



Engineering | Surveying | Planning

321-399 IBBOTSON STREET, ST LEONARDS

ADDENDUM 1 - HYDRAULIC MODEL
UPDATE & FLOOD IMPACT ASSESSMENT
REPORT

DRAFT

TGM GROUP PTY LTD

Level 1, 27-31 Myers Street
Geelong, Victoria 3220
Phone: (03) 5202 4600

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Client	Costa Property Nine Pty Ltd
Client Project Manager	Leigh Prossor
Author	Mark Colegate
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The information provided represents the best estimate based on currently available information as described; this information is subject to change as new information becomes available as further studies or significant alterations to the proposed development are carried out.

TGM Group Pty Ltd

Level 1, 27-31 Myers Street
Geelong, VIC 3220
Telephone – (03) 5202 4600
Fax – (03) 5202 4691

Document Location


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EXECUTIVE SUMMARY

TGM Group has been engaged by the Costa Property Nine Pty Ltd to submit a combined Planning Scheme Amendment Application under Section 96A of the Planning and Environment Act 1987 for the rezoning and staged multi-lot subdivision of land at 321-399 Ibbotson Street, St Leonards.

An application is being made to amend the Greater Geelong Planning Scheme and enable a rezoning of the subject land from the Farming Zone to the General Residential Zone Schedule. The application also seeks approval for a staged multi-lot subdivision which will create approximately 468 conventional residential lots.

The following report is designed to accompany and update the TGM report:

-  321-399 Ibbotson Street, St Leonards – Existing Flood Study and Site Stormwater Management Plan – Version 2 (28 August 2015) [TGM8-2015]

The following report provides a Flood Impact Assessment (FIA) of the proposed development site and assessment of flood mitigating designs for development of the site. This report has been prepared to inform and support the application process and incorporates current best practice techniques and the latest industry standards.

Existing Flood Conditions Update

This document includes an update to the *Existing* hydraulic modelling detailed in the previous report [TGM8-2015]. The variation involves increasing the analytical extent of the 2d hydraulic model (TUFLOW) to provide a detailed assessment of stormwater flows within the upper catchment area.



The objective is to identify possible diversion of flow in the proximity of the Old St Leonards Road and Grassy Point Road intersection.

Expansion of the 2d analytical area was a recommendation of the initial review process, documented in the following report:

-  321-399 Ibbotson Street St Leonards – Stage 1B Peer Review of Stormwater Management Plan (30 October 2015) – Venant Solutions

Study Objectives

The purpose of this addendum is to:






-  Extend the exiting regional hydraulic flood model for the St Leonards Lake catchment area to assess the diversion of runoff flow in the upper catchment; and
-  Undertake a flood impact assessment of the proposed developed site to inform the final overall development plan (ODP).

Extend Hydraulic Model (TUFLOW)

It was an outcome of the initial review process that the analytical extent of the 2d hydraulic model should be increased to enable a detailed assessment of a location capable of diverting runoff and creating cross-catchment flow patterns.

Flood Impact Assessment (FIA)

It is imperative that development of the Ibbotson Street site does not have an adverse impact on the surrounding areas during flood events up to and including the 1% AEP. The impact of the development will be assessed against the following flood characteristics:



-  Flood extents;
-  Flood storage;
-  Velocities and flow safety and hazard characteristics;
-  Duration; and
-  Cumulative flooding impact.

Study Methodology




The following study was undertaken using the detailed hydrologic and hydraulic assessment adopted in TGM's earlier assessment [TGM8-2015].

The *Existing Conditions* 1% AEP flood extent has been previously identified and documented in TGM reports [TGM8-2015]. Revision of the 2D analytical model extent will enable detailed mapping of additional area within the upper flood plain of the St Leonards Lake catchment.

To enable expansion of the modelled area, TGM undertook the following:

-  Updated the one-dimensional (1D) RAFTS hydrologic model to provide improved representation of inflow boundaries in the extended upper catchment area for the 1%, 2%, 5%, 10%, 20% and 50% annual exceedance probability (AEP); and
-  Updated the two-dimensional (2D) TUFLOW flood model to reflect the increased analytical model extents.

In order to demonstrate that the Ibbotson Street development achieves the design objectives for flooding, TGM has undertaken the following:

-  Created a developed case 1D and 2D model to reflect the expected changes caused by development of the site;
-  Assessed the impacts of the proposed development upstream and downstream of the development site for the nominated AEP events; and
-  Undertaken an iterative design process to identify maximum lot yield and ensure flooding design criteria is achieved.

Study Results

Existing Flooding

The updated Existing Conditions flood extent can be seen in Figure A, for the 1% AEP flood event. This will form the 'base-case' for the following flood impact assessment.

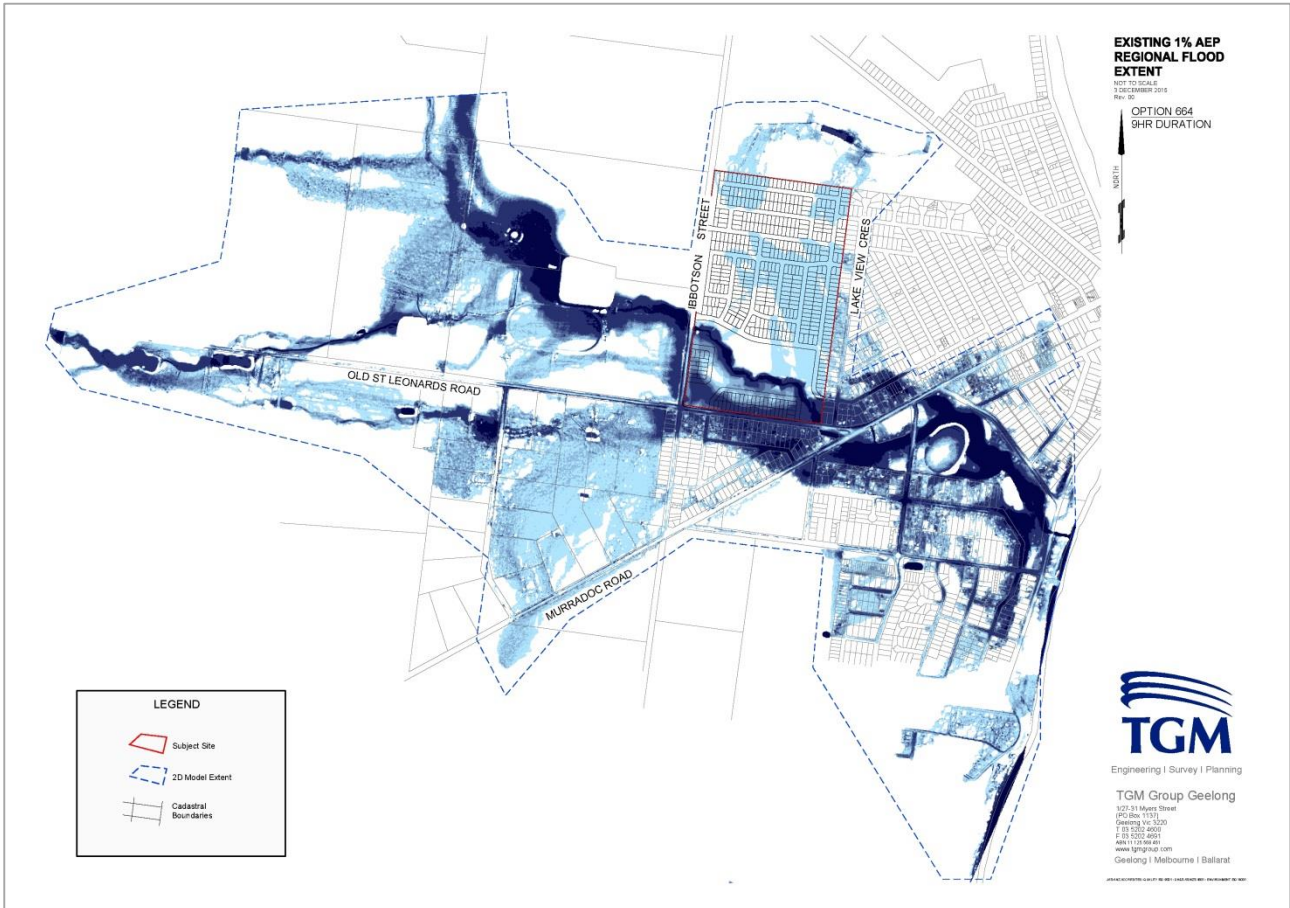


Figure A: Existing 1% AEP Flood (Full Extent)

Developed Flooding

The flood impact assessment was used to define and mitigate flooding under developed conditions. The developed case flood mapping is shown in Figure B for the 1% AEP flood event.

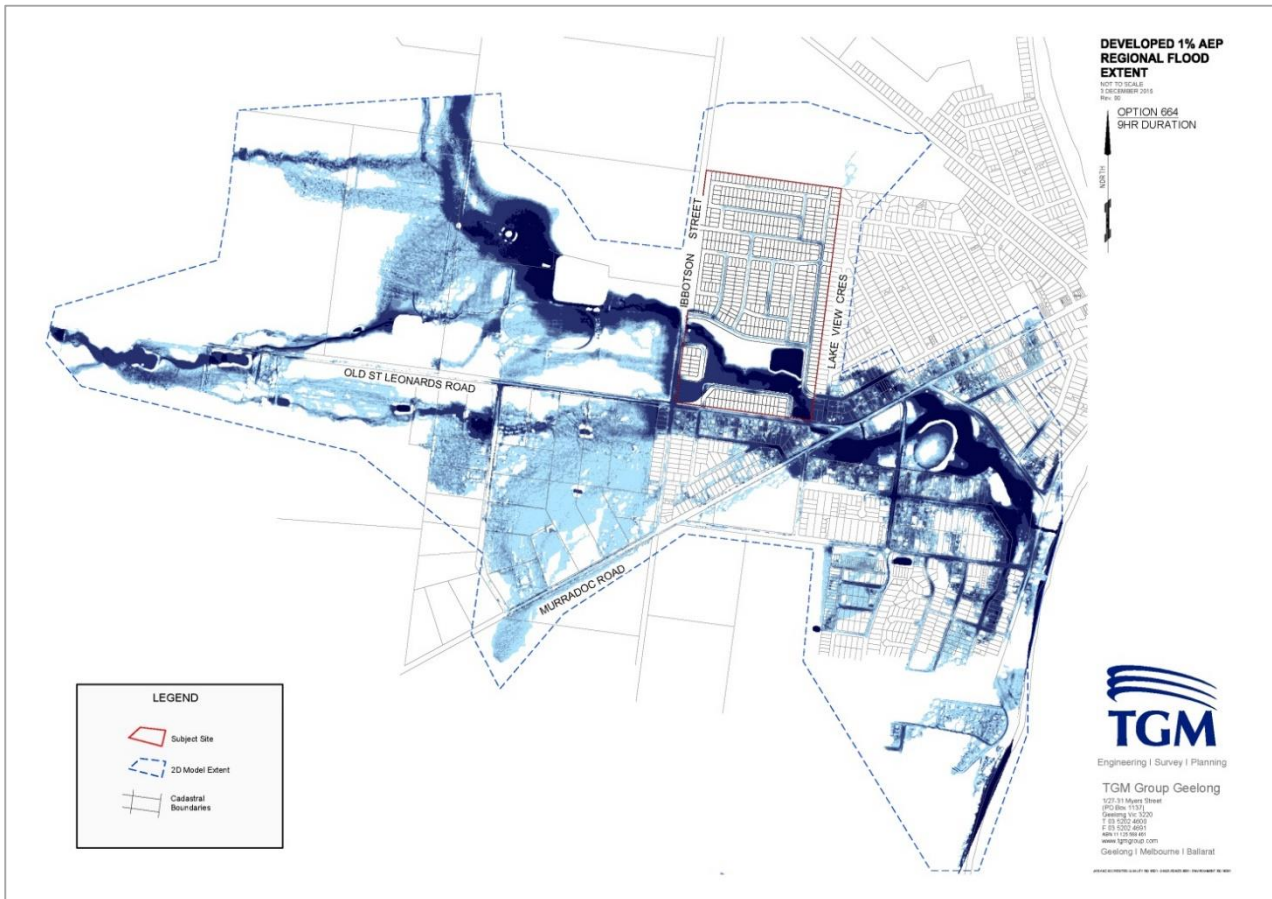


Figure B: Developed 1% AEP Flood (Full Extent)

Study Conclusion

The analysis documented in this report and **[TGM8-2015]** has demonstrated that the proposed development can be constructed and meet the requirements and objectives for stormwater management and supports development of the overall development plan (ODP8).

The key design features used to manage flooding and associated risks are:

- Construction of retarding basins to mitigate increases in stormwater runoff discharge from the developed site;
- Augmentation of the box culvert under Ibbotson Street to a 4 cell 2.7 m x 0.9 m culvert configuration;
- Construction of a low level weir (R.L 4.3 m AHD) at the constriction point between the north and south fill platforms in the south east corner of the site;
- Augmentation of the box culvert under Old St Leonards Road to a 3 cell 2.7 m x 0.9 m culvert configuration and maintained a sealed structure to the downstream side of Murradoc Road;
- Retaining a single cell 2.7 m x 0.9 m box culvert to capture surface flows within the drainage reserve upstream of Murradoc Road;
- Sealing the existing 1125 mm RCP along Old St Leonards Road to enable discharge to waterway reserve downstream of Murradoc Road. Flows within pipe will no longer daylight in the reserve upstream of Murradoc Road;
- An overland flow path will be provided in the south-west corner of the site to allow flows to enter the waterway corridor within the site. Shaping of the new reserve will occur to facilitate flows to the waterway; and
- Upgrade of the existing Cole Street culvert system to a 7 cell 1.2 m x 0.9 m box culvert arrangement.

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1. BACKGROUND

City of Greater Geelong (COGG) has identified two prospective Growth Areas within the Geelong regional town of St Leonards. TGM has previously prepared a number of hydrologic and hydraulic reports in support of development identified as Growth Area 1, known herein as ‘the site’.

The site is located at 321-399 Ibbotson Street, St Leonards and is a 39 hectare land parcel currently used for agricultural purposes.

Previous reporting had identified the regional 1% AEP flood and provided a detailed Site Stormwater Management Plan (SSMP) to mitigate stormwater runoff generated within the developed site.

The previous 2D modelling extent has been extended to analyse the probability of cross-catchment and diversion flows in the upper catchment area as discussed in *Section 1.2 [TGM8-2015]*. The change in model extent can be seen in Figure 1.1, below.

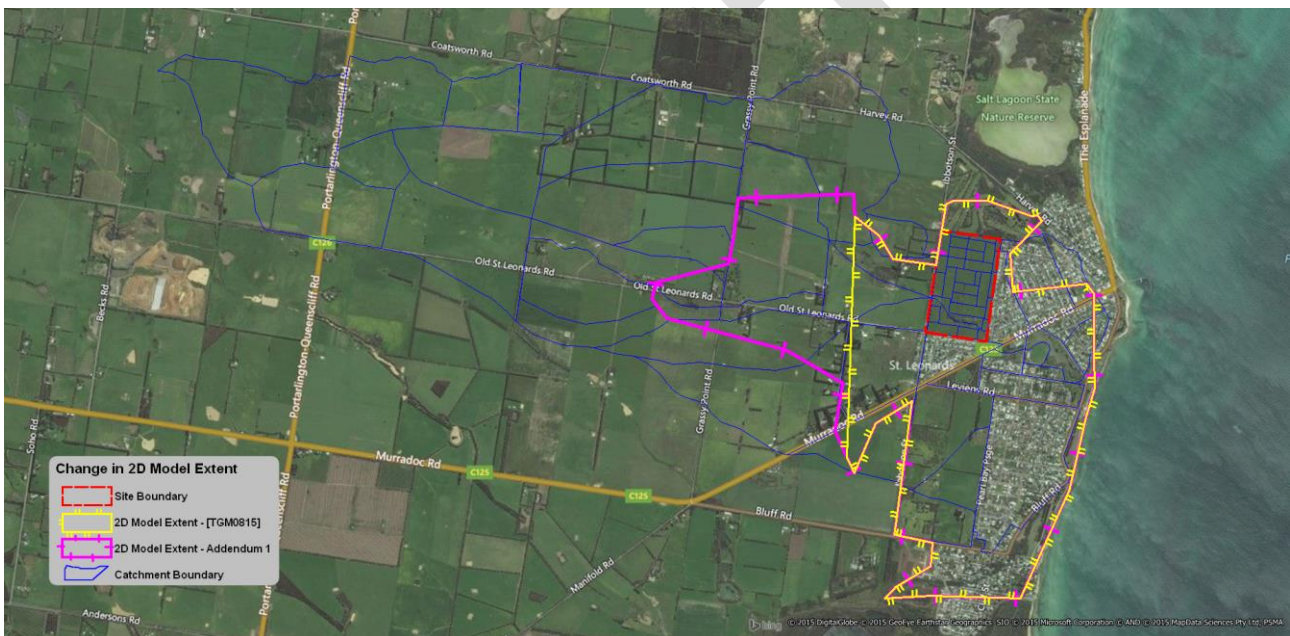


Figure 1.1: Change in 2D Model Extent

Change in 2D model extent resulted in reconfiguration of inflow boundary conditions in both the 1D and 2D analytical models.

