

ST ANTHONY OF PADUA, MASTERPLAN FLOOD ASSESSMENT

On behalf of Carmichael Tompkins Property Group

REPORT



March 2021



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FINAL REPORT

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Table of Contents

1. Introduction	4
2. Work Scope.....	4
3. Methodology.....	5
3.1 Direct Rainfall	5
3.2 TUFLOW Model Build.....	5
4. Existing Flood Behaviour	6
5. Implementation of the Proposed Masterplan	7
6. Flood Impact Assessment	7
7. Conclusions.....	7
8. References.....	8
APPENDIX A.....	9
FIGURES.....	10

1. Introduction

GRC Hydro have been engaged by Carmichael Tompkins Property Group to undertake a flood assessment for proposed development as per the masterplan (Date: 09/04/2021) shown in Appendix A at St Anthony of Padua, Catholic School in Austral (the subject site). Figure 1 presents the site's locality (see rear of report for figures). This flood study has been carried out using the 2D hydrodynamic modelling program, TUFLOW.

The site is located in the headwaters of the Kemps Creek catchment, with the watershed boundary being Edmonson/Tenth Avenue approximately 250m to the South-East. Flooding at the site is minor overland flow with depths in the 1% AEP event in the order of about 150mm to 300mm at most (arguably it is not flooding in fact although that decision rests with Council as per Appenidx C6.1 of the NSW FDM (NSW, 2005)). In the PMF event flood depths increase to between 150mm and 600mm.

The site runs off into the Kemps Creek catchment which then in turn flows in a north direction and is a tributary of South Creek.

The site is currently composed of nine rural residential lots. The proposed development consists of a merger of the existing lots and the construction of an education facility. The masterplan is presented in Appendix A, and the proposed ground level is shown in Figure 3.

Note that GRC Hydro came to the project with the School being operational and a Basin having been integrated into the school playground. GRC were immediately of the opinion that a retarding basin was not ideal for a school playground (especially as this area was the K-2 yard). Overall then it was considered an objective of the design to remove deep water from the site in a 1% AEP event. The removal of deep water from the site was considered a priority given that an educational facility for children aged 4-8 is being discussed.

2. Work Scope

The following work scope has been executed:

- Site Visit;
- Development of detailed hydrologic and hydraulic flood models for the site inclusive of proposed case Masterplan represented as a 3D terrain model which has been inserted into the TUFLOW model;
- Provision of relevant flood information, as per Council's DCP, for the site inclusive of mapping, levels, etc.;
- Assessment of flood impacts associated with the proposed masterplan; and
- Reporting.

The goal of the work was to define design flood affectation at the subject site, ensure that the Masterplan was sympathetic to the site's existing flood affectation, that flood risk management was optimised and that compliance with Council requirements was achieved.

The work included defining design flood affectation for the subject site in the 1% AEP and PMF flood events. Also summarising applicable flood provisions from the *Camden Growth Centre*

Precincts Development Control Plan (DCP) 2015 – Schedule 1 (Austral and Leppington North) and providing recommendations regarding the development and compliance with consent requirements.

3. Methodology

Existing design flood behaviour for the subject site is defined by hydraulic modelling developed as a part of the current study (Note this work pre-dates the availability of Council's model and hence our continuing are of it). This modelling is based on the use of a direct rainfall approach in a TUFLOW hydraulic model to convert applied rainfall into flood depths and levels. TUFLOW is commonly used in Australia for flood modelling and can be considered best practice.

3.1 Direct Rainfall

A direct rainfall approach applies rainfall directly to the individual cells of the 2D hydraulic model. 'Traditional' flood modelling typically utilises two individual models; a hydrologic model which simulates the rainfall-runoff process of a catchment, and a hydraulic model which uses flow from the hydrologic model to produce flood behaviour such as flood levels, depths and velocities. The direct-rainfall method is a relatively recent method of flood modelling which is particularly useful for overland flow flood modelling in very flat catchments such as the subject site.

