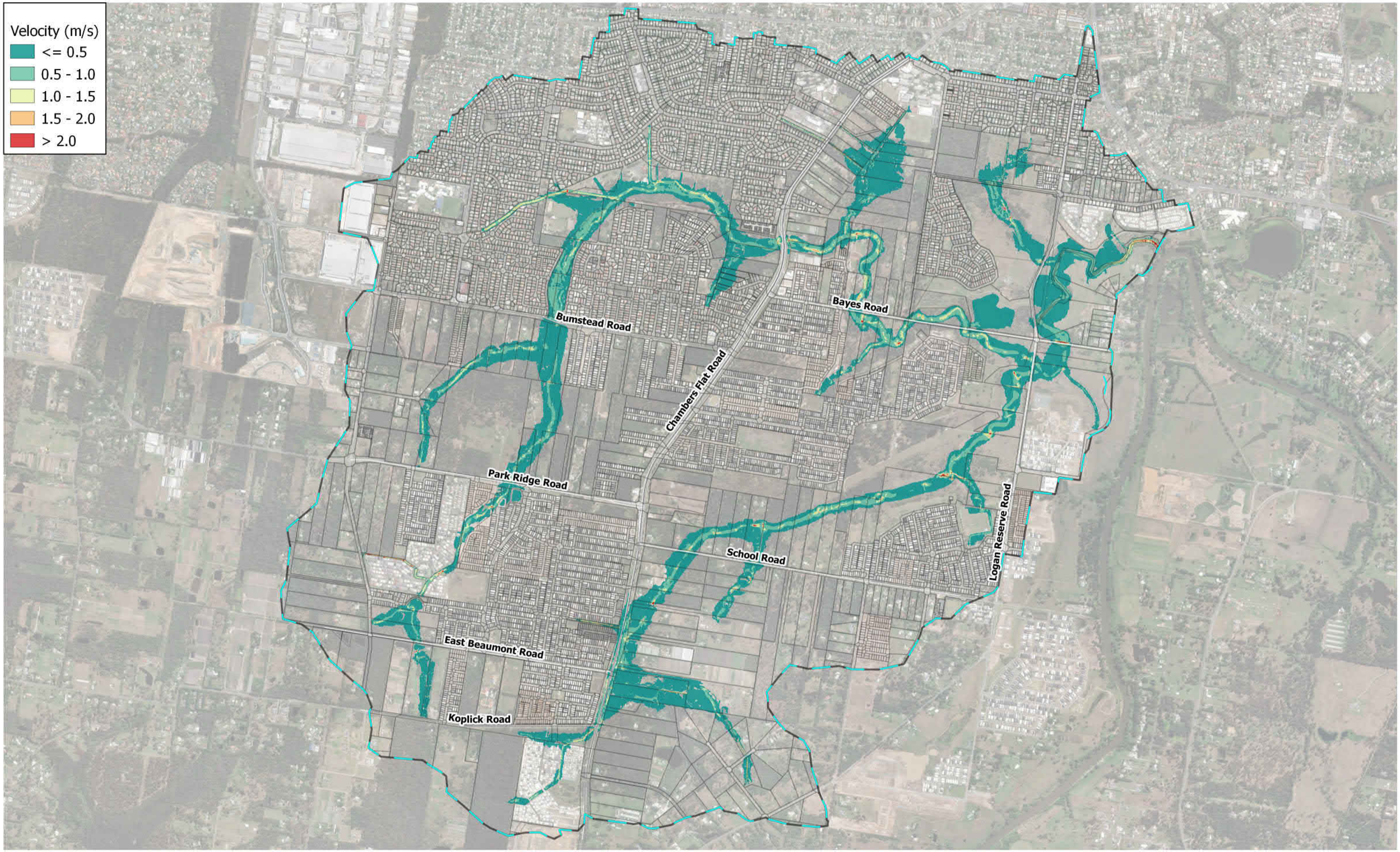


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping
# Flood Velocity - 50% AEP with Climate Change (RCP4.5)

Figure: E17

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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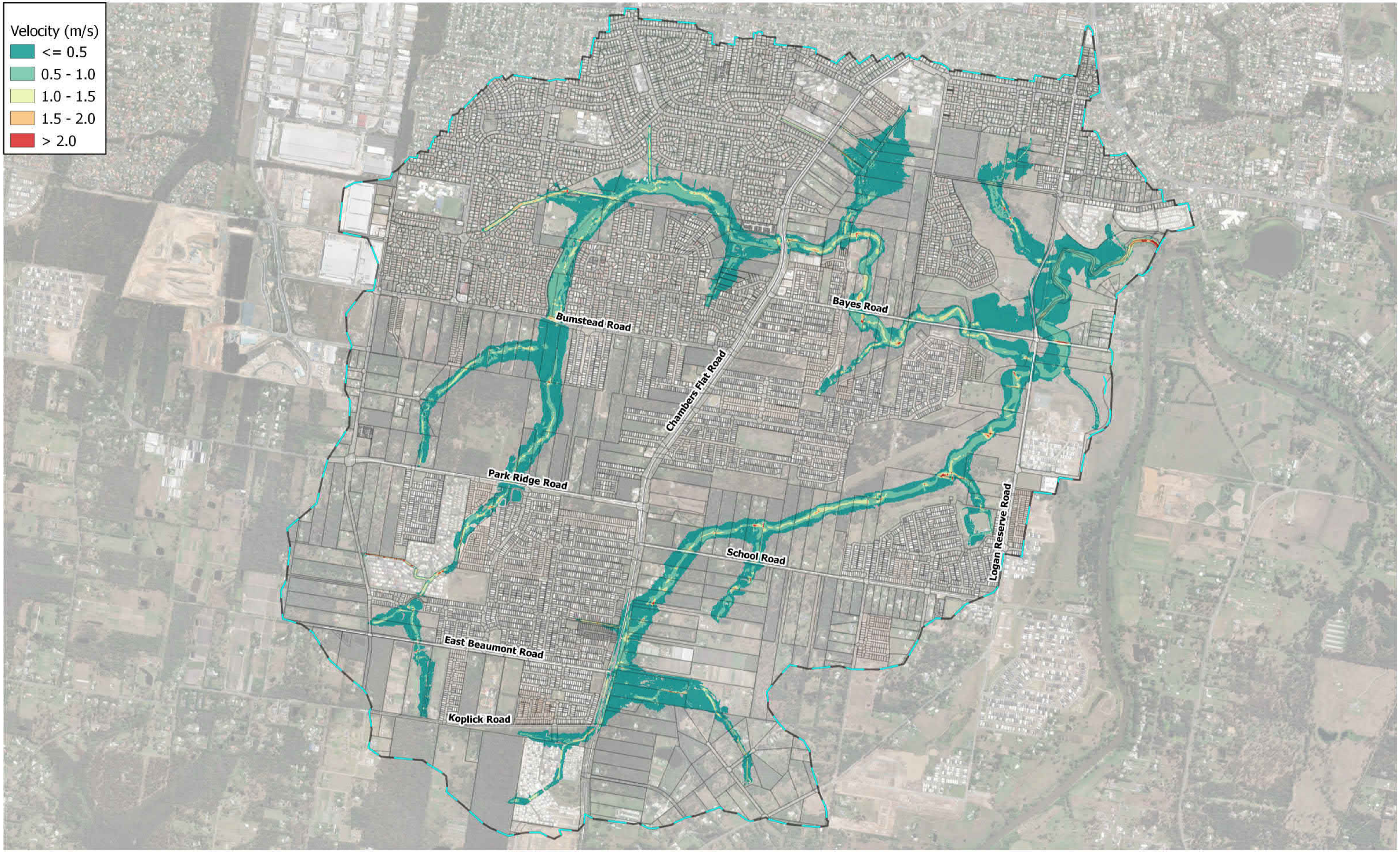


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Velocity - 20% AEP with Climate Change (RCP4.5)**

Figure: E18

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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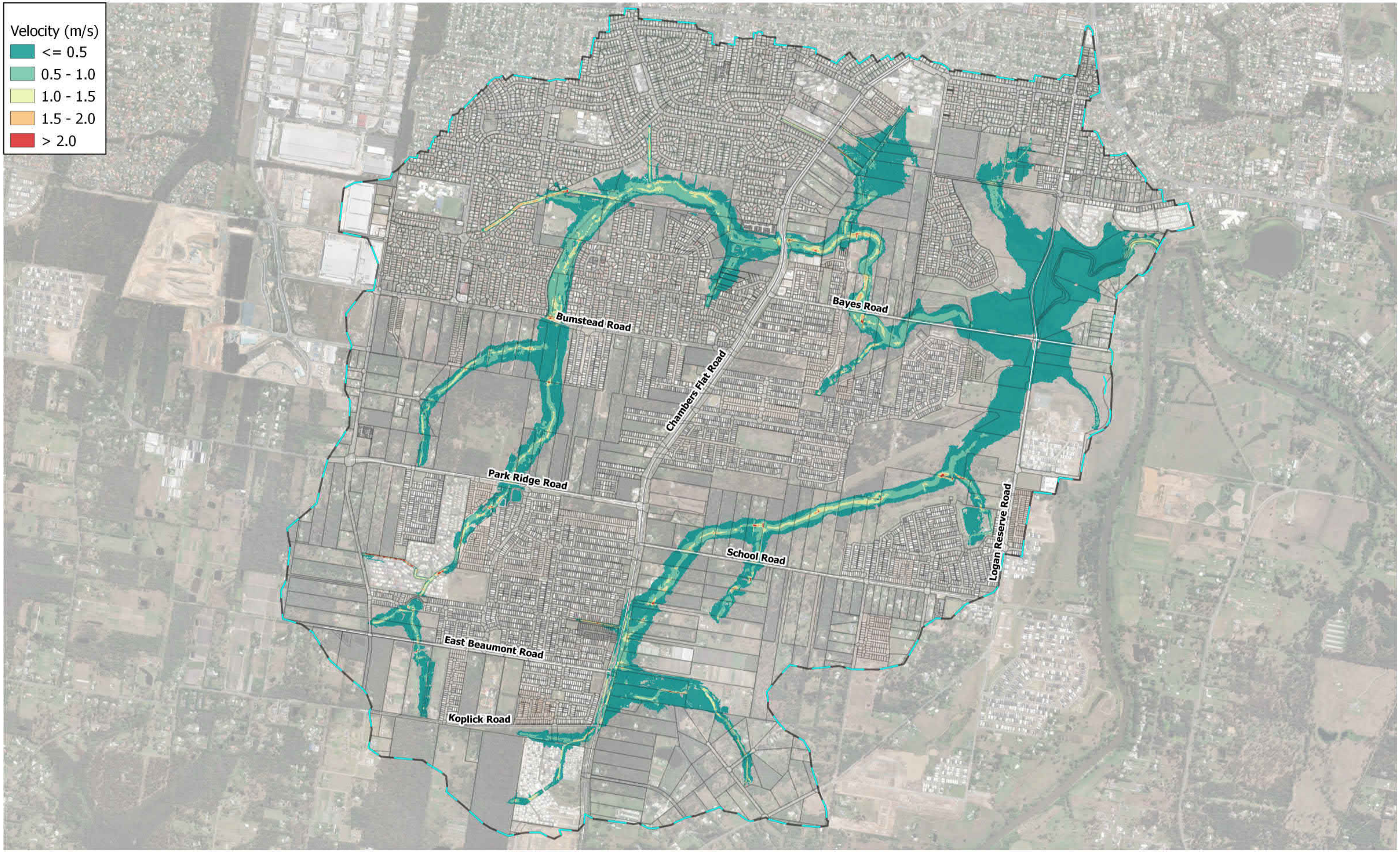


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Velocity - 10% AEP with Climate Change (RCP4.5)**

Figure: **E19**

Rev: **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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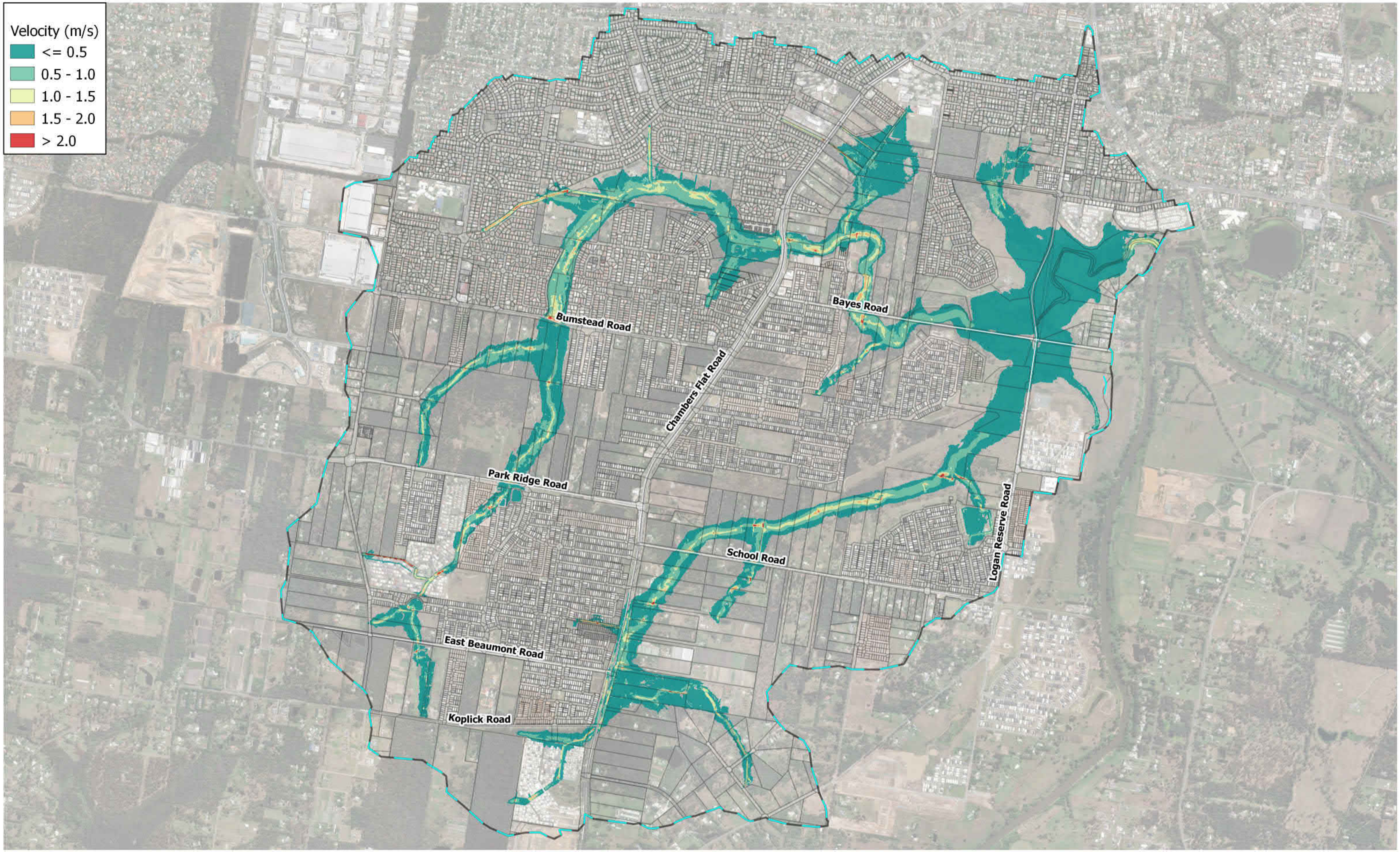


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

## Schmidt's Creek Flood Study - Climate Change Mapping
## Flood Velocity - 5% AEP with Climate Change (RCP4.5)

Figure: **E20**

Rev: **0**

Scale at A3 1:21000



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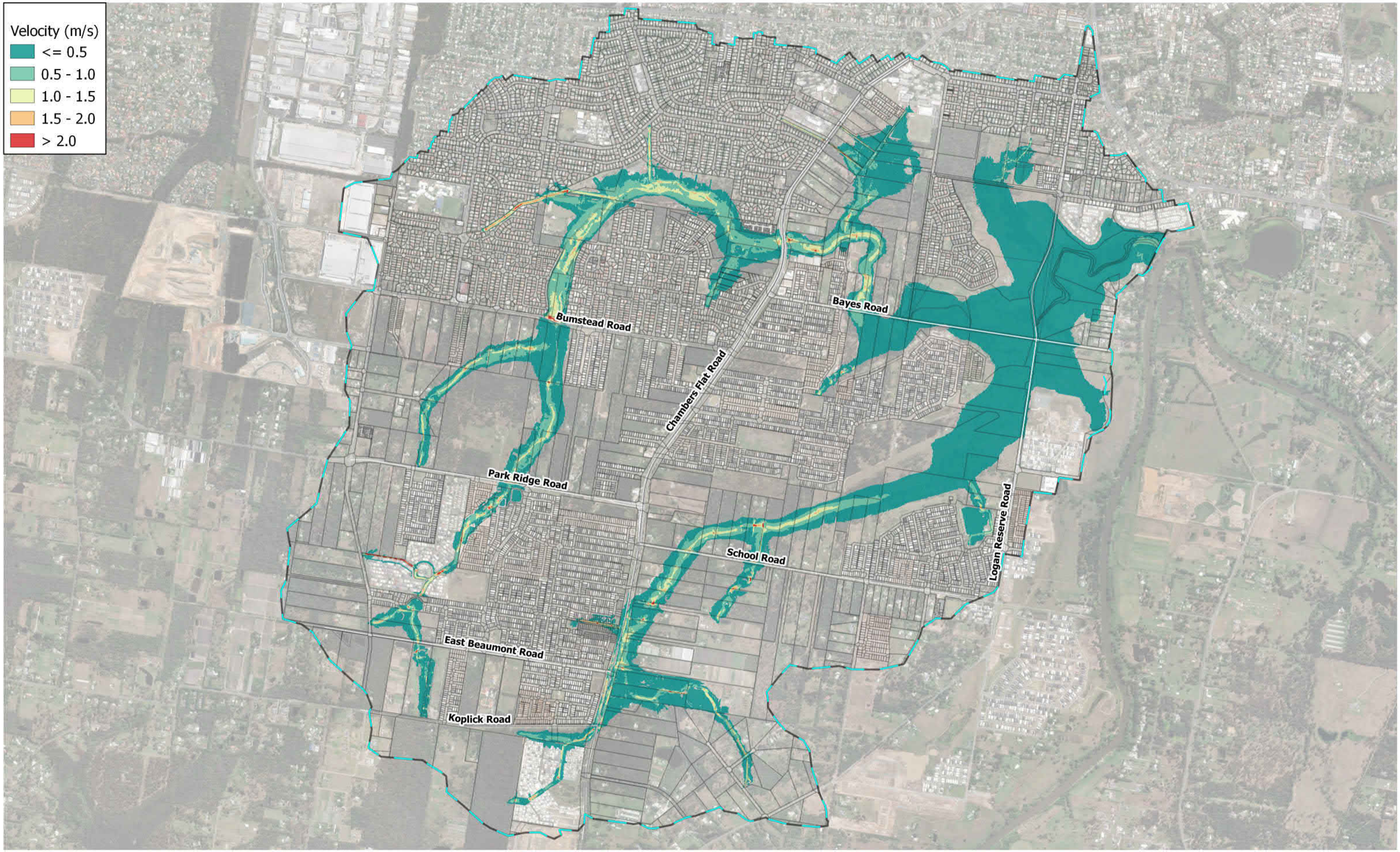


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Velocity - 2% AEP with Climate Change (RCP4.5)**

Figure: **E21**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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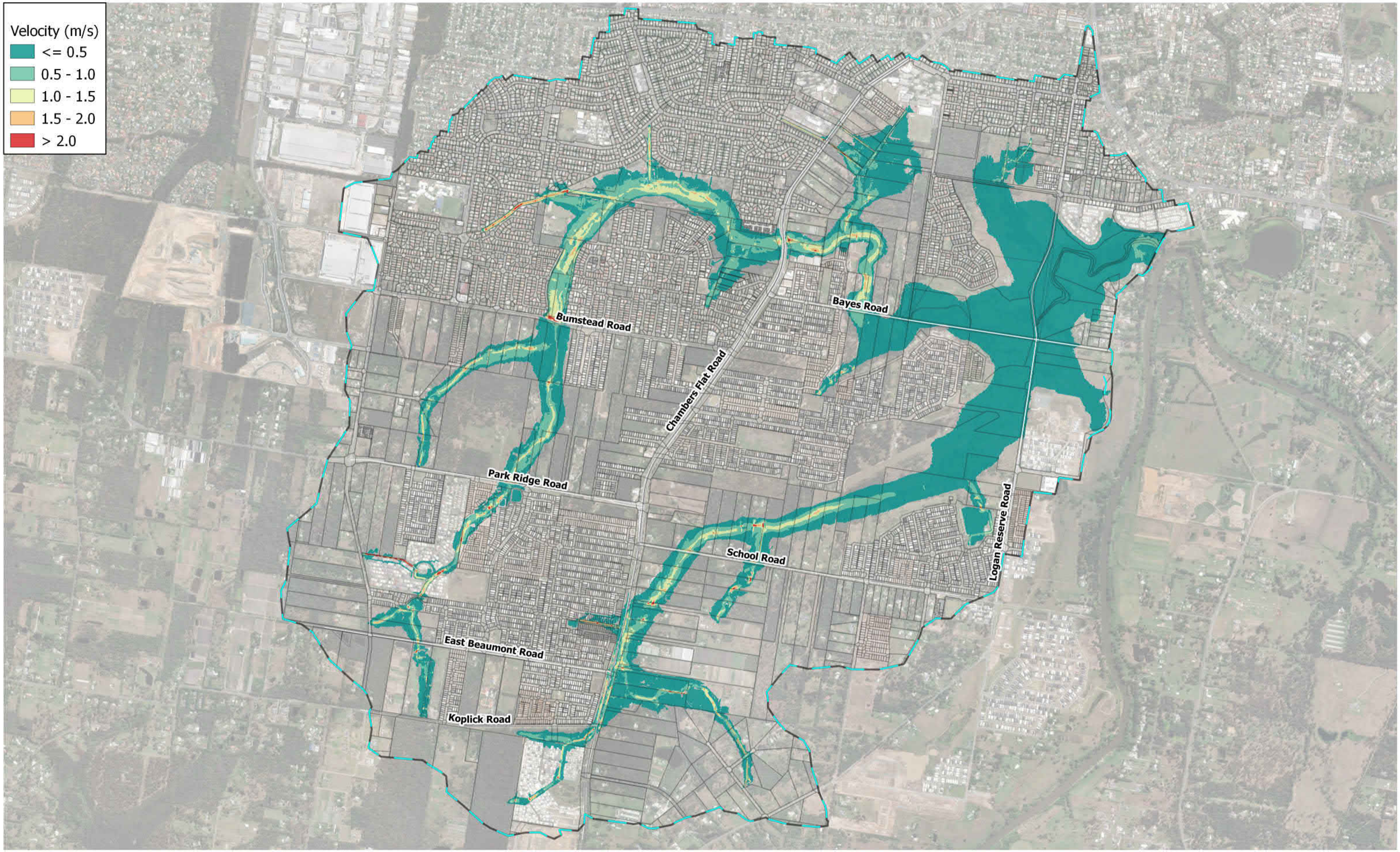


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Velocity - 1% AEP with Climate Change (RCP4.5)**

Figure: **E22** Rev: **0**

Scale at A3 1:21000


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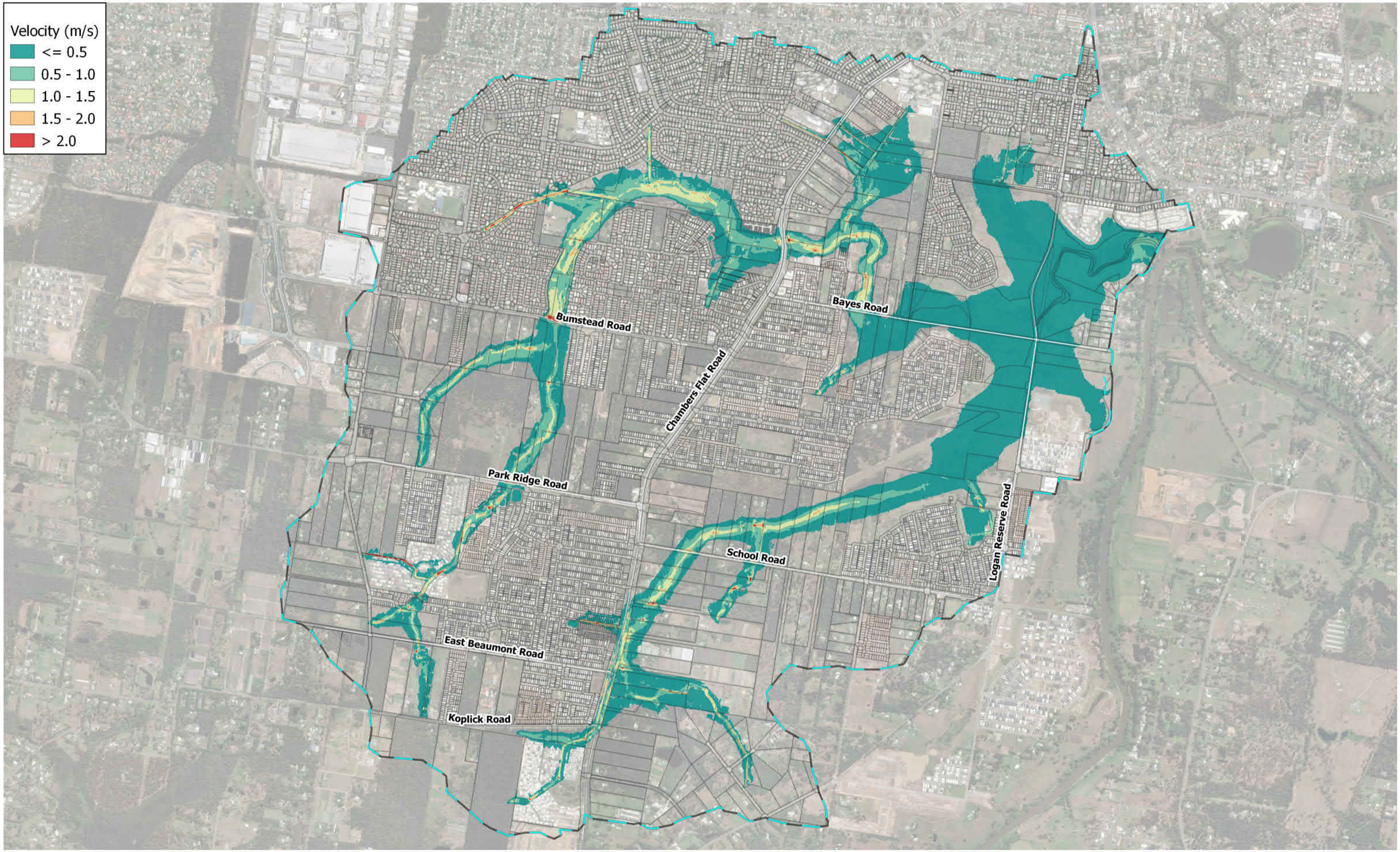



