Department of Planning, Housing and Infrastructure 30 September 2024

Dear Sir/Madam,

Re: Mirvac Planning Proposal – reply to Gateway Determination Report

The Department of Planning, Housing and Infrastructure (**DPHI**) have raised several flood planning issues in its Gateway Determination Report - PP 2024-658 (**GDRPP**) for the Moorebank Marina, Lot 3, 146 Newbridge Road, Moorebank. The GDRPP fails to appropriately consider the flood risk and does not properly regard the way the development, as proposed, is able to be safely delivered. It is incumbent upon DPHI to review flood planning matters within an adaptability and resilience framework, one that assists in creating a future-proofed built-environment which can stand the test of time. This report highlights the fundamental differences in opinion between DPHI and the Proponent regarding flooding.

1. Council Flood Mapping

Firstly, and foremost it is incorrect to strictly apply the BMT 2020 report, which was never adopted by Council, and is not publicly available. It should not be considered as the "*latest available data*", as that data was not adopted by Council, with Council staff disagreeing with the outcomes and base assumptions used. The Department are inconsistent on their approach with the application of such reports, as for example, later in the GDRPP DPHI states that the draft *Structure Report* completed by Tract Consultants for the Moorebank East precinct (which supports high density residential development on the site) "*has no weight, while it was referred within Council reporting, it has not been exhibited or formally considered or adopted by Council*".

Additionally, how the mapping is being considered and applied is critically incorrect. The building platform, incorrectly utilised below by DPHI, adjoins directly with the existing residential development to the north, at levels at or above RL7.6m (above the Flood Planning Level).

Figure 2 Excerpt of Liverpool Council's Flood Mapping, key site in yellow

Figure 1: Excerpt from the GDRPP of its Figure 2, with annotation by the proponent

The flood mapping used by DPHI is based on the historical landform, thus it fails to consider the building platform as proposed (and as approved under DA 611/2018), nor does it include current infrastructure including the road and pedestrian bridges connecting Moorebank East to Georges Fair. Updated mapping, which is considerate of the final form of development, should be treated the same as elsewhere in Sydney. Structures including residential uses at Walsh Bay and Woolloomooloo wharf, as well as infrastructure such as the M5 and Newbridge Road bridge (which all are located above floodwaters and rivers are mapped with their appropriate flood risk allocation or as flood free) are relatively common.

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Whilst the Department has raised concern over how the mapping could be completed as follows:

"*However, any future flood studies/mapping for the site may not contemplate this scenario and/or consider a change in the flood affectation of the site noting that the landform is not being raised (as distinct from the neighbouring northern residential site currently under construction).*"

This is easily accommodated and thus should not be considered as a limitation with examples shown in Figure 2 below.

Figure 2: Examples of updated flood mapping for comparable residential/retail/infrastructure items which are constructed within or over waters

To ensure that the building platform that is delivered at the future development application stage is consistent with the proposal that was submitted with the Planning Proposal, a site-specific clause could be introduced into the *Liverpool Local Environmental Plan 2008* to provide a minimum requirement for the building platform (i.e. above 7.6m AHD). An example of an updated, more accurate flood map for the site is provided below at Figure 3.

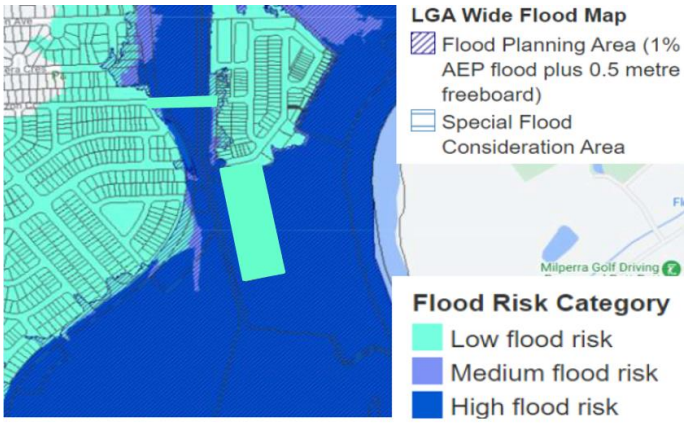

Figure 3: Example of an accurate flood map, showing the Low flood risk of the building platform

The flood levels referenced from the BMT 2020 Flood Study which refer to a flood depth of 2-5m in both the 5% and 1% AEP are taken from the existing site topography. It however needs to be recognised that the site has historically been used as a sand mining site and the flood model is not based on the approved landform under DA 611/2018 or as proposed in Planning Proposal 2024-658.

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2. Claims of the site being a *Floodway*

Stantec Australia Pty Ltd have been engaged by the Proponent to conduct additional modelling in response to DPHI's comments in the GDRPP. Stantec have extensively modelled various flood level scenarios including the PMF (their Report can be found at Annexure A to this response).

Stantec have concluded that:

"Based on the flood impact assessment and from the floodway definition and from the application of the floodway criterion given below, it is concluded that the Planning Proposal is not located in a Floodway but is instead located in a Flood Storage Area."

The BMT 2020 report itself states:

"There are no prescriptive methods for determining what parts of the floodplain constitutes floodway's, flood storages and flood fringes. Descriptions of these terms within the Floodplain Development Manual are essentially qualitative in nature".

Additionally, it is confirmed and as noted in the GDRPP that the difference in opinion is due to the BMT 2020 report being completed prior to the flood modelling relied upon within the *Flood Impact and Flood Emergency Response Plan* prepared by Tooker and Associates.

The changes in classification from *floodway* to *flood storage* needs to be considered as a substantial change in the overall risk profile of the development.

3. The utilisation of the Flood Hazard Classification

The map extracted below at Figure 4 from the BMT 2020 Flood study, identified the site as having a H5/H6 hazard classifications. This is incorrect for a number of reasons, but most importantly it does not represent the current or proposed landform as approved under DA 611/2018, or by Planning Proposal 2024-658 as discussed previously in this response.