As per Project 15 of ARR 2016 care needs to be taken when utilising the direct rainfall method in TUFLOW. Critically runoff hydrographs should be inspected to ensure that hydrologic response is not being unnaturally muted. The site is very well suited to the application of the rainfall on grid methodology owing to its very flat nature and the very poor definition of its flow paths. The chief drawback of applying hydrologic model developed hydrographs to the hydraulic model, as might typically be done, would be that flow concentration might be overestimated.

The modelling work reported upon herein has been conducted in accordance with methodology recommended in Australian Rainfall and Runoff 1987 (AR&R, Reference 1) as well as Project 15 from ARR 2016. Note these were the appropriate standards at the time the study began in 2017.

3.2 TUFLOW Model Build

GRC Hydro have built a TUFLOW model to undertake the assessment. TUFLOW is a hydraulic modelling tool that can utilise one and two-dimensional model elements.

Following initial runs which indicated that areas to the south of the subject site were impacted by local drainage, rather than Major Drainage (or overland flow as it is more commonly called).

The hydraulic modelling system is comprised of the following elements:

- LiDAR data (Penrith 2019) has been used to inform a 2 m finite difference grid. This data has a typical accuracy of ± 0.15 m (1st confidence interval);
- Rainfall losses were applied as follows:
 - Initial Loss: 10 mm
 - Continuing Loss: 2.0 mm/hr
- Pipe elements (shown in Figure 4) are based on data obtained from survey including pipe sizes and invert levels;

-
- Buildings can block flood waters natural flow path and therefore significantly impact flood behaviour. As such, buildings in the vicinity of the subject site were “nulled” out of the TUFLOW model.
 - Manning’s roughness values were applied as follows:
 - General: 0.045
 - Roads: 0.02
 - Sparse Vegetation: 0.055
 - Dense Vegetation: 0.08
 - A free draining outlet was allowed at the catchment’s downstream boundary at an appropriate distance downstream so that the boundary behaviour does not impact on design flood level estimates within the subject site.

A critical duration analysis was undertaken in the TUFLOW model which found that the 2 hour storm duration was critical in the 1% AEP event and a 15 minute duration was critical in the PMF event.

4. Existing Flood Behaviour

Figure 4 indicates the existing 1% AEP design flood affectation. Note that all flood maps are trimmed to exclude all flood depths less than 100 mm. This is appropriate as at some threshold overland flow ceases to be a flooding issue and becomes a storm water issue. Trimming of design flood depths less than some threshold depth (typically ranging between 0.1 and 0.3 m in the authors experience) is best practice as it ensures that property effected by inconsequential inundation in the 1% AEP event is not overly restricted relative to flood risk.

If we refer to Figure 5, we can more easily see how flow moves across the site. Note however that Figure 5 shows results for the PMF, not the 1% AEP event. The PMF is a very rare event about 10,000 times rarer than the 1% AEP event. It has been modelled herein as it informs risk management requirements for the site.

As can be seen however there are four flow paths across the site shown in Figure 5. These are separated by a ridge of sorts that splits the site from approximately the SE corner to the NW corner. There is only one flow path in the northern portion of this split, this being the flow path that runs to the NE corner of the site. In the southern portion we see three flow paths; one that runs from east to west across the site out onto Tenth Avenue, another that runs to the SW corner of the site from the NE, and then another that runs from the NE to the SW corner of the lot.

In Figure 4 we can see the existing basin and the depths achieved at the basin location in the 1% AEP event and in Figure 5 depths for the PMF event. In both cases peak depths are observed at the basin location and depths exceed 0.5 m but are less than 1 m. As per advice on Page 1 of this report GRC are of the opinion that a basin should not be located on an educational facility in this case and Council, in as much as they consented to such a design previously, may wish to review the concept. Broadly creating deep areas of flood at the school is not in the interests of flood risk management and the basin needs to be eliminated from the design. It is noteworthy that the deepest and hence most hazardous flooding that occurs on site is located at the basin. If runoff from this upper catchment location is left to run instead of being concentrated into

storage areas depths are minor and so is hazard. Low hazard is what is required for this educational facility.