1.1 Hydrology Model

The extension of the 2D model area meant the extent of external catchments analysed in the RAFTS hydrologic model needed to be modified. The revised 1D RAFTS catchments can be seen in Figure 1.2, in relation to each specified external inflow boundary in the 2D model.

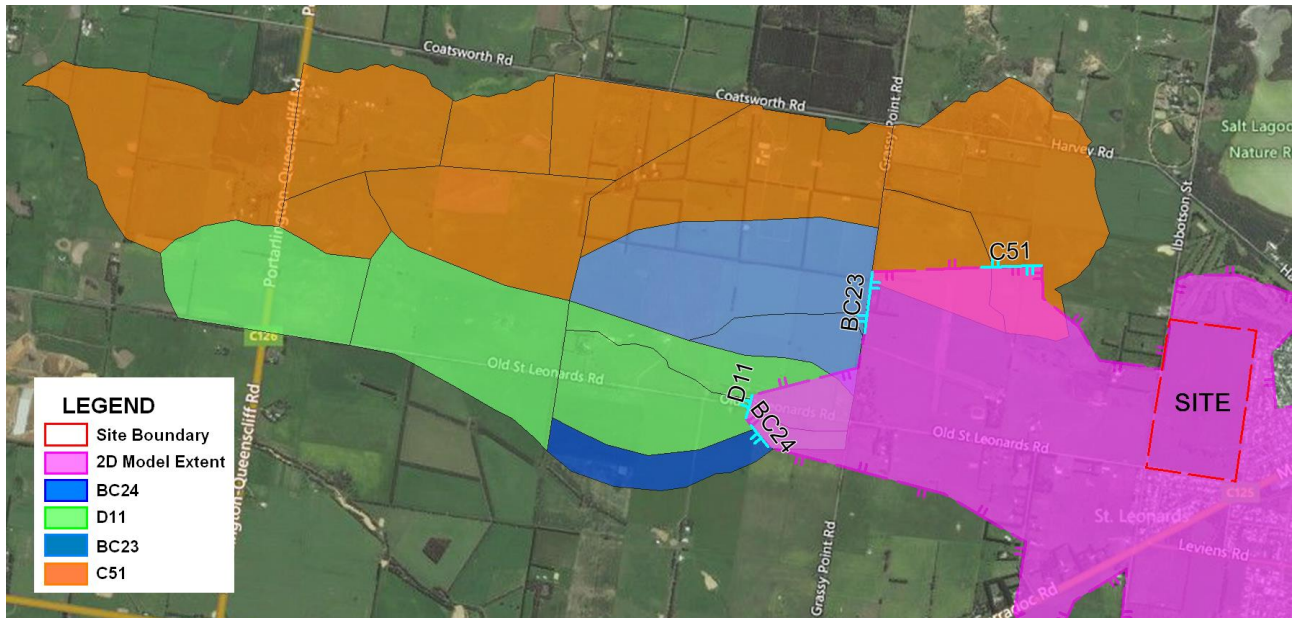


Figure 1.2: External Inflow Catchments

The revised inflow boundaries were assessed against the validation process undertaken in [TGM8-2015] to ensure that expected peak discharges were still achieved. The hydrographs for each inflow boundary are depicted below in Figure 1.3.

As there were no physical changes to the RAFTS model, there was no need to change the validation process detailed in Section 4.5 [TGM8-2015]. Therefore, the validation factors were maintained in this study.

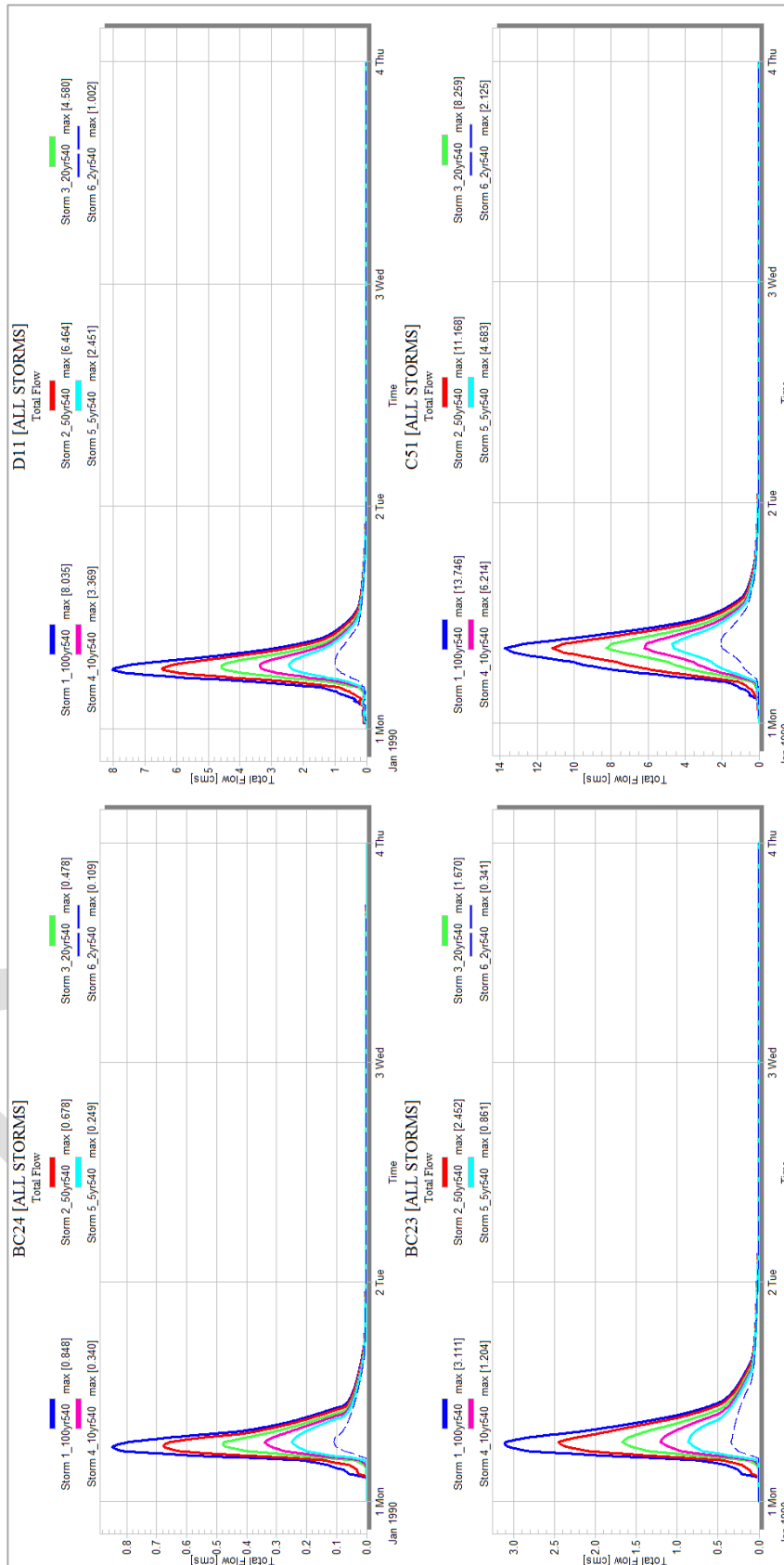


Figure 1.3: External Inflow Boundary – Hydrographs

1.2 Hydraulic Model Layout and Coverage

The TUFLOW model boundary was extended sufficiently upstream of the Ibbotson Road site to ensure that the complex distributions of flow in the catchments upstream of the development were reliably modelled, and also to ensure that any flood impacts resulting from the development could be simulated within the model domain. It was not considered necessary to extend the TUFLOW model domain to the limits of the 1D RAFTS model, and the smaller model domain enabled reduced model run times.

The proposed TUFLOW model schematic is shown in Figure 1.4.

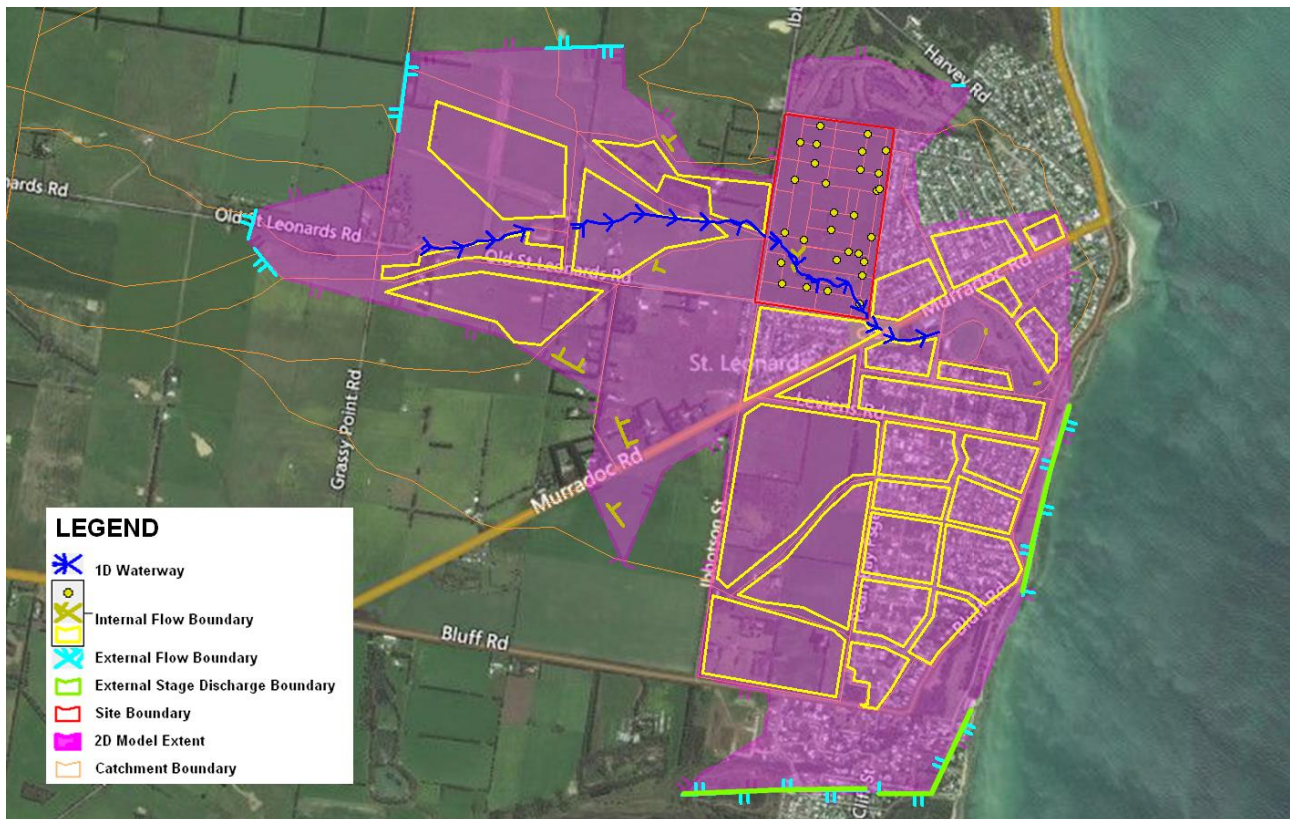


Figure 1.4: Hydraulic Model Layout and Extent

1.3 Developed Site

The preferred development plan proposes creation of 468 medium-density housing lots within the 39 hectare site. The preferred development plan is shown in Figure 1.5.

The proposed development plan shown in Figure 1.5 shows that the majority of the development (85%) is located north of the waterway alignment. Extent of development of the southern section of the site, has been determined through detailed hydraulic analysis to mitigate adverse impacts on regional flood characteristics and ensure safety and hazard criteria are achieved.



Figure 1.5: Ibbotson Street, Overall Development Plan (ODP8)



2. STUDY OBJECTIVES

The objectives detailed below are specific to this report and are designed to be used in conjunction with those stated in [TGM8-2015], unless otherwise indicated.

Specific objectives are detailed below.






2.1 Existing Flooding Update Objectives

The objective of the existing flood update is to:

-  Extend the 2D model analytical area to detail complex hydraulic characteristics in the upper catchment and ascertain impact on the site; and
-  Update existing flood mapping.

2.2 Flood Impact Assessment Criteria

Development of the Ibbotson Street site must not have a negative impact on the surrounding areas during flood events up to and including the 1% AEP. The impact of the development will be assessed in regards to the following:

-  Flood extents – No worsening of flood extents;
-  Flood storage – No loss of waterway flood storage;
-  Velocities and flow characteristics – Flow velocity, depths and the product of velocity and depth must not exceed safety limits for people and vehicle access (egress) to (from) the site. The criteria are as follows:
 - Site Safety (People) [ARR 2010]
 - Depth must be no greater than or equal to 0.5 metres;
 - Velocity must be no greater than or equal to 3.0 m/s; and
 - The product of depth multiplied by velocity must be no greater than or equal to 0.4 m²/s.
 - Access Safety (Vehicles) [ARR 2010]
 - Depth must be no greater than or equal to 0.3 metres;
 - Velocity must be no greater than or equal to 3.0 m/s; and
 - The product of depth multiplied by velocity must be no greater than or equal to 0.3 m²/s.
-  Duration – Restrict change in flood durations in external properties; and
-  Cumulative flooding impact – No worsening of overall flood impacts.

3. STUDY METHODOLOGY

To extend the existing conditions 'base case' model and undertake a flood impact assessment of the proposed development, more detail was required in the upper catchment area to enable reliable modelling of the complex distributions of flow.

3.1 Topography – feature survey

In addition to the topographical data detailed in *Section 4.1 [TGM8-2015]* further feature survey was undertaken by TGM surveyors to detail waterway profiles, dam spillways and additional flow paths in the upper catchment and within the drainage reserve downstream of the site.

The extent of the recent feature survey in the upper catchment can be seen in Figure 3.1.

The feature survey shown in Figure 3.2 indicates the extent of survey taken to date. Recent survey also defined the drainage reserve south east of Murradoc Road to downstream of Cole Street.