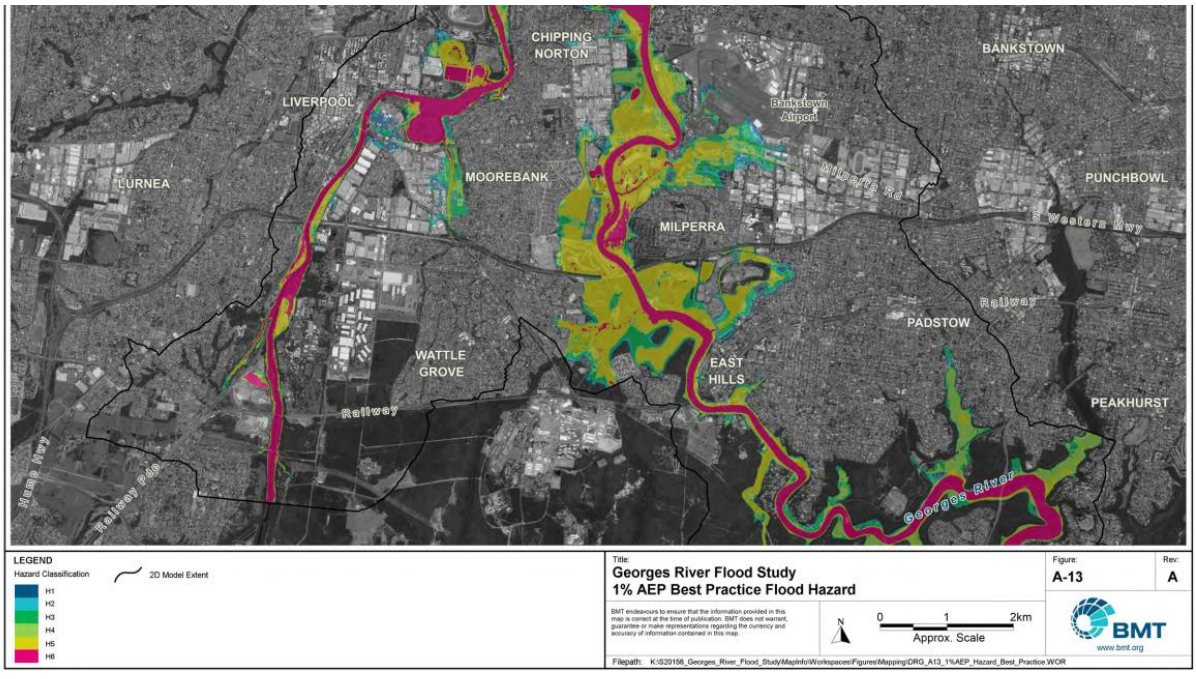

Figure 4: Extract of 1% AEP Best Practice Flood Hazard from the BMT 2020 Flood Study

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Additionally, the Department has incorrectly stated that the:

"*Development resulting from this planning proposal will be constructed above a marina development that will be subject to frequent and high hazard flood. The high hazard classification meaning all buildings being vulnerable to failure, regardless of the design standard the supporting structures."*

This statement is false and is not what is being proposed. The development proposed will be a new building located in the approved Marina landform area, well above hazards (by piers and an elevated basement), and designed in accordance with 'Construction of Buildings in Flood Hazard Areas' Building Code and certified by the appropriate engineers.

The additional work completed by Stantec, shows that in the 1% AEP event (shown in Figure 4 above) "*the overall flood velocities (within the building area of the subject site) remain much lower than 1 m/s and consequently does not pose a scour risk*". Therefore, the whole reason that a H5 classification was applied by DPHI, is only because the marina basin bed levels (and not the proposed building platform area) are situated at -2.8m AHD. For clarity, this is the area within the proposed marina where boats will be stored noted as location points GC3 and GC1 in Figure 5 below and not the building platform. This demonstrates that this is the wrong flood/flow metric to be measuring the planning proposal against.

Figure 5: Location points used for flood modelling

Stantec have confirmed that pedestrians are only exposed to inundation and flood hazards (at the pedestrian level of the development) in events greater than a 1 in 5,000yr AEP. No residential use (and therefore any resident) is exposed to any floodwaters even in the PMF (one in 1,600,000 year) event.

A H6 classification is not uncommon on land adjacent to a river, however there are many examples where the building platform has been designed to extend above the flood level to, in essence, remove the hazard. This is demonstrated at recently approved developments at;

- 125-129 Arthur Street, Parramatta
- 2-8 River Road West, Parramatta,
- 120c Old Canterbury Road, Summer Hill (beside Hawthorne Canal)

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These recent developments have been supported for shelter-in-place in floods that exceed the flood planning level and are subject to H6 hazard in the PMF. This planning proposal 2024-658 is located well above these levels.

4. Extreme damage to structures

The DPHI's '*Flood Risk Management Guideline'* provides the hazard threshold for buildings and the graph is extracted in Figure 6 below.

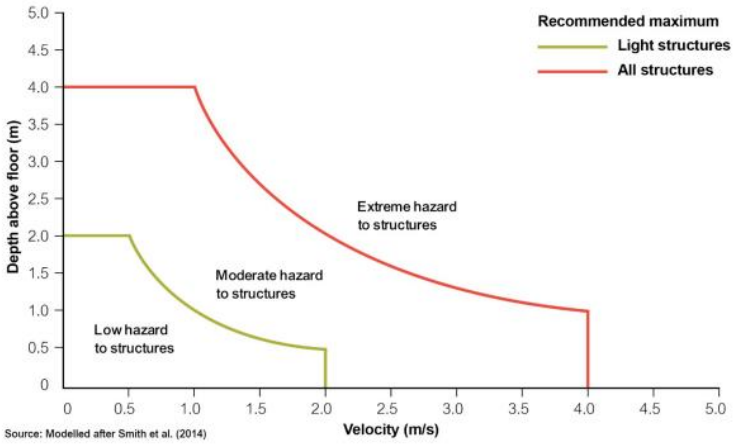

Figure 4 Thresholds for building stability in floods
Source: Figure 10 ADR 2017b; modelled after Smith, Davey and Cox (2014).

Figure 6: Thresholds for building stability in flood extracted from Flood Risk Management Guideline

In interpreting that graph our building platform and first 'floor' is proposed at RL7.6m, thus it would therefore only be when the flood level reaches RL11.6m (4m above the building platform) that the extreme hazard to structure threshold is met. However, this is unlikely to ever occur as the Probable Maximum Flood Level is lower at RL10.20m. Therefore, the proposed buildings would be considered to have a 'moderate hazard to structures' rating up to a PMF event and can therefore be designed in accordance with 'Construction of Buildings in Flood Hazard Areas' to address any perceived hazard.

This has been verified by an additional structural engineering assessment prepared in response to the GDRPP (attached at Annexure B to this Response - *Georges Cove Marina Development Flood Assessment-EPS August 2024*). The report has structurally assessed the performance of the proposed development's podium, basement walls, low level columns and footings in the 1% AEP flood event, the 1 in 5,000yr AEP flood event, and the PMF event, using standard practice construction methods. The report adopts the requirements of the Australian Building Codes Board handbook 'Construction of Buildings in Flood Hazard Areas'. The building standards consider any flood flow velocity at or below 1.5 m/s to be a 'deemed to satisfy' approval (which the development is significantly under given the highest velocity even during a PMF event is 0.66m/s).

The structural assessment concludes that:

"*Based on this, we are satisfied that columns above podium level which the super-structure of apartments, and the lower walls of townhouses which are below habitable rooms, will be adequate to resists lateral forces… The type and form of structures that will achieve this outcome are standard practice in NSW and commonly adopted for similar medium and large-scale developments."*

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Figure 7: The planning proposal building design is shown above, where the building platform is at 7.6m below that is only basement and piers.

5. Alignment with the Flood Risk Management Manual

The GDRPP assessment report refers to the Section 9.1 Ministerial Direction, and specifically, focus area - 4.1 Flooding. The Direction requires planning authorities to give effect and be consistent with the NSW Flood Prone Land Policy and the *Flood Risk Management Manual 2023.*

The manual states that the:

"*effective management of flood risk to the community requires a flexible merit-based approach to decision-making which supports sustainable use and development of the floodplain"*.

This is precisely what is proposed under this Planning Proposal. DPHI have relied on two specific matters from the manual to justify why planning proposal 2024-658 should not proceed. Evacuation is discussed in extensive detail by Risk-e Businesses Consultants in their separate response, therefore only one point is discussed below.

a) *Limiting increases in flood risk related to new and modified development. In the context of this planning proposal, it relates to the risk of enabling a new permanent population above a development that will be subject to high hazard flood events.*

As articulated in Section 1 and 3 of this response, the high hazard flood rating is not being applied correctly to this development. Stantec have proven that residents are only directly exposed to inundation and flood hazards at low velocities (at the pedestrian level of the development) in events greater than

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a 1 in 5,000yr AEP. Furthermore, as noted above, H6 classification is not uncommon on land adjacent to a river, whereby the building platform can extend above the flood level, to in essence remove the hazard.