5. Implementation of the Proposed Masterplan

The following elements from the proposed masterplan (shown in Appendix A) were incorporated into the TUFLOW model:

- Basin eliminated with a building replacing the basin;
- Proposed buildings were nulled out of the TUFLOW model – this means no flow occurs through the space occupied by buildings;
- Designed ground levels were provided by Warren Smith & Partners (WS&P) as a 3D TIN that was inserted into our model; and
- Proposed pipe elements were based on data obtained from WS&P.

Figure 6 shows the 1% AEP event proposed flood behaviour on the subject site.

6. Flood Impact Assessment

A flood impact assessment has been undertaken which compared the existing and proposed flood behaviour using the TUFLOW hydraulic model. The proposed building alignment (shown in Appendix A) was implemented in the TUFLOW model and the changes in peak flood levels (impacts) compared to the existing conditions for the 1% AEP event as shown in Figure 7.

Flood level impacts of less than 0.01 m are considered to not be significant (Project 15, ARR 2016) and as such are shown as no impact.

Three areas of impact (yellow areas) do exist and these do indicate an increase in flood level that exceeds 0.01 m. Arguably however these increases are not material as discussed below:

- Increase to the south-west is in kerb/gutter area and impacts no private property. Absolute depths are minimal;
- Increase to the south-east is on land owned by the Proponent and they advise the impact is not of concern to them; and finally
- Increase to the north is in the waterway and is a direct result of the Basin being removed from the overall design layout. This impact in the water way does not alter flood risk negatively whilst the removal of deep water from the subject site at the location of the Basin reduces, significantly, site flood risk.

7. Conclusions

This flood study and flood impact assessment has been undertaken by qualified civil engineers (specialising in floodplain modelling), in accordance with Australian Rainfall and Runoff, the NSW Floodplain Development Manual and Council's DCP.

Flood behaviour for the subject site has been modelled using a TUFLOW direct rainfall hydraulic modelling system.

The existing conditions and proposed masterplan flood behaviour has been examined. No proposed building is impacted by over floor flood liability. Importantly flood affectation is not exacerbated for any private property other than the subject site.

Impacts were they do occur are not material. Impacts in the north directly result from the removal of the Basin from the subject site.

Overall the development substantially reduces flood risk by removing the Basin from the school grounds. Arguably the Basin should not have been allowed on the site being incompatible with a educational facility for 4-8 year olds.

8. References

1. Pilgrim DH (Editor in Chief), Australian Rainfall and Runoff – A Guide to Flood Estimation, Institution of Engineers, Australia, 1987.
2. NSW Government, Camden Growth Centre Precincts Development Control Plan 2015, 2015.
3. NSW Government, Floodplain Development Manual, 2005.

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1. $\frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

[illegible]