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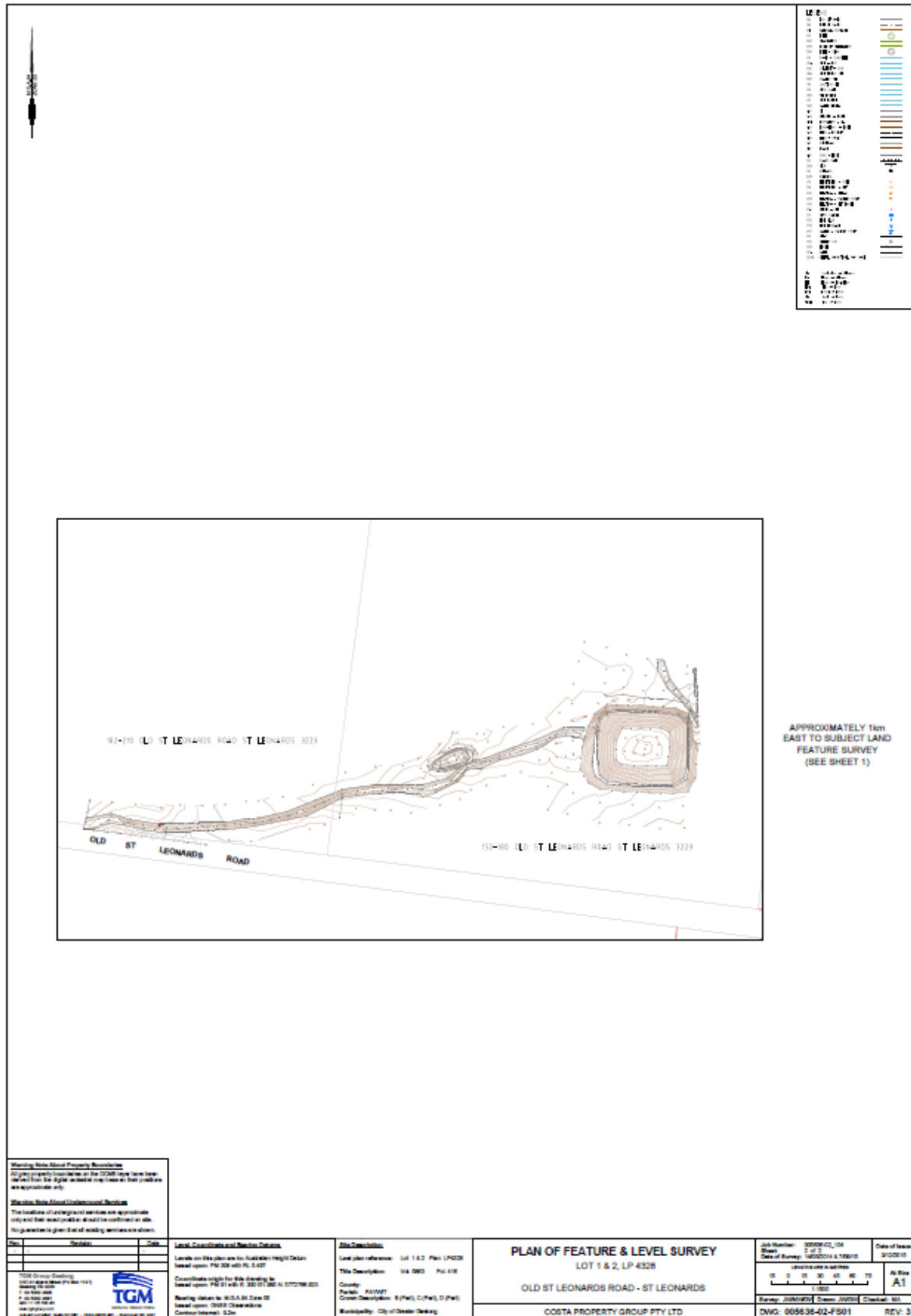


Figure 3.1: St Leonards Feature Survey – Upper Waterway

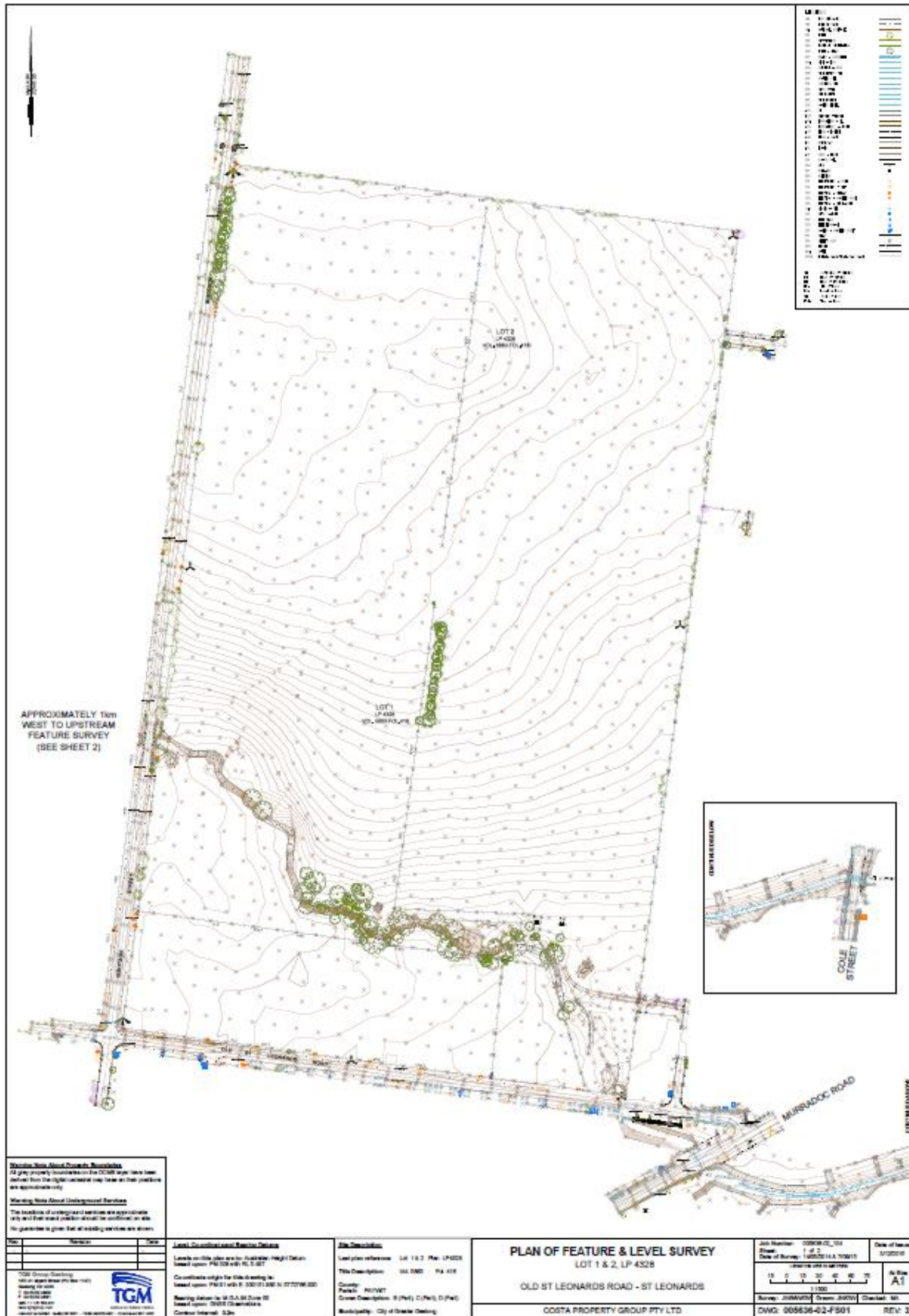


Figure 3.2: St Leonards Feature Survey – Site Waterway and Lower Reserve

3.2 Developed Site Stormwater Catchments

Site stormwater catchment delineation has been altered slightly to reflect the functional development plan (ODP8). ODP8 proposes construction of 468 residential lots, footpaths, road and drainage reserves and public open space.

The functional developed site stormwater catchments are shown in Figure 3.3.

The ODP of the proposed development has been confirmed using detailed hydraulic assessment to ensure flood impacts are mitigated.

The proposed overall development plan has changed the runoff characteristics from the previously documented layout. The updated catchment characteristics are shown in Table 3-1 and were adopted for this study.

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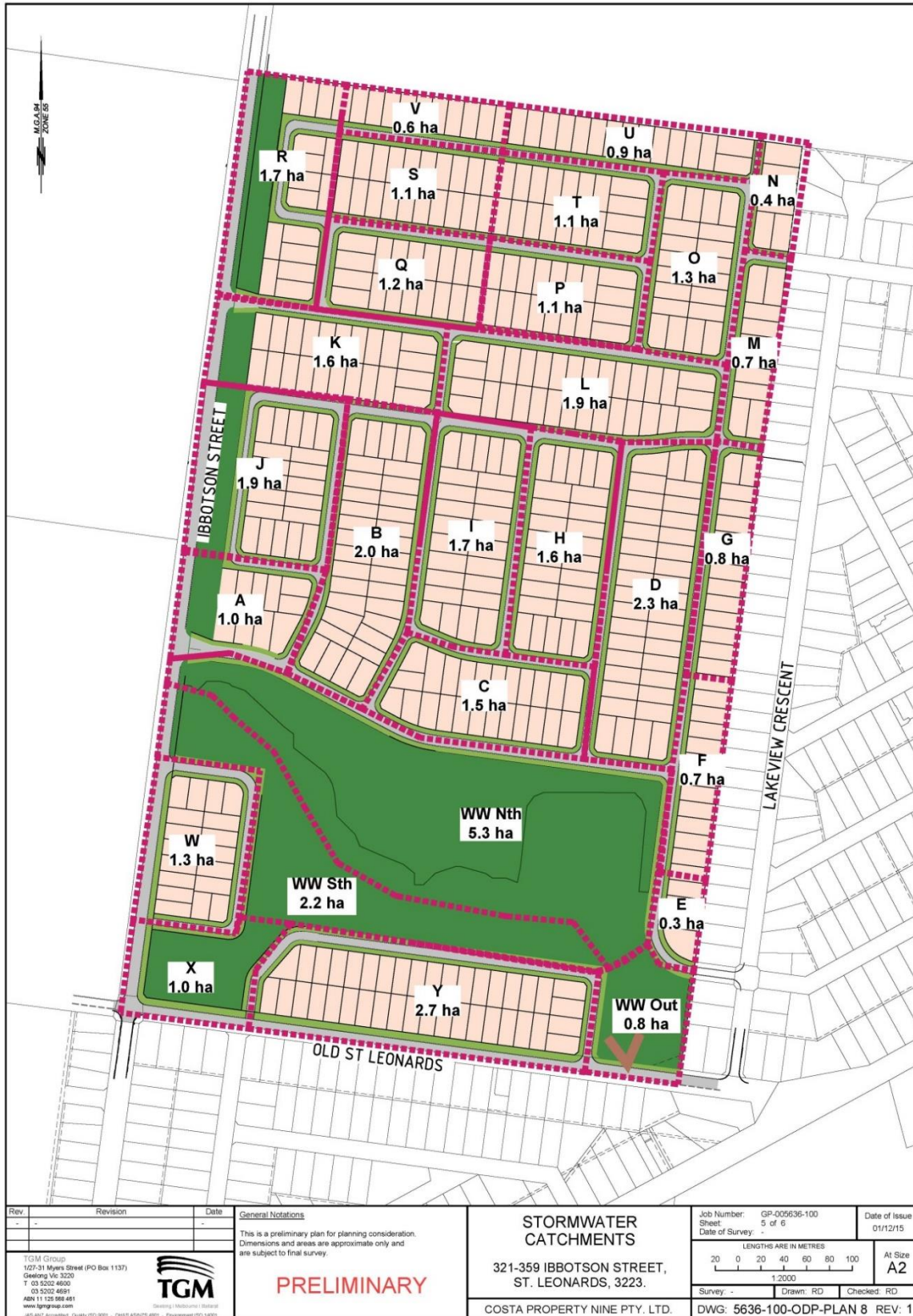


Figure 3.3: Ibbotson Street proposed development plan and stormwater catchment area

Table 3-1: Characteristics of Ibbotson Street developed catchments

Sub-catchment	Area (ha)	Impervious area (%)	Dominant land use
A	1.0	60	Residential
B	2.0	70	Residential
C	1.5	70	Residential
D	2.3	70	Residential
E	0.3	70	Residential
F	0.7	70	Residential
G	0.8	70	Residential
H	1.6	70	Residential
I	1.7	70	Residential
J	1.9	60	Residential
K	1.6	60	Residential
L	1.9	70	Residential
M	0.7	70	Residential
N	0.4	70	Residential
O	1.3	70	Residential
P	1.1	70	Residential
Q	1.1	70	Residential
R	1.7	60	Residential
S	1.1	70	Residential
T	0.6	70	Residential
U	0.9	70	Residential
V	0.6	70	Residential
W	1.3	70	Residential
X	1.0	0	Waterway Zone & Green Corridor
Y	2.7	70	Residential
WW North	5.3	0	Waterway Zone & Green Corridor
WW South	2.2	0	Waterway Zone & Green Corridor
WW Out	0.8	0	Waterway Zone & Green Corridor

3.3 Hydraulic Modelling

The hydraulic analysis was undertaken using the fully 2D, TUFLOW (Build 2013-12-AD-iDP-w64) hydraulic modelling package. TUFLOW is a fully 2D hydraulic modelling package with the ability to dynamically integrate 1D elements.

Overland flow paths, obstructions and storages were modelled in the 2D domain, whilst underground drainage systems were represented as 1D elements linked to the 2D domain. The TUFLOW model was run in unsteady state.

3.3.1 Existing Drainage Network

The extent of the existing drainage network incorporated into the flood analysis was directly related to its proximity and influence on flows impacting the site and within critical hydraulic locations with known flooding issues. The drainage network modelled is shown in the below Figure 3.4, below.



Figure 3.4: Existing underground drainage network analysed

3.3.2 Design Drainage Network

The proposed development required augmentation of the existing underground drainage and waterway culvert network around Old St Leonards Road, Ibbotson Street and within the waterway drainage reserve leading to St Leonards Lake to mitigate the impact on regional flooding.

Other measures were required to mitigate the change in overland flows resulting from construction of a new road along Old St Leonard Road and Ibbotson Street North and, to a lesser degree, fill pads corresponding to the proposed lot layout.

The modelled design drainage network can be seen in Figure 3.5, below. However, it is recommended that these measures be reassessed & potentially optimised at the time of detailed design.



Figure 3.5: Design drainage network and infrastructure

4. 2D DOMAIN ANALYTICAL GRID

The 2D domain was analysed using a 2 metre grid mesh to be consistent with the modelling previously undertaken by TGM. This maintained an accurate definition of the variable terrain topography, road obstructions and defined waterways. This grid size was determined to be of optimum size so as to accurately define the terrain and not adversely affect the simulation run times.

4.1 Old St Leonards Road & Ibbotson Street north

The proposed development plan calls for upgrades to the existing Old St Leonards Road and Ibbotson Street along the southern and western site boundaries respectively. The proposed upgrades are outlined in the Traffic and Transport Assessment CG140338, prepared by Cardno.

The new roads have been designed as part of the developed surface model in the civil design package 12d and represented in the 2D digital elevation model (DEM) in TUFLOW. Stormwater is conveyed along the Ibbotson Street and Old St Leonards Road alignments during flood events, forming an integral part of the drainage system for the developed site.

The proposed design for both Ibbotson Street and Old St Leonards Road has been designed and modelled utilising a sealed road pavement with standard kerb and channel design only on the side of the road fronting the development.

Due to the existing flat longitudinal grades along both Ibbotson Street and Old St Leonards Road, and the requirement to match to the existing surface profiles at the limits of the road reserve for access to existing properties, the detail designs for both of these roads were required to have some ‘sawtoothing’ of the longitudinal grades. The cross-sectional profile of the new roads can be seen in Figure 4.1.

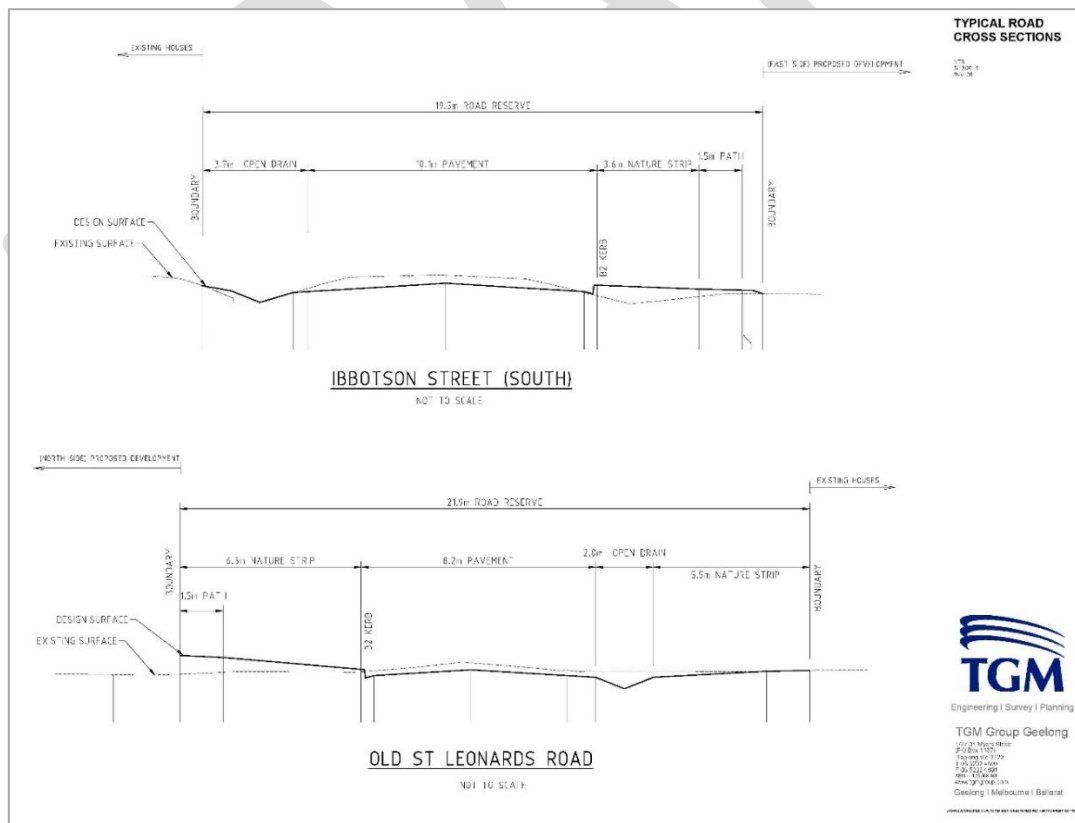


Figure 4.1: Cross-sectional profile of new roads

It is noted that modelling of the construction of kerb and channel on both sides of the road was also undertaken, however due to the constraints on integrating the design into the existing surface levels along the frontage of the existing properties, this design resulted in unacceptable flood hazard results that were unable to be resolved within the timeline for this investigation.