**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

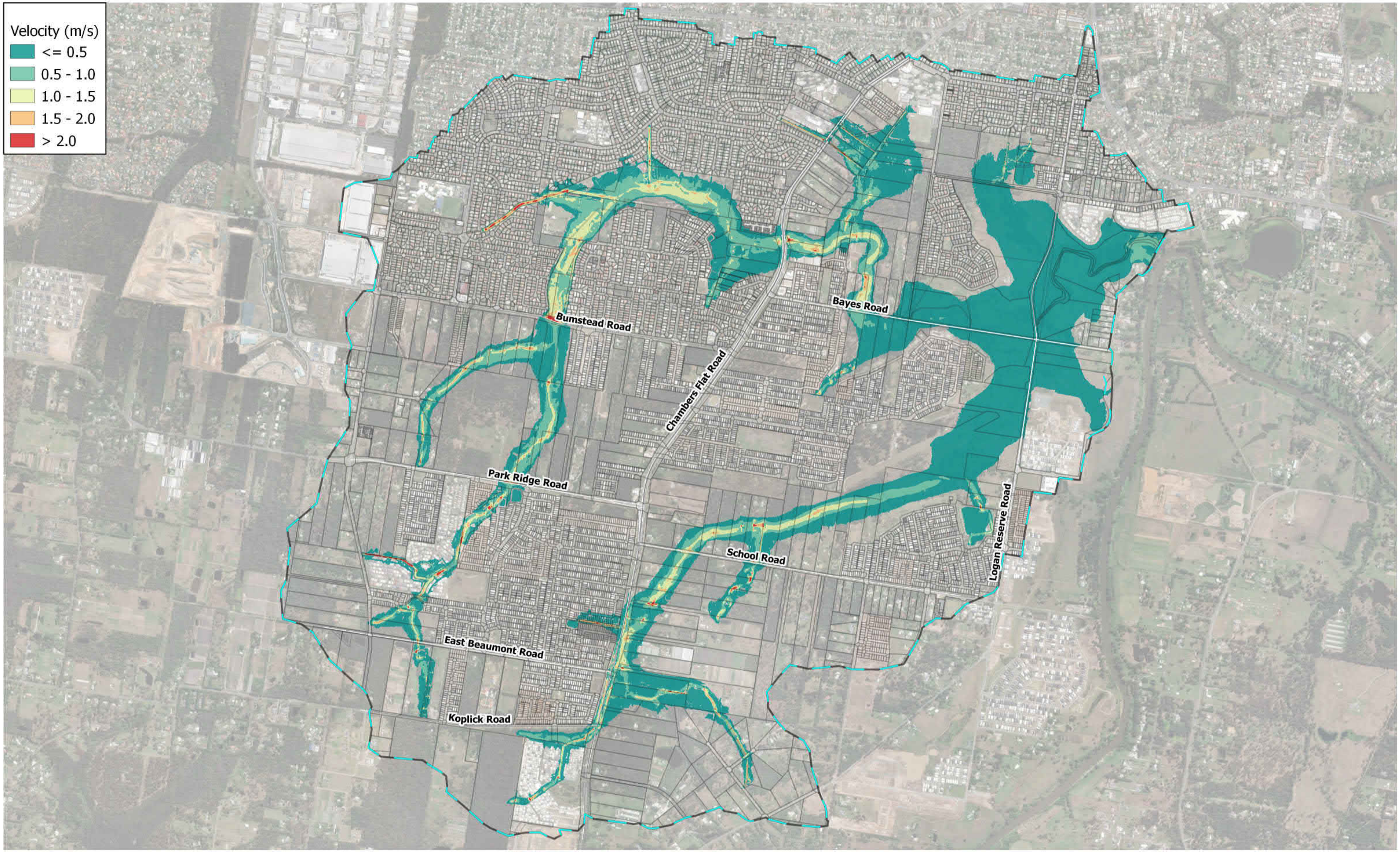
# Schmidt's Creek Flood Study - Climate Change Mapping
# Flood Velocity - 0.5% AEP with Climate Change (RCP4.5)

Figure: E23

Rev: 0



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping Flood Velocity - 0.2% AEP with Climate Change (RCP4.5)

Figure: E24

Rev: 0

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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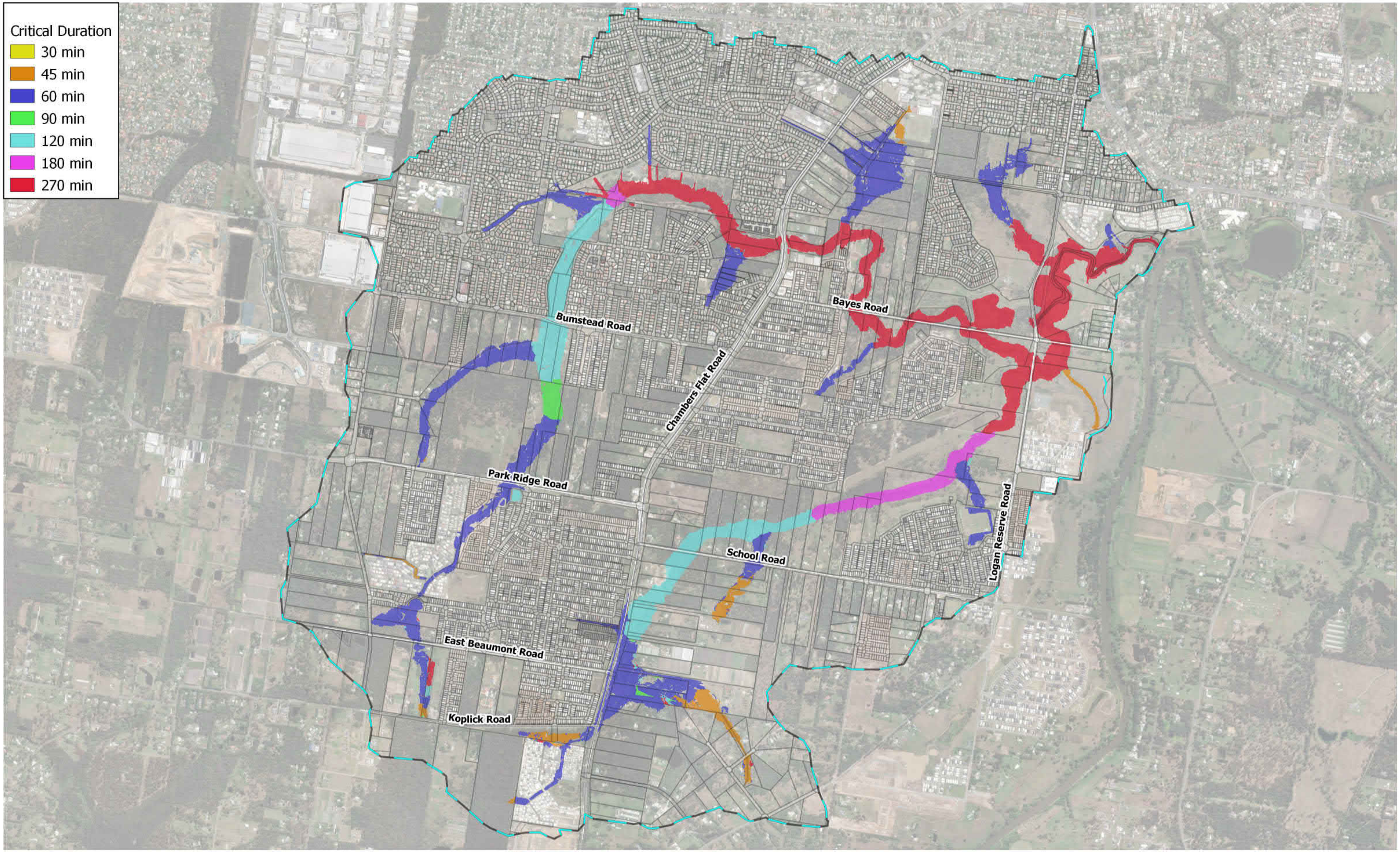


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Critical Duration - 50% AEP with Climate Change (RCP4.5)**

Figure: E25

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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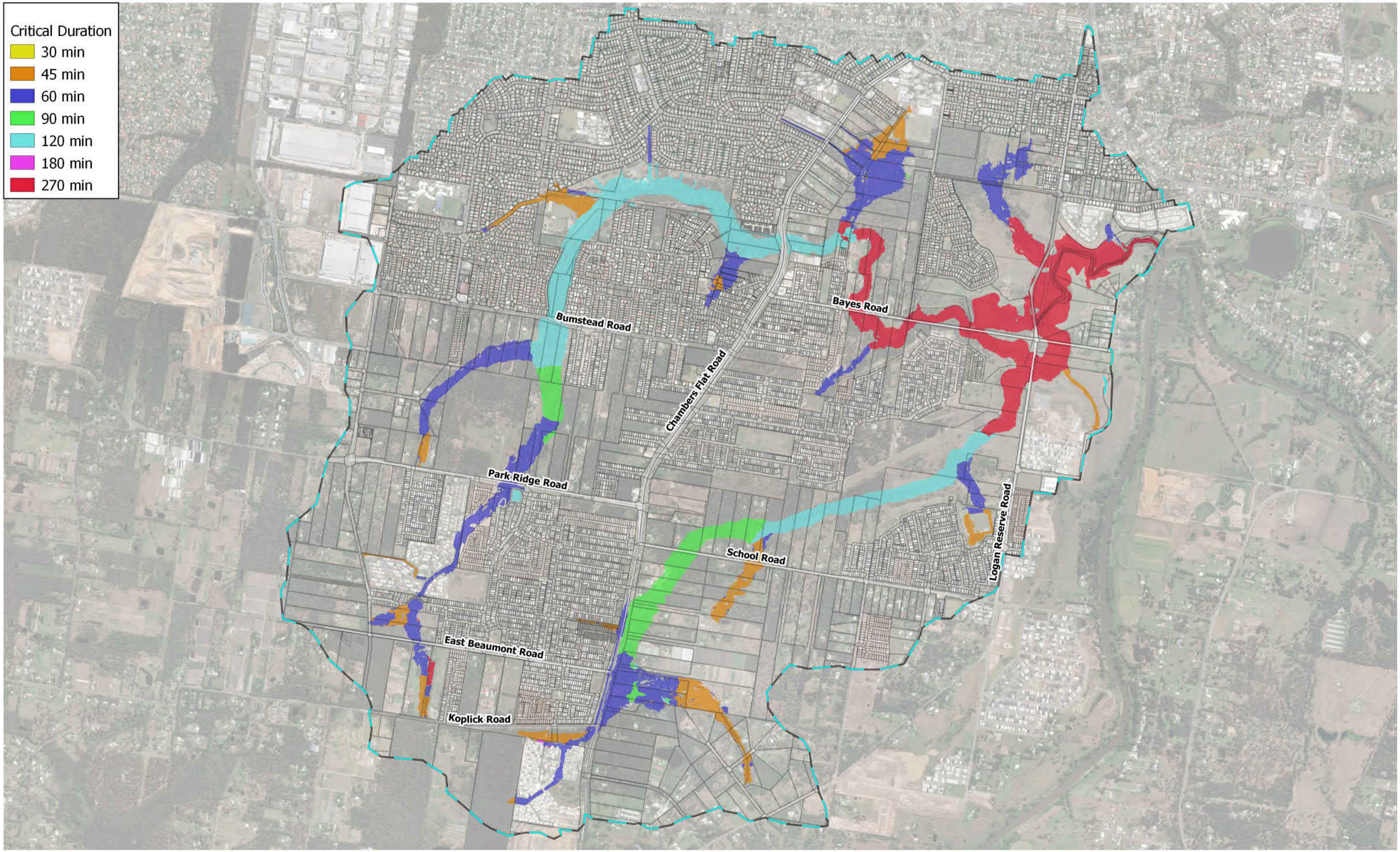


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title:

# Schmidt's Creek Flood Study - Climate Change Mapping
# Critical Duration - 20% AEP with Climate Change (RCP4.5)

Figure: **E26**

Rev: **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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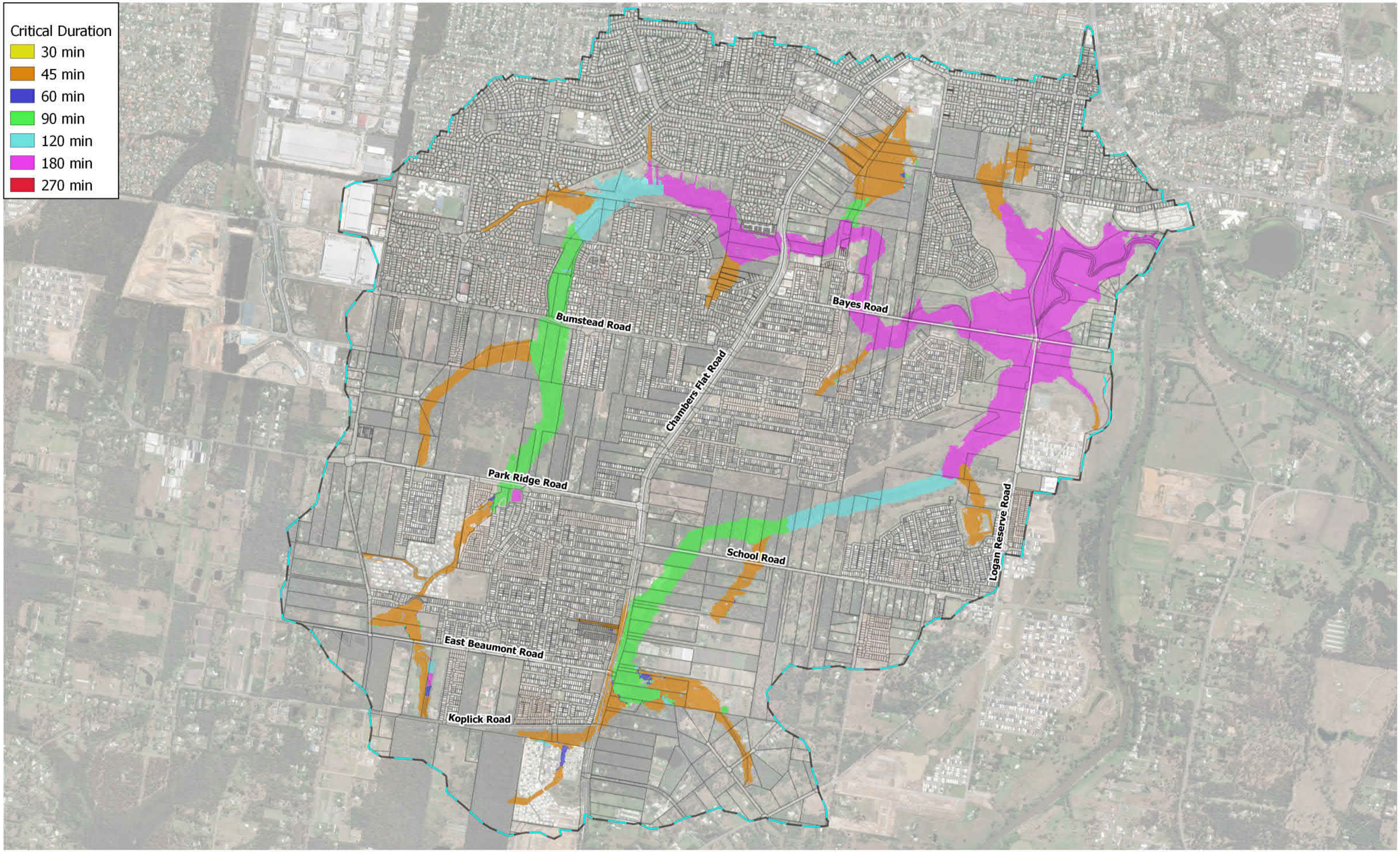


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

## Schmidt's Creek Flood Study - Climate Change Mapping
## Critical Duration - 10% AEP with Climate Change (RCP4.5)

Figure: E27

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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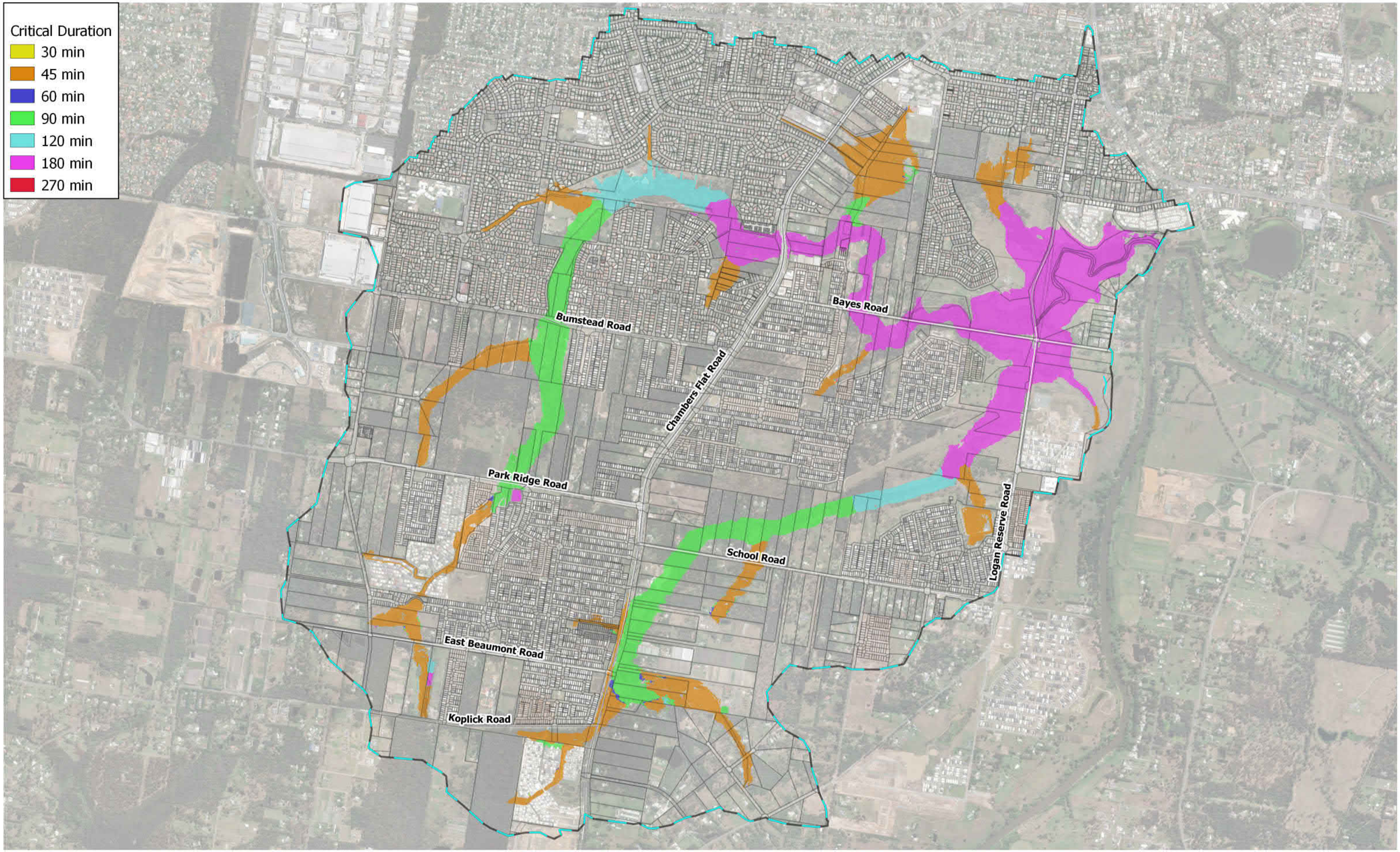


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Critical Duration - 5% AEP with Climate Change (RCP4.5)**

Figure: E28

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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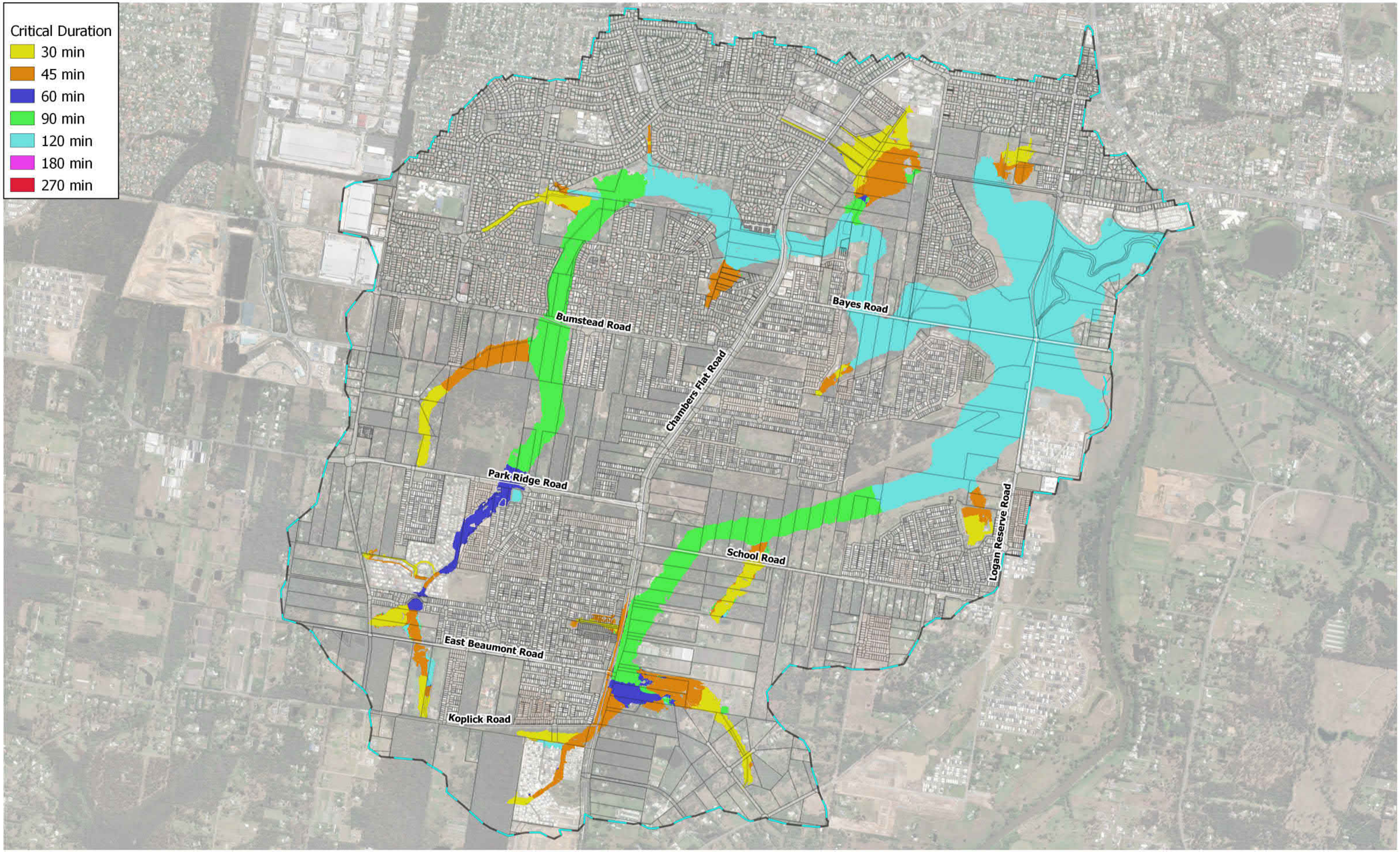


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Critical Duration - 2% AEP with Climate Change (RCP4.5)**

Figure: E29

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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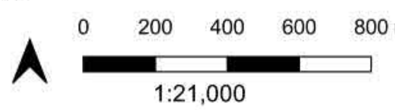

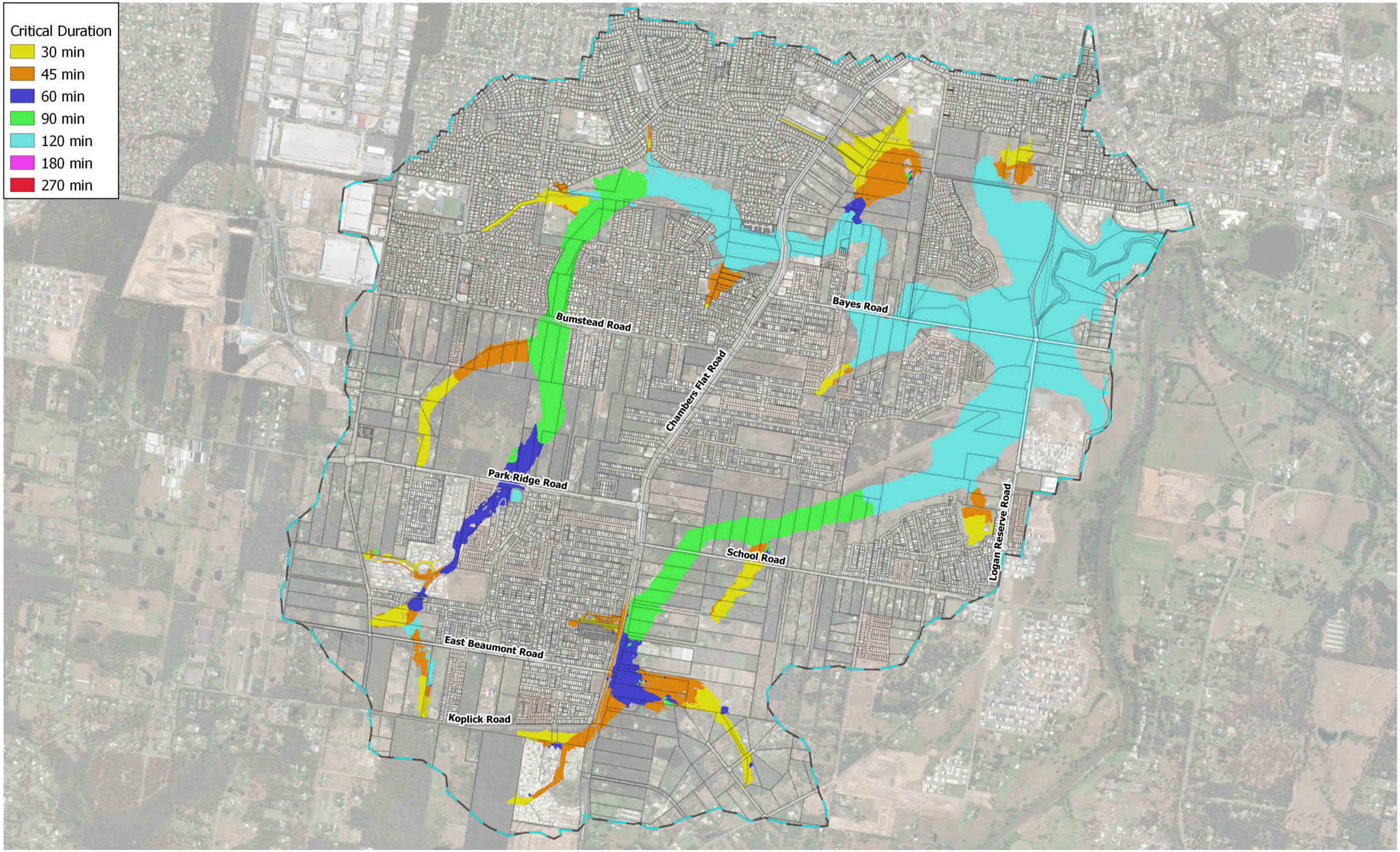


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping
# Critical Duration - 1% AEP with Climate Change (RCP4.5)