FIGURES

FIGURE 1
CATHOLIC SCHOOL DEVELOPMENT
SUBJECT SITE LOCATION

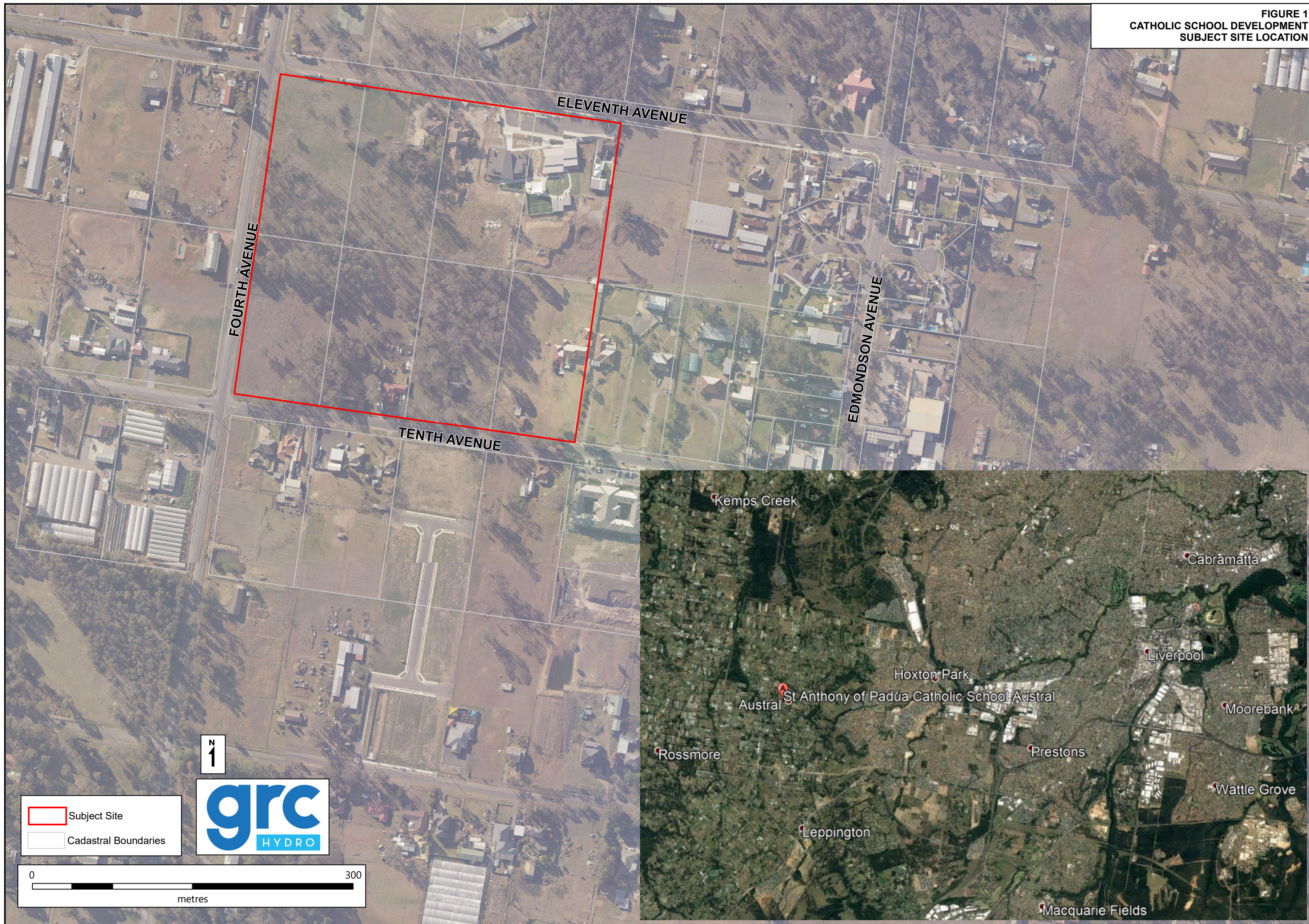


FIGURE 2
CATHOLIC SCHOOL DEVELOPMENT
GROUND LEVEL

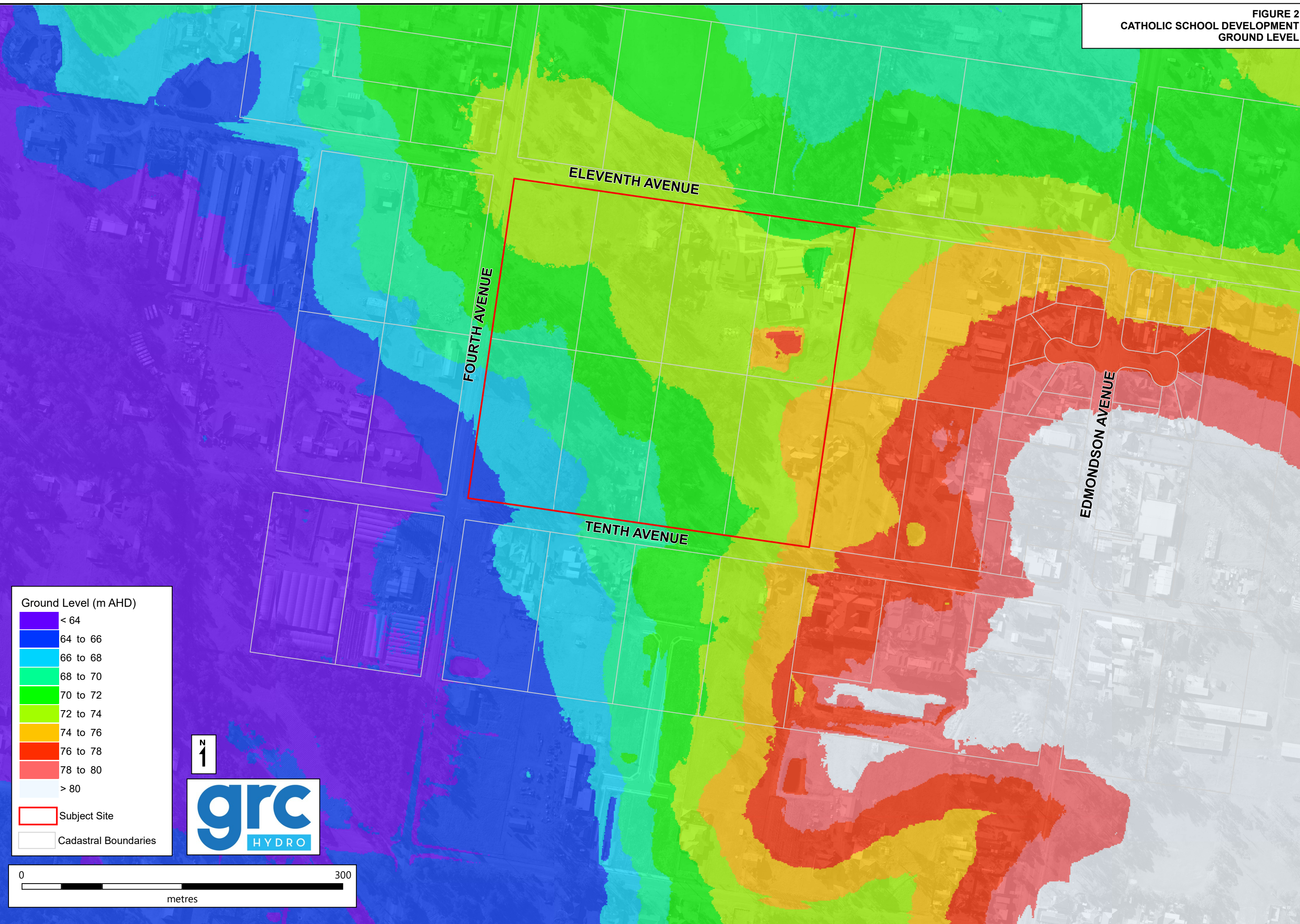


FIGURE 3
CATHOLIC SCHOOL DEVELOPMENT