The road profile forms an integral hydraulic feature within the floodplain. To ensure the road profile is properly referenced within the 2m analytical grid, alignment strings representing the crown of road, invert of channel/swale, and kerbs were input into the 2D hydraulic model as elevation strings using the elevation line (2d_zln) and elevation shape (2d_zsh) features in TUFLOW.

The feature survey detailed in Figure 3.1 and Figure 3.2 was integrated into the hydraulic model using the same process to ensure full representation of hydraulic features within the flood plain. The extent of embedded 2D data can be seen in Figure 4.2, below.

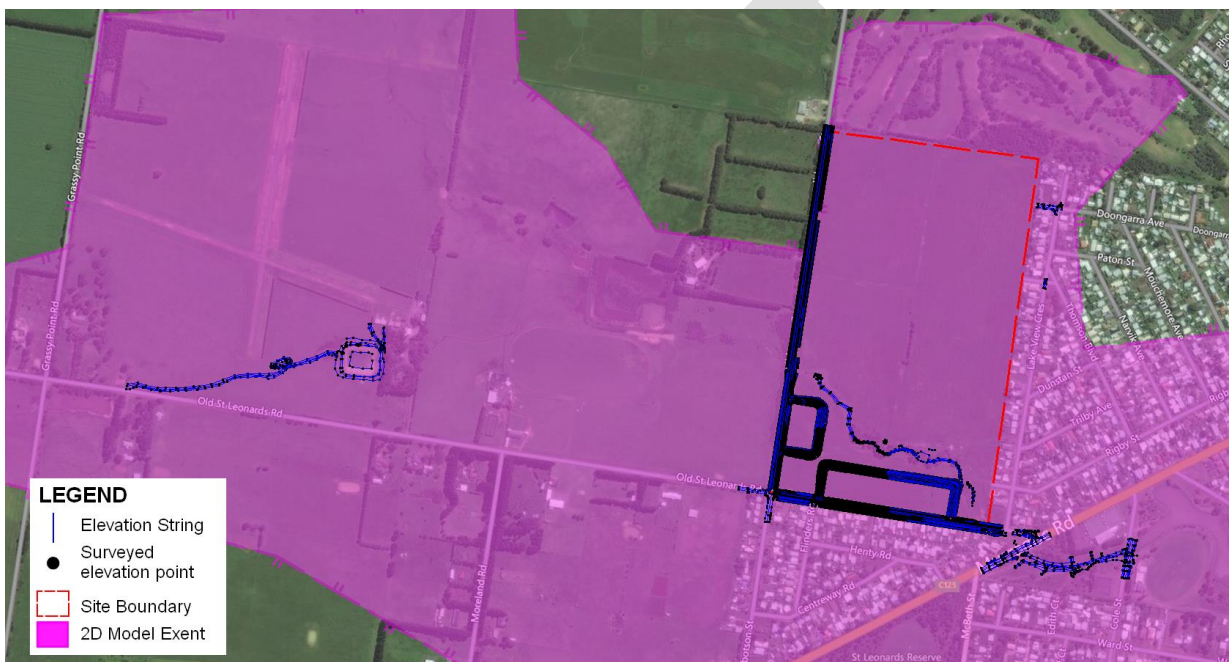


Figure 4.2: Elevation break lines

5. RESULTS

The results of the flood analysis are shown in this section. The design has been undertaken to meet ensure a no-worsening of flood characteristics in external properties during the range of AEP storm events. The extended existing conditions flood extent is also detailed in this section.

5.1 Hydraulic Simulation

The simulated developed model returned a final cumulative mass error (ME) of 0.11%. The recommended mass balance error range for a healthy model is between +1% and -1%. The model experienced a maximum mass error of -1.61% at time 0, however, this had stabilized to an acceptable level within a few timesteps.

To maintain an acceptable courant number the model was run at a 1 second timestep which is half the grid cell size. TUFLOW manual recommends a 2D model timestep $\frac{1}{2}$ to $\frac{1}{5}$ of the grid cell size.

The TUFLOW simulation summary is shown in Figure 5.1.

```
Simulation FINISHED

Total 1D Negative Depths: 0
Total 2D Negative Depths: 89

WARNINGS prior to simulation:    28 [0 not in _messages layer]
WARNINGS during simulation:      89 [0 not in _messages layer]
CHECKS prior to simulation:      13 [0 not in _messages layer]
CHECKS during simulation:        0  [0 not in _messages layer]

Peak Flow In (m3/s):    45.9 at Time 5.48
Peak Flow Out (m3/s):   33.2 at Time 7.98
Volume at Start (m3):   17
Volume at End (m3):     339340
Total Volume In (m3):   631638
Total Volume Out (m3):  291275
Volume Error (m3):      -1040 or -0.1% of Volume In + Out
Final Cumulative ME:    -0.11%

                                     Whole Simulation           Qi+Qo > 5%
Peak +ve dV (m3):           42.4 at 0.24h           42.4 at 0.24h
Peak -ve dV (m3):           -19.6 at 0.34h          -19.6 at 0.34h
Peak ddV over one timestep:  -3.1 at 0.29h           1.8 at 5.83h
Peak ddV as a % of peak dV:  7.2%                4.2%
Peak Cumulative ME:         -1.61% at 0.00h          0.85% at 0.29h
```

Figure 5.1: TUFLOW simulation summary (.tlf)

5.2 Existing Conditions Flood Extent – Updated Base Case

The existing conditions 1% AEP full flood extent is depicted in Figure 5.2 below. Representation of the full extent is useful for identifying flow paths and cross catchment flows, however these will not be used for planning purposes. The existing flood extents, with depths greater or equal to 50 mm, constitute the 1% AEP flood extent appropriate to define the planning flood boundary.

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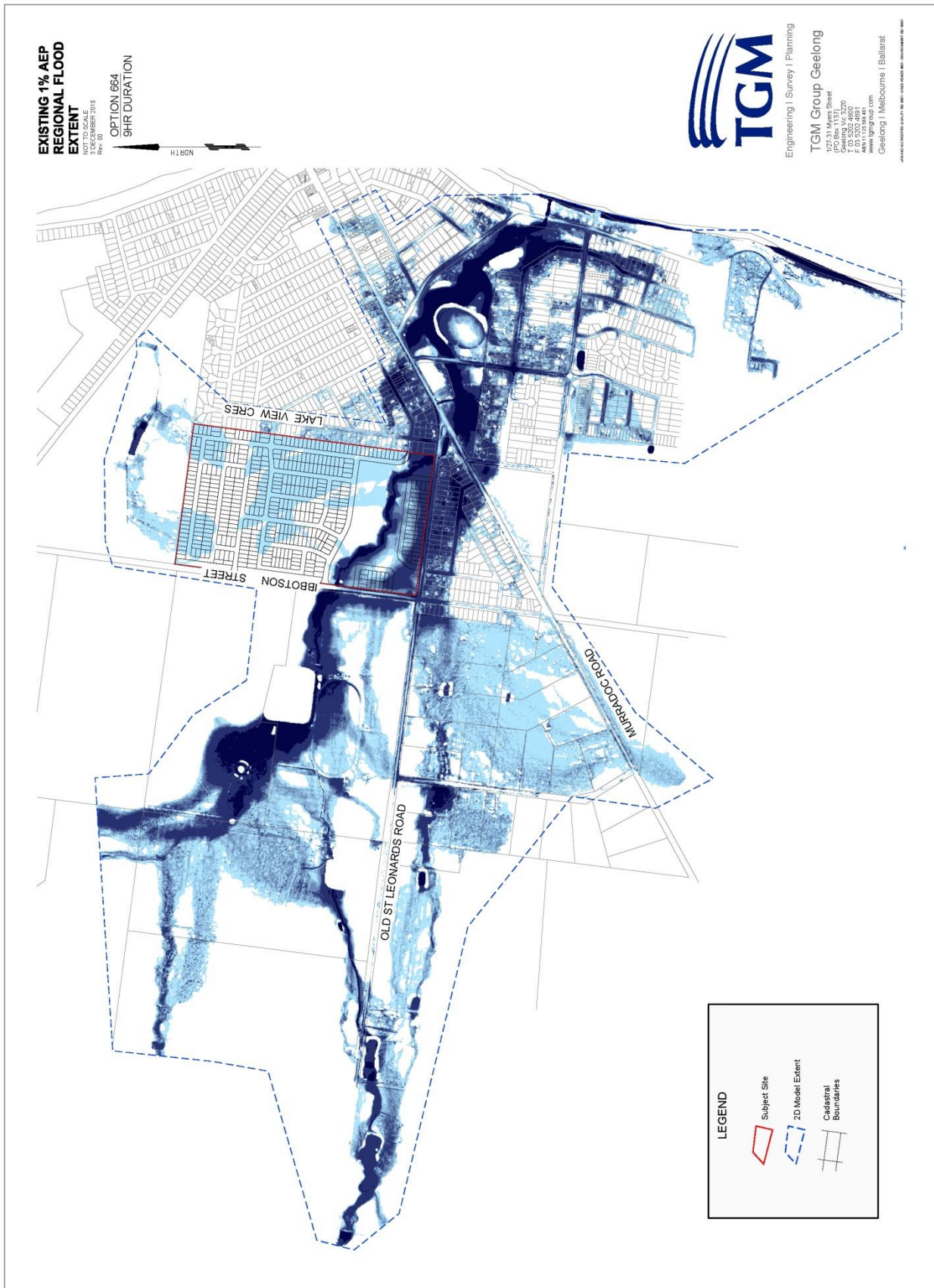


Figure 5.2: Existing 1% AEP Flood

5.3 Developed Conditions Flood Extent

The impact of the development on regional flooding has been assessed and enabled confirmation of the overall development plan (ODP8). The developed conditions flood extent for the specified range of AEP's is shown in Figure 5.3 to Figure 5.8.

The underground drainage system for the proposed development has not yet been designed and as such has not been represented in the hydraulic model. It is assumed, however, that the underground drainage system will be designed to accommodate and convey stormwater flows generated within the developed site for all flood events up to and including the 10%-20% AEP.

Stormwater runoff generated within the developed site will be conveyed to the site retention basins wholly within the internal underground drainage system for the 10%, 20% and 50% AEP events and as overland flow within the internal road network for the larger events.

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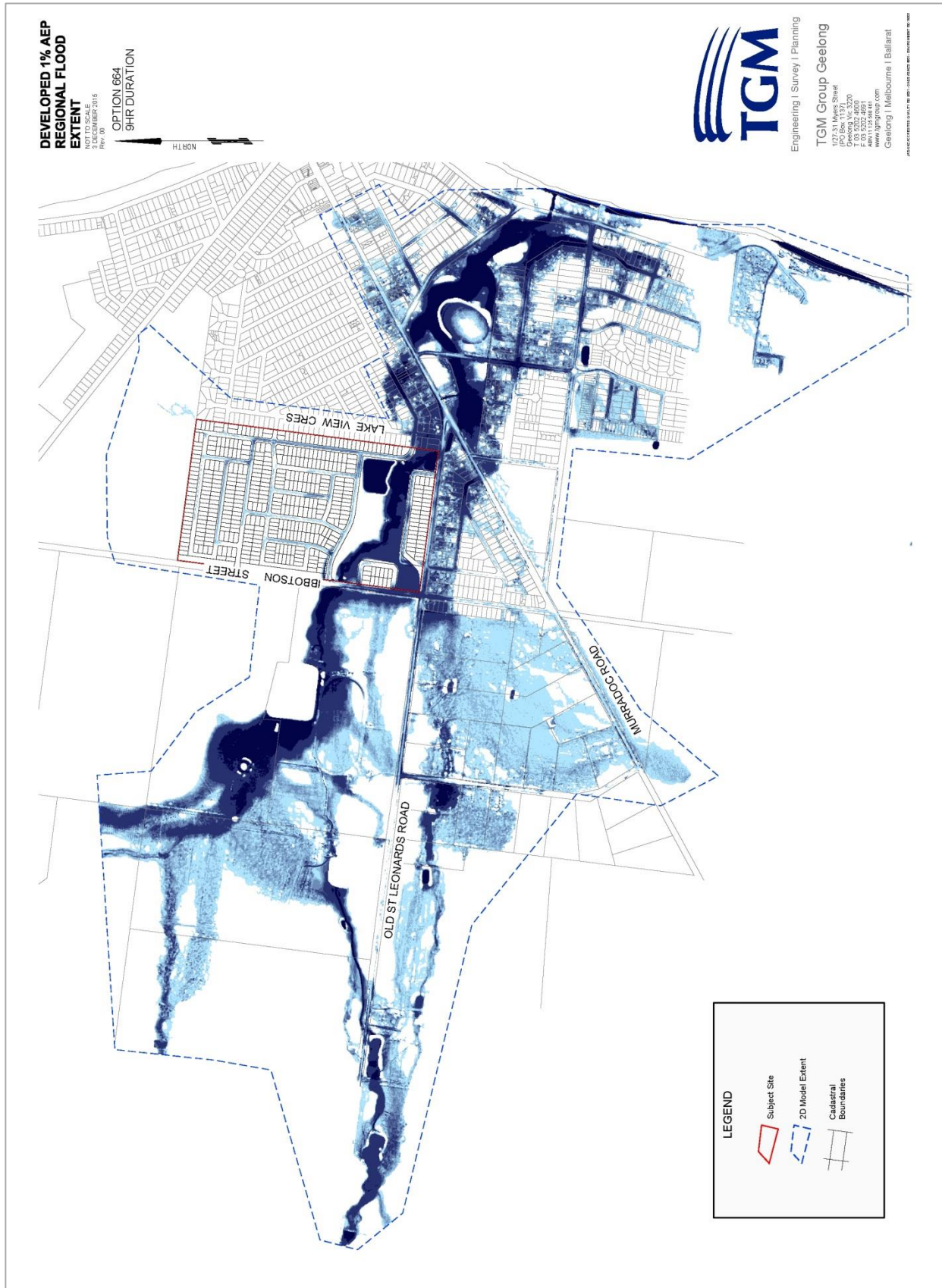