Figure: E30

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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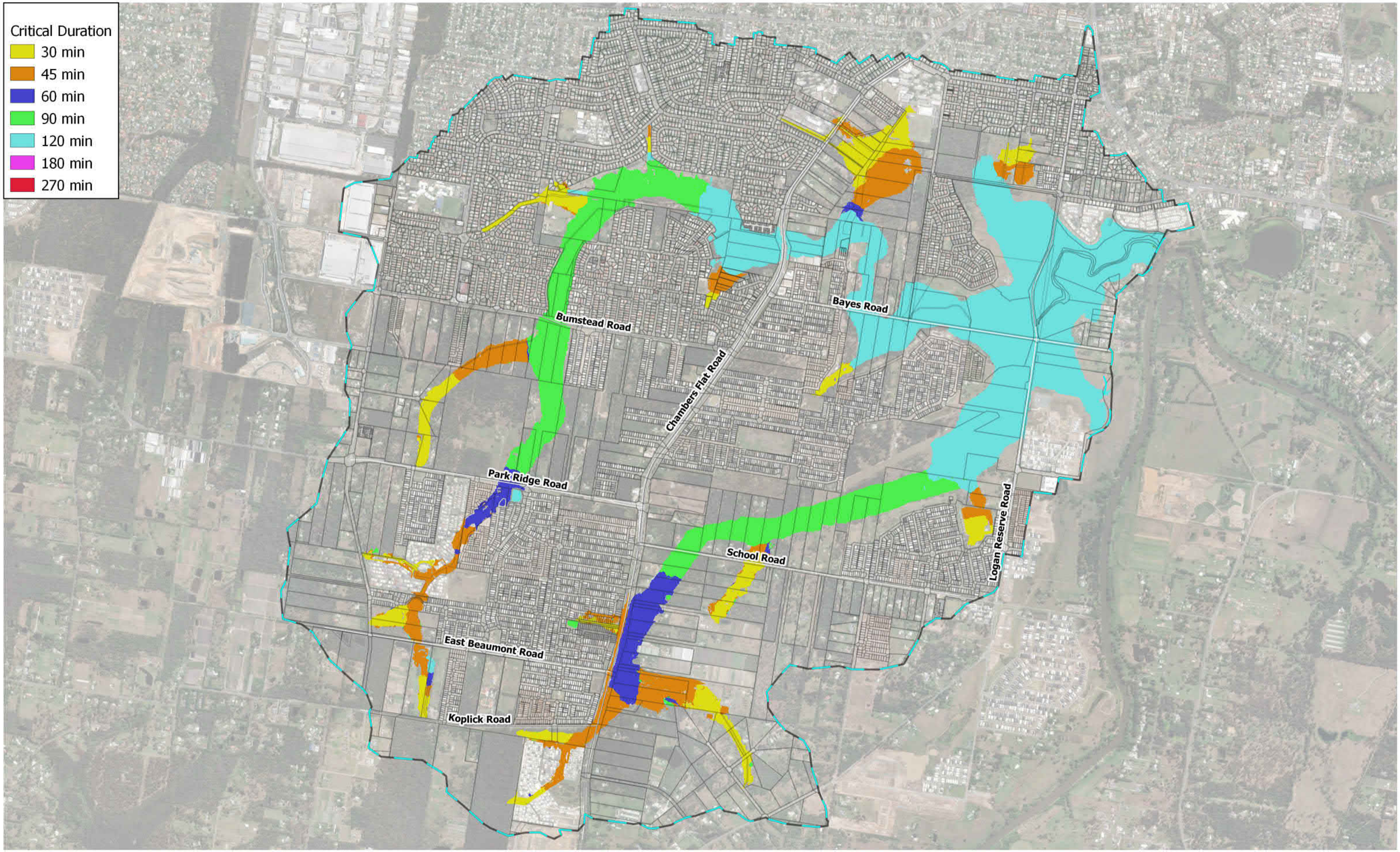


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Critical Duration - 0.5% AEP with Climate Change (RCP4.5)**

Figure: **E31** | Rev: **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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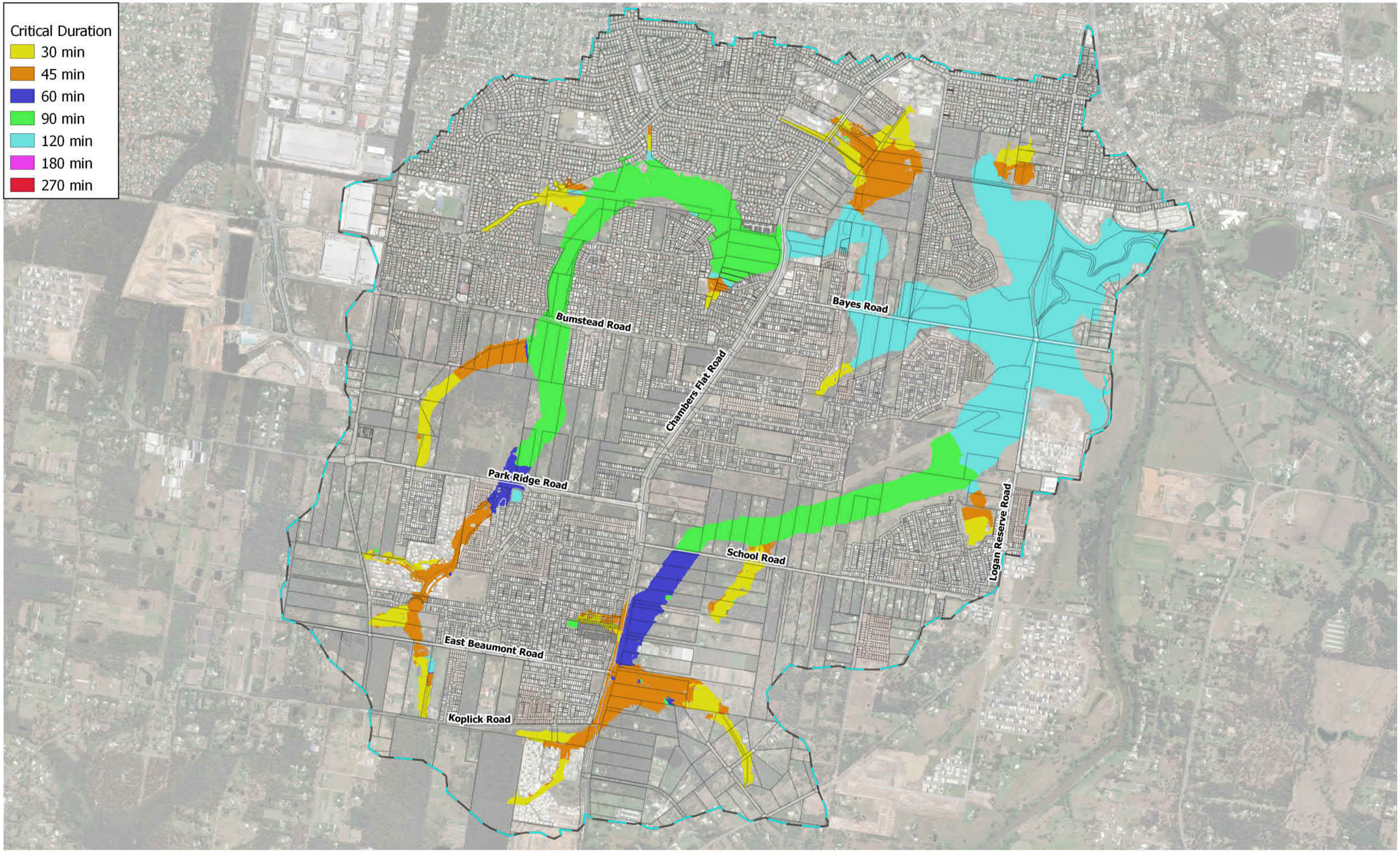


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping
# Critical Duration - 0.2% AEP with Climate Change (RCP4.5)

Figure: E32

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wlg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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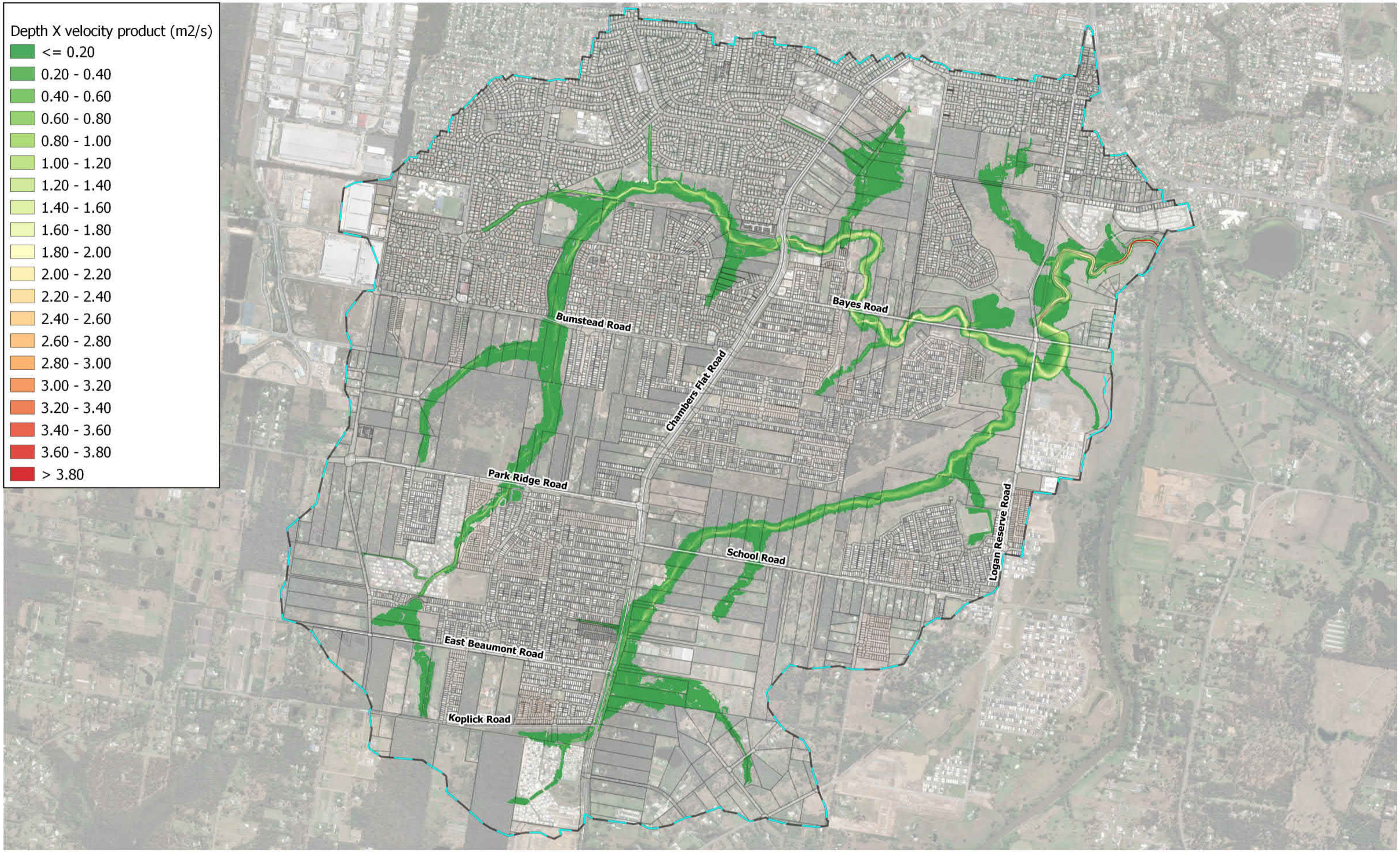


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 50% AEP with Climate Change (RCP4.5)**

Figure: E33

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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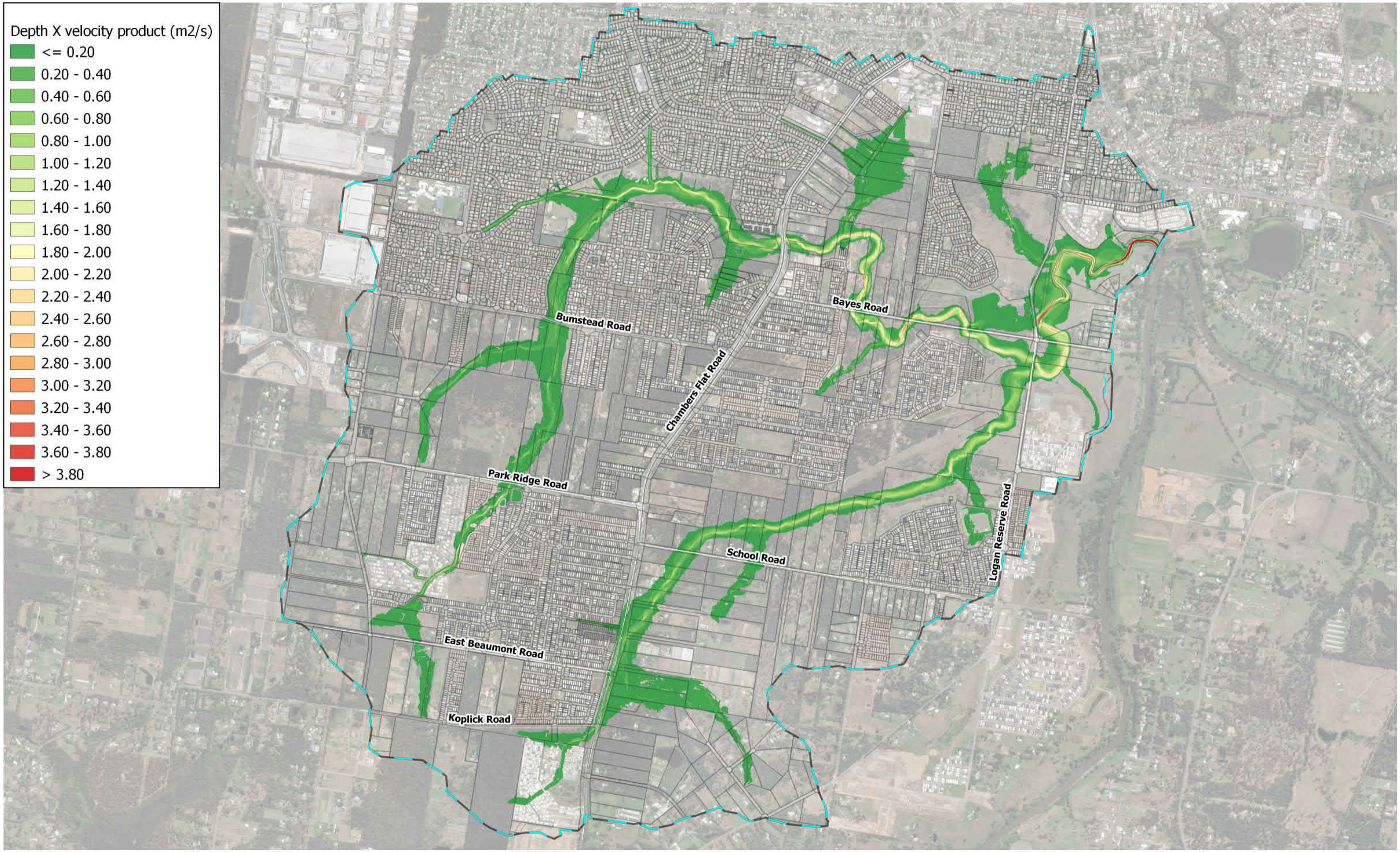


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 20% AEP with Climate Change (RCP4.5)**

Scale at A3 1:21000
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File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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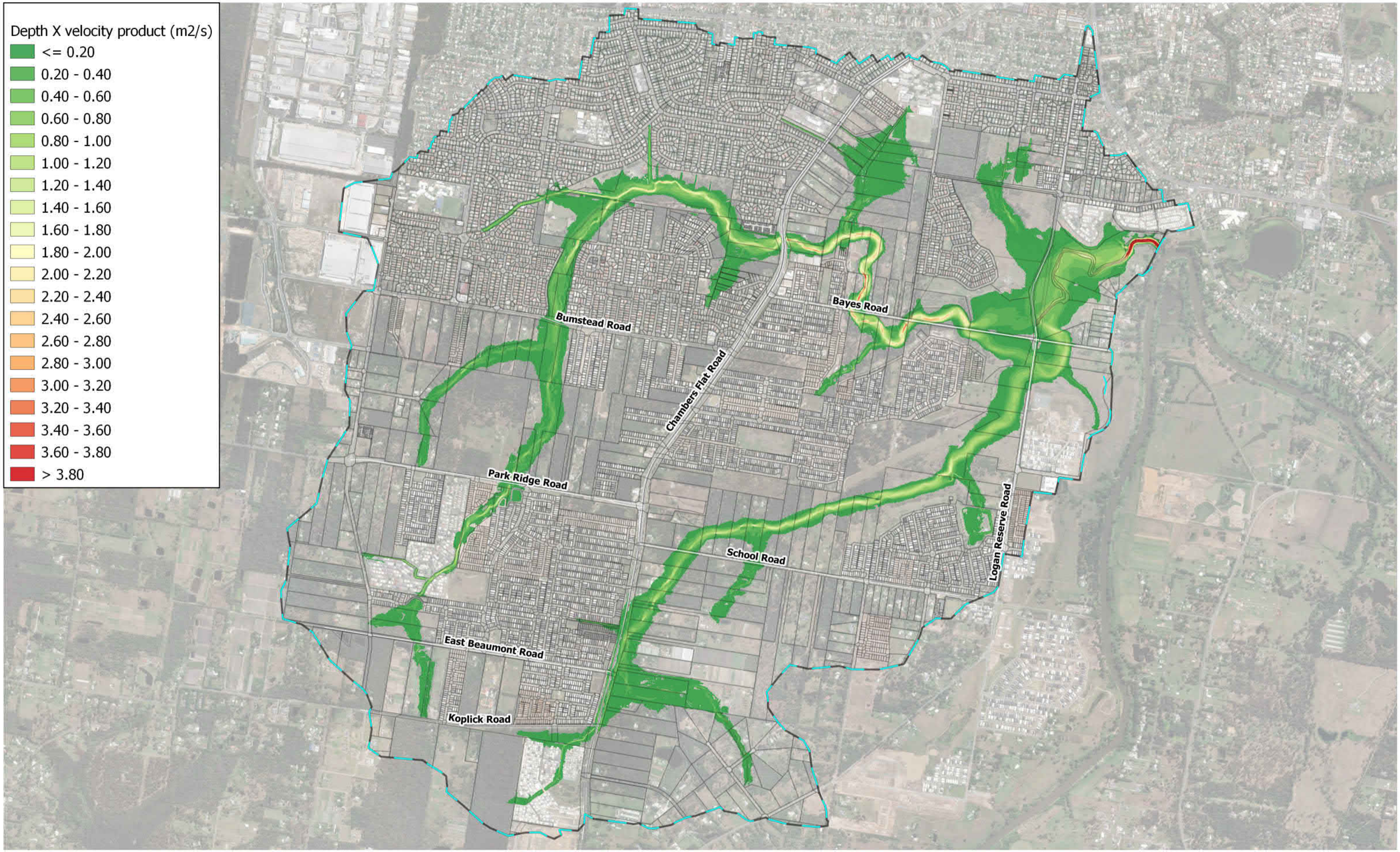
1:21,000

Figure

E34

Rev

0




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 10% AEP with Climate Change (RCP4.5)**

Figure: **E35**

Rev: **0**

Scale at A3 1:21000
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Scale:

0 200 400 600 800 m

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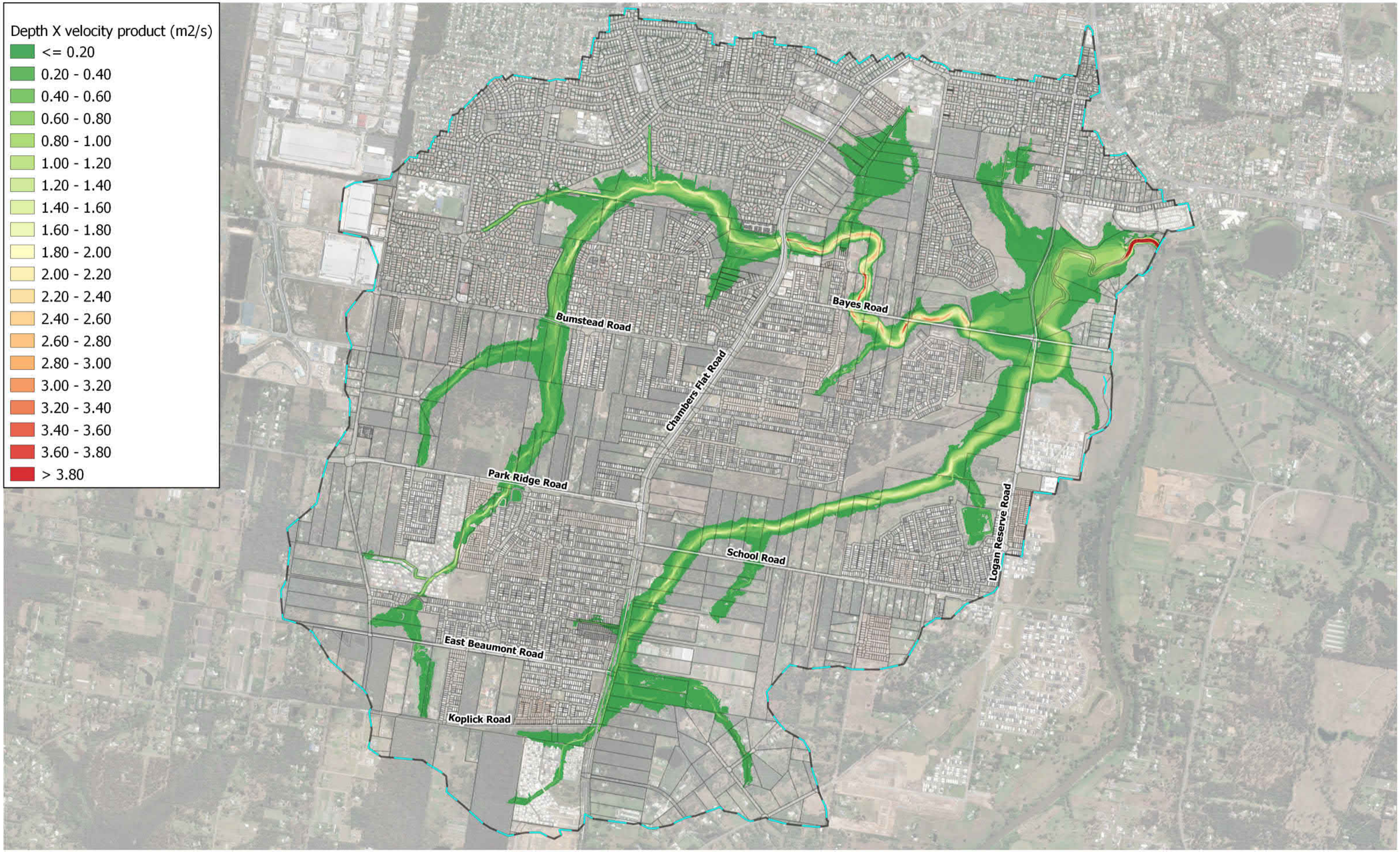


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 5% AEP with Climate Change (RCP4.5)**

Figure **E36**

Rev **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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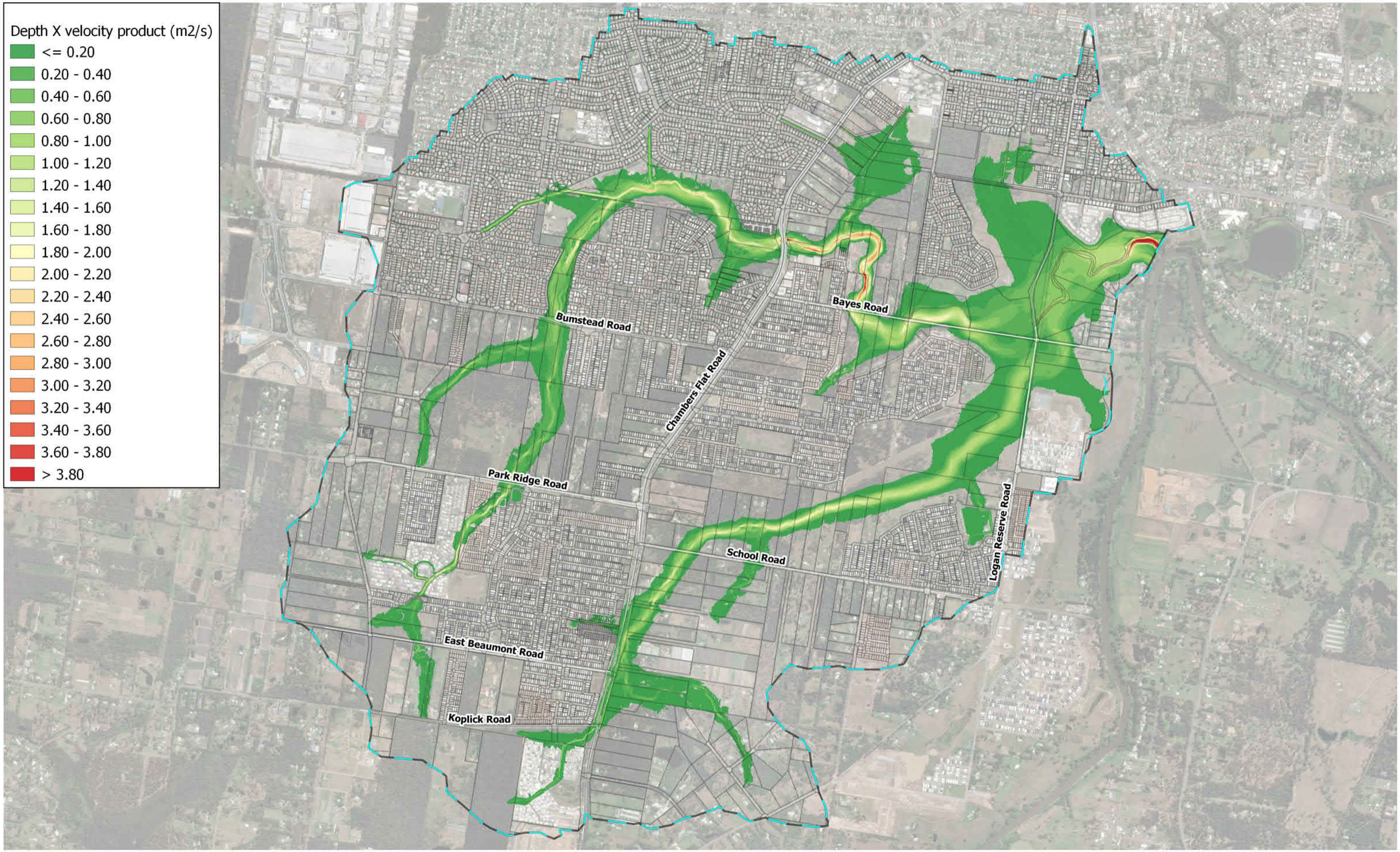


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title:

# Schmidt's Creek Flood Study - Climate Change Mapping
# Flood Hazard (D x V) - 2% AEP with Climate Change (RCP4.5)

Figure: E37

Rev: 0

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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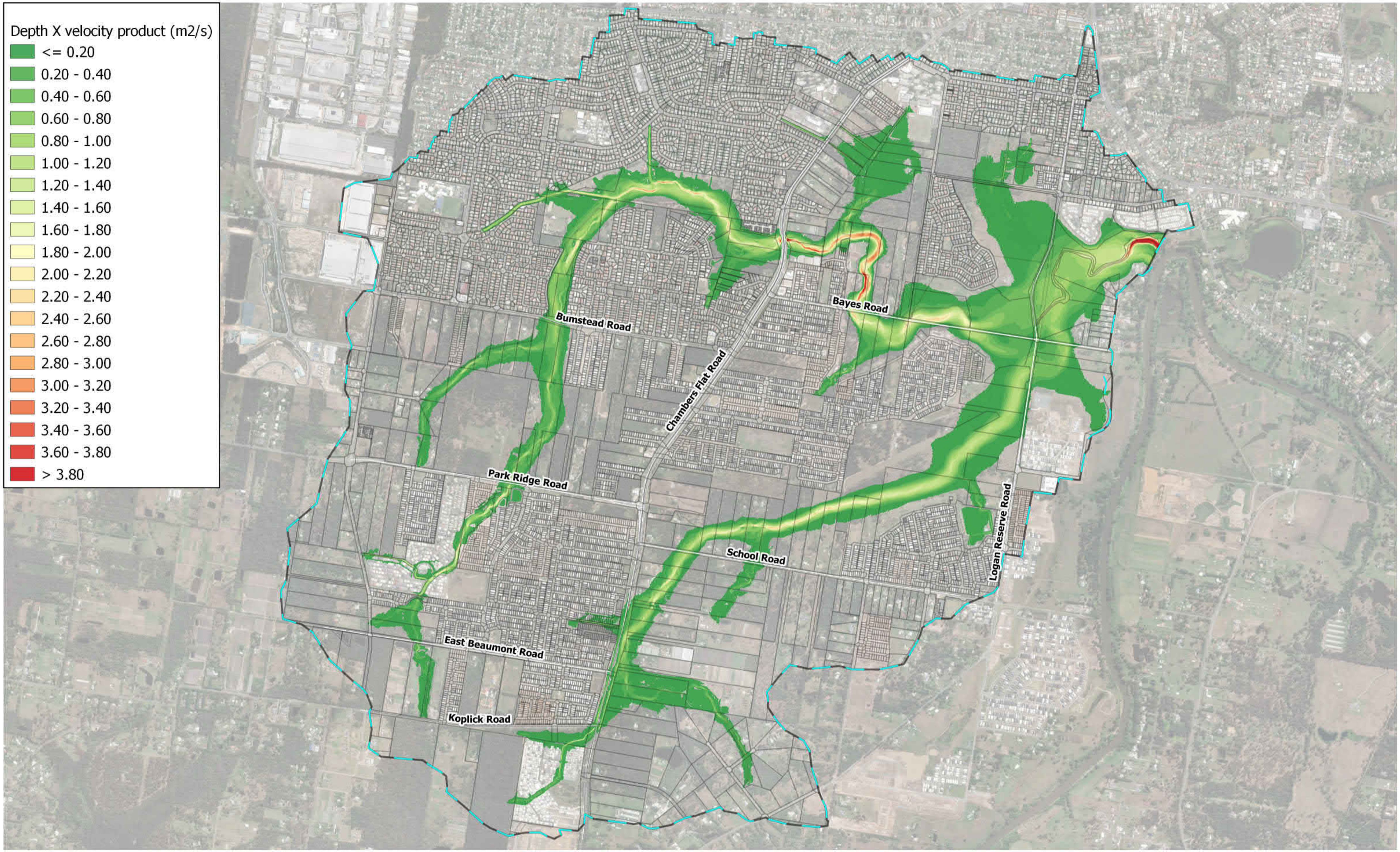