PROPOSED CASE
PROPOSED GROUND LEVEL

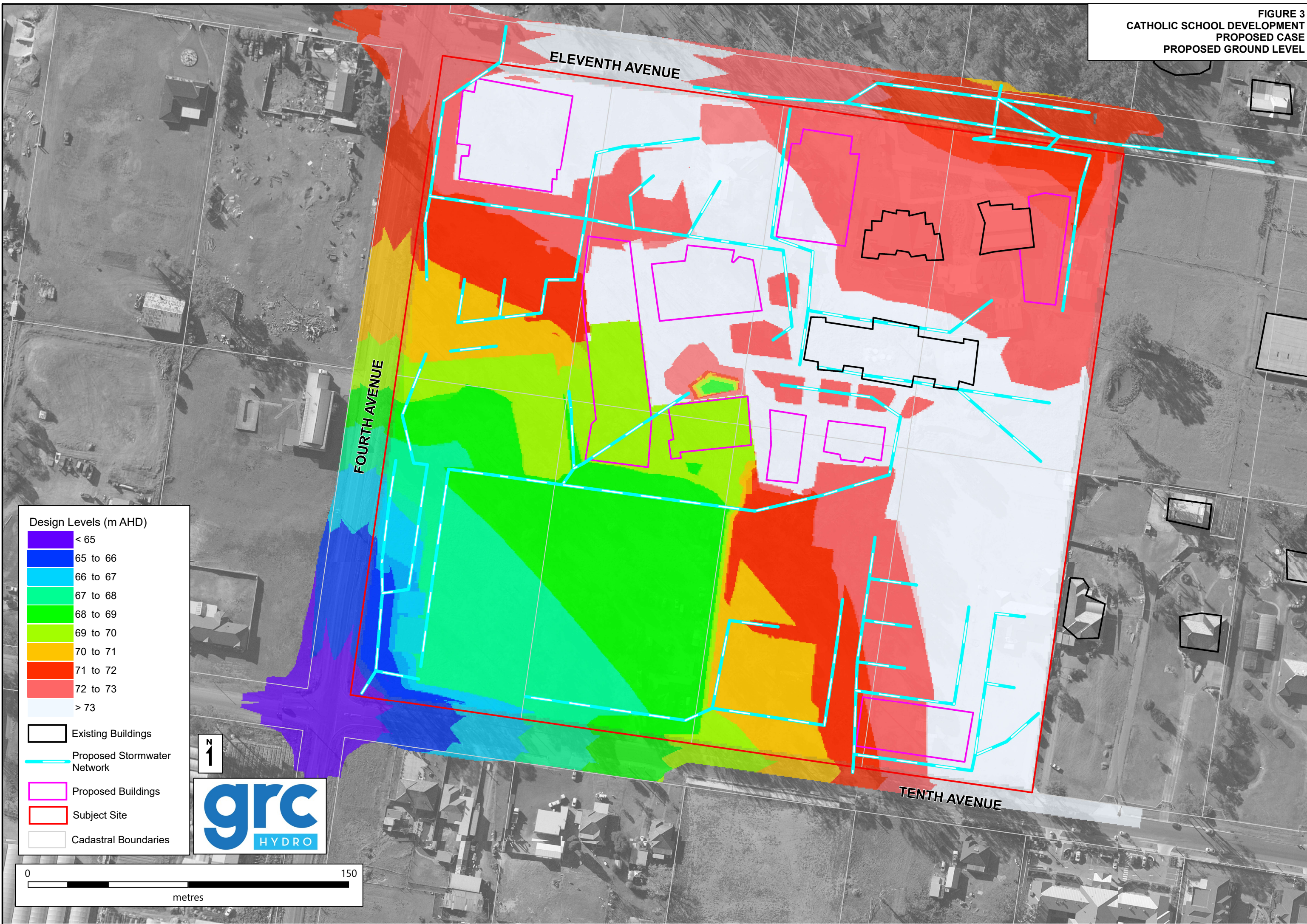


FIGURE 4
CATHOLIC SCHOOL DEVELOPMENT
EXISTING CASE
1% AEP PEAK FLOOD LEVELS & DEPTHS



FIGURE 5
CATHOLIC SCHOOL DEVELOPMENT
EXISTING CASE
PMF PEAK FLOOD LEVELS & DEPTHS