Figure 5.3: Developed 1% AEP Flood

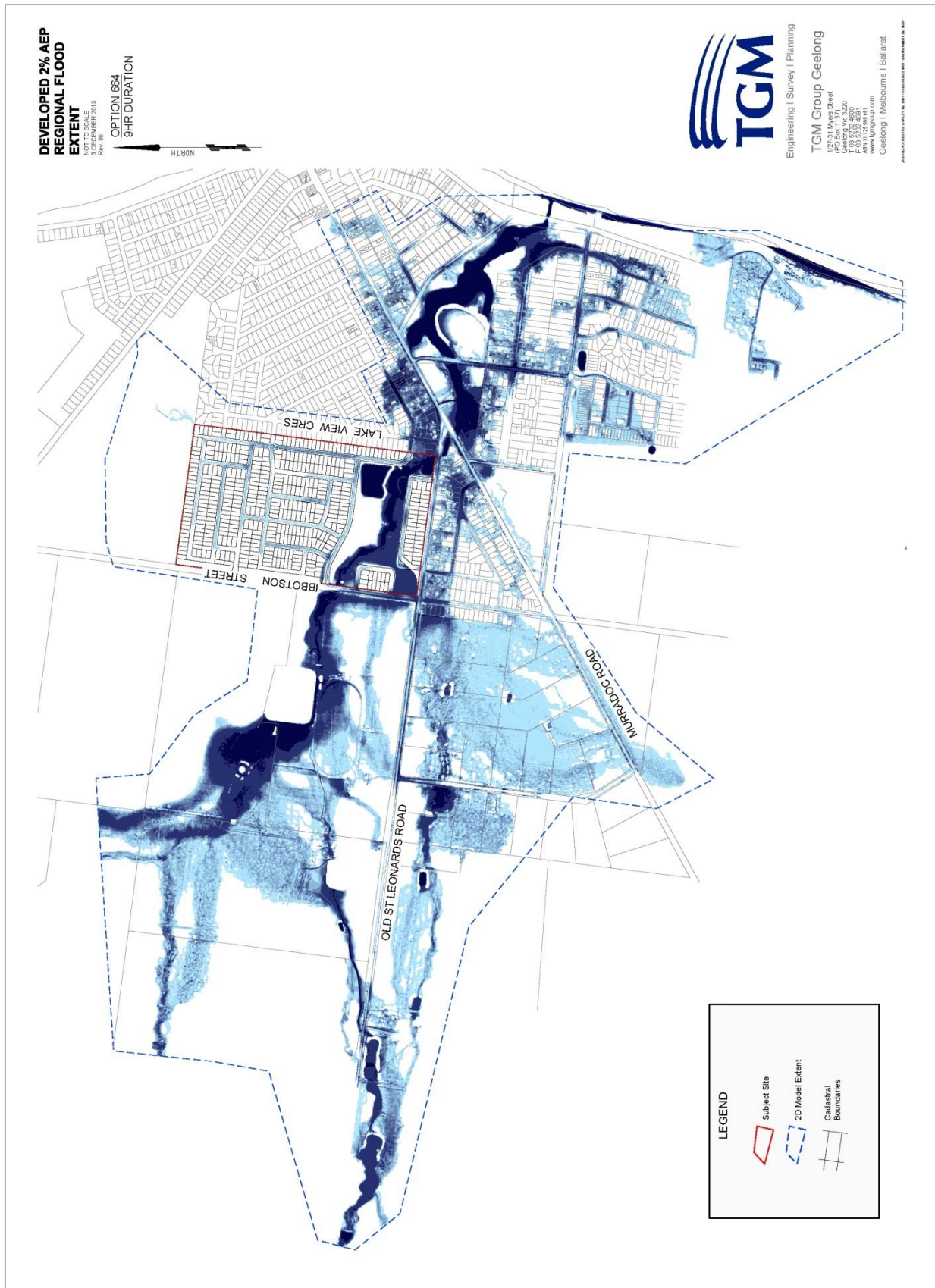


Figure 5.4: Developed 2% AEP Flood

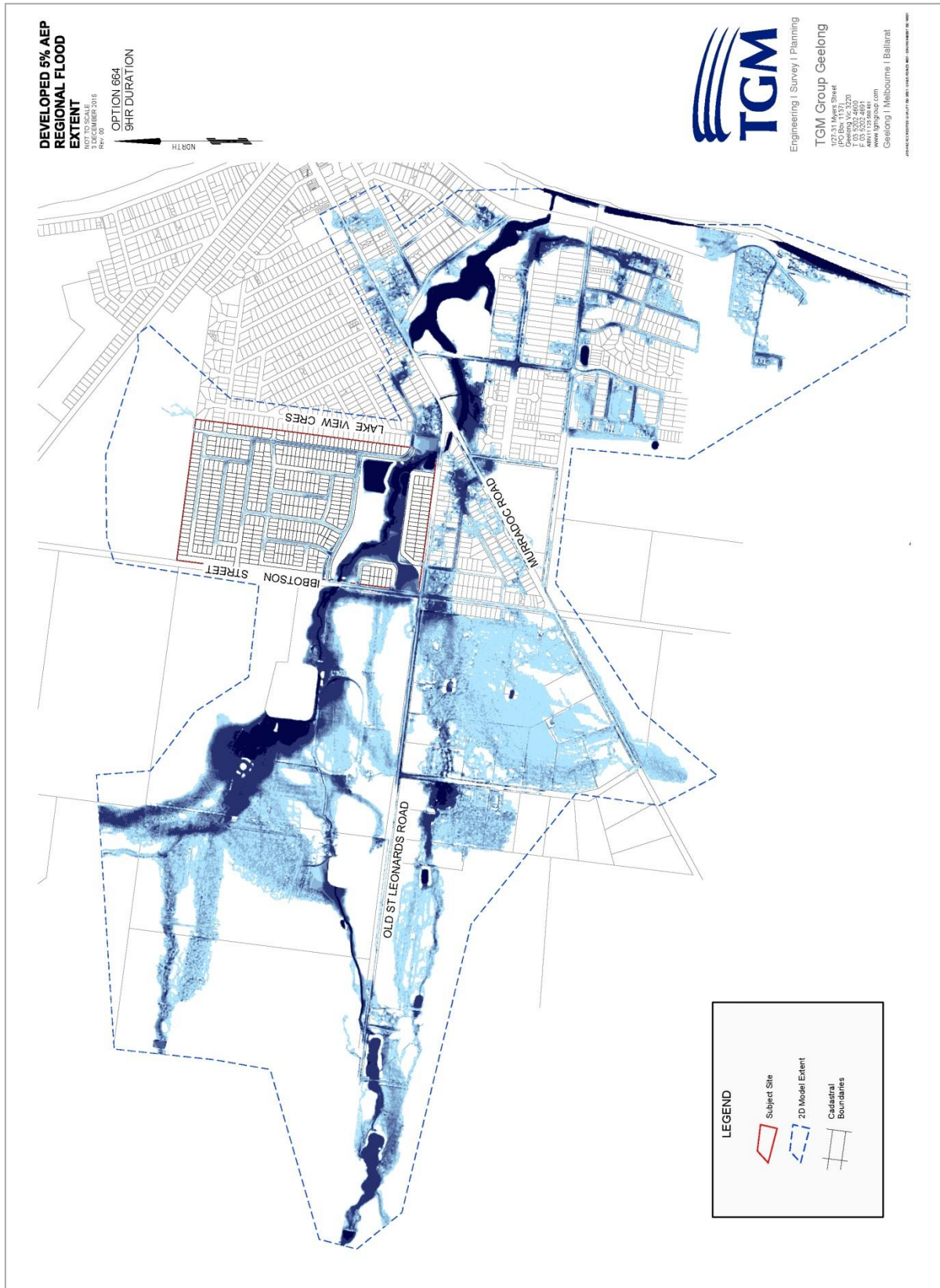


Figure 5.5: Developed 5% AEP Flood

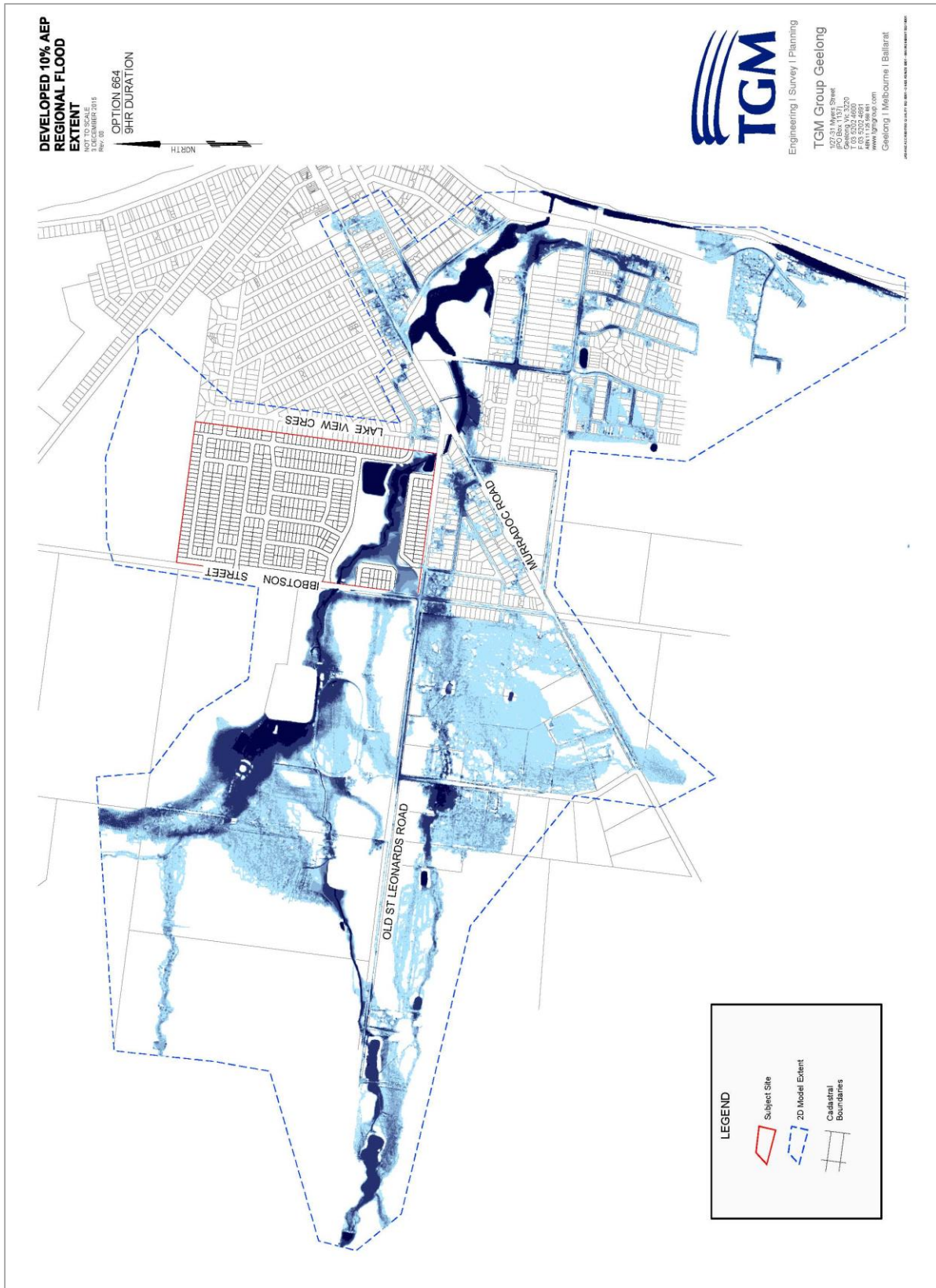


Figure 5.6: Developed 10% AEP Flood

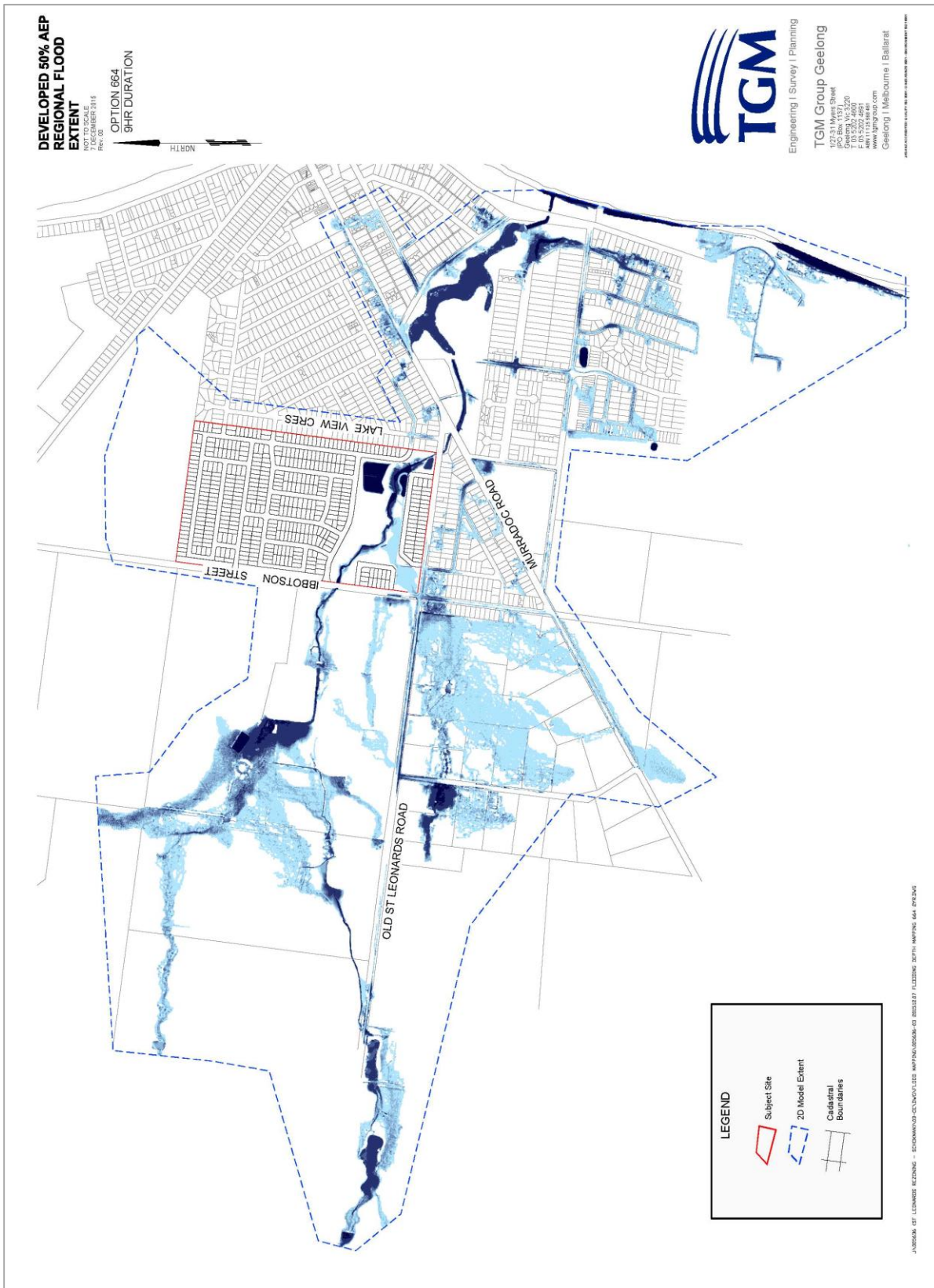


Figure 5.8: Developed 50% AEP Flood

5.4 Change in Flood Extent – Developed vs Existing

The impact of the development on the regional flood extent can be observed by analysing the change in flood extents, or flood water level, between the *Developed* case and the *Existing* case. The change in flood maps are shown below for the 1%, 2%, 5%, 10%, 20% and 50% AEP event for the 9 hour storm duration and can be seen in Figure 5.9 to Figure 5.14.

It is noted that an increase ‘was dry now wet’ is observed in the higher events in the reserve south of Murradoc Road at the base of the mapped extent. This is not a true impact but rather a modelling artefact relating to the application of the boundary condition at that location.

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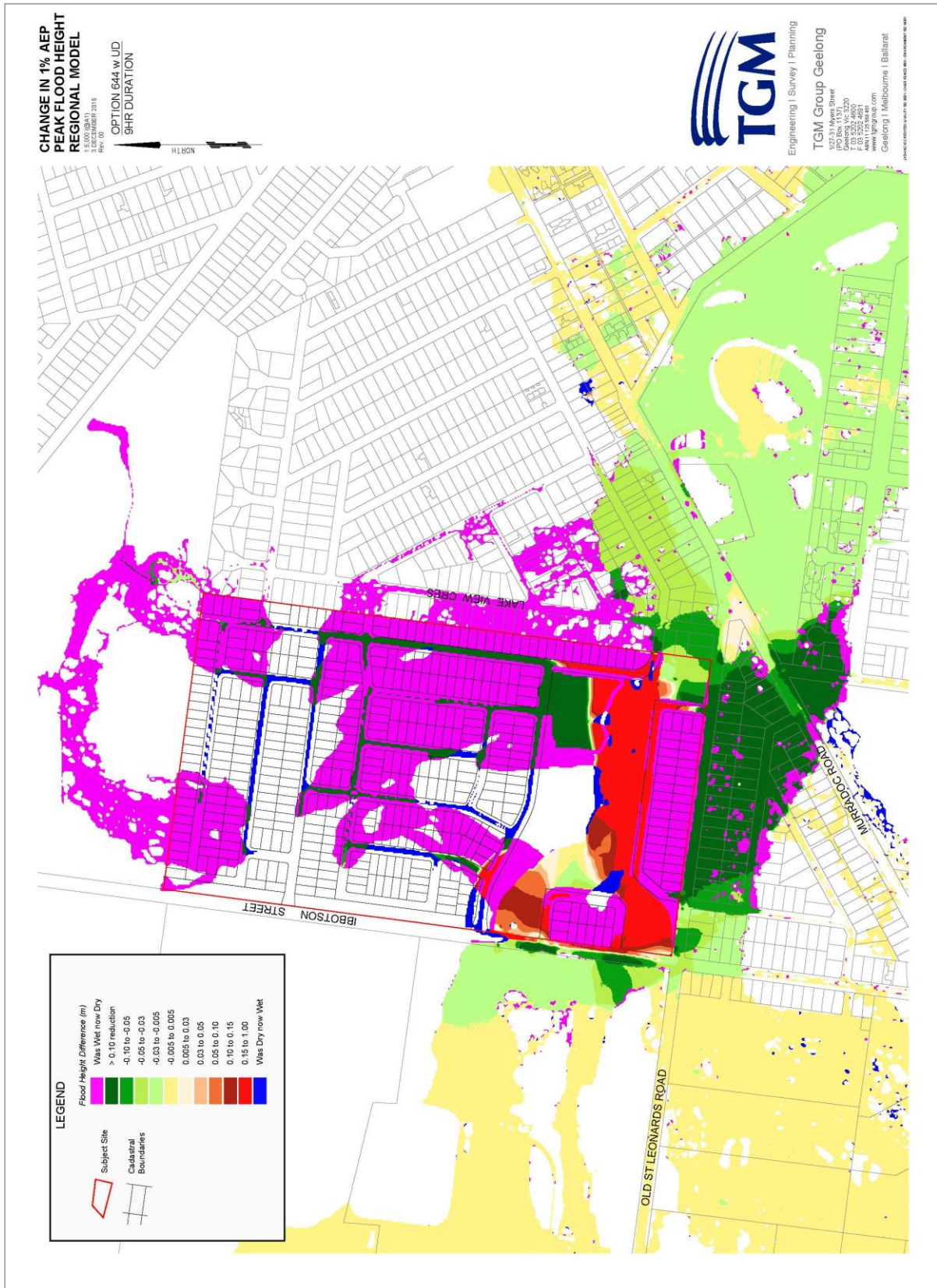