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 1% AEP with Climate Change (RCP4.5)**

Figure: **E38**

Rev: **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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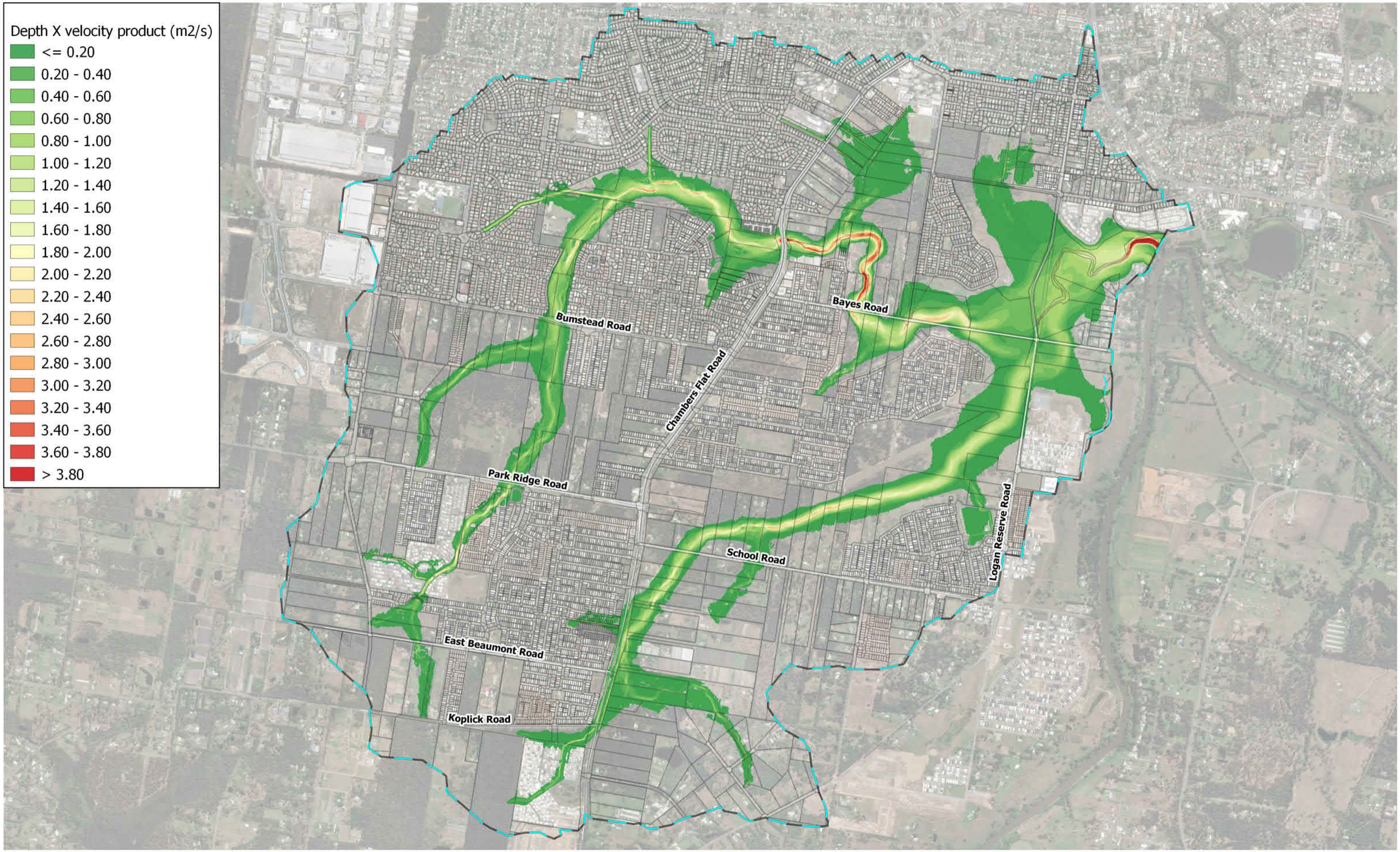
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 0.5% AEP with Climate Change (RCP4.5)**

Figure: **E39**

Rev: **0**

Scale at A3 1:21000
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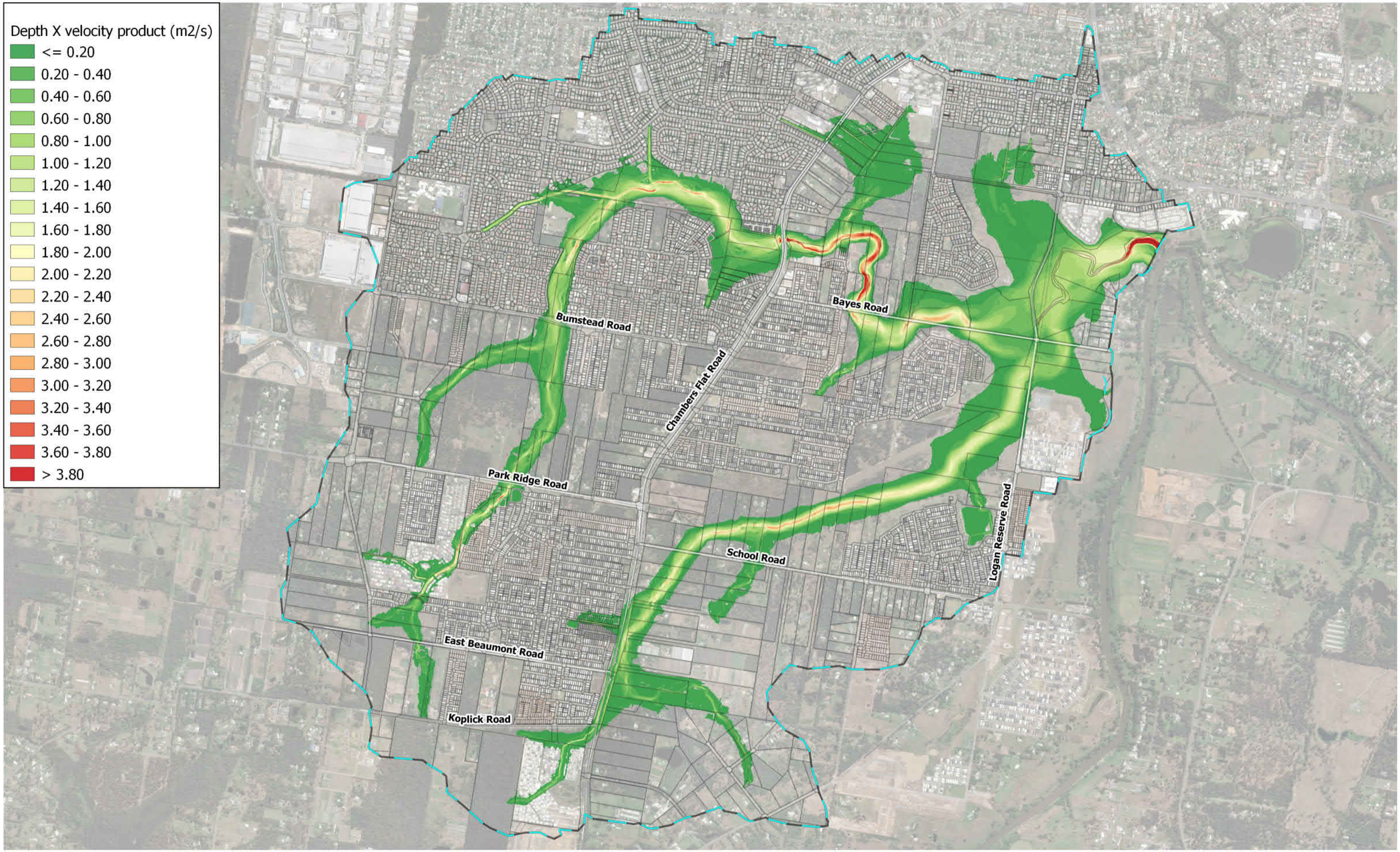
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (D x V) - 0.2% AEP with Climate Change (RCP4.5)**

Figure: **E40**

Rev: **0**

Scale at A3 1:21000
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Scale:

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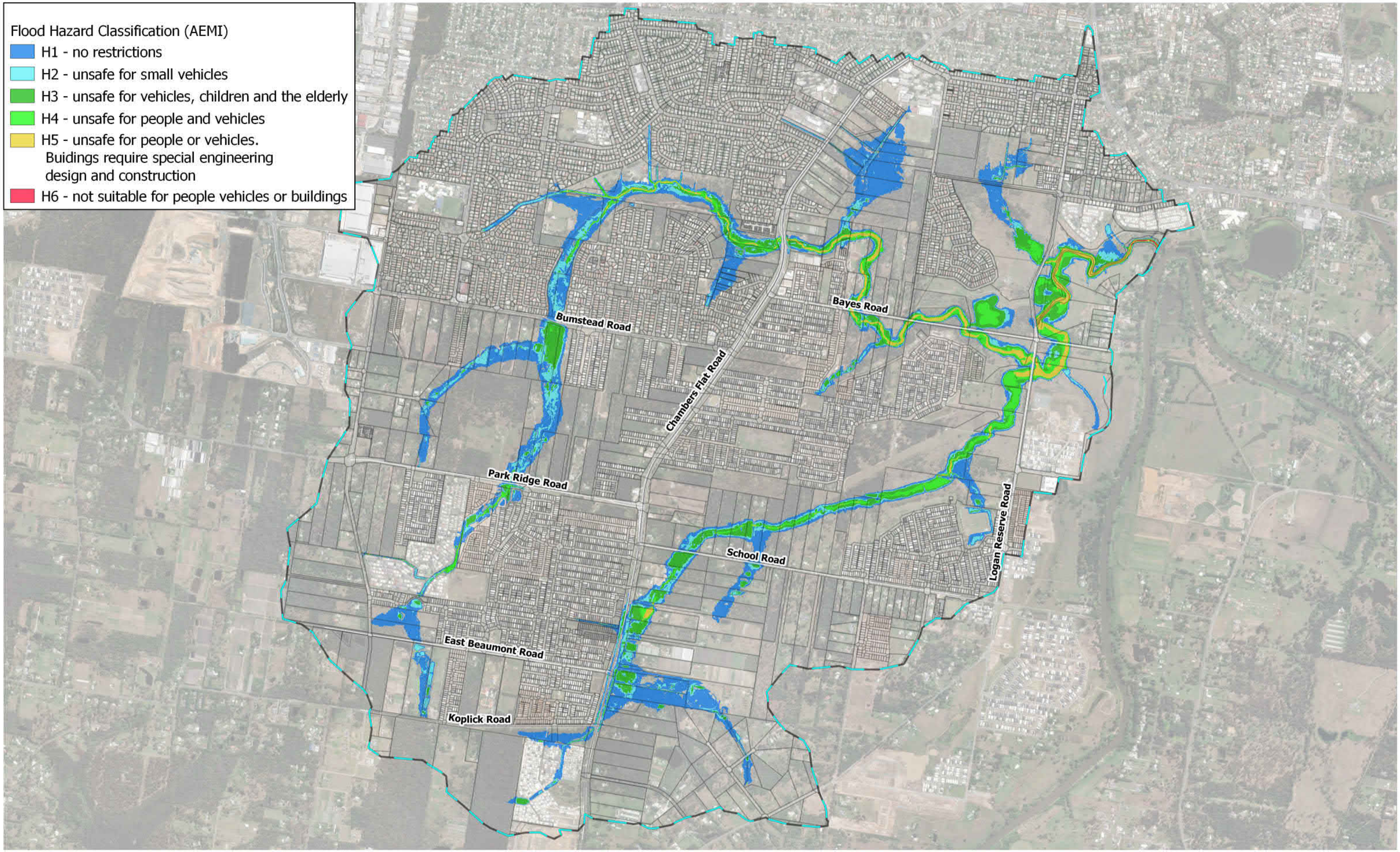
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping Flood Hazard (ZAEM1) - 50% AEP with Climate Change (RCP4.5)

Figure: E41

Rev: 0

Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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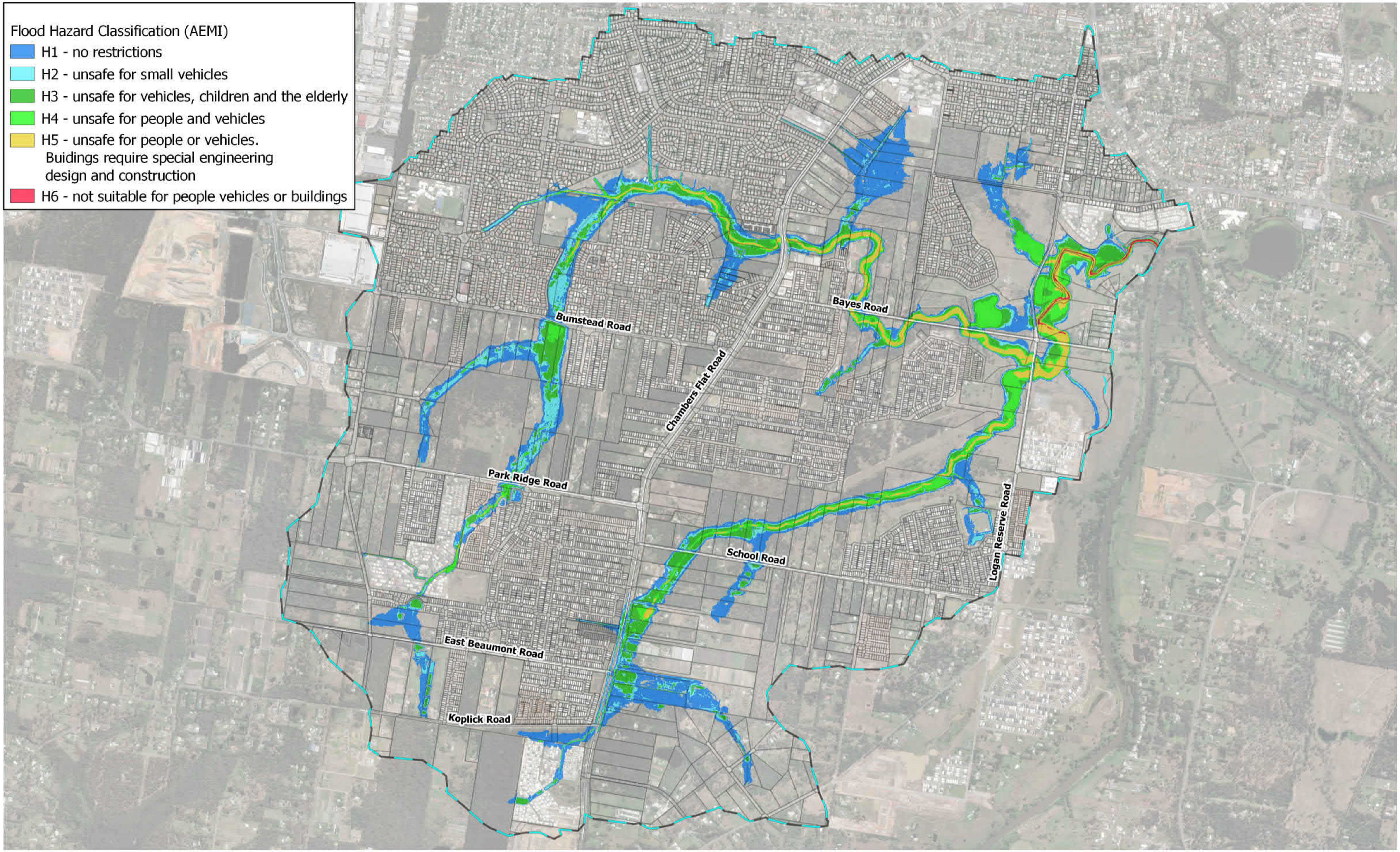
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (ZAEM1) - 20% AEP with Climate Change (RCP4.5)**

Figure: E42

Rev: 0

Scale at A3 1:21000





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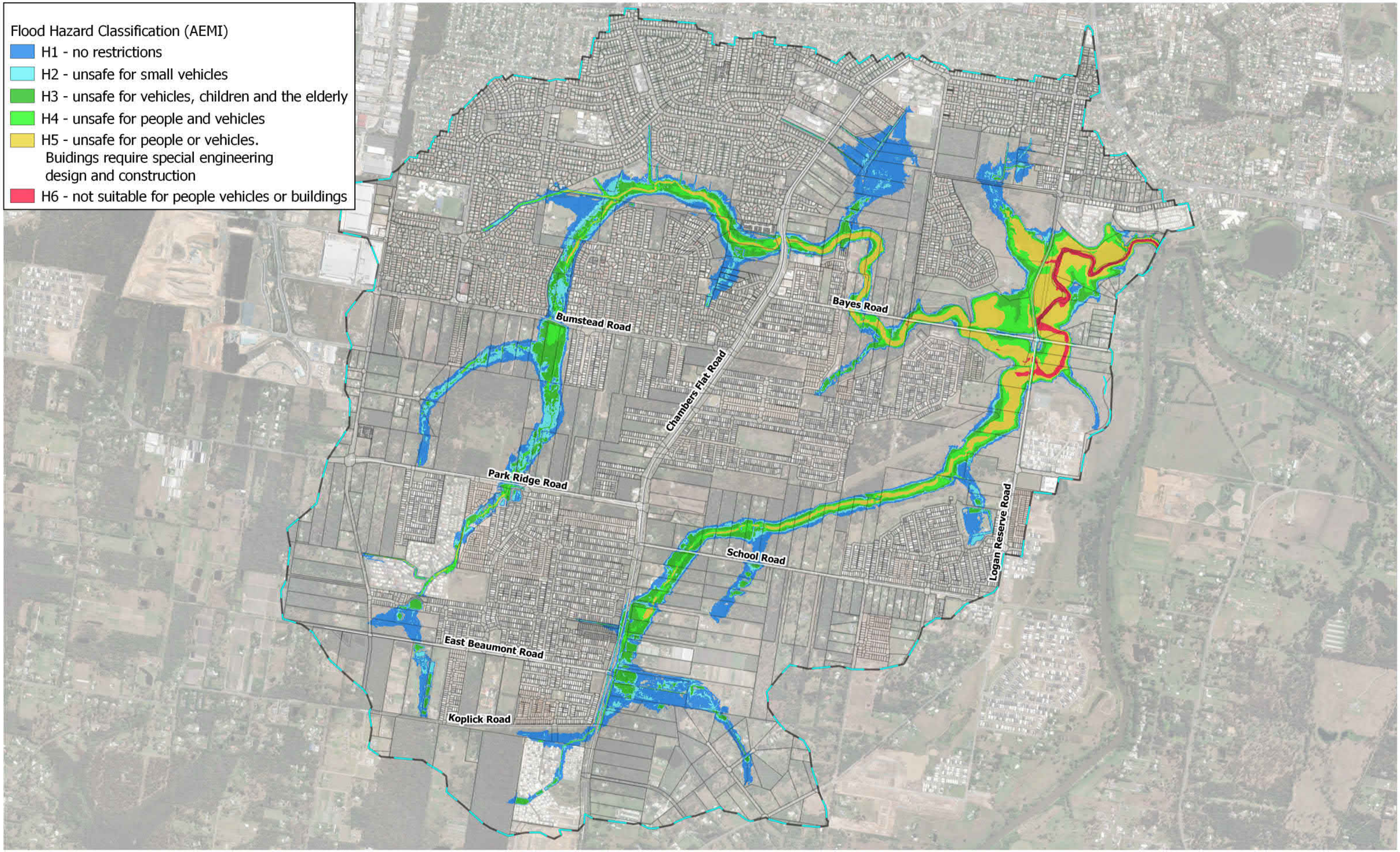
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (ZAEM1) - 10% AEP with Climate Change (RCP4.5)**

Figure: **E43**

Rev: **0**

Scale at A3 1:21000
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Scale:

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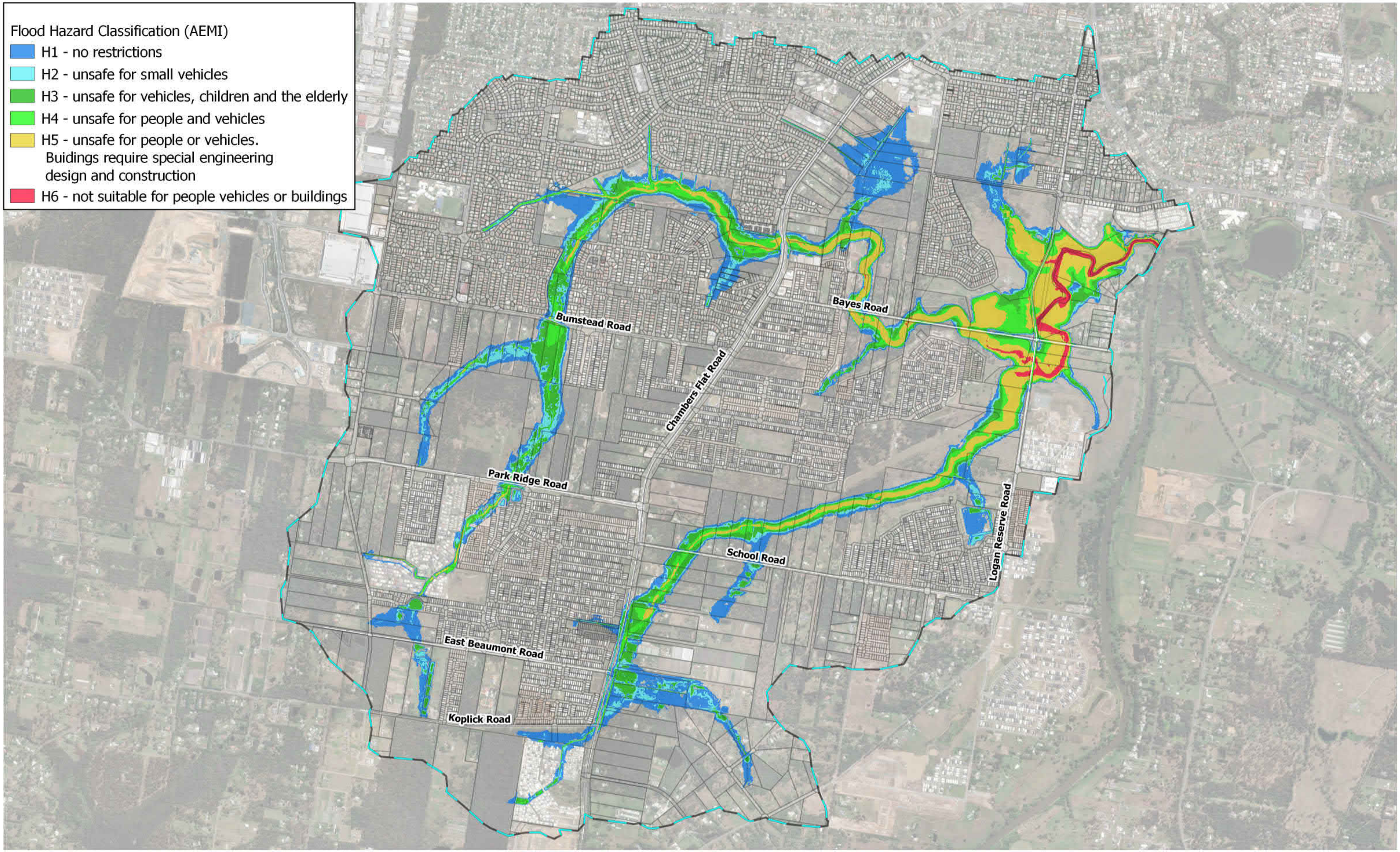
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

# Schmidt's Creek Flood Study - Climate Change Mapping Flood Hazard (ZAEM1) - 5% AEP with Climate Change (RCP4.5)

Figure: E44

Rev: 0

Scale at A3 1:21000





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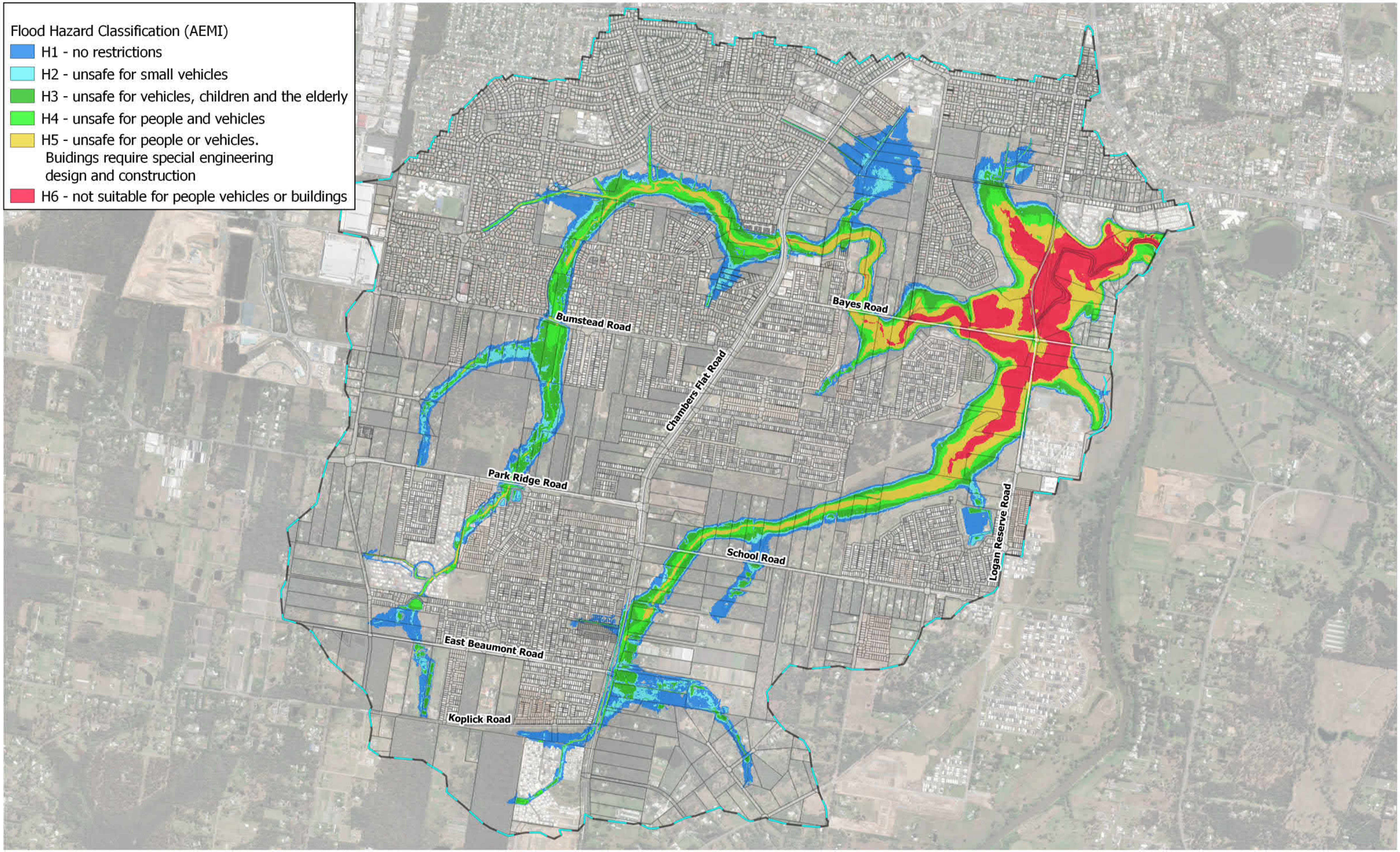
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (ZAEM1) - 2% AEP with Climate Change (RCP4.5)**