Additionally, the *Flood Hazard Technical Report* by the University of New South Wales (which has directly informed the Flood Risk Management Manual 2023) extracted imagery at Figure 9, stipulates that there is a different risk profile for high rise buildings as opposed to standard single storey houses. As per the diagram below, apartments are able to withstand higher flood risks as opposed to greenfield development. The Flood Risk Management manual applies to all land uses across NSW including greenfield development, hence why is it focused upon doing a merits-based assessment and considering the site-specific risks. The consideration of the development needs to be against what is actually proposed and how, in our case, the George River acts in a flood event and not against blanket statements that apply across the State in many different flood catchments.

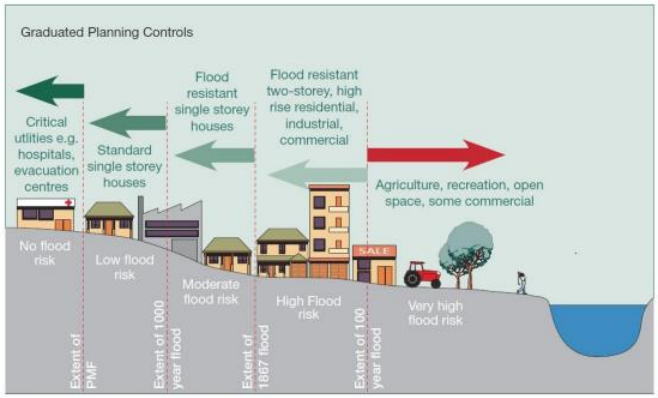

Figure 9: Distribution of land uses on the floodplain to reduce risk extracted from Smith, Davey and Cox 2014, which informed the *Flood Risk Management Manual 2023*

Furthermore, the proposed building itself is not characterised as meeting the threshold of extreme hazard. Helpfully, the Flood Risk Management Manual which is being relied upon also states that:

"*the FRM framework promotes proactive development and implementation of measures in FRM plans to manage flood risk effectively and sustainably so that existing and growing communities can be more resilient to flooding"*.

This is precisely the intention of the present Planning Proposal. The design has considered the flood risks and responded appropriately without unnecessarily sterilising potential development land.

Additionally, the policy

"*recognises that flood prone land is a valuable resource and that development applications and proposals for rezoning of flood prone land should be the subject of careful assessment which incorporates consideration of local circumstances*".

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It is therefore reiterated that the proposed development itself is above the flood planning level and has extensively and technically considered the local circumstances of the site, with the only portion of the development below the flood planning level being the piles and basement structure and should therefore the proposal should be reconsidered for development.

Yours sincerely

Mark Tooker
Director
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ANNEXURE A

Stantec Flood Modelling

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Stantec Australia Pty Ltd
Level 16, 207 Kent Street
Sydney NSW 2000
AUSTRALIA
ABN 17 007 820 322

26 August 2024

Project/File: 304600120

The Development Manager
Mirvac Development
Level 28, 200 George Street
SYDNEY NSW 2000

Attention: Elyse Debrincat
E: elyse.debrincat@mirvac.com

FLOOD HAZARD ASSESSMENT AT GEORGES COVE DEVELOPMENT, NEWBRIDGE ROAD, MOOREBANK

Dear Elyse,

It is our understanding that the Department of Planning, Housing and Infrastructure was concerned that H5 to H6 flood hazards would destabilise the proposed buildings. Consequently, flood hazard information has been presented to inform consideration of the impact or otherwise of the flood hazards on the building stability.

SUMMARY

The 2018 flood impact assessment of the Mirvac Planning Proposal located at Newbridge Road, Moorebank concluded that:

- In both the 20 yr ARI and 100yr ARI flood the Planning Proposal has nil adverse impact on water levels (less than 0.01 m) at any location on the floodplain in comparison to the benchmark conditions; and
- The overall flood velocities remain much lower than 1 m/s and consequently does not pose a scour risk.

Based on the flood impact assessment and from the floodway definition and from the application of the floodway criterion given below, it is concluded that the Planning proposal is not located in a Floodway but is instead located in a Flood Storage area.

The potential impacts of flood hazards on the stability of the proposed buildings were assessed by analysing the hazards at the reference locations (refer **Figure 1**) during the 100 yr ARI, indicative 5,000 yr ARI and EFE 36 hr floods. The EFE 36 hr flood is considered to be the PMF.

Location E1 is at the same level as the plinth 7.6 m AHD and is representative of the flood hazards experienced by residents. Location E2 is at the roundabout on the evacuation path. Locations GC1 and GC3 have bed levels at -2.8 m AHD so the flood hazard is no lower than H5 in these locations, even under 0 m^3/s, while Location GC2 is located on the floodplain immediately west of the development.

Residents are only directly exposed to inundation and flood hazards in events greater than around a 5,0000 yr ARI flood (refer Locations E1 and E2). Even in extreme floods the velocity remains low (refer Attachment A).

Based on the flood depths and velocities that have been assessed in the EFE 36 hr (PMF), it is our understanding that the structural engineer has confirmed that the buildings can be designed structurally and constructed to remain stable and withstand hydraulic forces in floods up to the EFE 36 hour (PMF) event.

Examples where multi-storey residential buildings have been approved and either constructed or are under construction in areas mapped as H6 hazard in the PMF include multiple developments in the Parramatta River and Clay Cliff Creek confluence area (west of James Ruse Drive) and in Summer Hill (beside Hawthorne Canal).

In the case of development in the Parramatta River and Clay Cliff Creek confluence area (in the Parramatta LGA) single storey residential dwellings are being gradually replaced by multi-storey residential apartments. These developments support shelter-in-place in floods that exceed the flood planning level. The whole confluence area experiences H6 hazard in the PMF.

Similarly, a multi-storey residential development located at 120c Old Canterbury Road beside Hawthorne Canal is nearing completion in Summer Hill (in the Inner West LGA). This development supports shelter-in-place in floods that exceed the flood planning level. This development is subject to H6 hazard in the PMF.

1. BACKGROUND

1.1 Location

Council has identified the following development sites on the Moorebank Peninsula:

- Site A – B6 commercial/residential development Benedict Planning Proposal;
- Site B – Flower Power site;
- Site C – Moorebank Cove Mirvac residential site. This development has been approved by Council; and
- Site D – Georges Cove marina site is the Benedict development approved by Council. This site is also referred to the Mirvac marina site which is a Planning Proposal to incorporate residential development into the marina site.

1.2 Flood Modelling of the Mirvac Planning Proposal

A flood impact assessment of the Mirvac Planning Proposal located at Newbridge Road, Moorebank was detailed in a 2018 report prepared by Cardno.

The 2018 flood impact assessment concluded that:

- *In both the 20 yr ARI and 100yr ARI flood it was assessed that the Planning Proposal has nil adverse impact on water levels (less than 0.01 m) at any location in the floodplain in comparison to the benchmark conditions; and*
- *While in the 20yr and 100yr ARI events there are modest velocity impacts west of the northern section of the elevated car park this was because under benchmark conditions this area was filled and under the Planning Proposal this area is re-established as a flowpath (as existed prior to any development on the site). Notwithstanding these local changes in velocity the overall velocity remains much lower than 1 m/s and consequently does not pose a scour risk.*

In flood events up to the 100 yr ARI flood a flood-free vehicular evacuation route and a separate flood-free pedestrian evacuation route is available to residents, visitors and staff on the site.

The indicative level at which access to the site at the intersection of the new access bridge and Brickmakers Drive become unsafe for vehicles is 6.0 m AHD. This equates to a 250 yr ARI flood level.

Pedestrian evacuation can continue via an elevated pedestrian bridge up to the 2,000 yr ARI flood level.