Figure 5.9: Change in Flood - 1% AEP

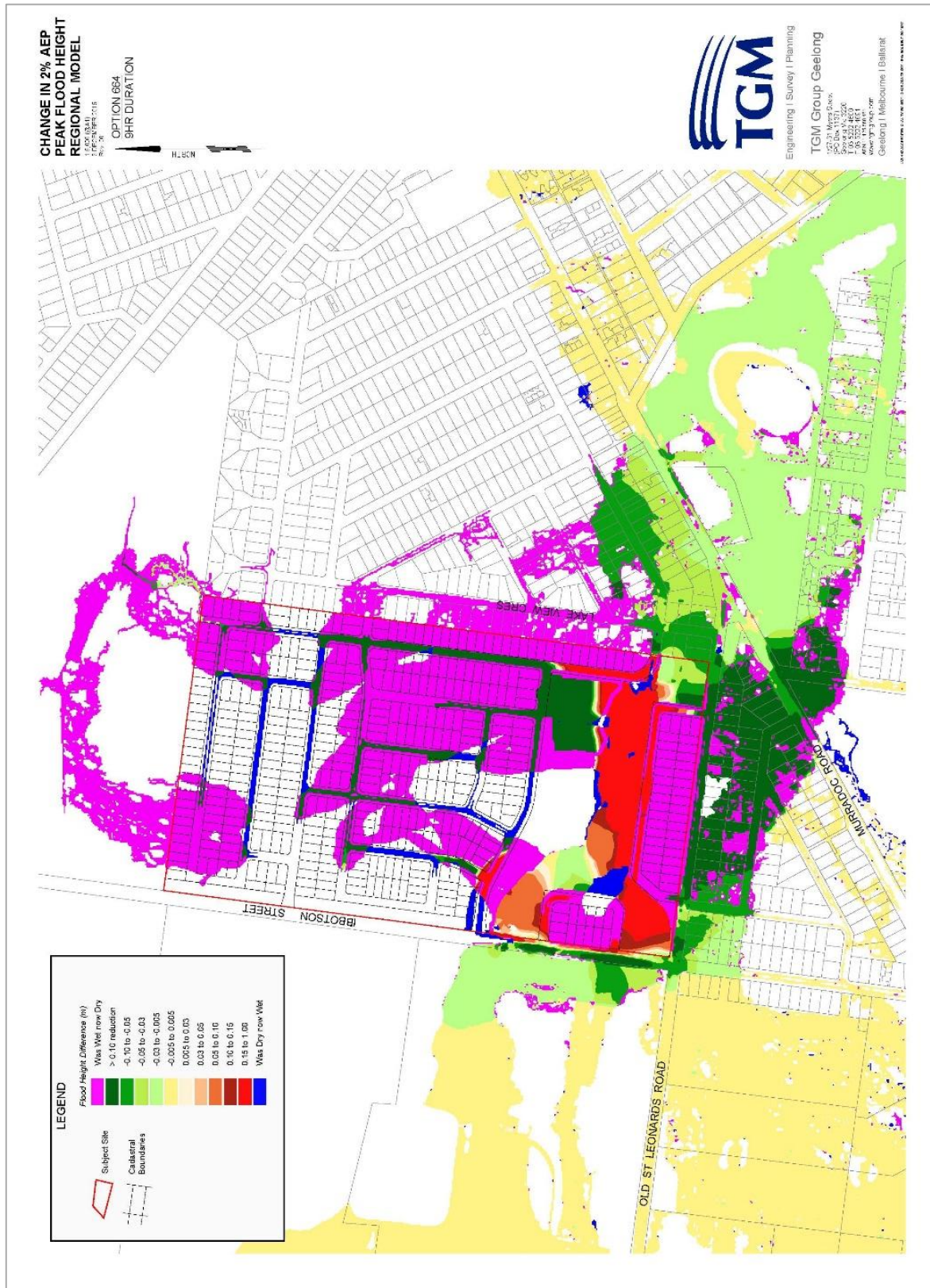


Figure 5.10: Change in Flood - 2% AEP

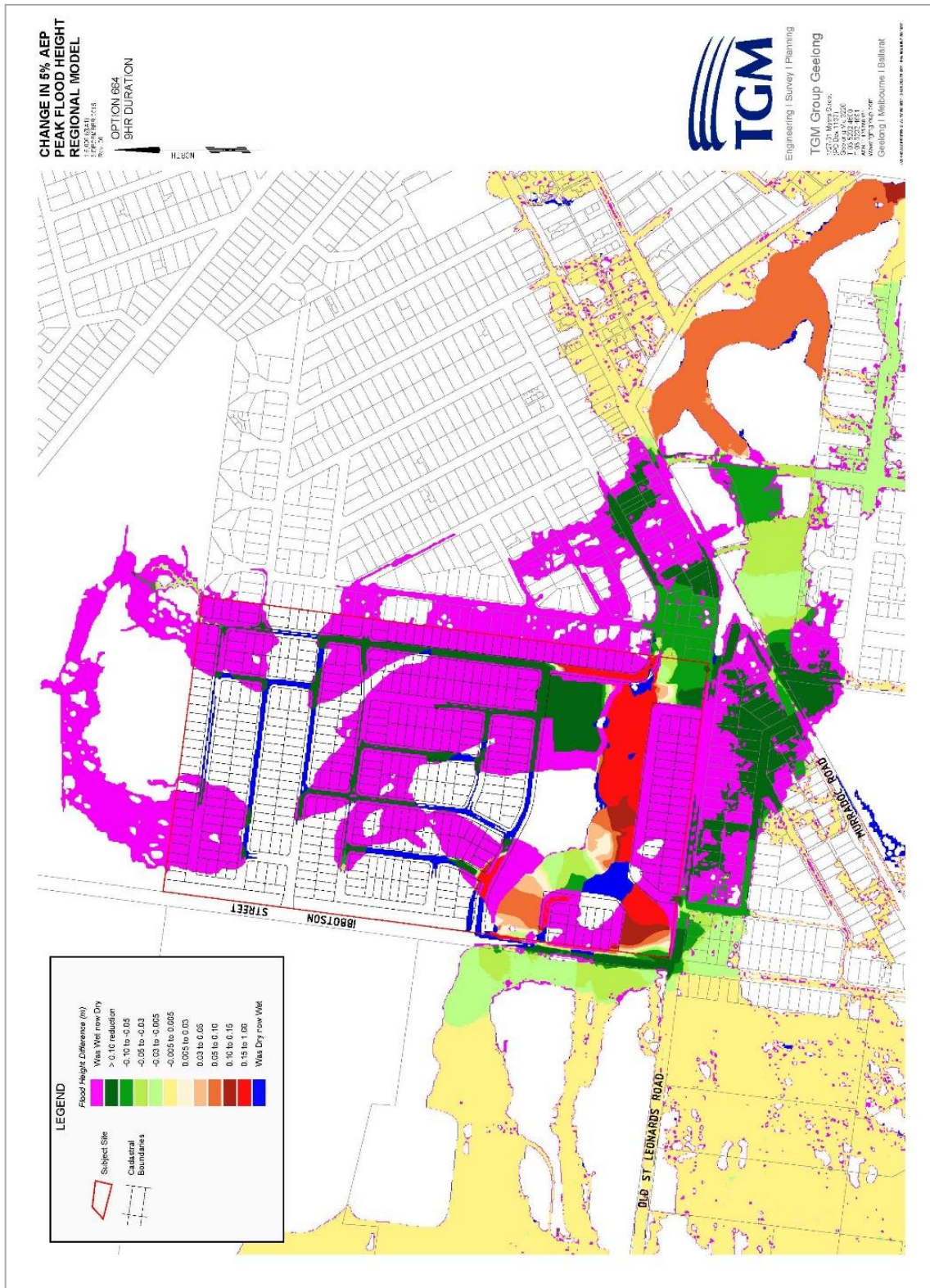


Figure 5.11: Change in Flood - 5% AEP

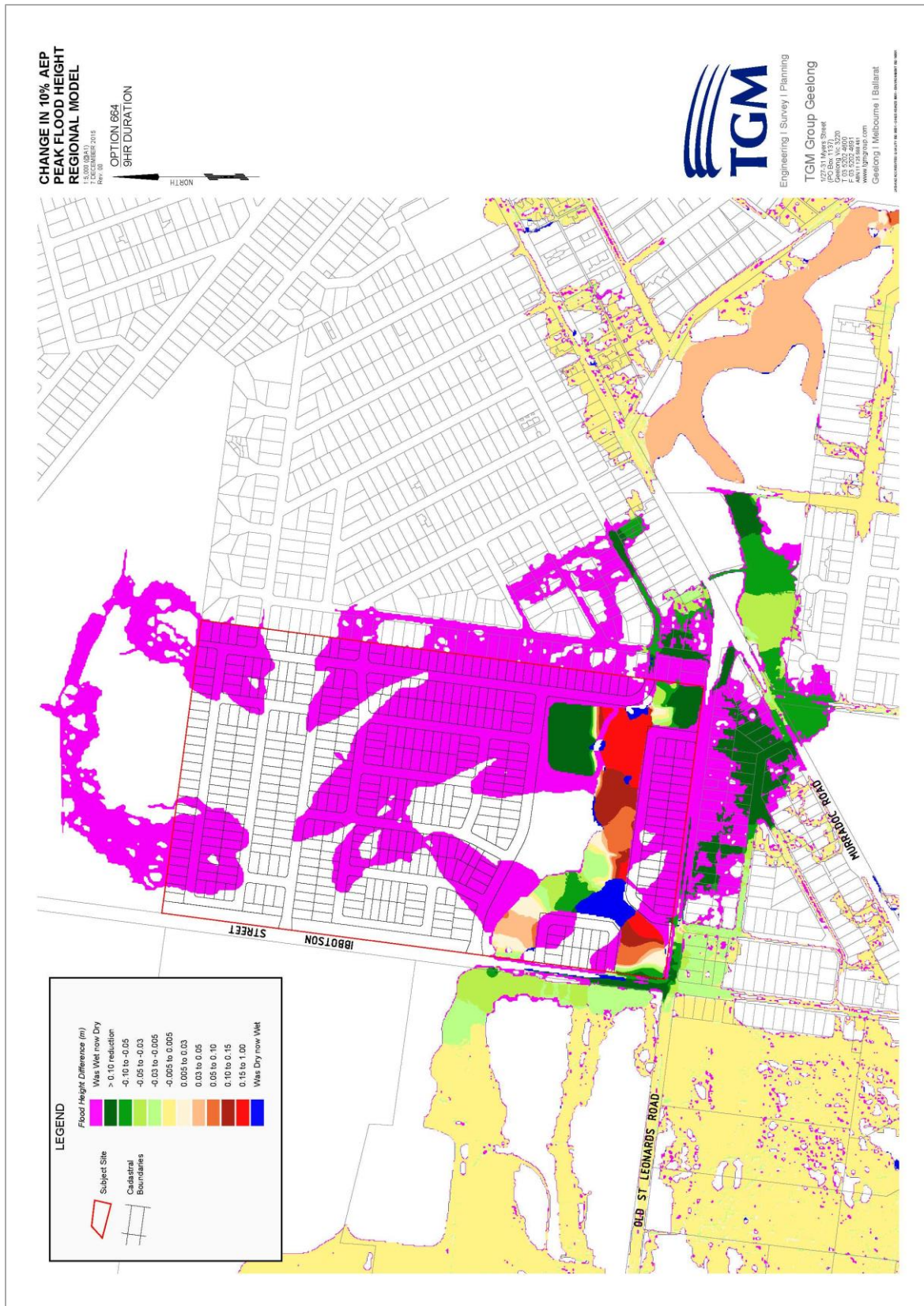


Figure 5.12: Change in Flood - 10% AEP

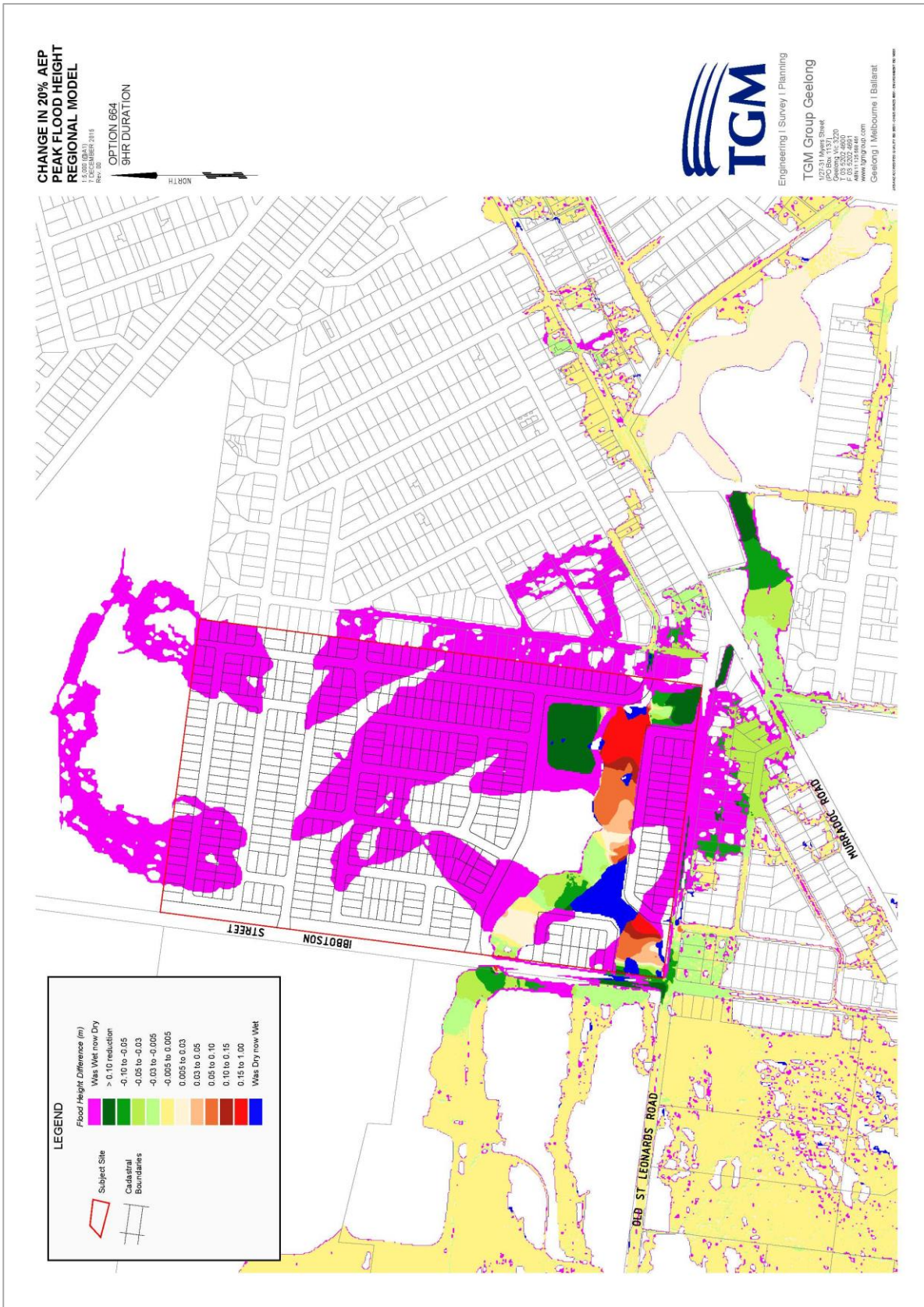


Figure 5.13: Change in Flood - 20% AEP

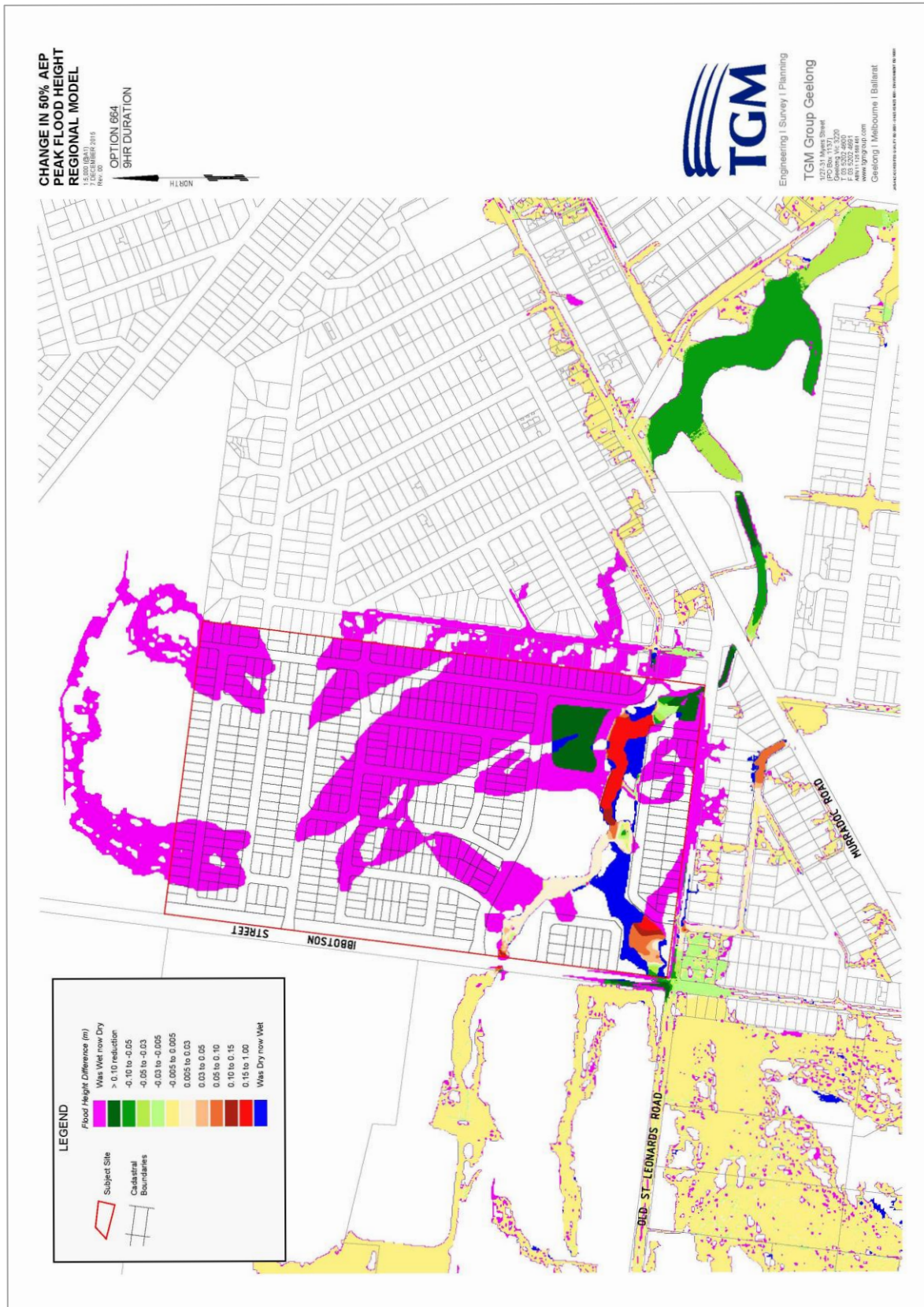


Figure 5.14: Change in Flood - 50% AEP

5.5 Site Access

Site access is an important factor in flood safety assessment. The proposed development has five (5) access points north of the waterway and two (2) access points south of the waterway, as seen in ODP8 Plan 7 in Figure 5.15.

Each lot within the proposed development must have a safe access/egress route during flood events up to and including the 1% AEP.

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Figure 5.15: Acces/Egress Routes – Proposed Site

5.6 Flood Hazard Mapping – Existing Conditions

Results of the regional St Leonards model were also mapped in terms of flood velocity risk, flood depth risk and flood depth velocity risk and are presented in the section for *Existing* and *Developed* conditions.

The hazard mapping applies the methodology in ARR Project 10 – ‘Appropriate Safety Criteria for Vehicles’, as this provides the limiting factor for safety and egress during flood events. The hazard regime criteria are defined in Section 2.2 above.