Figure: E45

Rev: 0

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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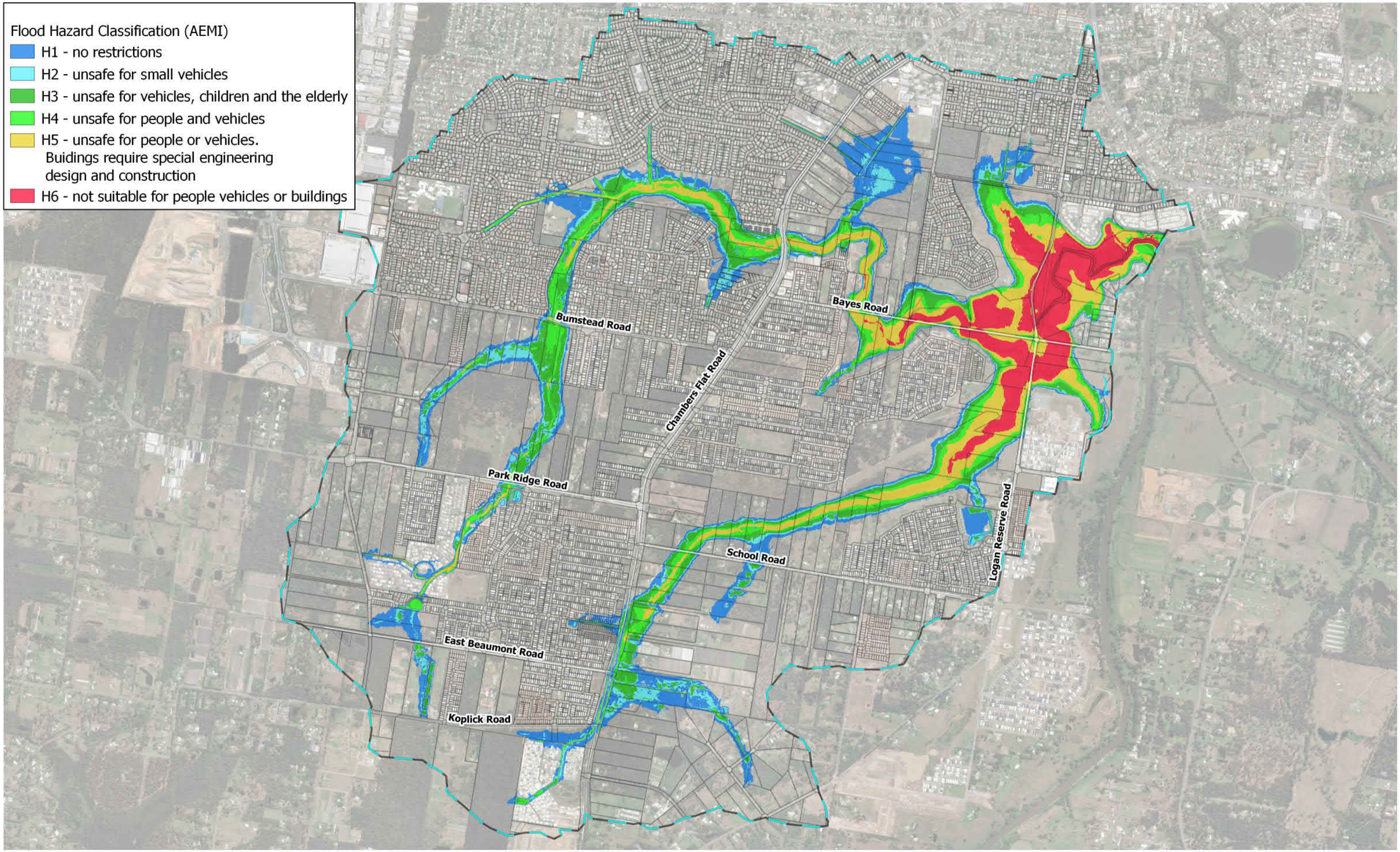
1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (ZAEM1) - 1% AEP with Climate Change (RCP4.5)**

Figure: E46

Rev: 0

Scale at A3 1:21000

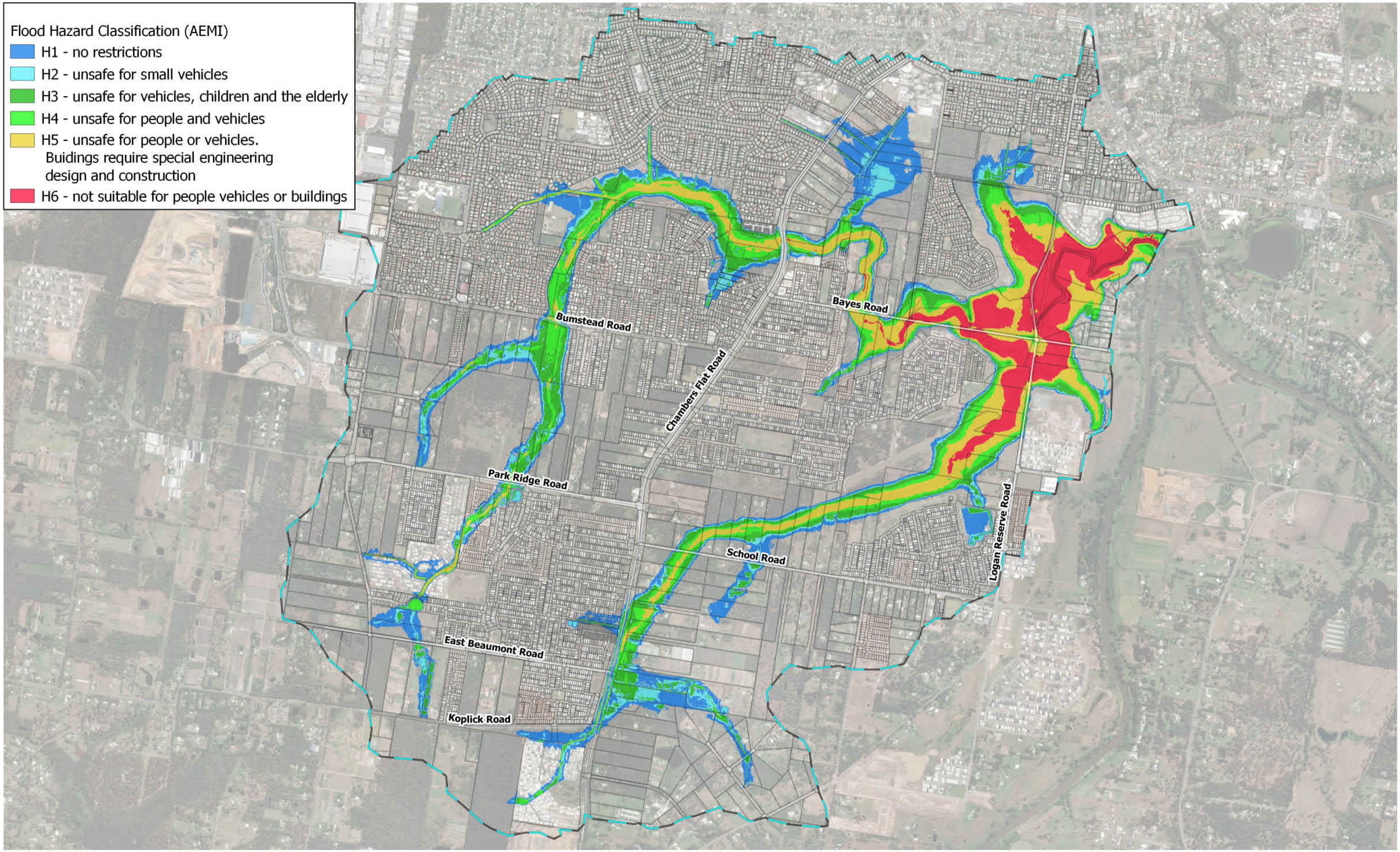


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (ZAEM1) - 0.5% AEP with Climate Change (RCP4.5)**

Figure: **E47**

Rev: **0**

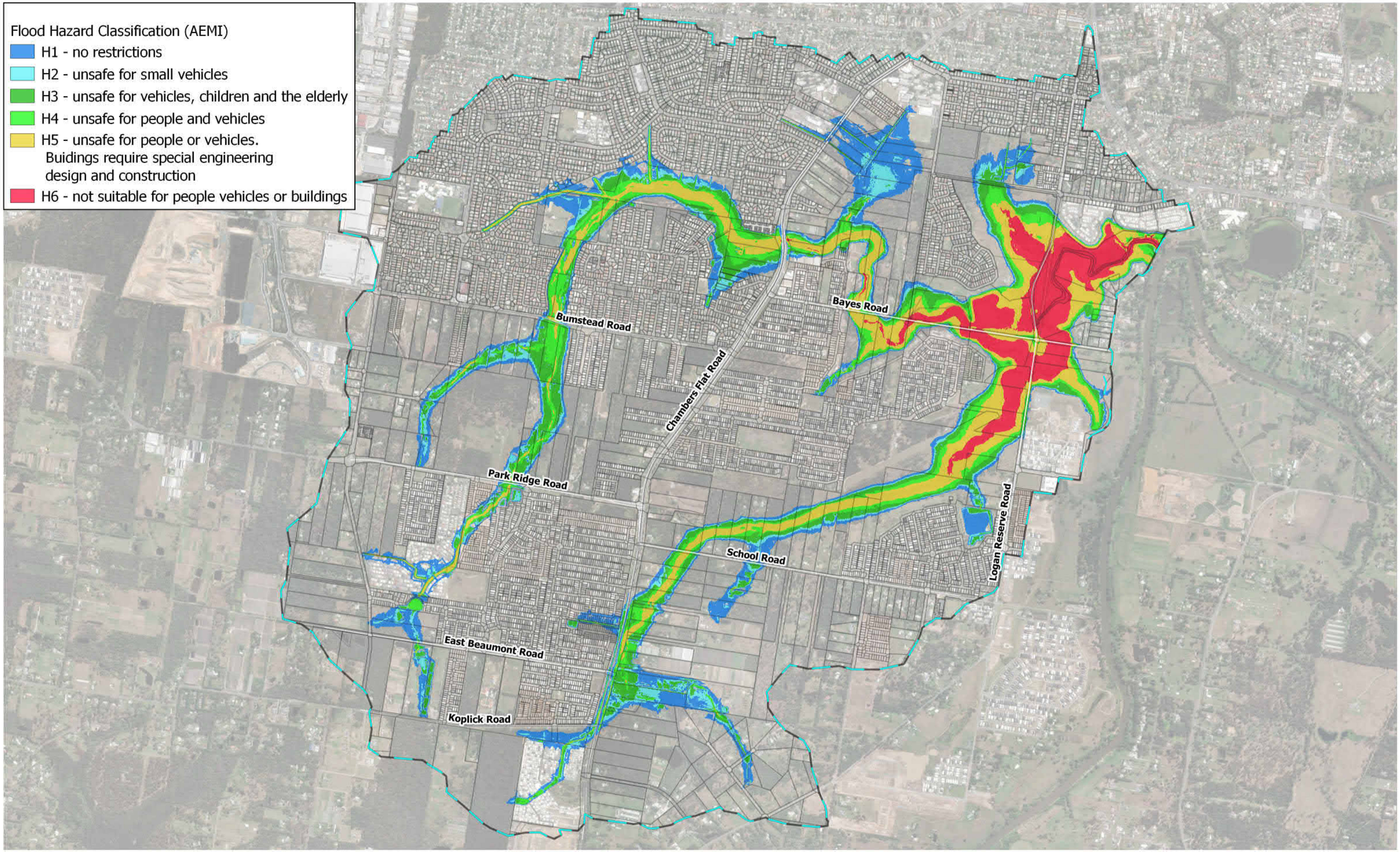
Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title:

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (ZAEM1) - 0.2% AEP with Climate Change (RCP4.5)**

Figure: **E48** Rev: **0**

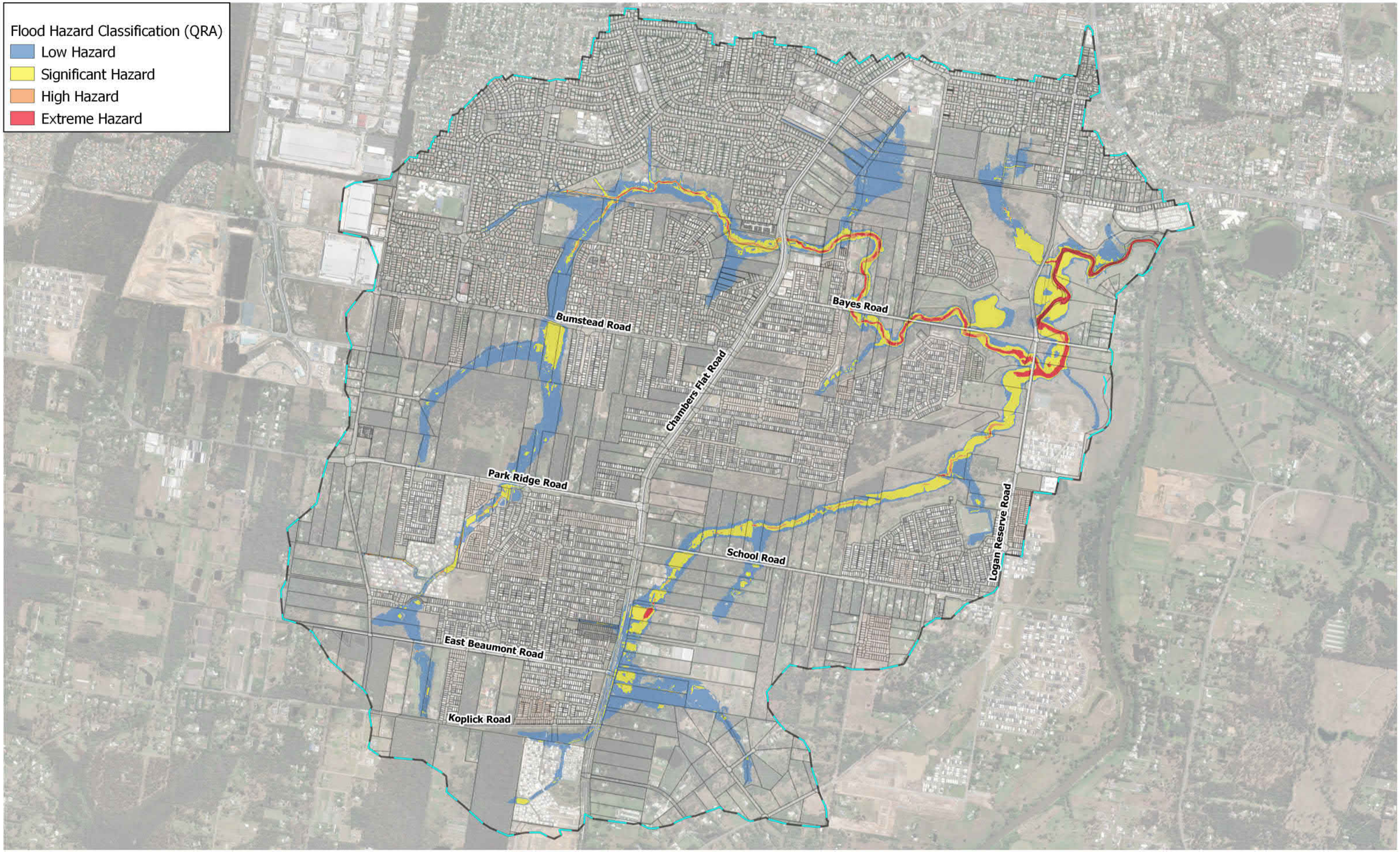
Scale at A3 1:21000



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale: 0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 50% AEP with Climate Change (RCP4.5)**

Figure: E49

Rev: 0

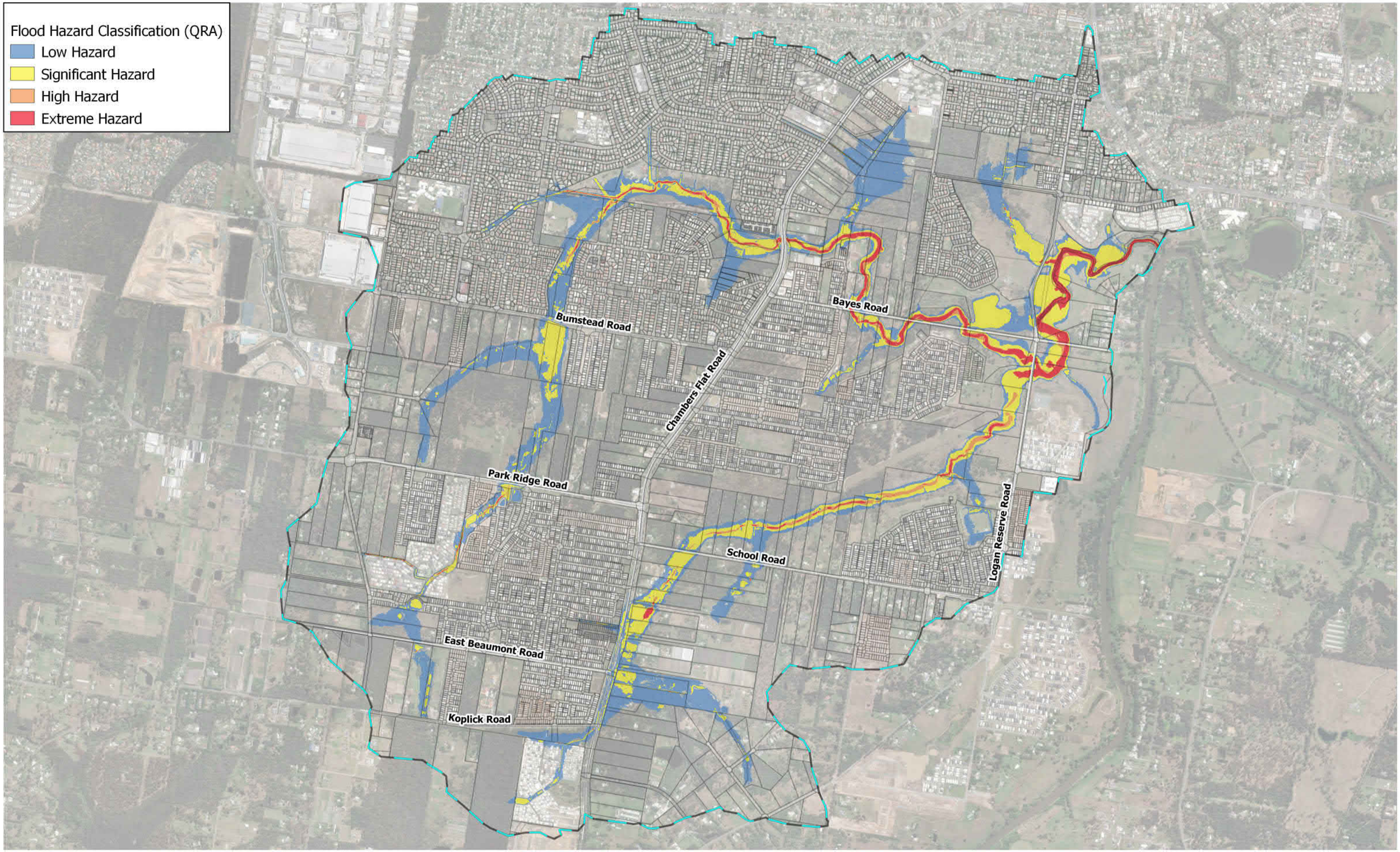
Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 20% AEP with Climate Change (RCP4.5)**

Figure: E50

Rev: 0

Scale at A3 1:21000
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Scale:

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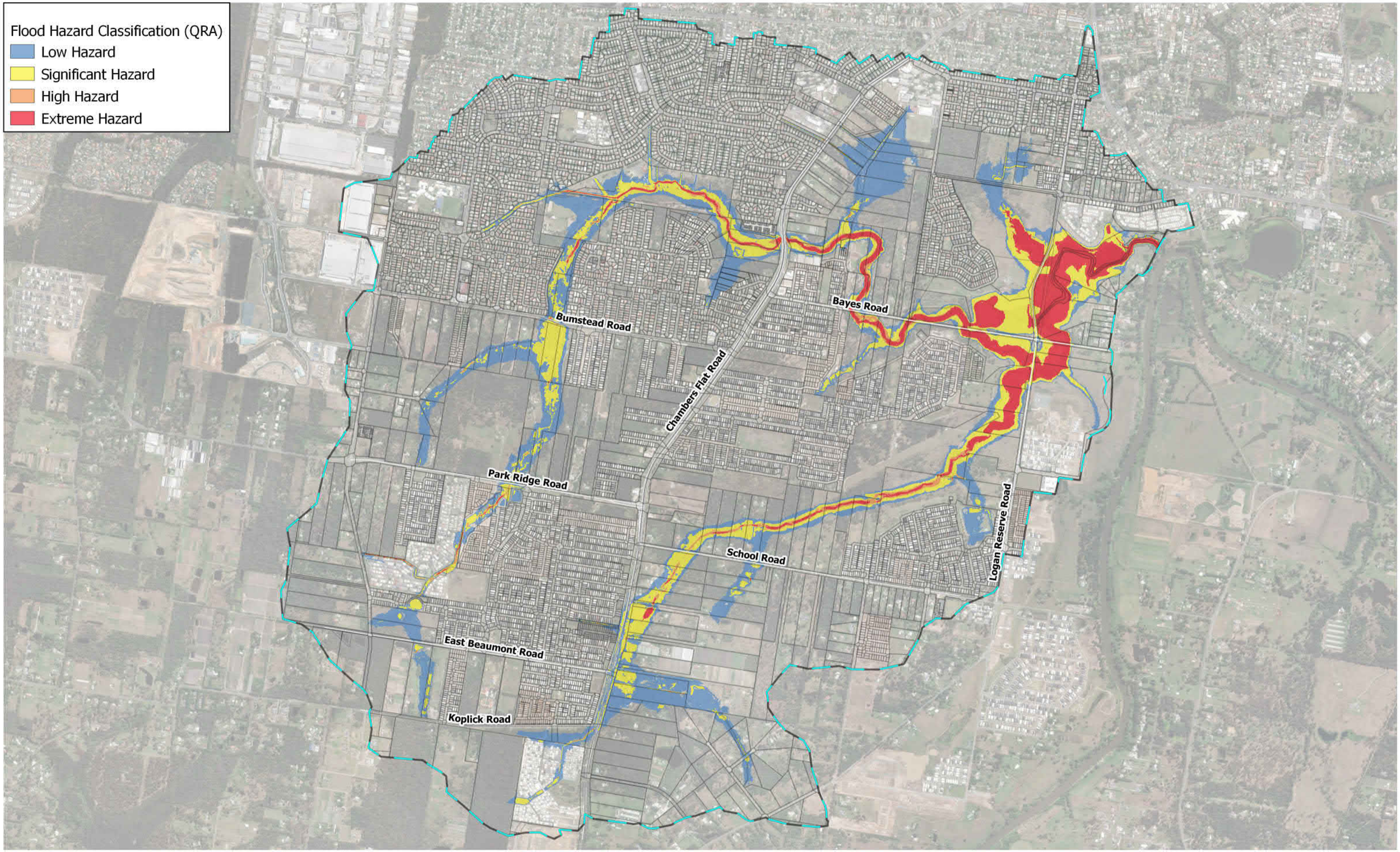


**LEGEND**

Cadastre
TUFLOW model extent
Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 10% AEP with Climate Change (RCP4.5)**

Figure: **E51** | Rev: **0**



File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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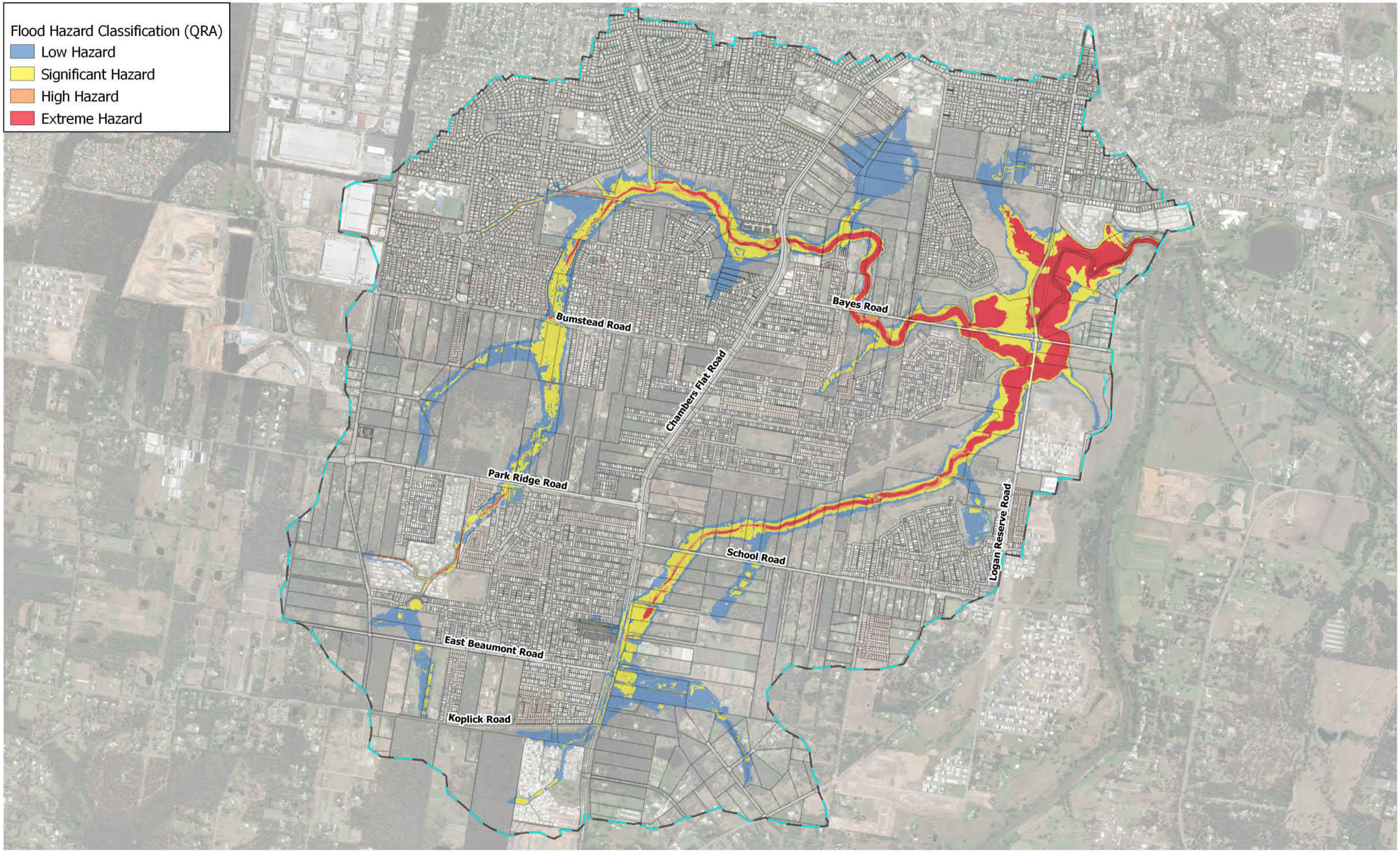
1:21,000