The FERP prepared by Tooker & Associates proposes:

- Plan 1 – the primary response is to evacuate all the residents and visitors by car;
- Plan 2 – if the car evacuation is blocked along Nuwarra Rd, residents are to evacuate on foot across the pedestrian bridge across Brickmakers Drive;

Evacuation of all cars from the site can readily occur prior to the peak of the 100 yr ARI flood.

1.3 Hydraulic Categories

Hydraulic categorisation of the floodplain is used to inform planning and development controls. Three hydraulic categories are defined typically as follows:

- Floodway - Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.
- Flood Storage - Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges.
- Flood Fringe - Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined.

The Nepean River Flood Study (Worley Parsons, 2015) adopted the following depth and velocity criteria to define a floodway:

- Velocity x Depth product must be greater than 3 m^2/s ; and
- Velocity is greater than 1 m/s.

The flood storage area was mapped based on:

- Depth greater than 0.5m
- Not classified as a Floodway.

All flood areas that were not categorised as Floodway or Flood Storage were mapped as Flood Fringe within the identified flood extents.

Based on the assessed nil impact on the Planning proposal on 100 yr ARI flood levels and with 100 yr ARI velocities much lower than 1 m/s it is concluded from the floodway definition and from the application of the floodway criterion given above that the Planning proposal is not located in a Floodway but is instead located in a Flood Storage area.

2. FLOOD MODELLING

For the purpose of this assessment, three floods have been assessed as follows:

- 100 yr ARI (1 in 100 AEP)
- Indicative 5,000 yr ARI (1 in 5,000 AEP)
- EFE (Extreme Flood Event) 36 hr. (This is considered to be the PMF).

2.1 Upstream Boundary Condition

The upstream100 yr ARI inflow for the local Georges Cove floodplain model was obtained from the MIKE-11 100 yr ARI results supplied previously by Council. The 100 yr ARI peak inflow is 2,081 m^3/s.

The estimated peak inflow that would give an indicative 5,000 yr ARI flood level of around 7.5 m AHD at Georges Cove is 3150 m^3/s. The indicative 5,00 yr ARI hydrograph was obtained by scaling up the 100 yr ARI hydrograph.

The upstream EFE 36 hr (PMF) inflow for the local Georges Cove floodplain model was obtained from the MIKE-11 EFE 36 hr (PMF) results supplied previously by Council. The EFE 36 hr (PMF) peak inflow is 5,029 m^3/s.

2.2 Downstream Boundary Condition

The boundary condition for the indicative 5,000 yr ARI flood was based on upscaling the adopted 100 yr ARI boundary condition while the EFE 36hr (PMF) boundary condition was obtained from the MIKE-11 EFE 36 hr (PMF) results previously provided by Liverpool City Council.

2.3 Flood Gradients

To confirm that the downstream boundary condition was not artificially lowering or raising flood levels in the vicinity of Georges Cove the flood gradients along the Georges River for all modelled floods were plotted and compared. It was found that the flood gradients were all consistent and that the adopted downstream boundary conditions do not have any impact on assessed flooding in the vicinity of Georges Cove.

Re: FLOOD HAZARD ASSESSMENT AT GEORGES COVE DEVELOPMENT, NEWBRIDGE ROAD, MOOREBANK

Figure 1 Reference Locations

3. FLOOD HAZARDS IN MAJOR AND EXTREME FLOODS

The potential impacts of flood hazards on the stability of the proposed buildings were assessed by analysing the hazards at the reference locations (refer **Figure 1**) during the 100 yr ARI, indicative 5,000 yr ARI and EFE 36 hr (PMF) floods.

Location E1 is at the same level as the plinth 7.6 m AHD and is representative of the flood hazards experienced by residents. Location E2 is at the roundabout on the evacuation path. Locations GC1 and GC3 have bed levels at -2.8 m AHD so the flood hazard is no lower than H5 in these locations, even under 0 m^3/s, while Location GC2 is located on the floodplain immediately west of the development.

3.1 Hazard Categories (2023 FRMG)

The 2023 Flood Risk Management Guideline FB03 released on 30 June by NSW DPE includes a plot of flood hazard vulnerability curves based on six hazard categories H1 – H6.

3.2 Flood Hazards at Georges Cove

Time series results have been extracted at five (5) locations identified in **Figure 1.** The plots collated in **Attachment A** plot the temporal variations at the five reference locations in turn of the floods for the following:

- Flood depth time series
- Flood velocity time series
- Hazard variations (H1-H6)

4. MULTI-STOREY RESIDENTIAL DEVELOPMENT IN PMF H6 HAZARD ZONES

Examples where multi-storey residential buildings have been approved and either constructed or are under construction in areas mapped as H6 hazard in the PMF include multiple developments in the Parramatta River and Clay Cliff Creek confluence area (west of James Ruse Drive) and in Summer Hill (beside Hawthorne Canal).

In the case of development in the Parramatta River and Clay Cliff Creek confluence area (in the Parramatta LGA) single storey residential dwellings are being gradually replaced by multi-storey residential apartments. These developments support shelter-in-place in floods that exceed the flood planning level. The whole confluence area experiences H6 hazard in the PMF.

Examples of development in the confluence area include 125-129 Arthur Street, Parramatta and 2-8 River Road West, Parramatta.

Re: FLOOD HAZARD ASSESSMENT AT GEORGES COVE DEVELOPMENT, NEWBRIDGE ROAD, MOOREBANK

Similarly a multi-storey residential development located at 120c Old Canterbury Road beside Hawthorne Canal is nearing completion in Summer Hill (in the Inner West LGA). This development supports shelter-in-place in floods that exceed the flood planning level. This development is subject to H6 hazard in the PMF.