The *Existing* conditions velocity hazard and depth hazard are shown in Figure 5.16 and Figure 5.17, respectively.

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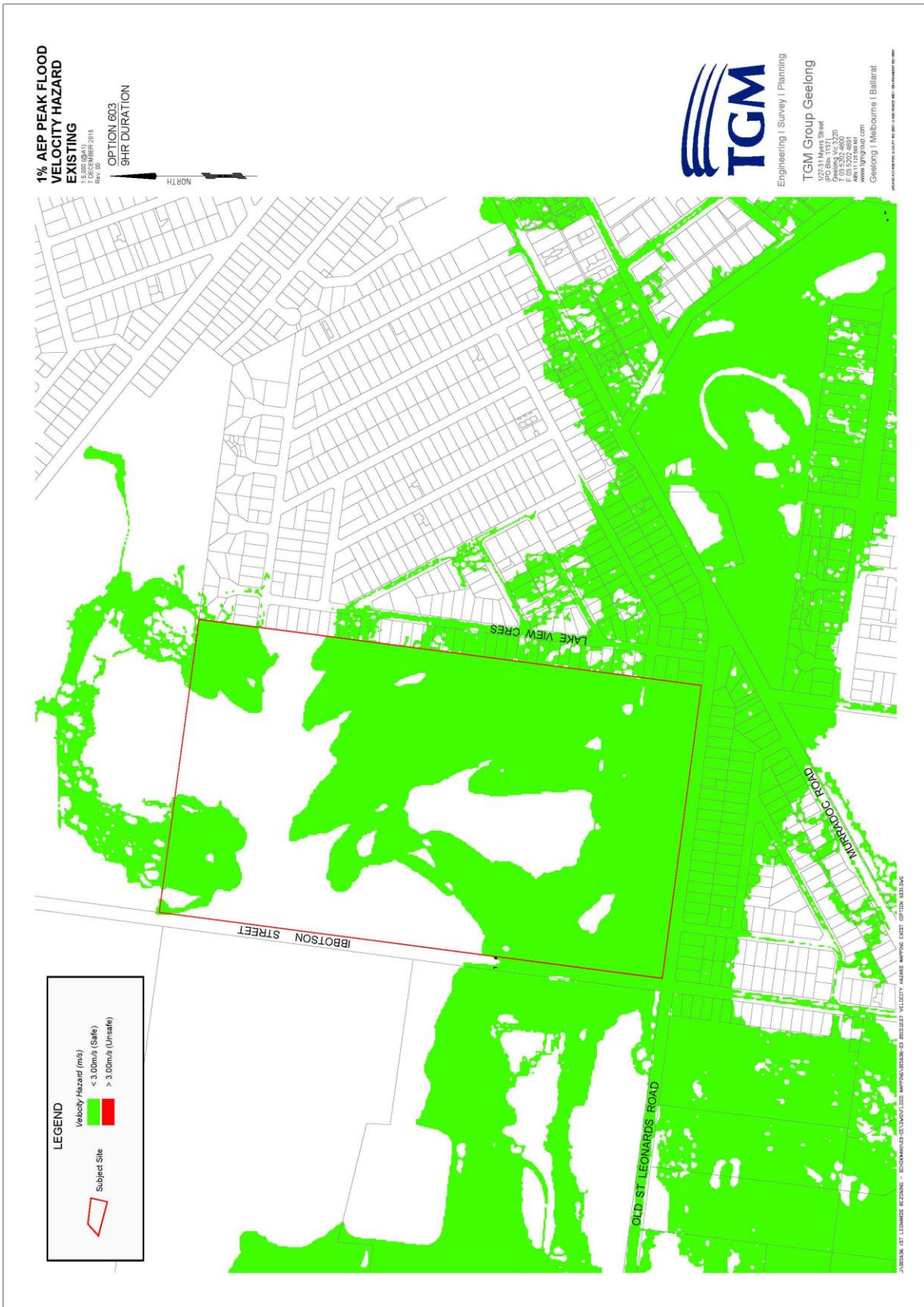


Figure 5.16: Existing Velocity Hazard - 1% AEP

Existing hazard mapping indicates that the road network surrounding the site experiences substantial depth hazards related to flood waters during a 1% AEP event. Depth hazards generated by the regional flood extend into properties south of the site and are contained predominantly to the existing waterway alignment, within the site itself.

The *Existing* conditions depth x velocity hazard is shown in Figure 5.18.

The product of flood depth and velocity, under existing conditions, are flood waters within the subject area meet the safety criteria for egress. The locations exhibiting a 'Moderate' to 'Extreme' hazard are contained within the waterways and Lake.

Poor drainage systems within the existing St Leonards residential area results in depths considered 'unsafe', future development will have to ensure these problems area aren't exasperated. The hazard maps will form the 'base case' to assess the suitability of the design development.

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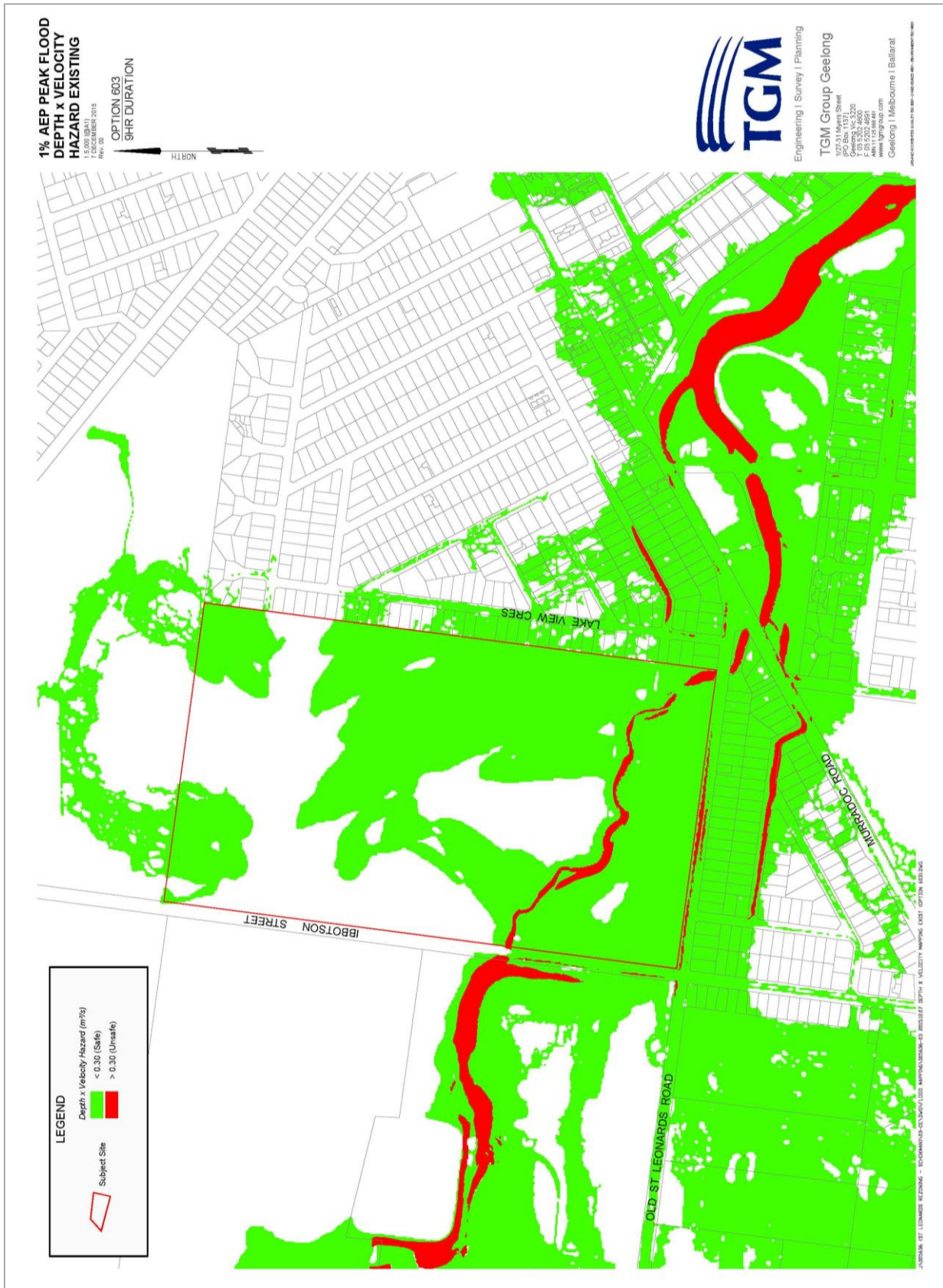