**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 5% AEP with Climate Change (RCP4.5)**

Figure: **E52**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

0 200 400 600 800 m

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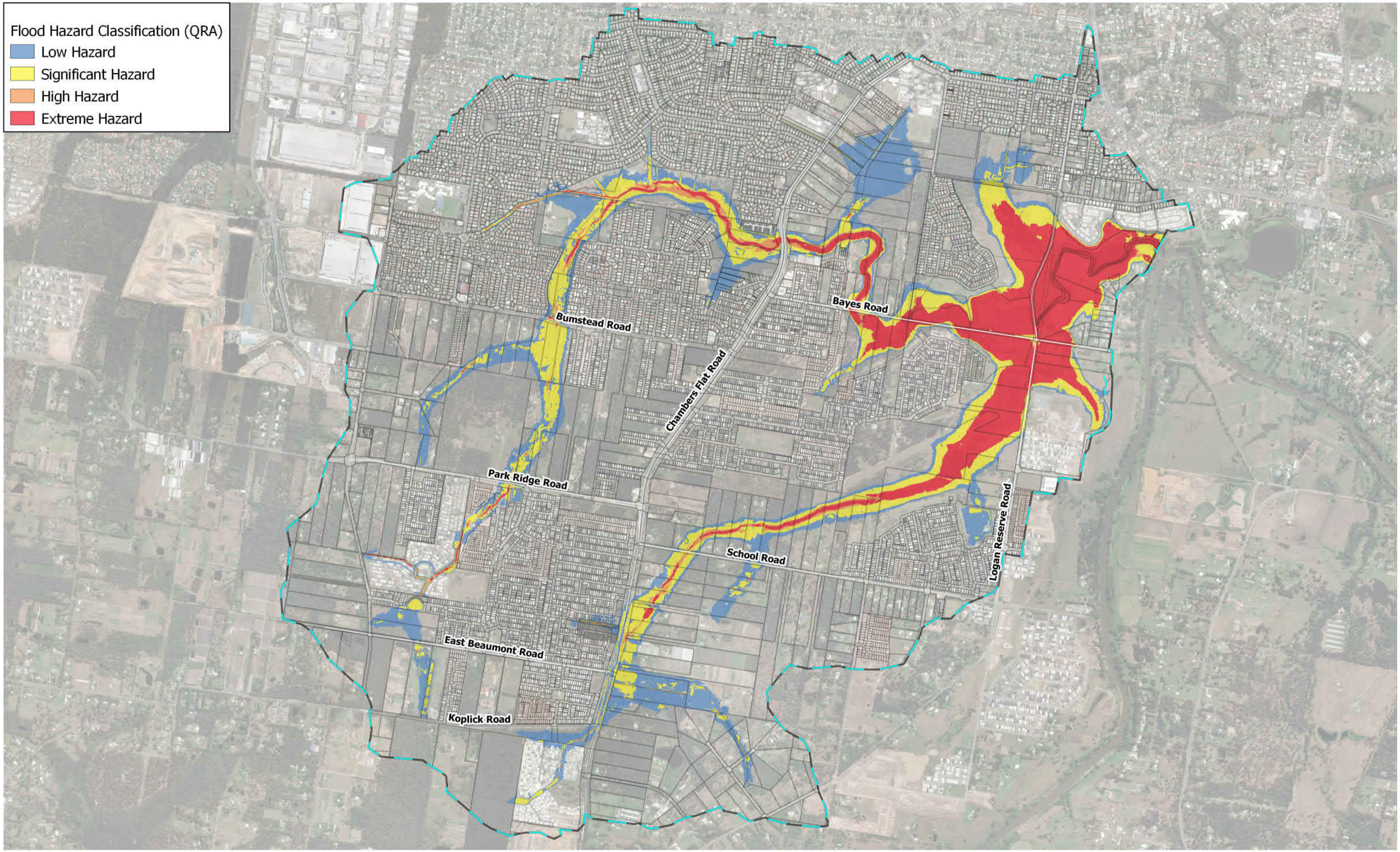
KBR




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 2% AEP with Climate Change (RCP4.5)**

Figure: **E53**

Rev: **0**

Scale at A3 1:21000

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Scale: 0 200 400 600 800 m

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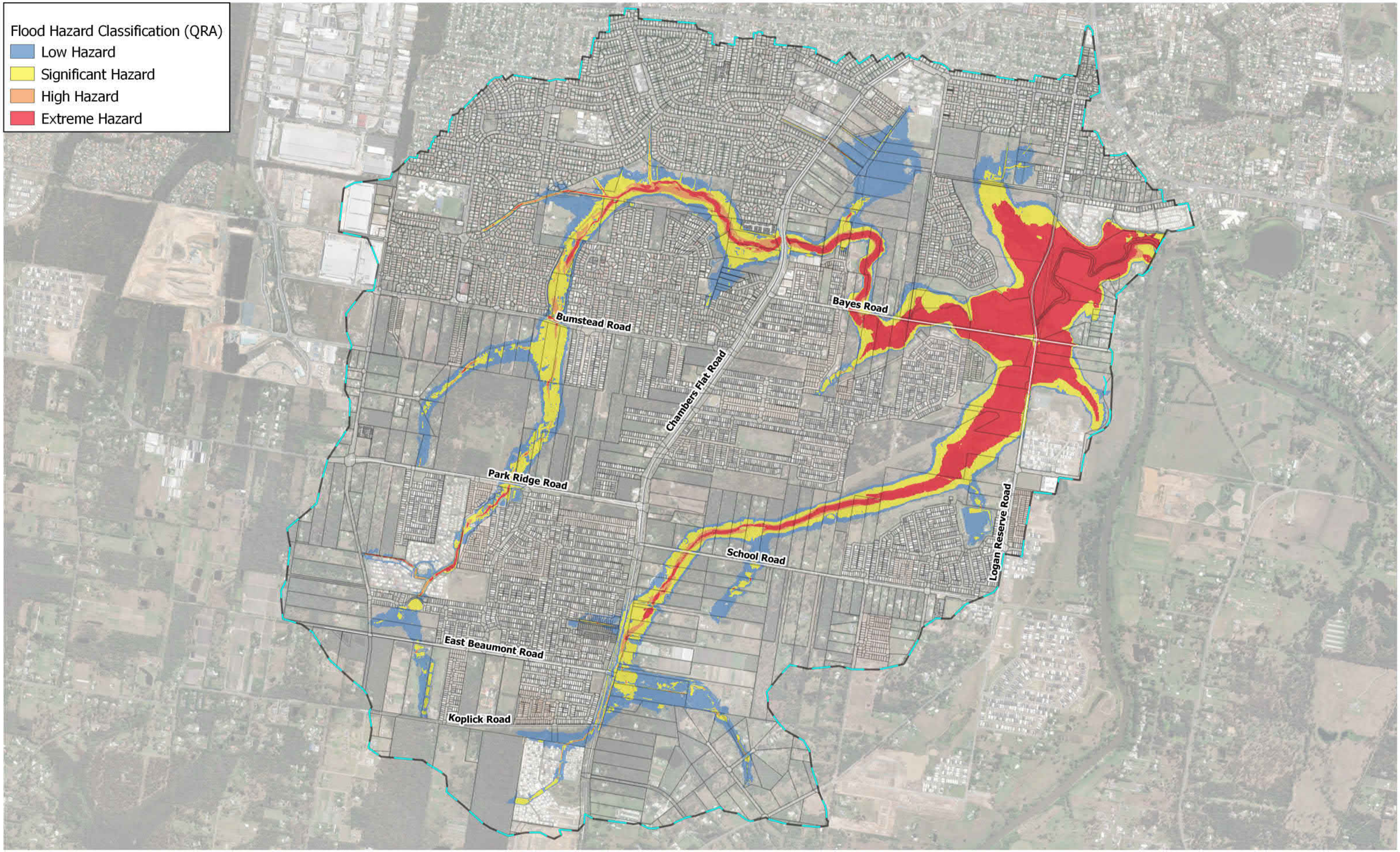


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 1% AEP with Climate Change (RCP4.5)**

Figure: **E54**

Rev: **0**

Scale at A3 1:21000


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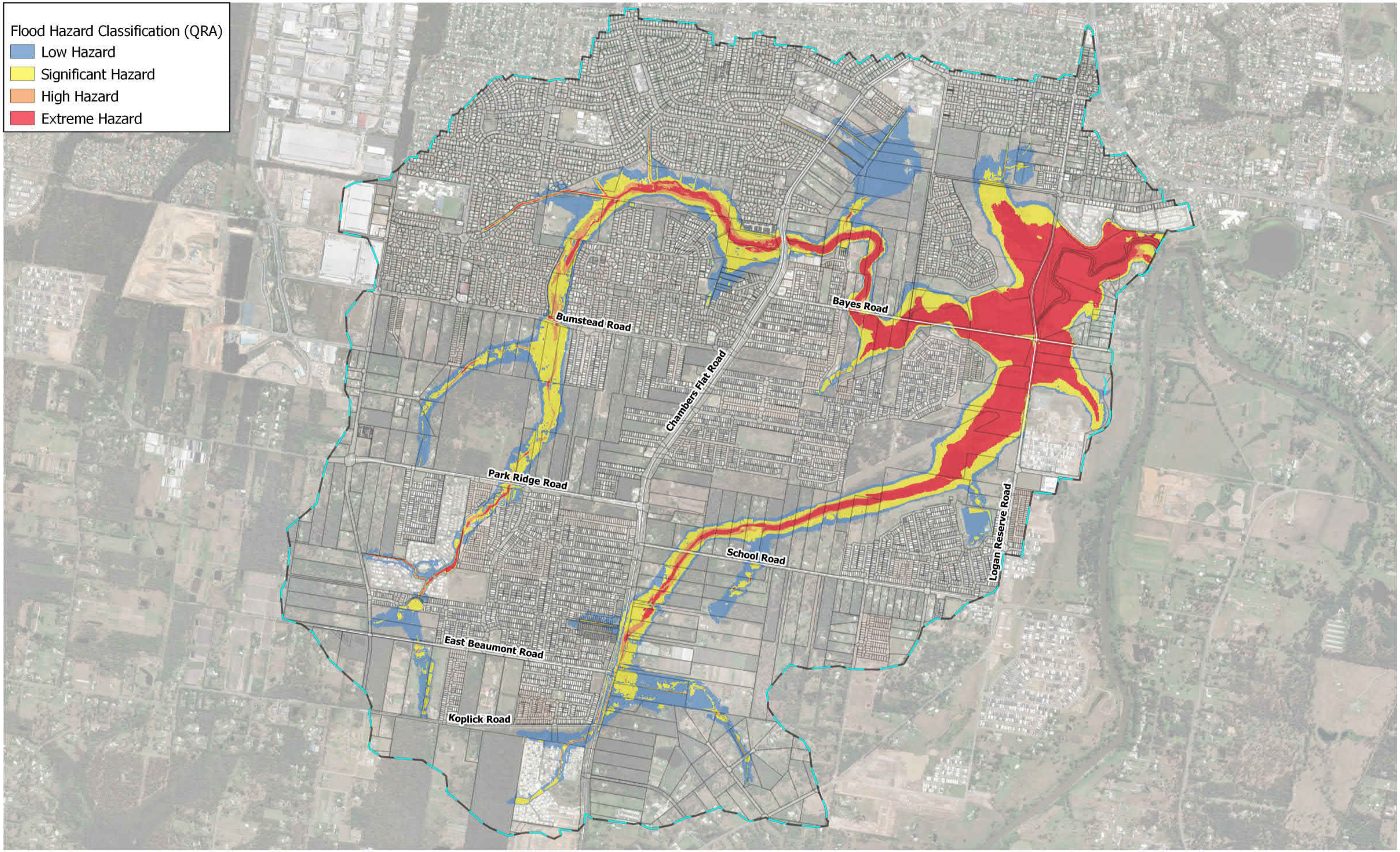


**LEGEND**

Cadastre
TUFLOW model extent
Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 0.5% AEP with Climate Change (RCP4.5)**

Figure: **E55**

Rev: **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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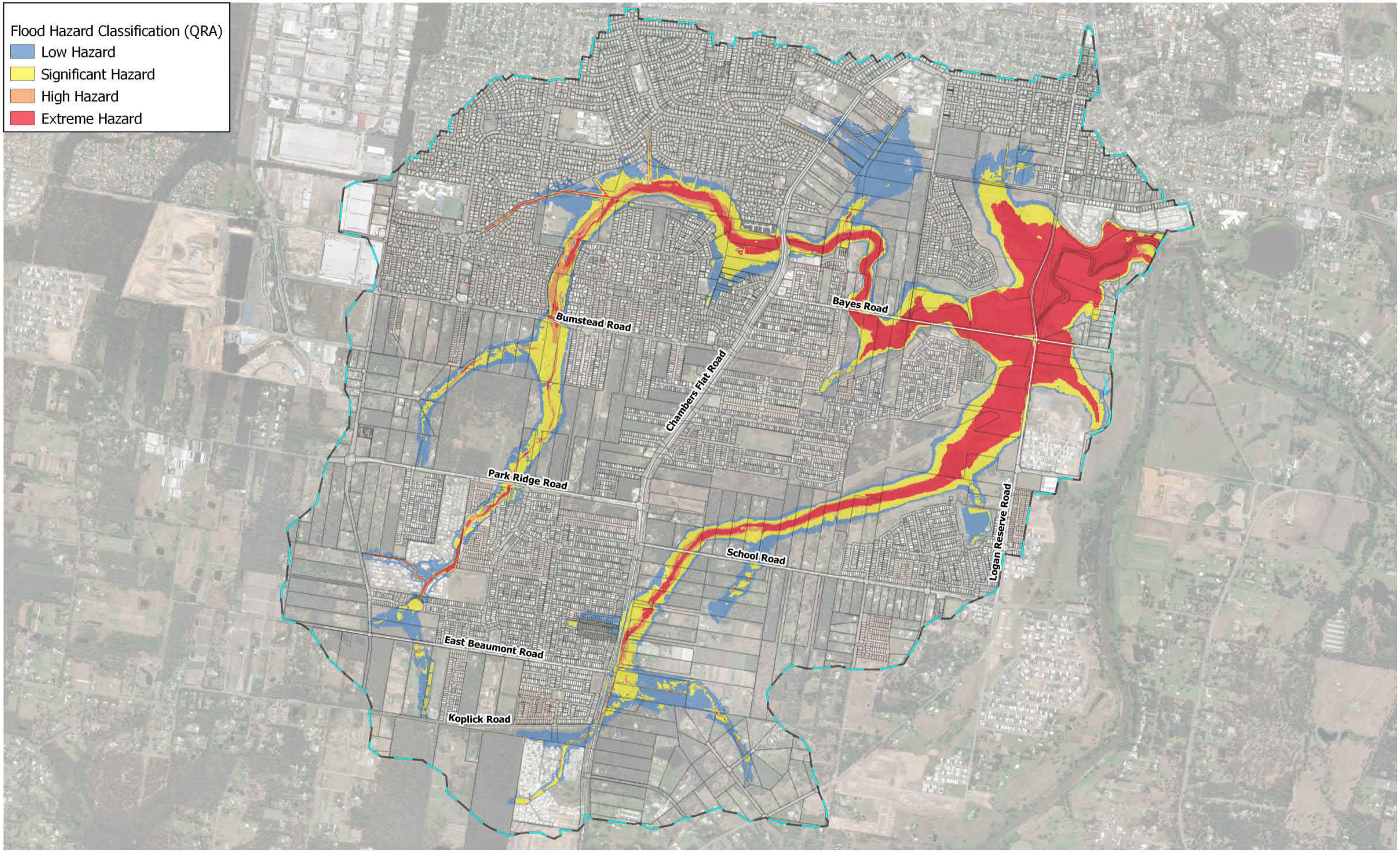


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study - Climate Change Mapping**
**Flood Hazard (QRA) - 0.2% AEP with Climate Change (RCP4.5)**

Figure: **E56**

Rev: **0**

Scale at A3 1:21000







File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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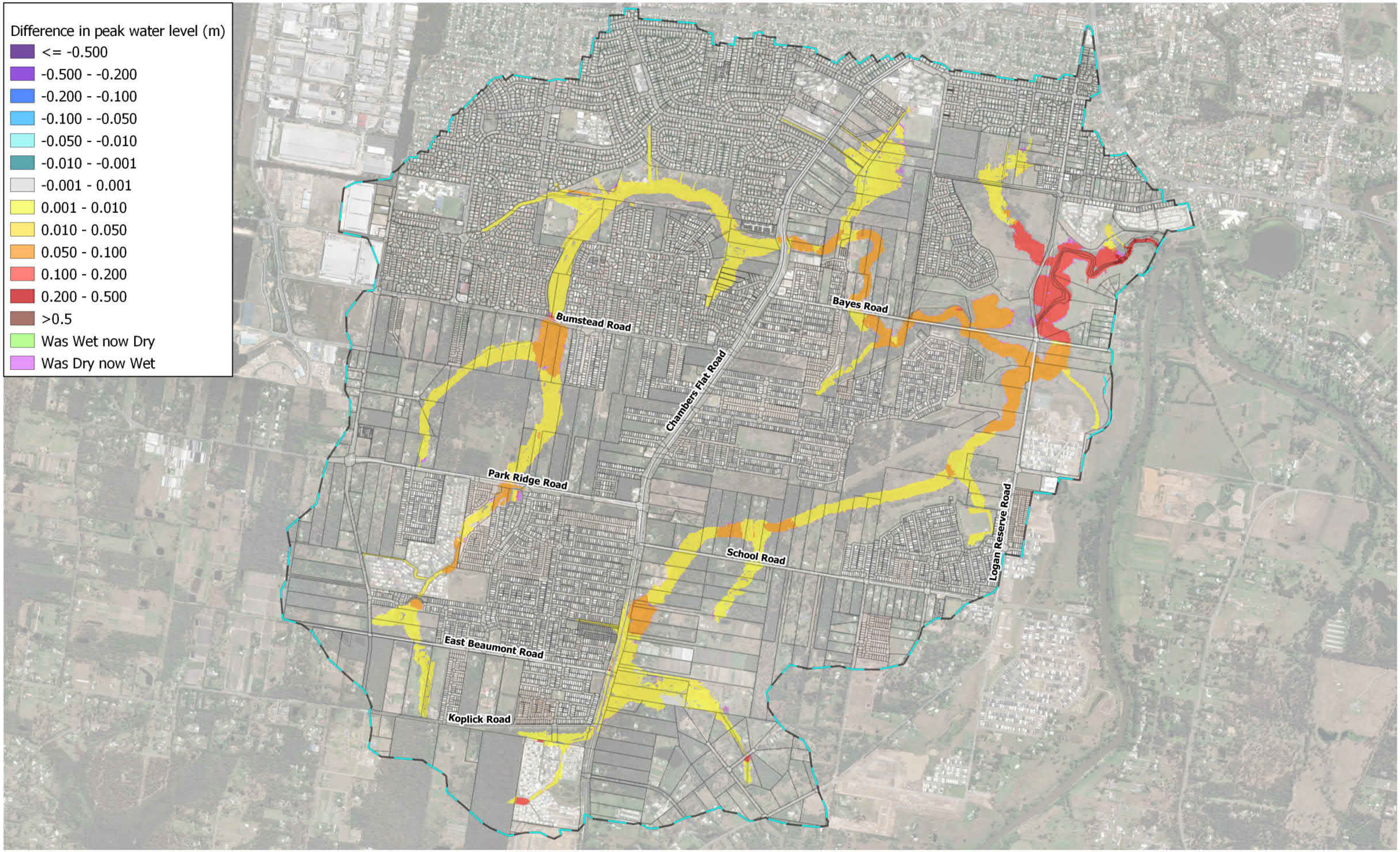
1:21,000

# Appendix F: Difference in Flood Levels – Climate Change

Differences in Water Surface Level – Climate Change minus Design Event




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 50% AEP with Climate Change (RCP 4p5) minus 50% AEP**

Scale at A3 1:21000


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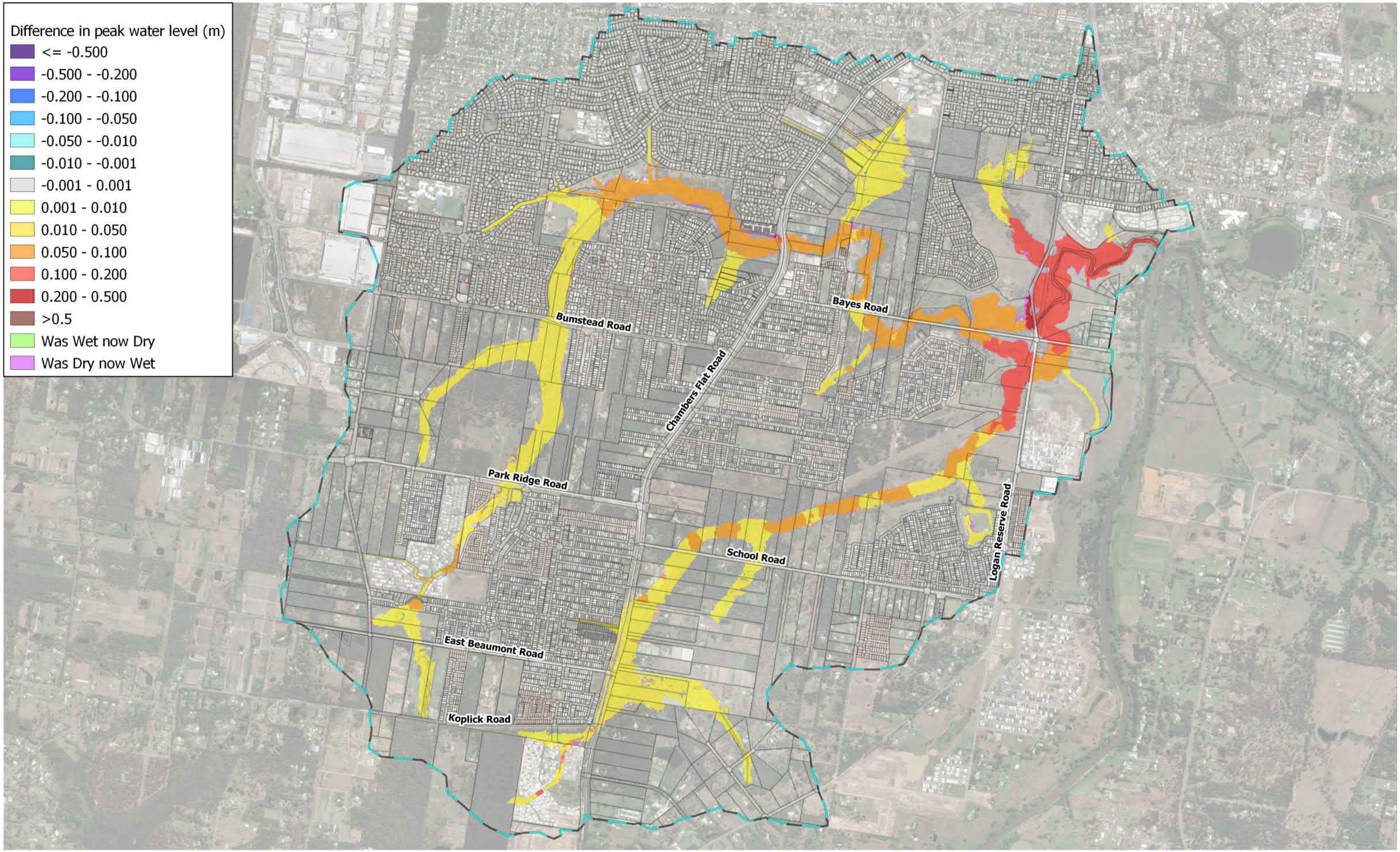
Figure

**F1**

Rev

**0**




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**

**Difference in Water Surface Level - 20% AEP with Climate Change (RCP 4p5) minus 20% AEP**

Figure **F2**

Rev **0**

Scale at A3 1:21000



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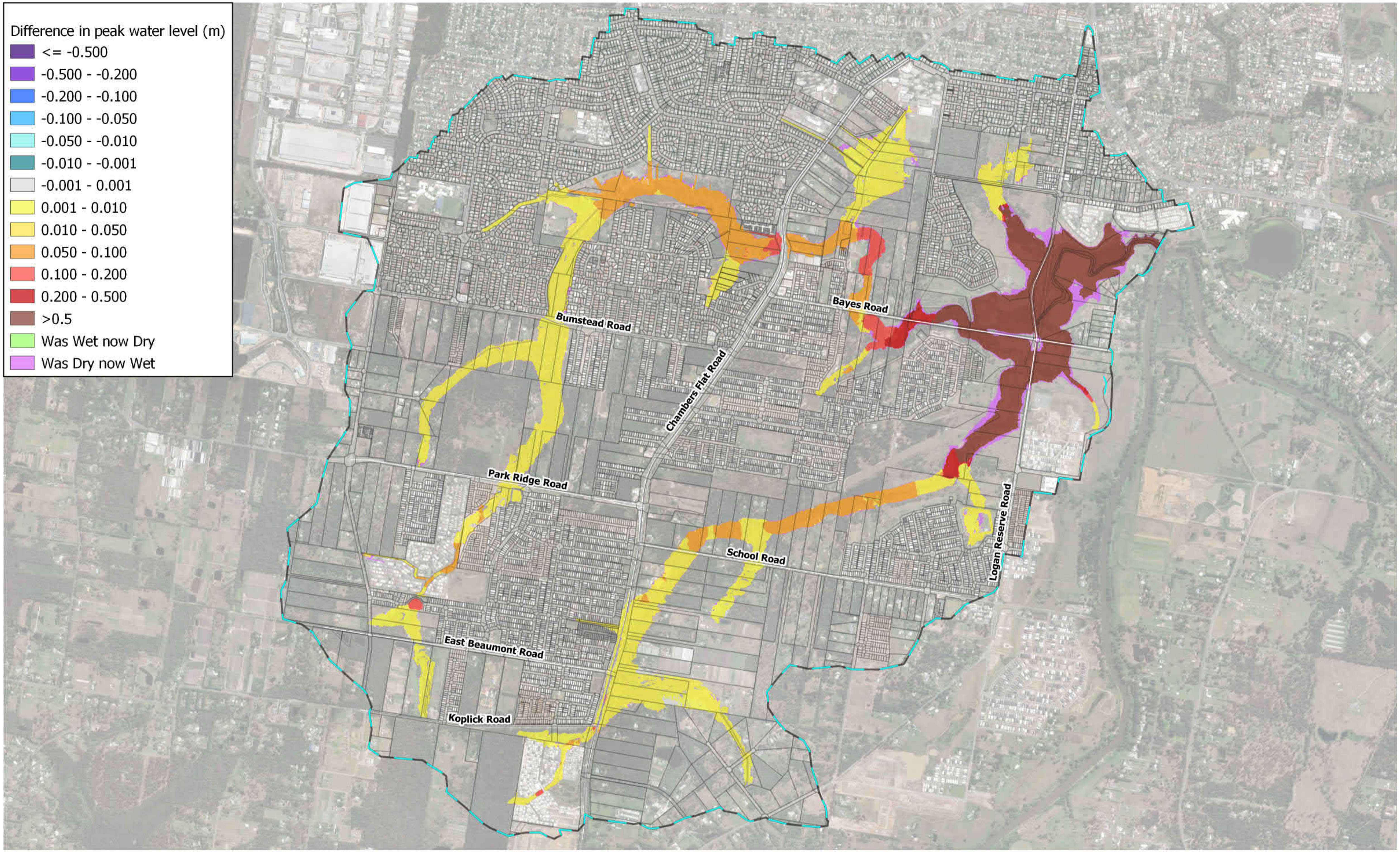