Yours faithfully,

STANTEC AUSTRALIA PTY LTD

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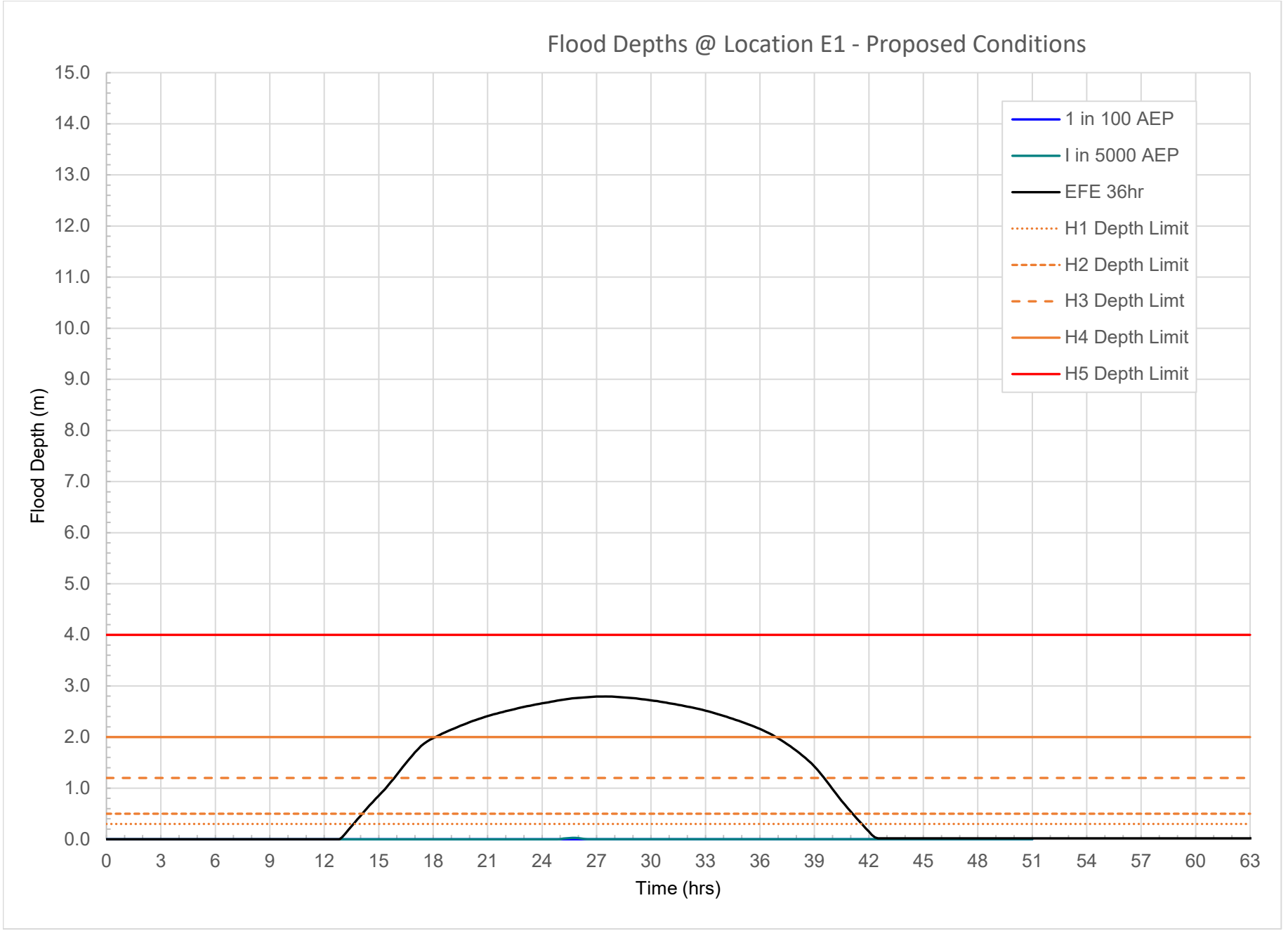
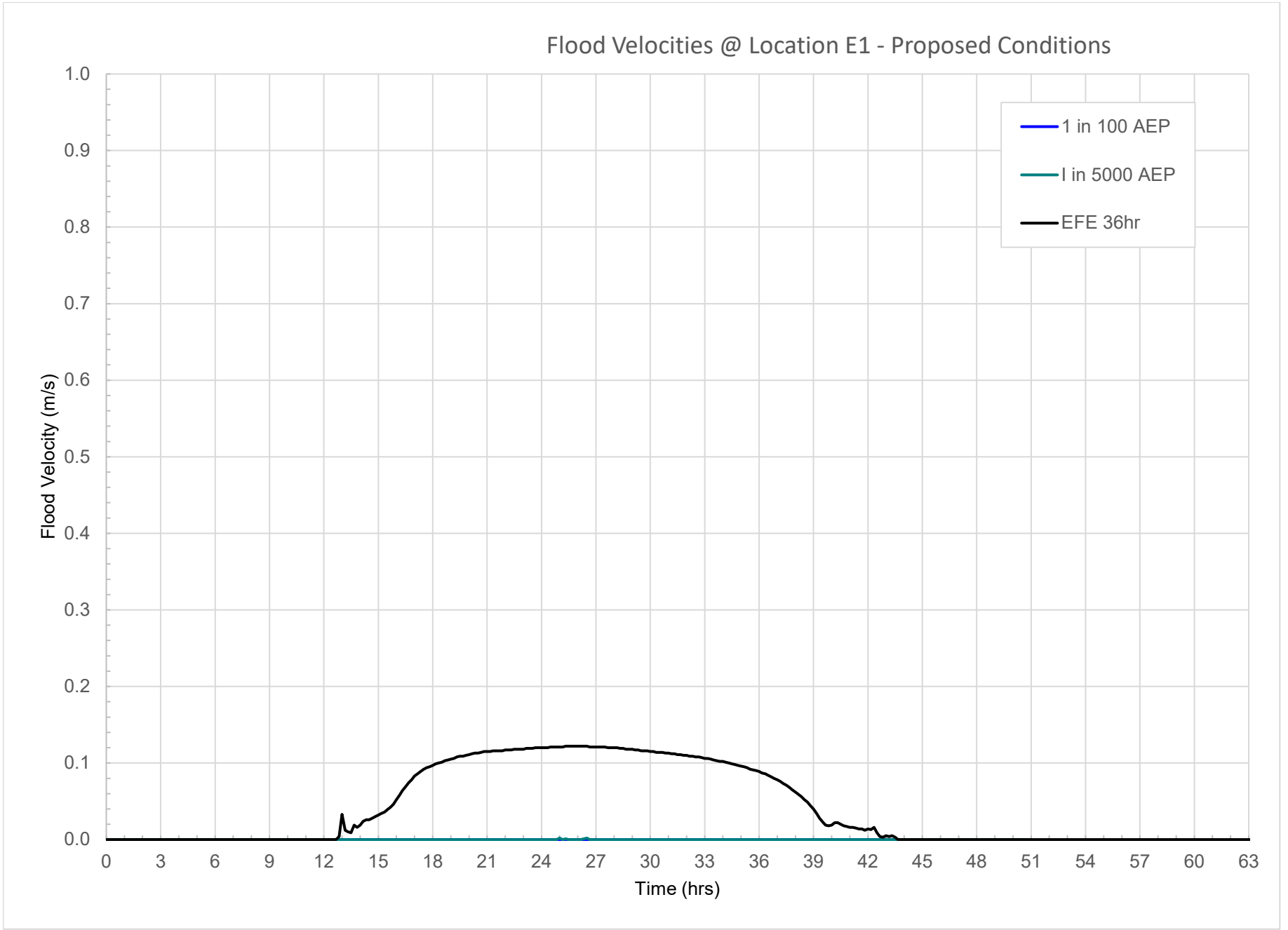
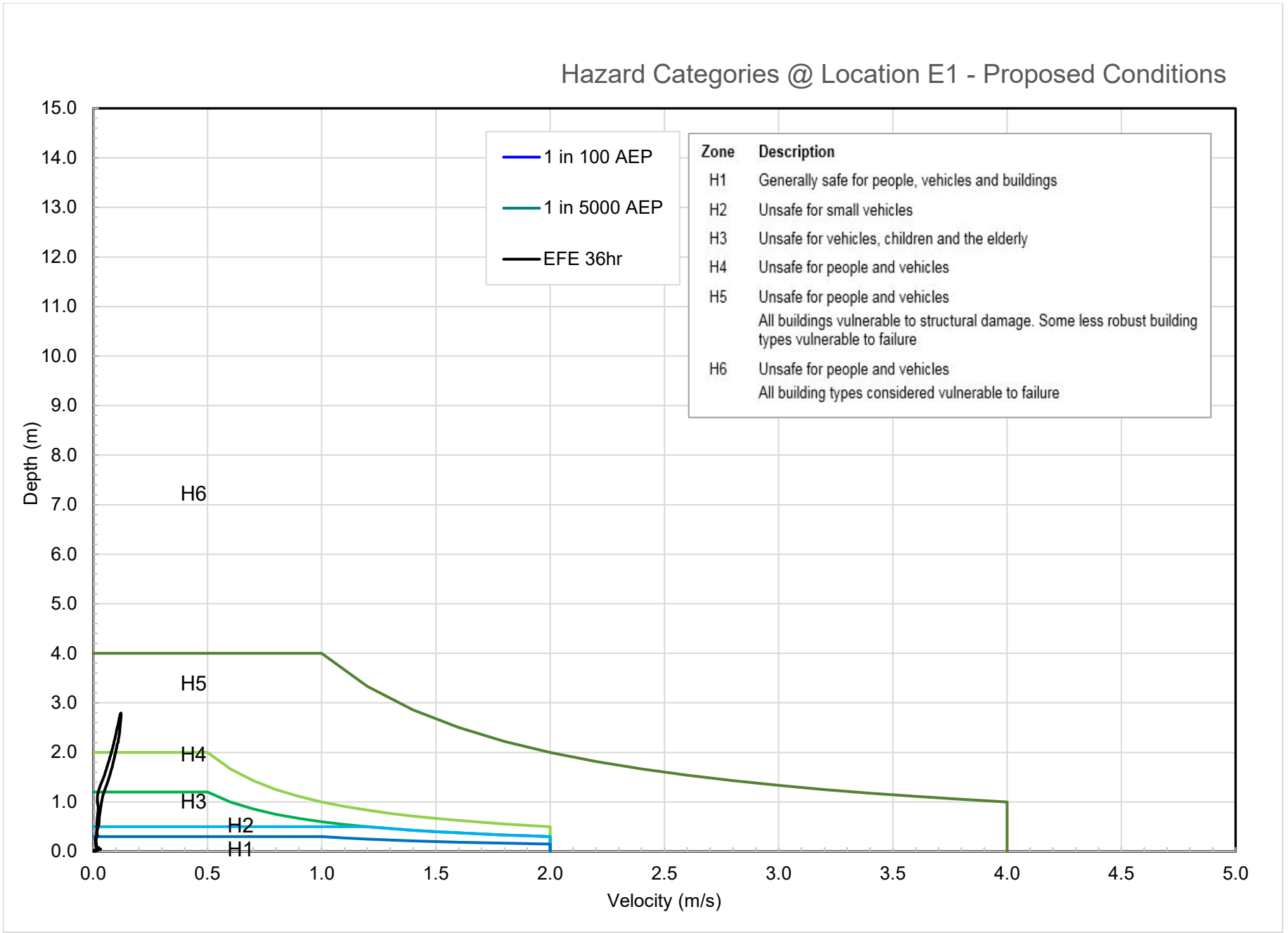
Attachments: [