Figure 5.18: Existing Conditions Depth x Velocity Hazard - 1% AEP

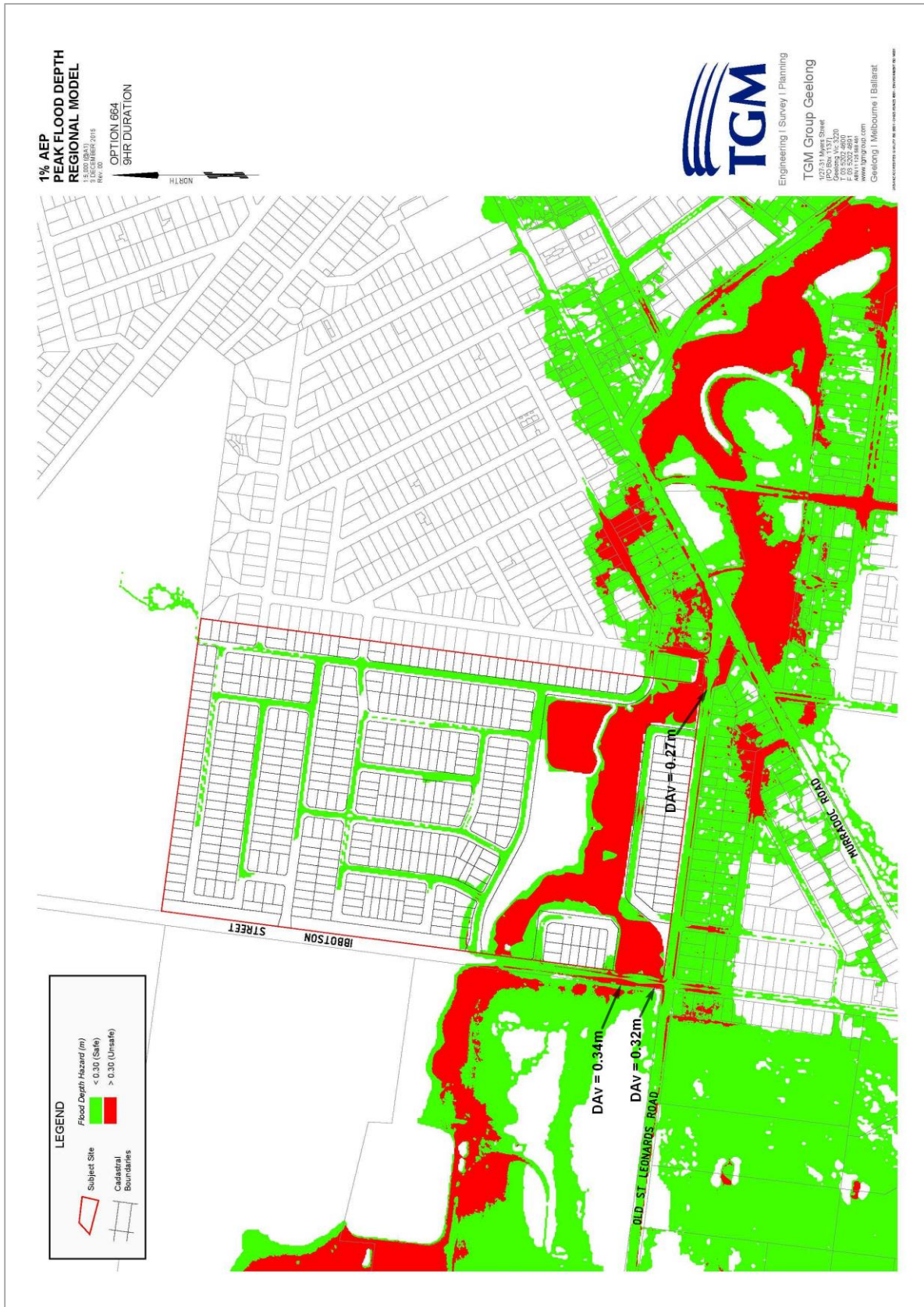


Figure 5.20: Depth Mapping – Developed Conditions

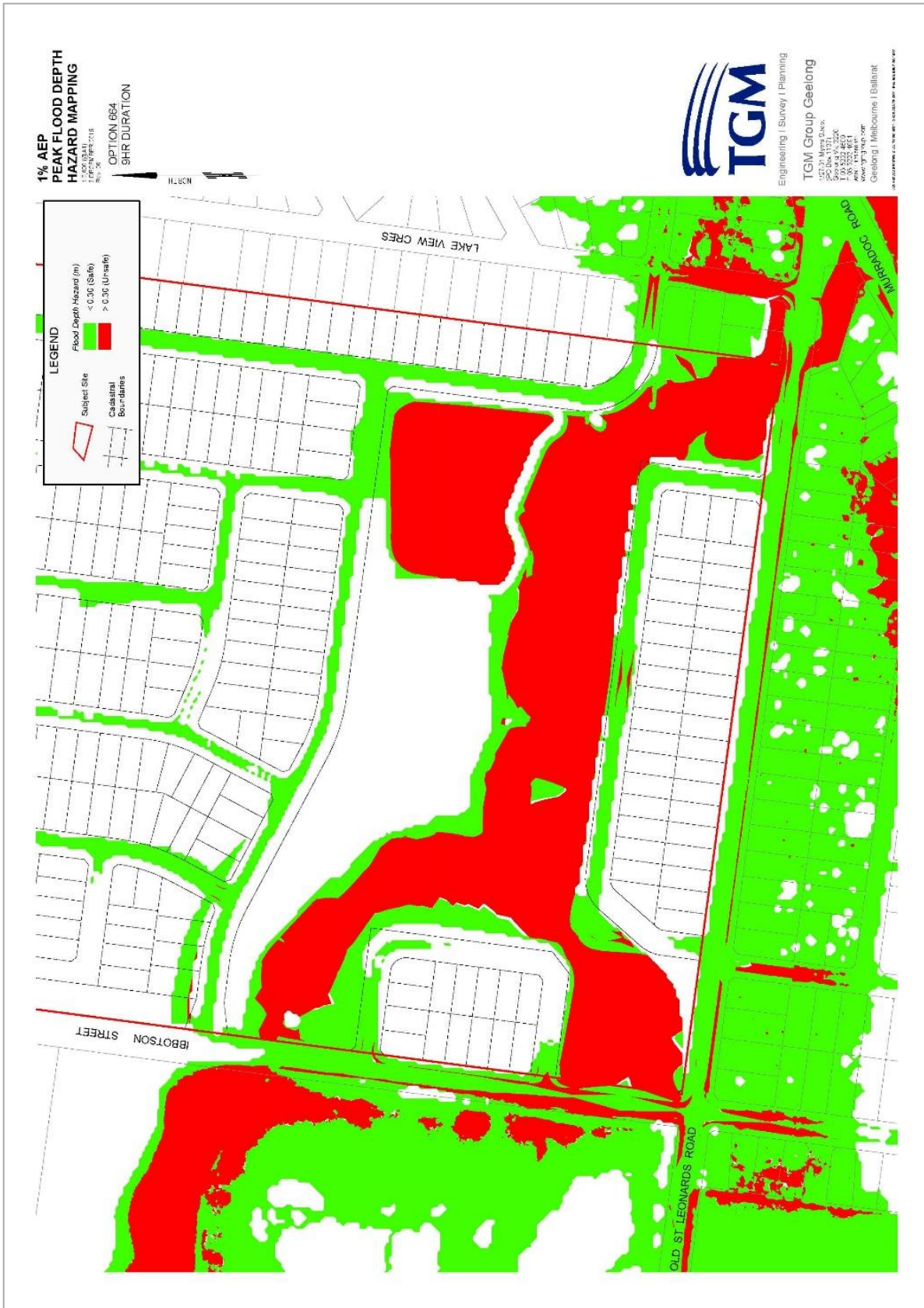


Figure 5.21: Depth Mapping (Site) – Developed Conditions

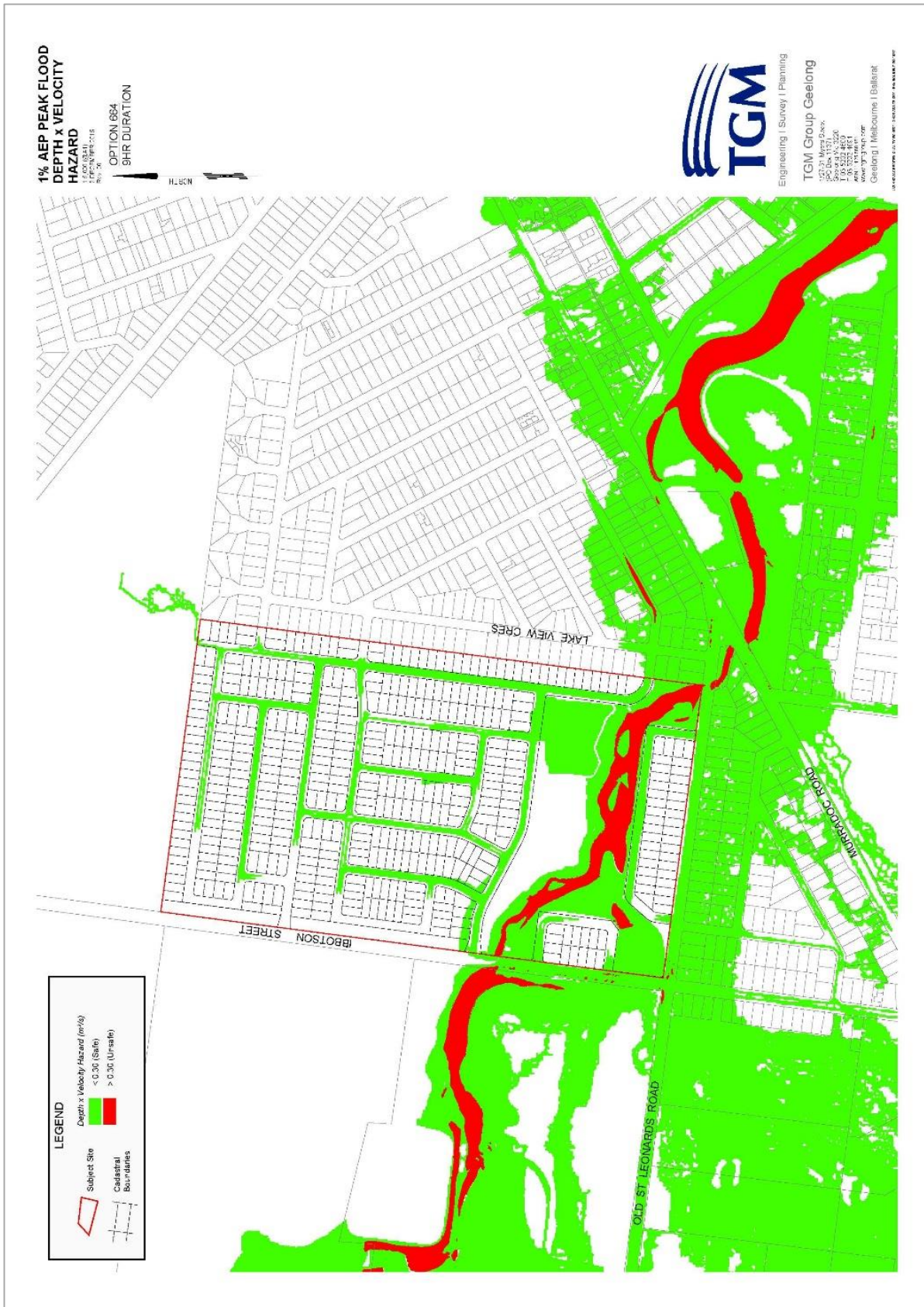


Figure 5.22: Depth x Velocity Mapping – Developed Conditions

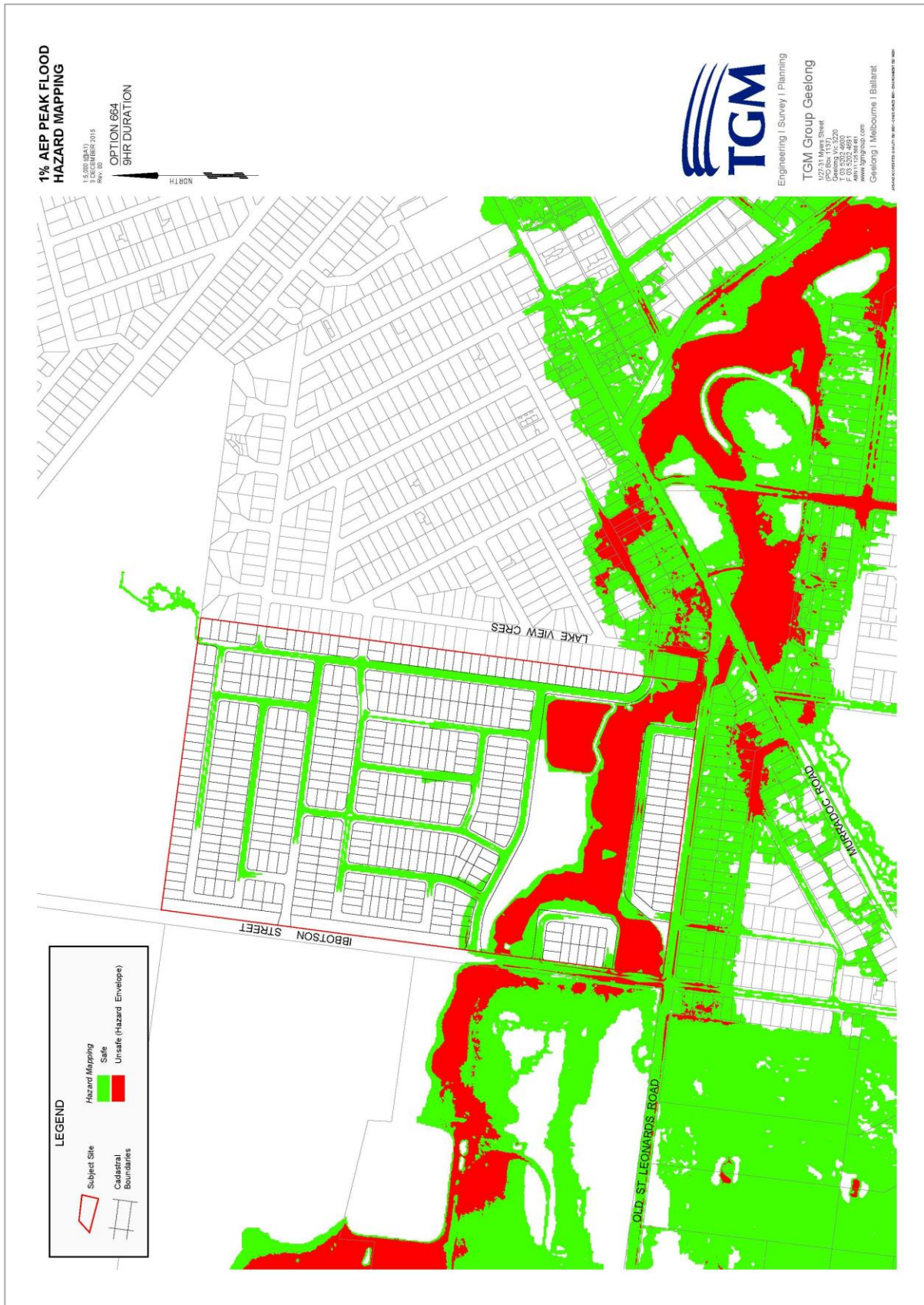


Figure 5.23: Hazard Map – Developed Conditions

5.7.1 Discussion of Flood Hazard Mapping

As seen in Figure 5.23 the development meets safety criteria [ARR 2010] for egress during the 1% AEP flood for all egress points, although restrictions may apply to some travel directions. The safe egress routes for the proposed development for the 1% AEP flood event can be seen in Figure 5.24.

Existing mapping had shown a hazard problem over Old St Leonards Road, but this was overcome by providing additional underground drainage, defined overland flow paths and conveyance of stormwater runoff along the road reserve. This provides a benefit to the wider community by removing an existing hazard.

5.8 Change in Flood Storage

The impact of filling associated with the proposed development on the existing floodplain within the site along with the flood mitigation features has provided more flood storage with the site and waterway corridor. This has provided an added benefit to greater community.

The variation in flood storage is shown in Table 5-1.

Table 5-1: Characteristics of Ibbotson Street developed catchments

Scenario	1% AEP Flood - Available Storage (m ³)
Existing	20,948
Developed	42,691

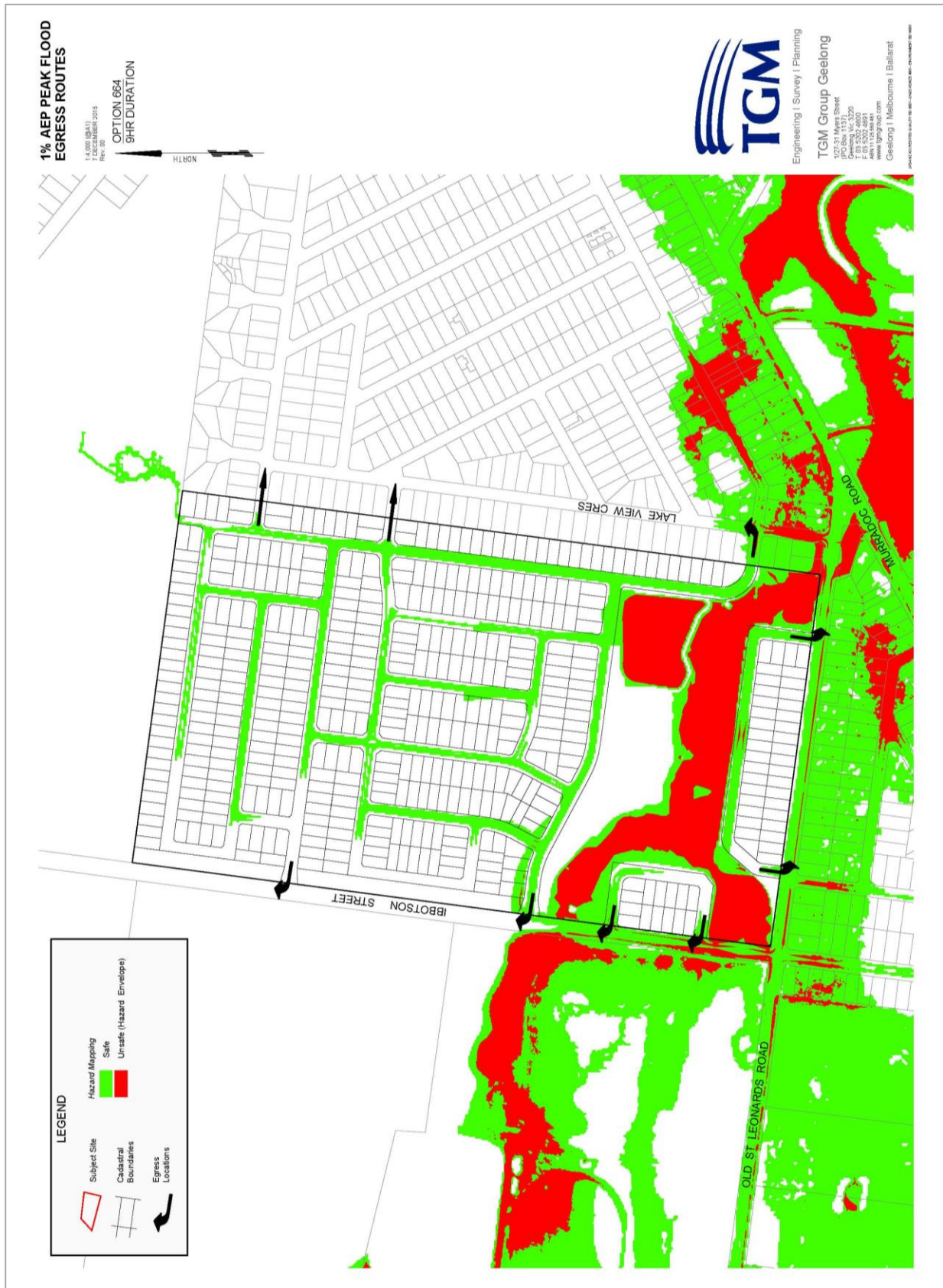


Figure 5.24: Safe Egress Routes – Developed Conditions

6. CONCLUSION







A full and proper hydrological and hydraulic flood investigation was undertaken applying the latest best practice analytical techniques, research and science to define the 1% AEP flood for St Leonards Lake and undertake a flood impact assessment of the proposed Ibbotson Street development.

The fully two-dimensional TUFLOW model was developed, applying hydrological inputs from XP-RAFTS to define the existing 1% AEP flooding, simulate the design mitigation options and prove that the proposed residential development at Ibbotson Street, St Leonards creates no adverse impacts on flood characteristics external to the site and ensuring that the development meets specific objectives for safety and egress during floods. It is clear that there is an overall benefit to the local community with reductions in flood impacts as a direct result of the proposed development.

The analysis undertaken in this assessment has demonstrated that the proposed development can be constructed as per the overall development plan (ODP8) and achieve all requirements and objectives for stormwater management and flood impacts during all events up to and including the 1% AEP.

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7. REFERENCES

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-  Cardno
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