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 10% AEP with Climate Change (RCP 4p5) minus 10% AEP**

Figure **F3**

Rev **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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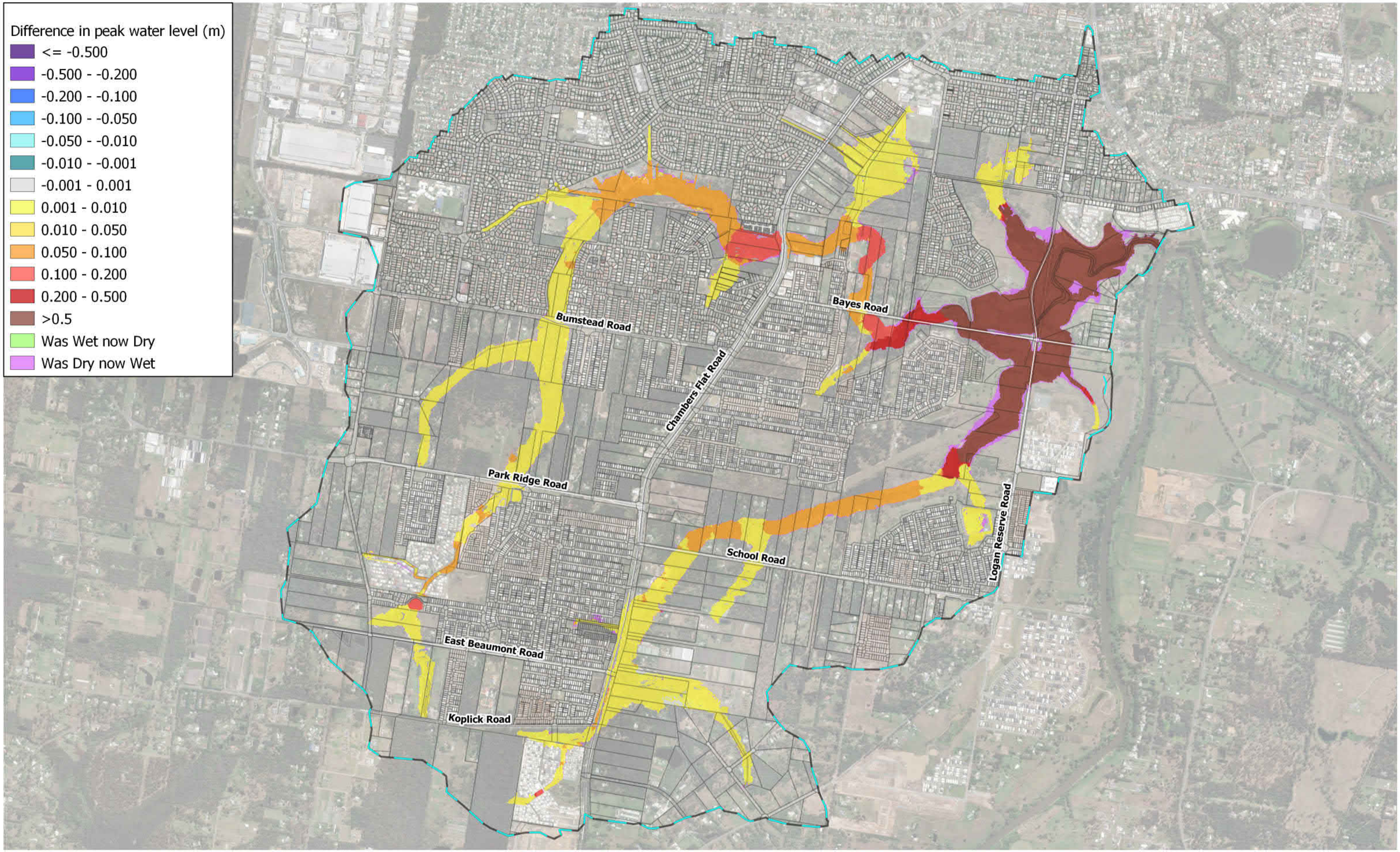


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 5% AEP with Climate Change (RCP 4p5) minus 5% AEP**

Figure **F4**

Rev **0**

Scale at A3 1:21000


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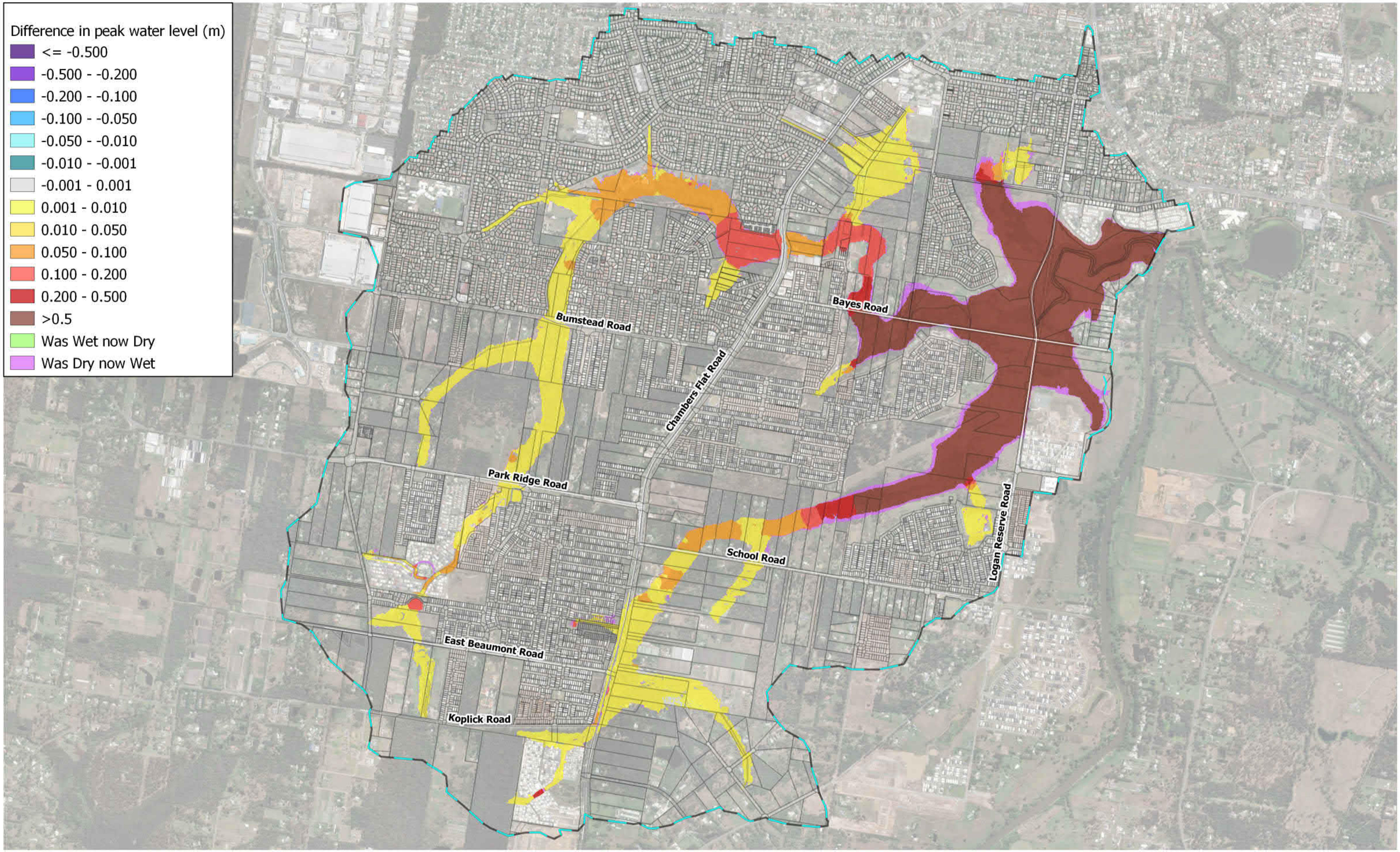


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 2% AEP with Climate Change (RCP 4p5) minus 2% AEP**

Figure: **F5** | Rev: **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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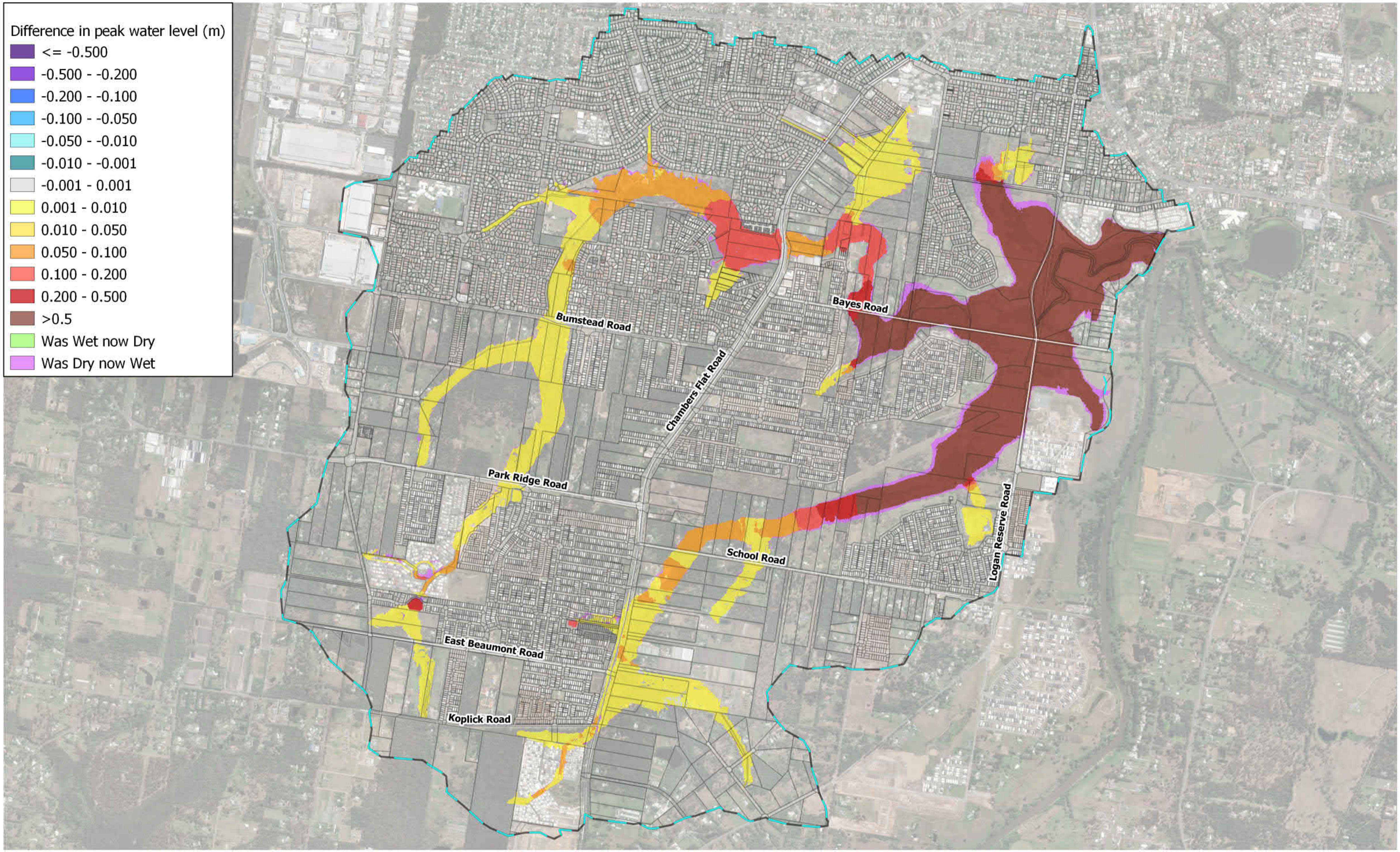


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 1% AEP with Climate Change (RCP 4p5) minus 1% AEP**

Figure **F6**

Rev **0**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale

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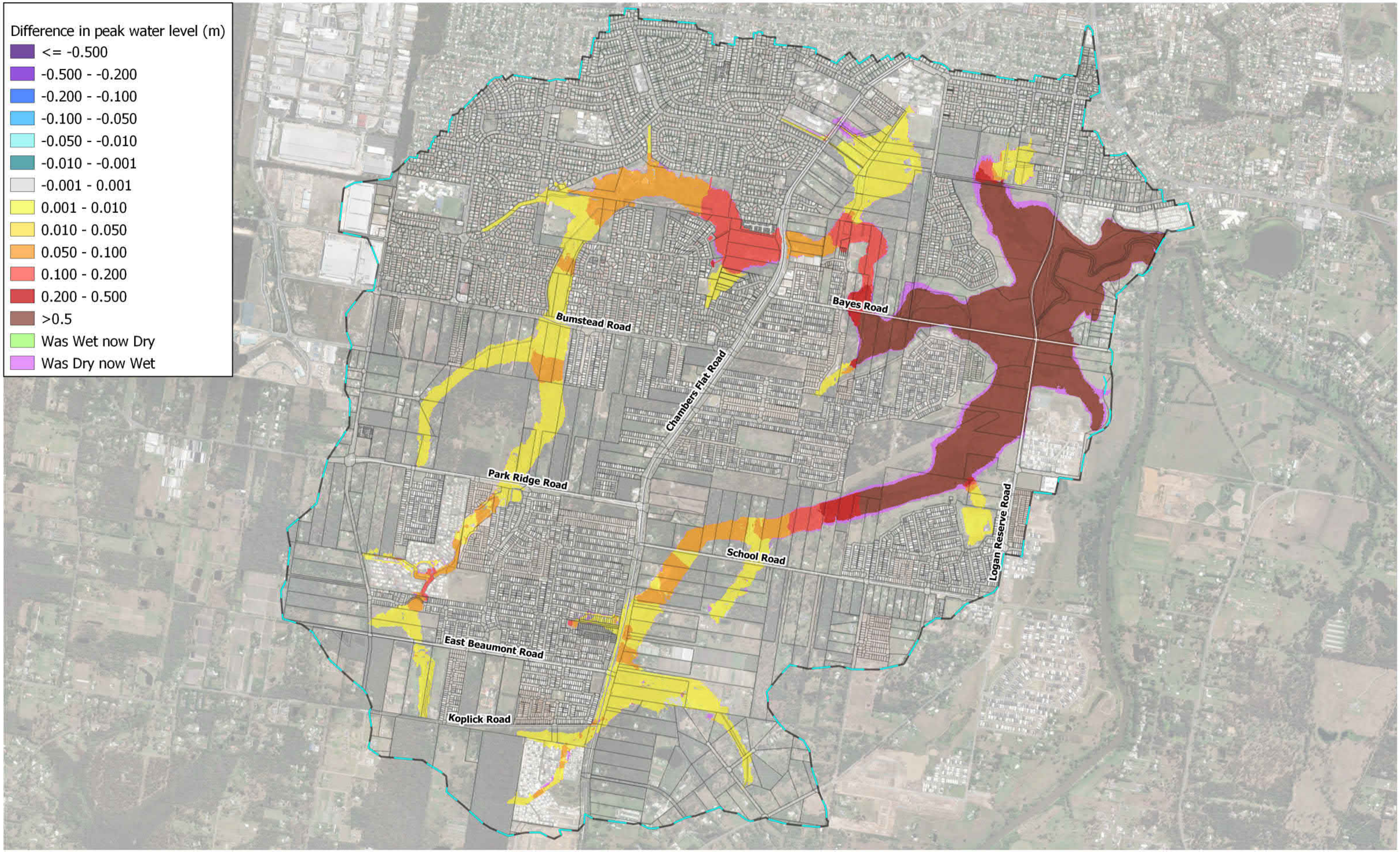


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 0.5% AEP with Climate Change (RCP 4p5) minus 0.5% AEP**

Scale at A3 1:21000






File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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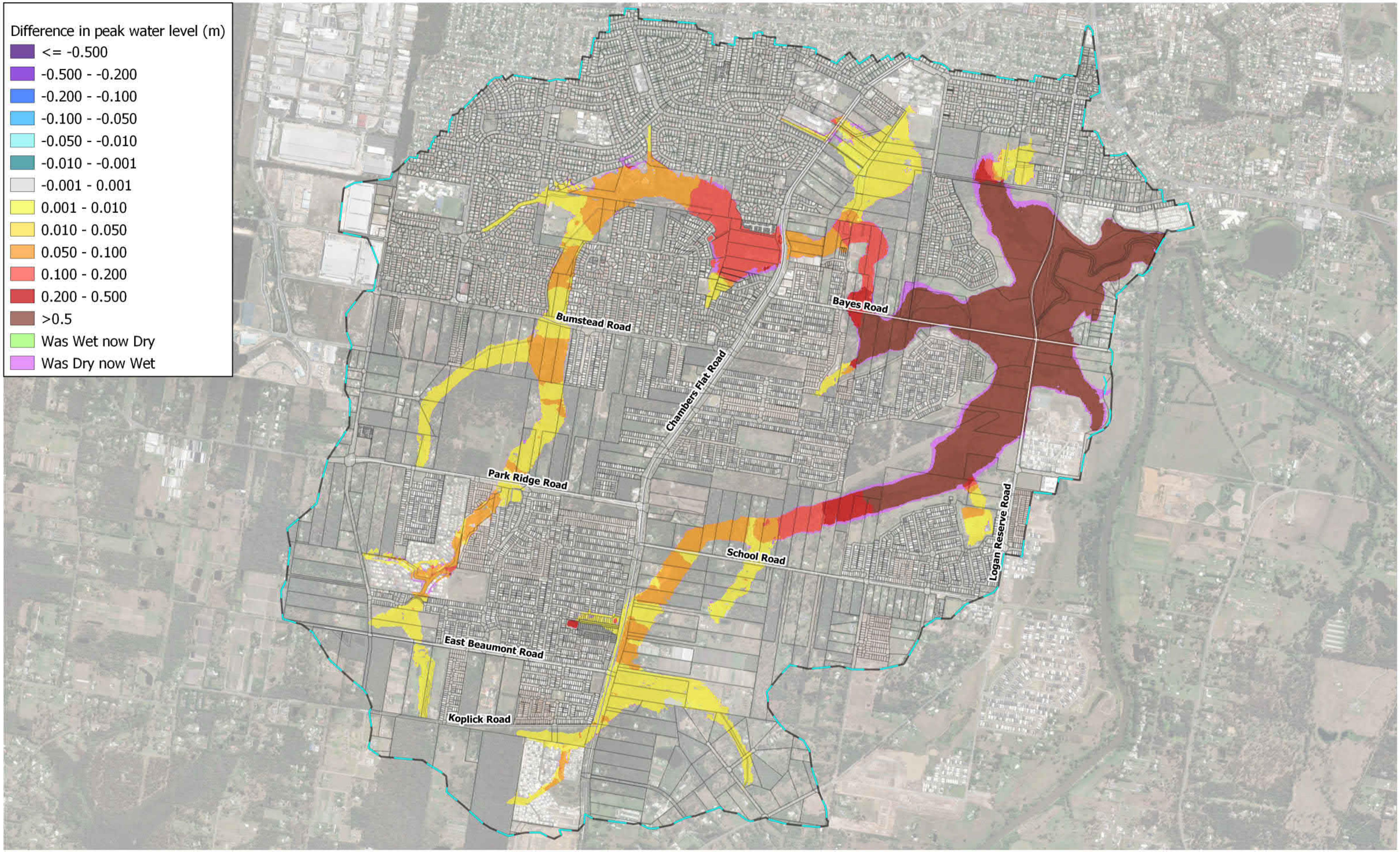
Figure

**F7**

Rev

**0**




**LEGEND**

Cadastre
TUFLOW model extent
Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 0.2% AEP with Climate Change (RCP 4p5) minus 0.2% AEP**

Scale at A3 1:21000




File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

Scale:

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Figure

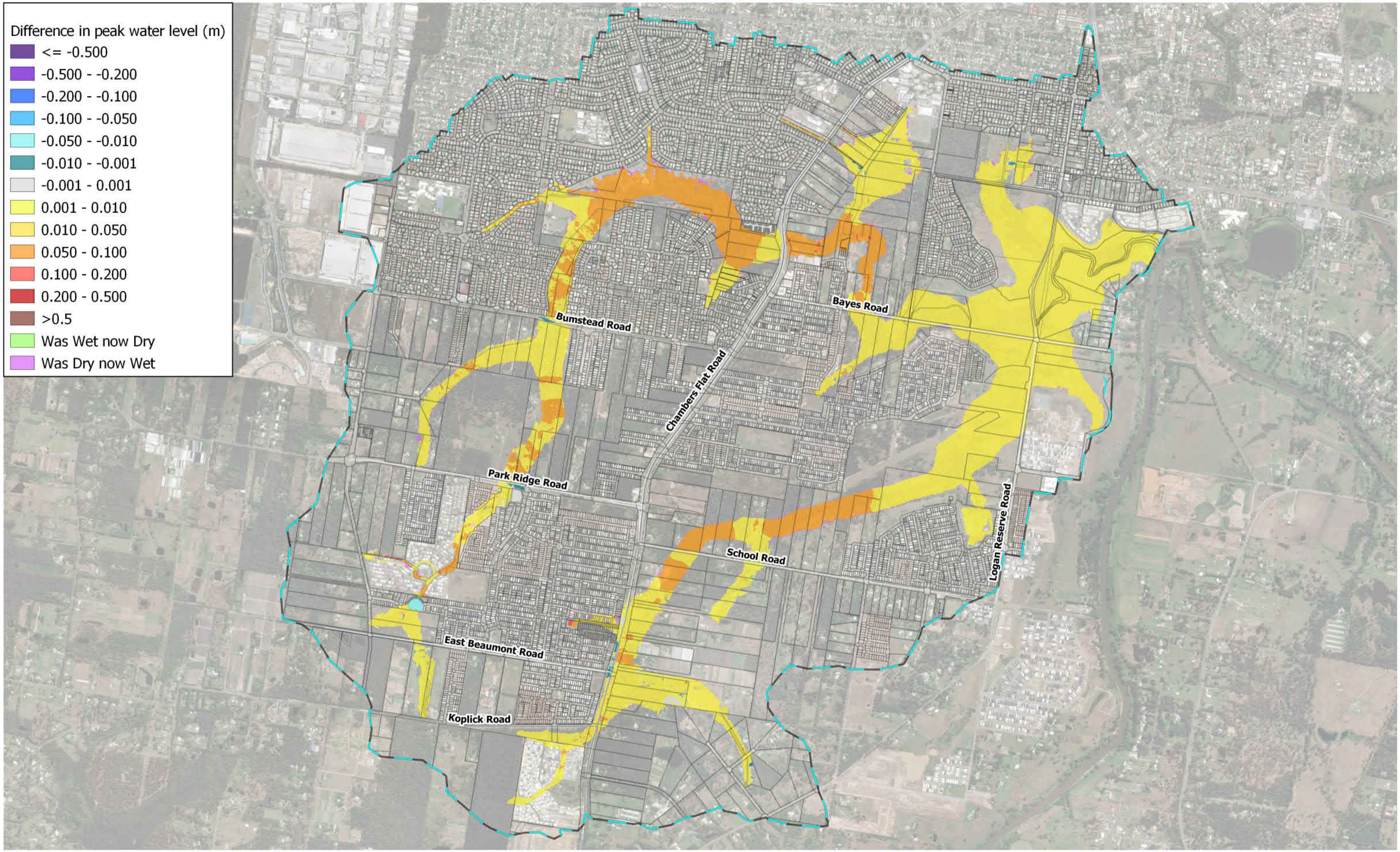
F8

Rev

0

# Appendix G: Sensitivity Analysis Mapping

Sensitivity Analysis Flood Level Impact Mapping




**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impacts of 20% increase in Manning's roughness on 1% AEP flood levels**

Figure: G1

Rev: 0

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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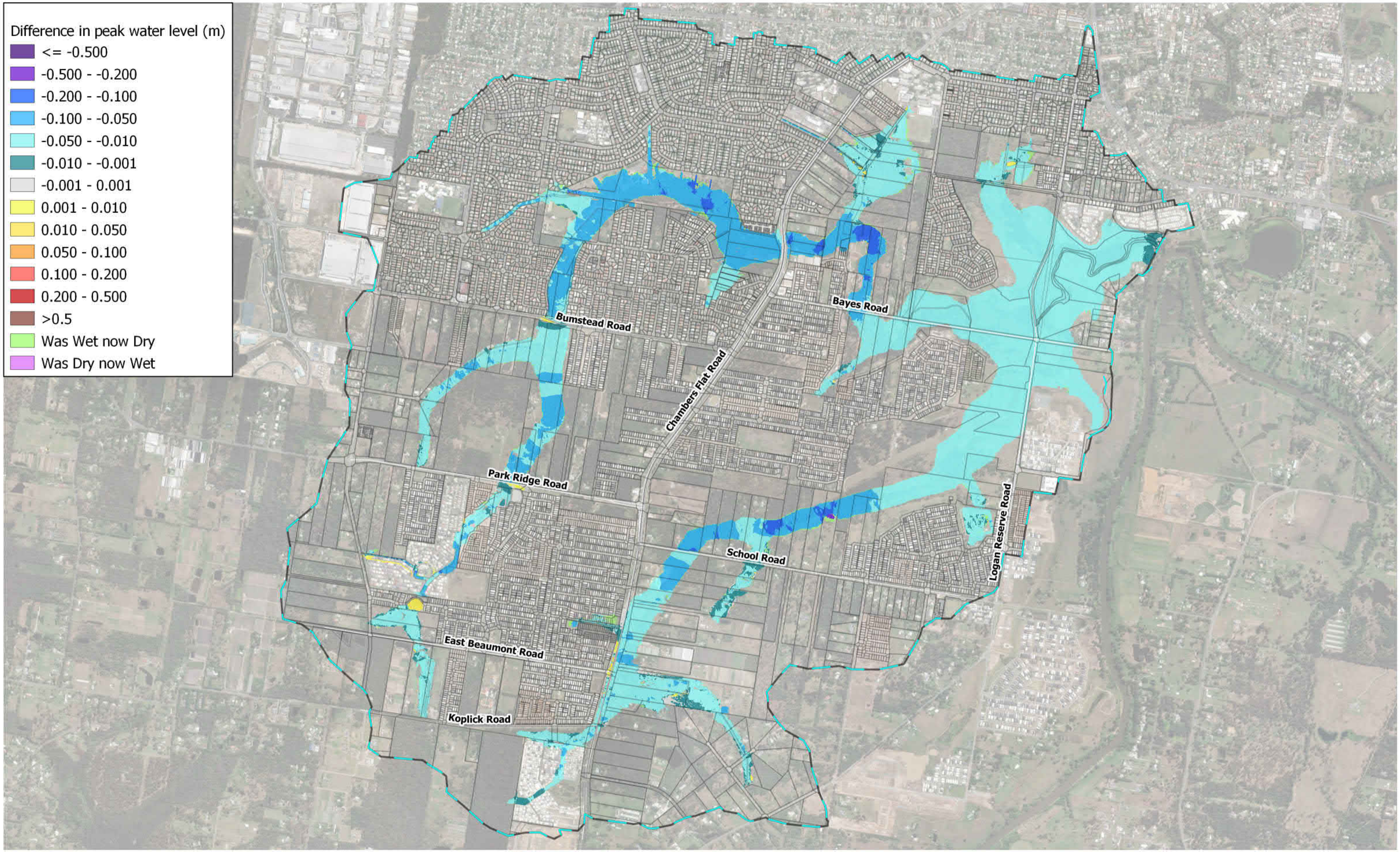