Attachment A1




Flood Velocities @ Location E1 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63


Hazard Categories @ Location E1 - Proposed Conditions
1 in 100 AEP
1 in 5000 AEP
EFE 36hr
Zone
Description
H1
Generally safe for people, vehicles and buildings
H2
Unsafe for small vehicles
H3
Unsafe for vehicles, children and the elderly
H4
Unsafe for people and vehicles
H5
Unsafe for people and vehicles
All buildings vulnerable to structural damage. Some less robust building types vulnerable to failure
H6
Unsafe for people and vehicles
All building types considered vulnerable to failure
Depth (m)
Velocity (m/s)
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
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H6
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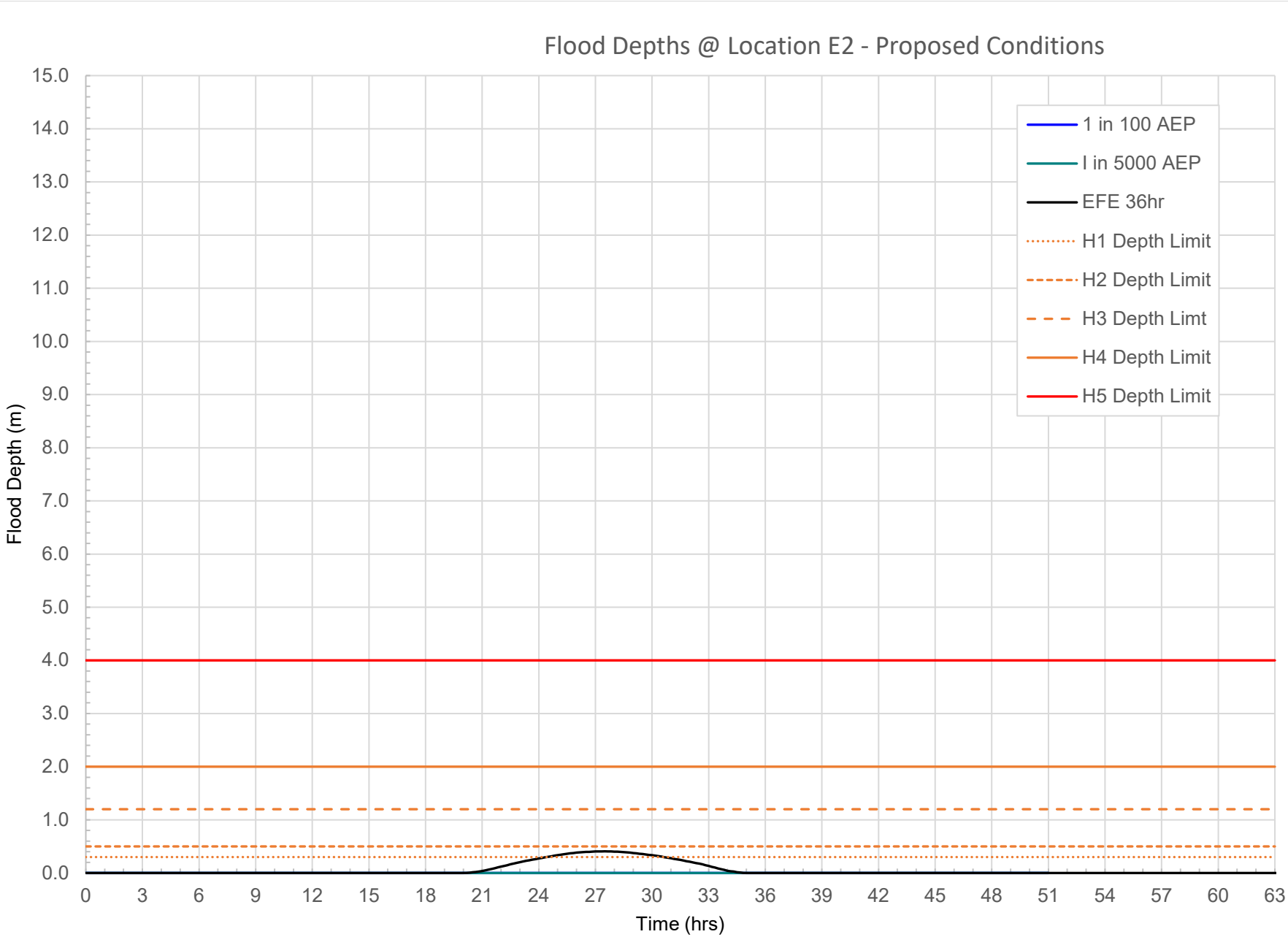
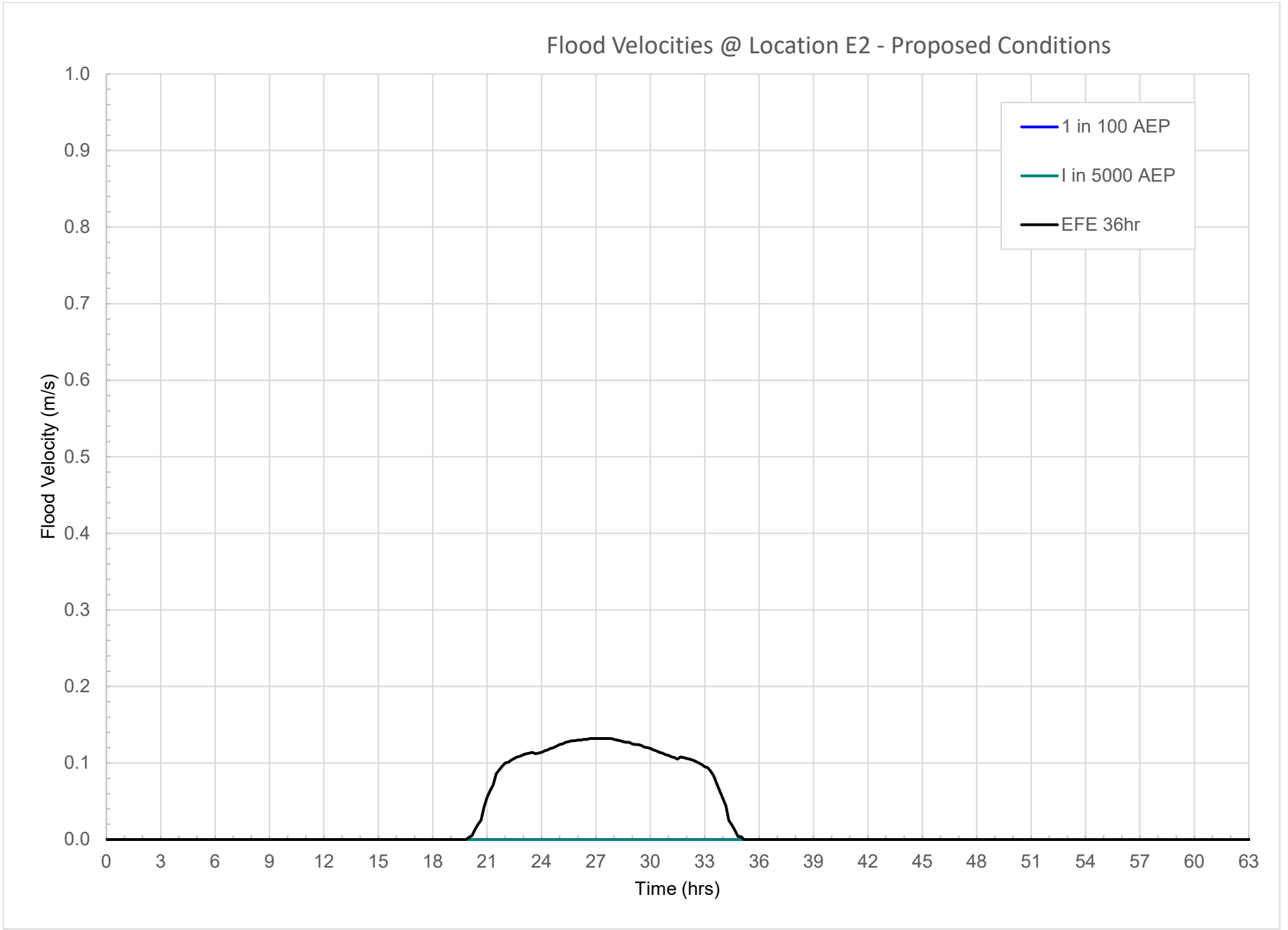
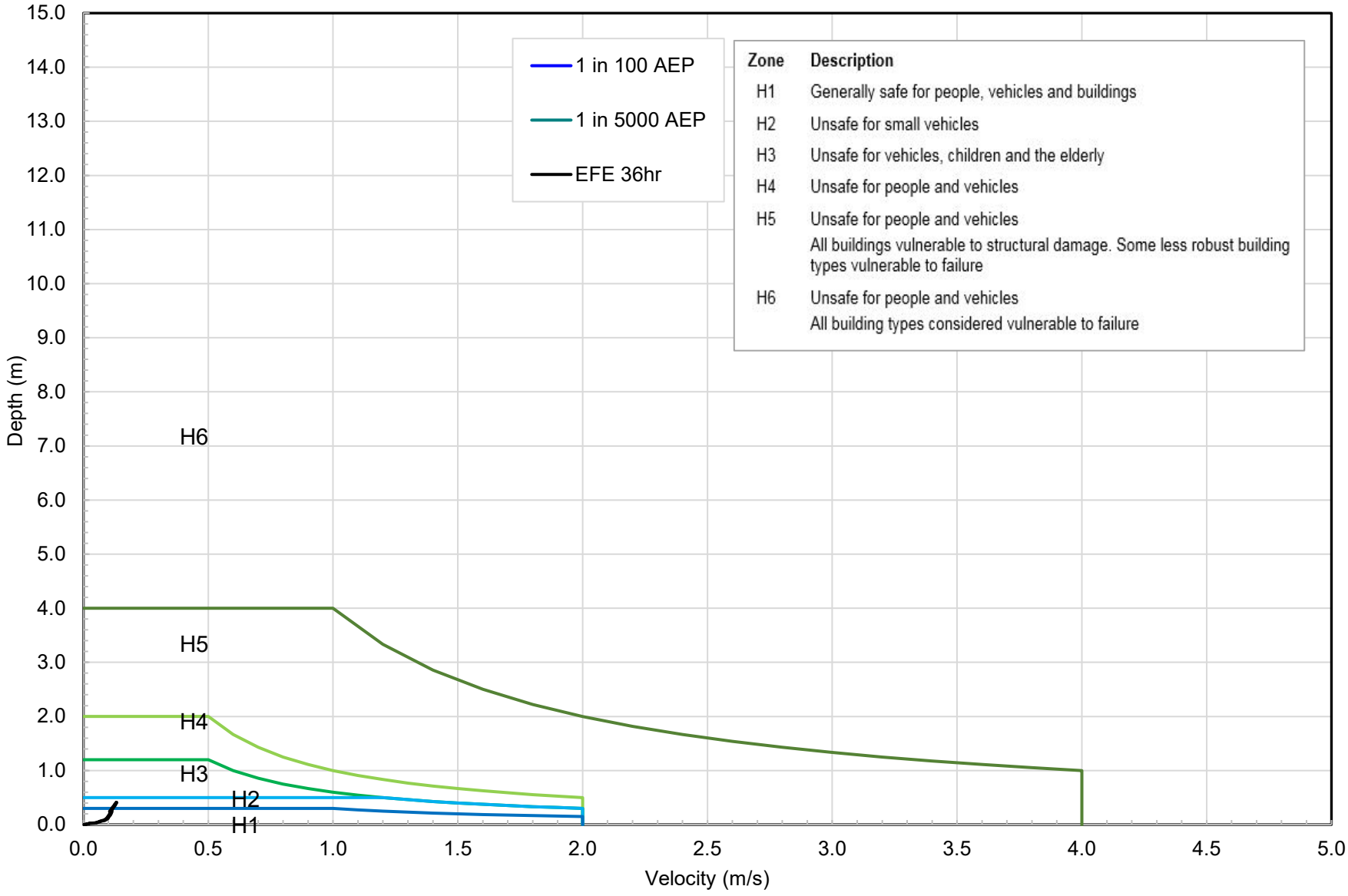
H2
H1