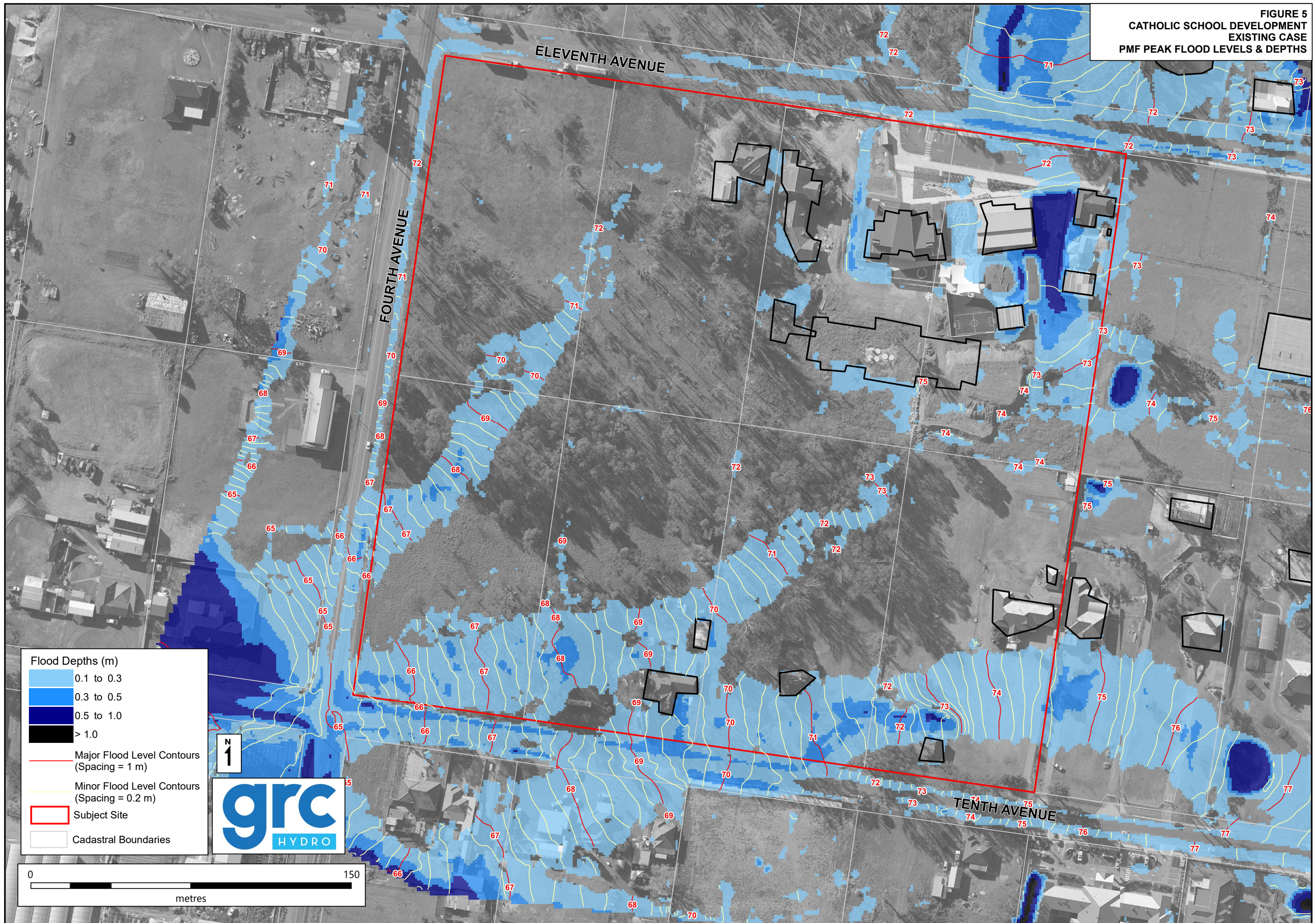


FIGURE 6
CATHOLIC SCHOOL DEVELOPMENT
PROPOSED CASE
1% AEP PEAK FLOOD DEPTHS & LEVELS



Flood Depths (m)

Light Blue	0.1 to 0.3
Medium Blue	0.3 to 0.5
Dark Blue	0.5 to 1.0
Black	> 1.0

Proposed Buildings

Proposed Stormwater Network

Major Flood Level Contours (Spacing = 1 m)

Minor Flood Level Contours (Spacing = 0.2 m)

Subject Site

Cadastral Boundaries

grc
HYDRO

FIGURE 7
CATHOLIC SCHOOL DEVELOPMENT
PROPOSED CASE
1% AEP PEAK FLOOD LEVEL IMPACTS