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impacts of 20% decrease in Manning's roughness on 1% AEP flood levels**

Figure: **G2**

Rev: **0**

Scale at A3 1:21000
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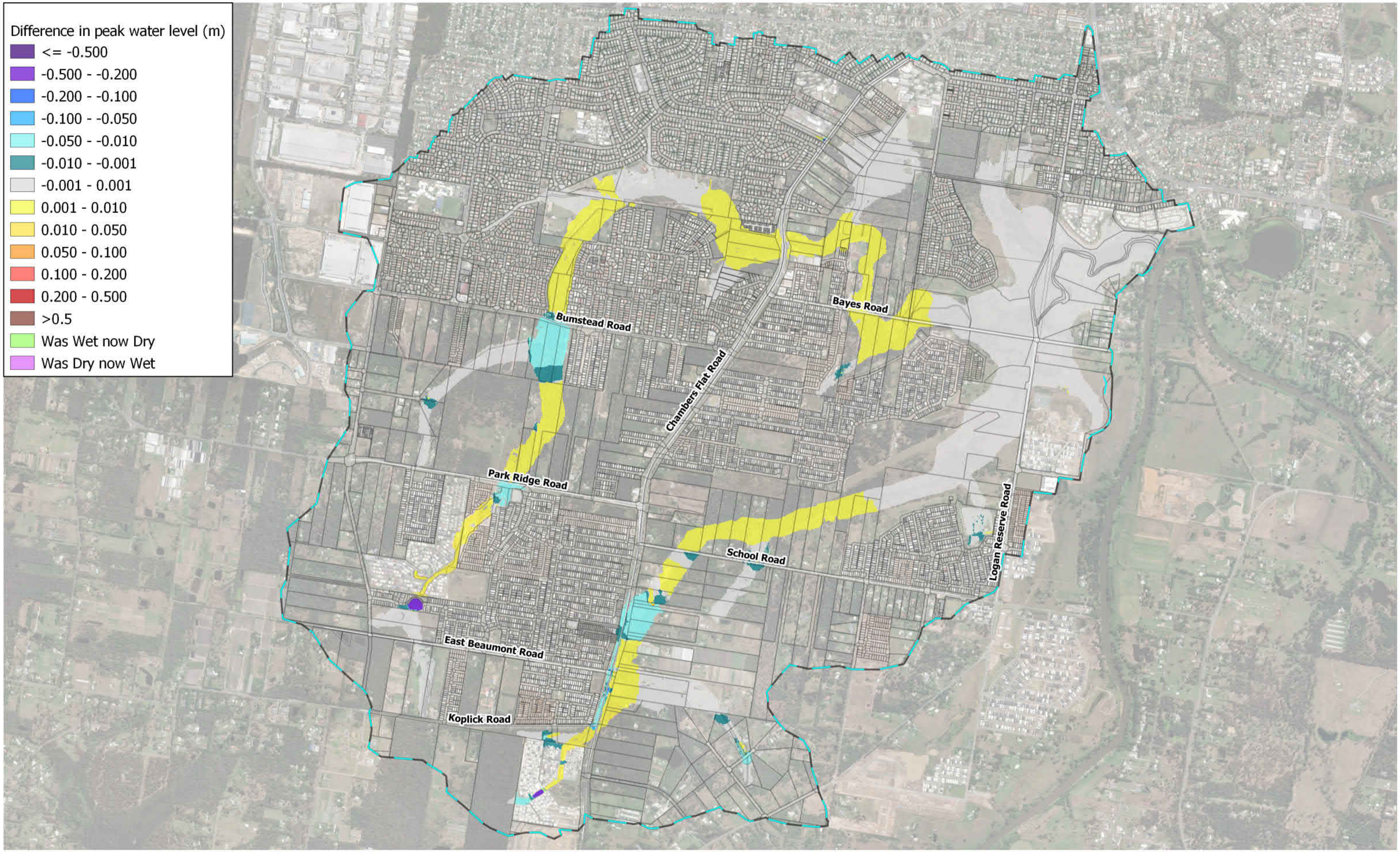


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impact of removing blockages of structures on 1% AEP flood levels**

Figure: G3

Rev: 0

Scale at A3 1:21000
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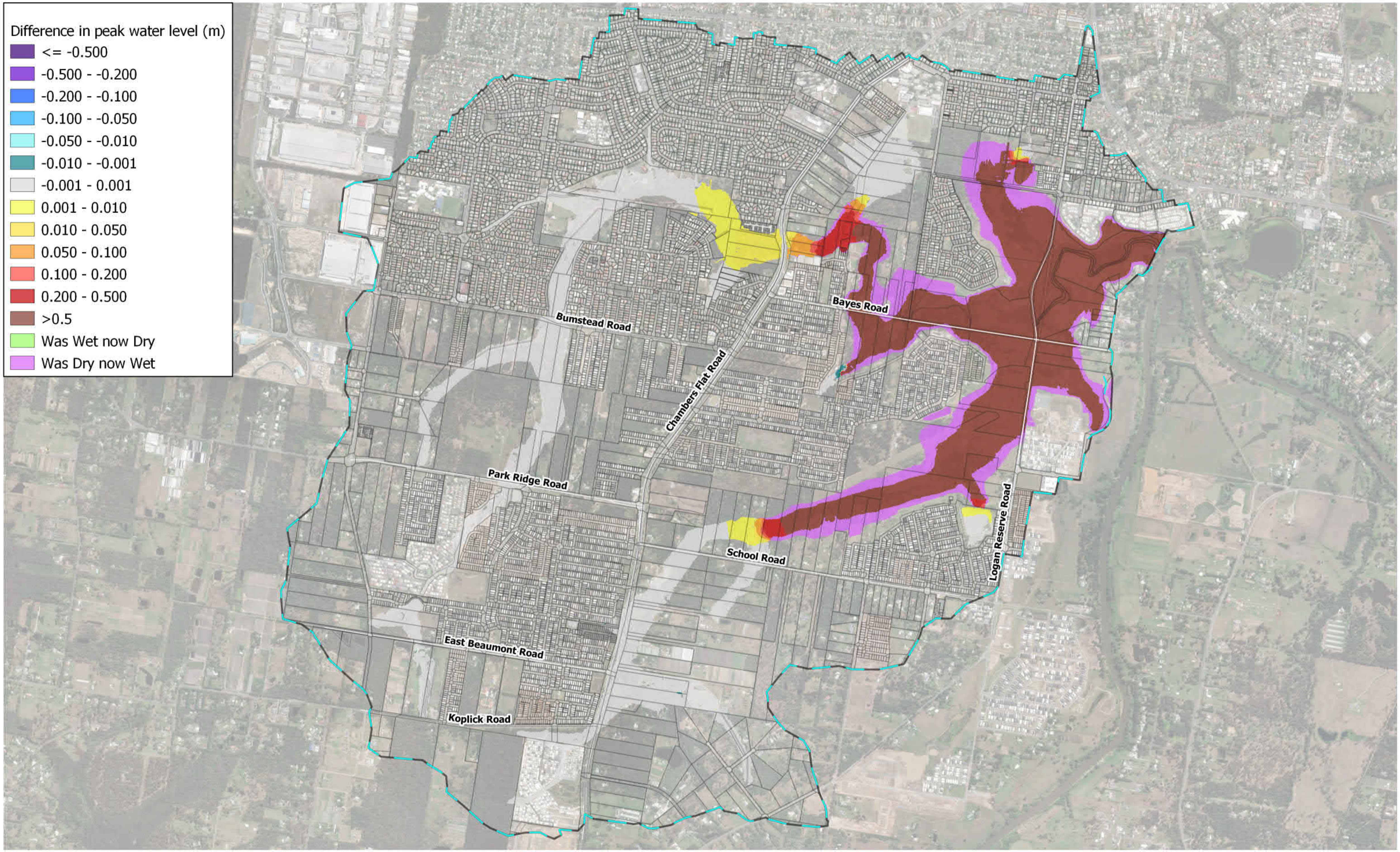


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impact of increasing static water level on 1% AEP flood levels**

Figure: **G4**

Rev: **0**

Scale at A3 1:21000


File: Y:\Water_Resources\Projects\XXXX_SchmidtsCk_FS\G - GIS\Workspaces\Figures_Wkg\Figures_APPX_Sens_RP03_TRG_2_MJ.qgz

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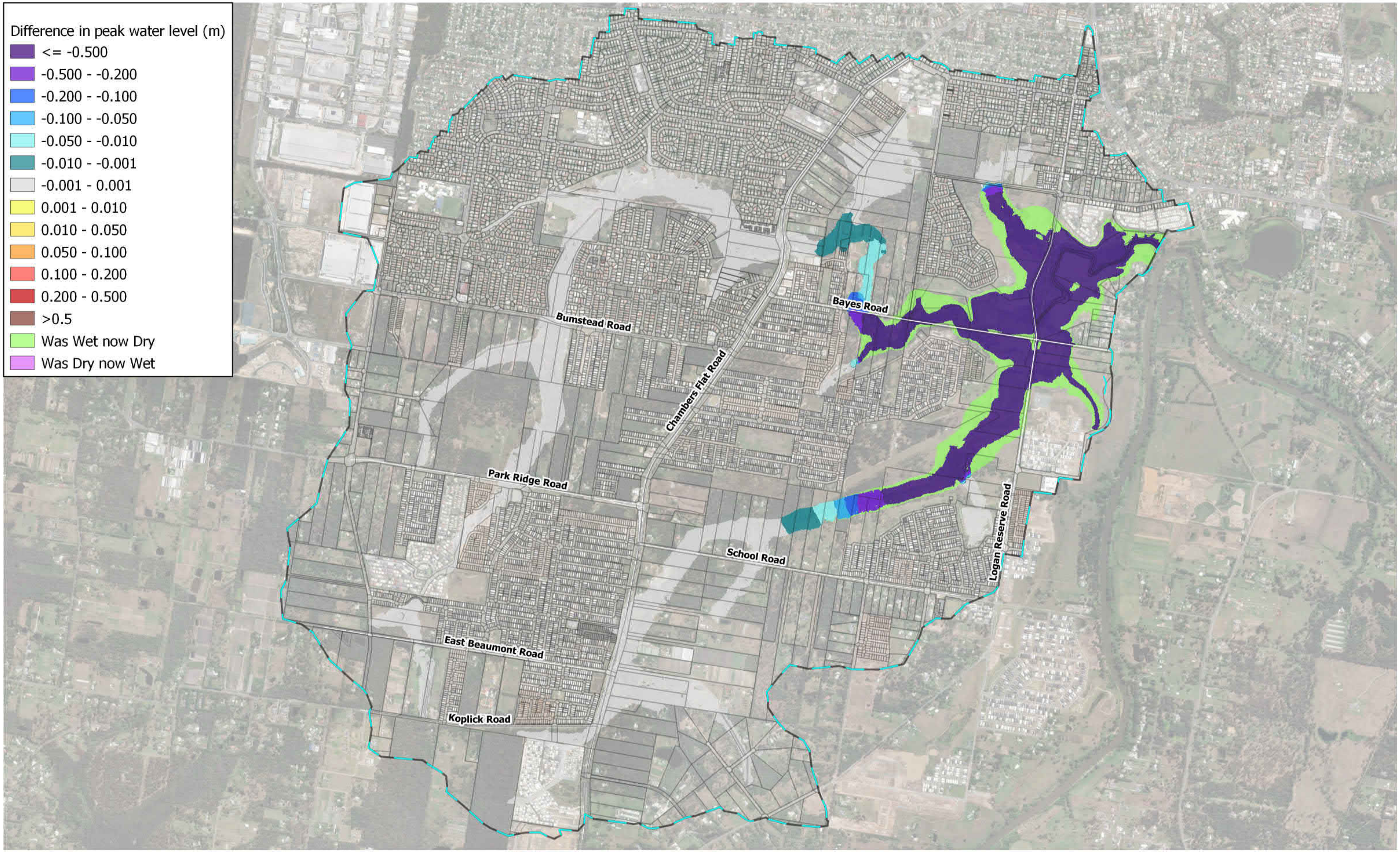


**LEGEND**

Cadastre

TUFLOW model extent

Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impact of decreasing static water level on 1% AEP flood levels**

Figure: G5

Rev: 0

Scale at A3 1:21000



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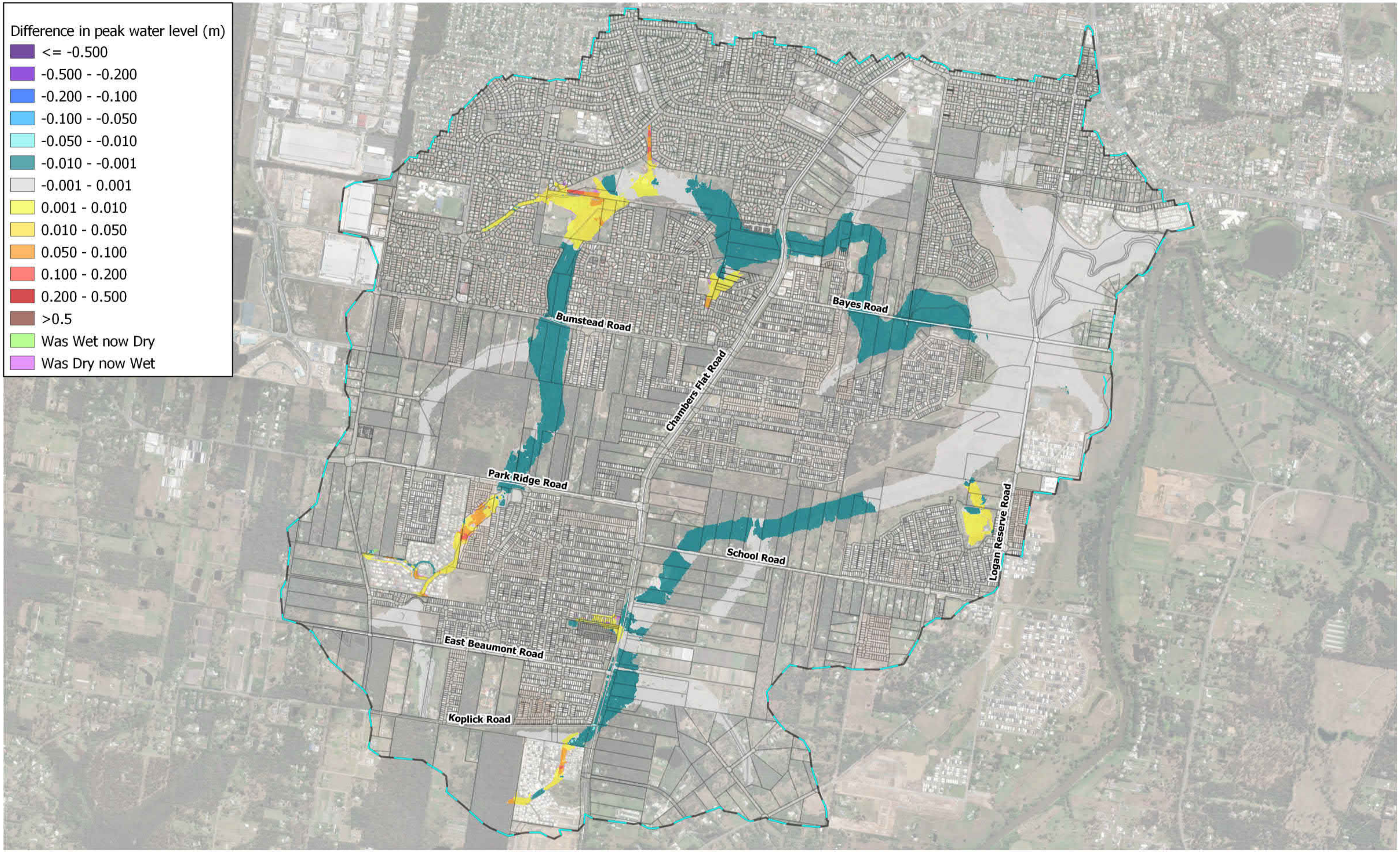


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impact of revegetation of waterway corridor on 1% AEP flood levels**

Figure: **G6**

Rev: **0**

Scale at A3 1:21000



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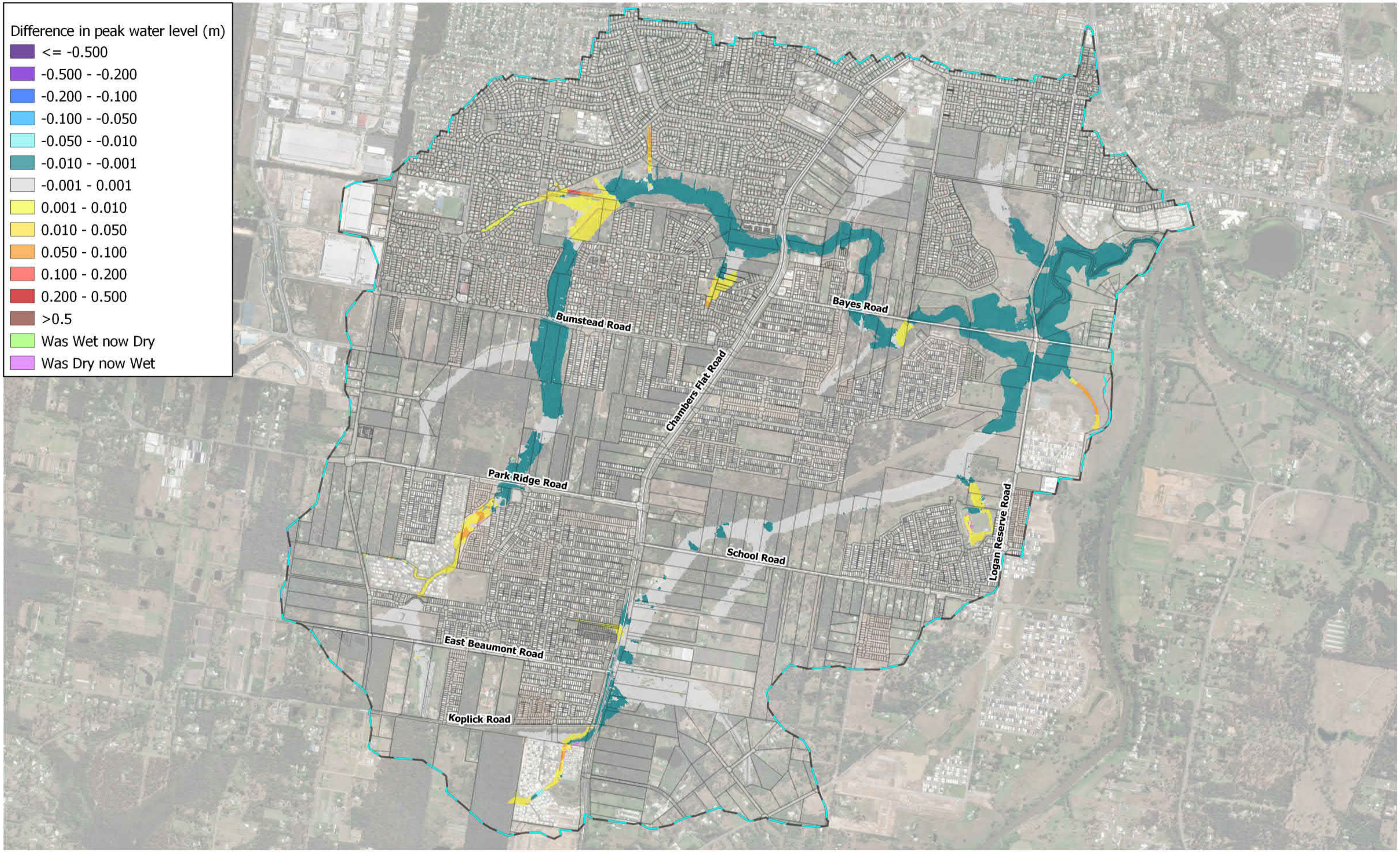


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Impact of revegetation of waterway corridor on 20% AEP flood levels**

Figure: **G7**

Rev: **0**

Scale at A3 1:21000
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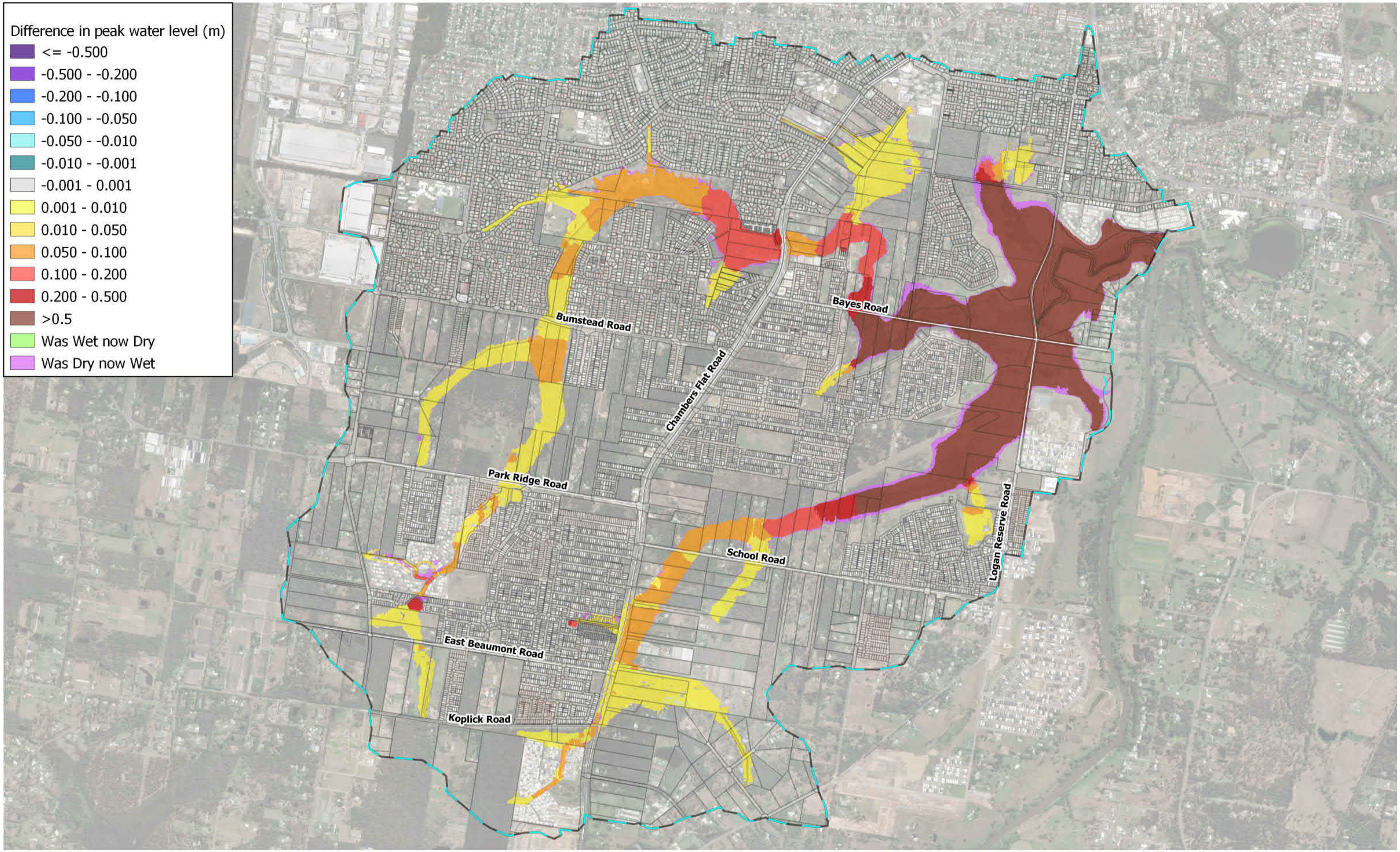


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level -1% AEP with Climate Change (RCP 6p) minus 1% AEP**

Figure: **G8**

Rev: **0**

Scale at A3 1:21000



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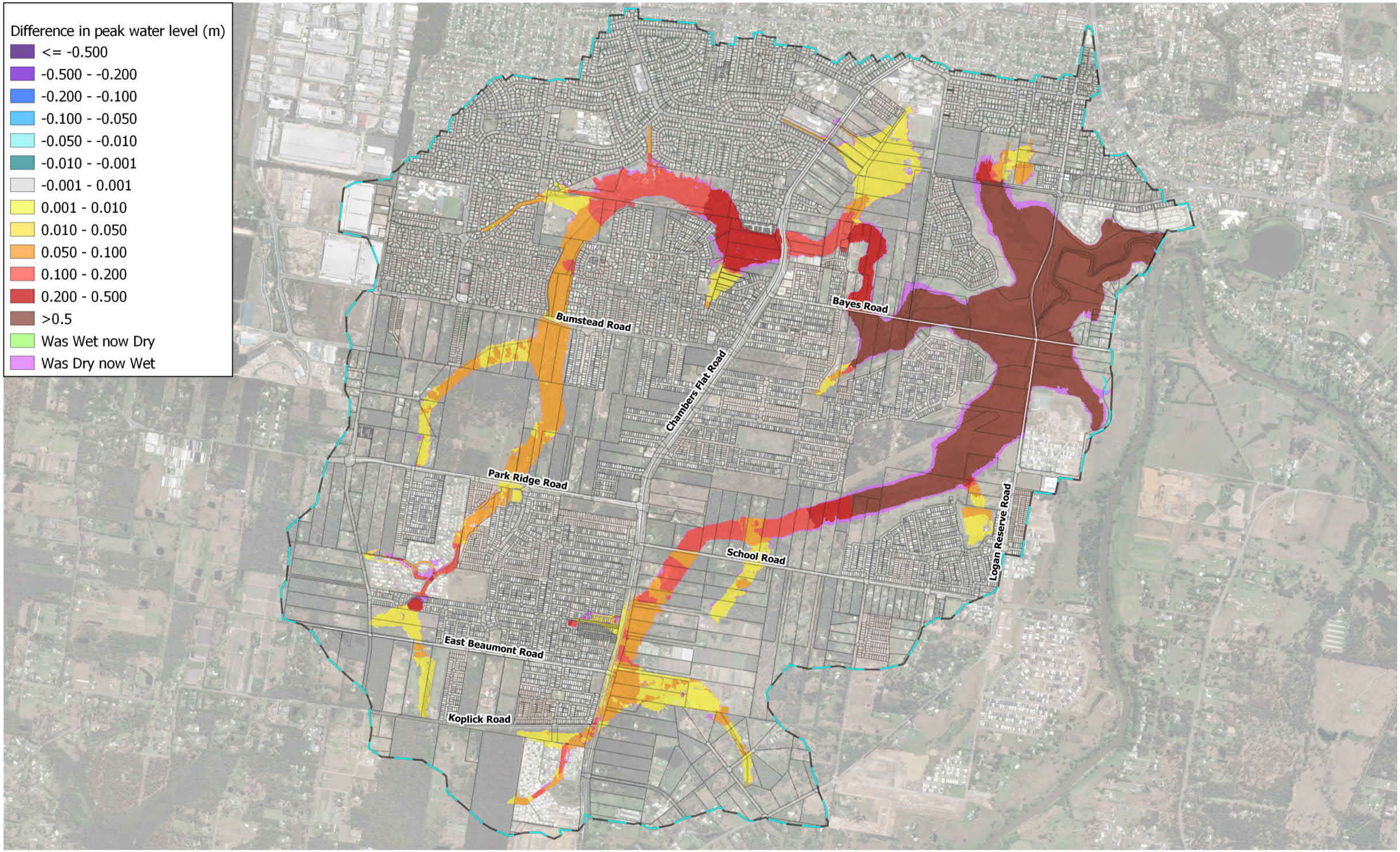


**LEGEND**

- Cadastre
- TUFLOW model extent
- Catchment boundary

Title

**Schmidt's Creek Flood Study**
**Difference in Water Surface Level - 1% AEP with Climate Change (RCP 8p5) minus 1% AEP**

Figure: **G9** | Rev: **0**

Scale at A3 1:21000



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