Attachment A2

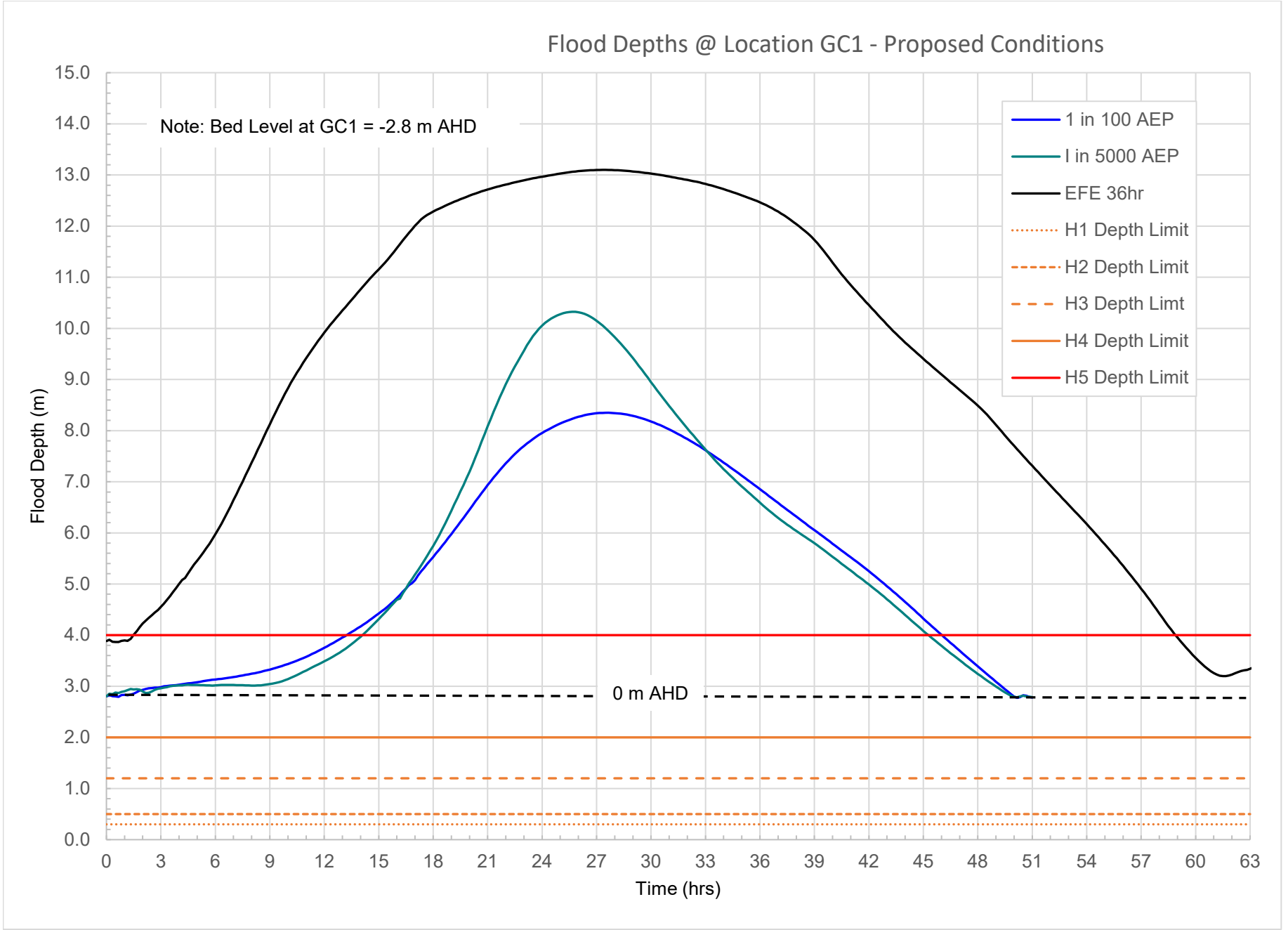


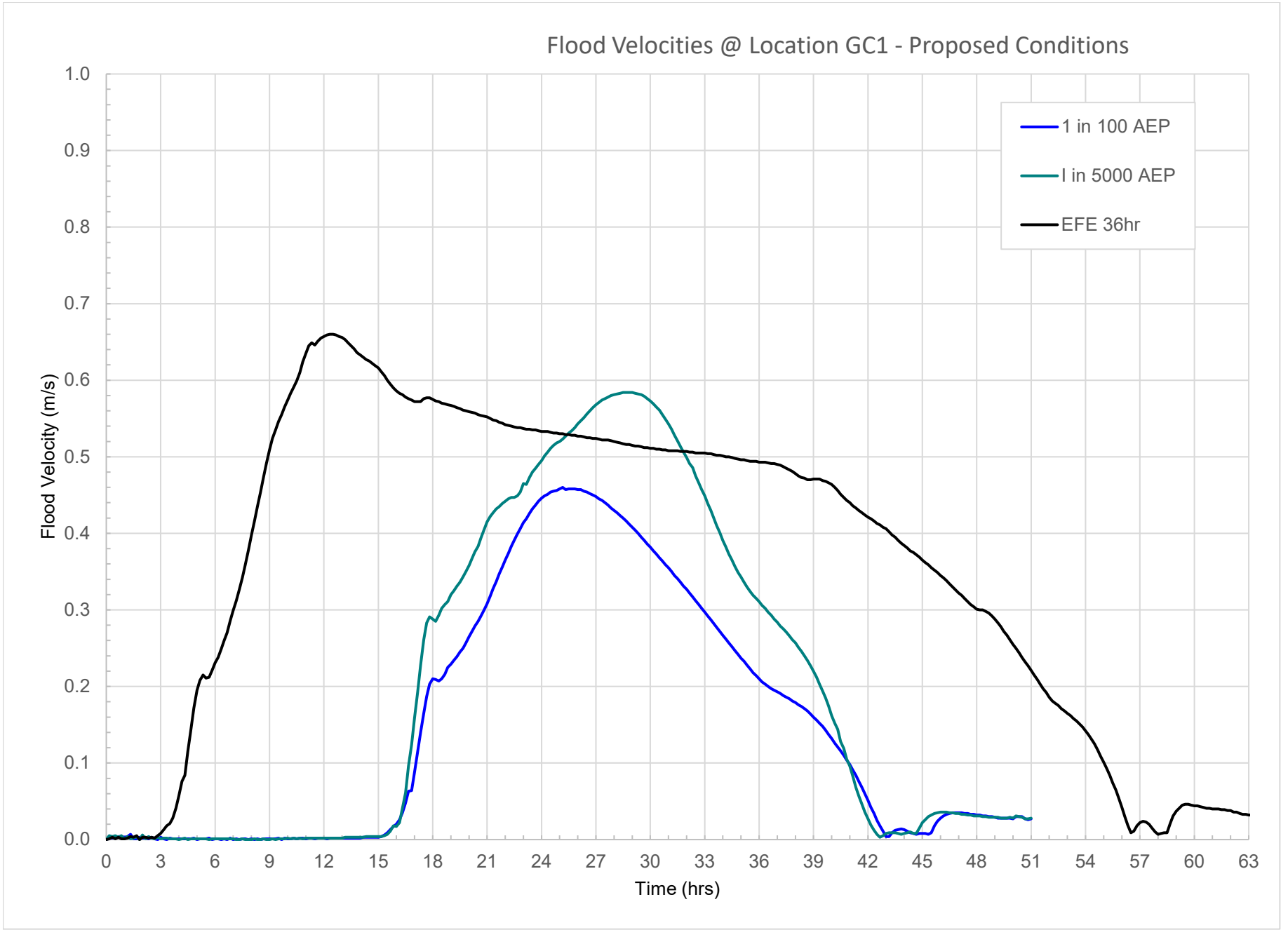

Flood Velocities @ Location E2 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63
Time (hrs)

Hazard Categories @ Location E2 - Proposed Conditions



Attachment A3




Flood Velocities @ Location GC1 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
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48
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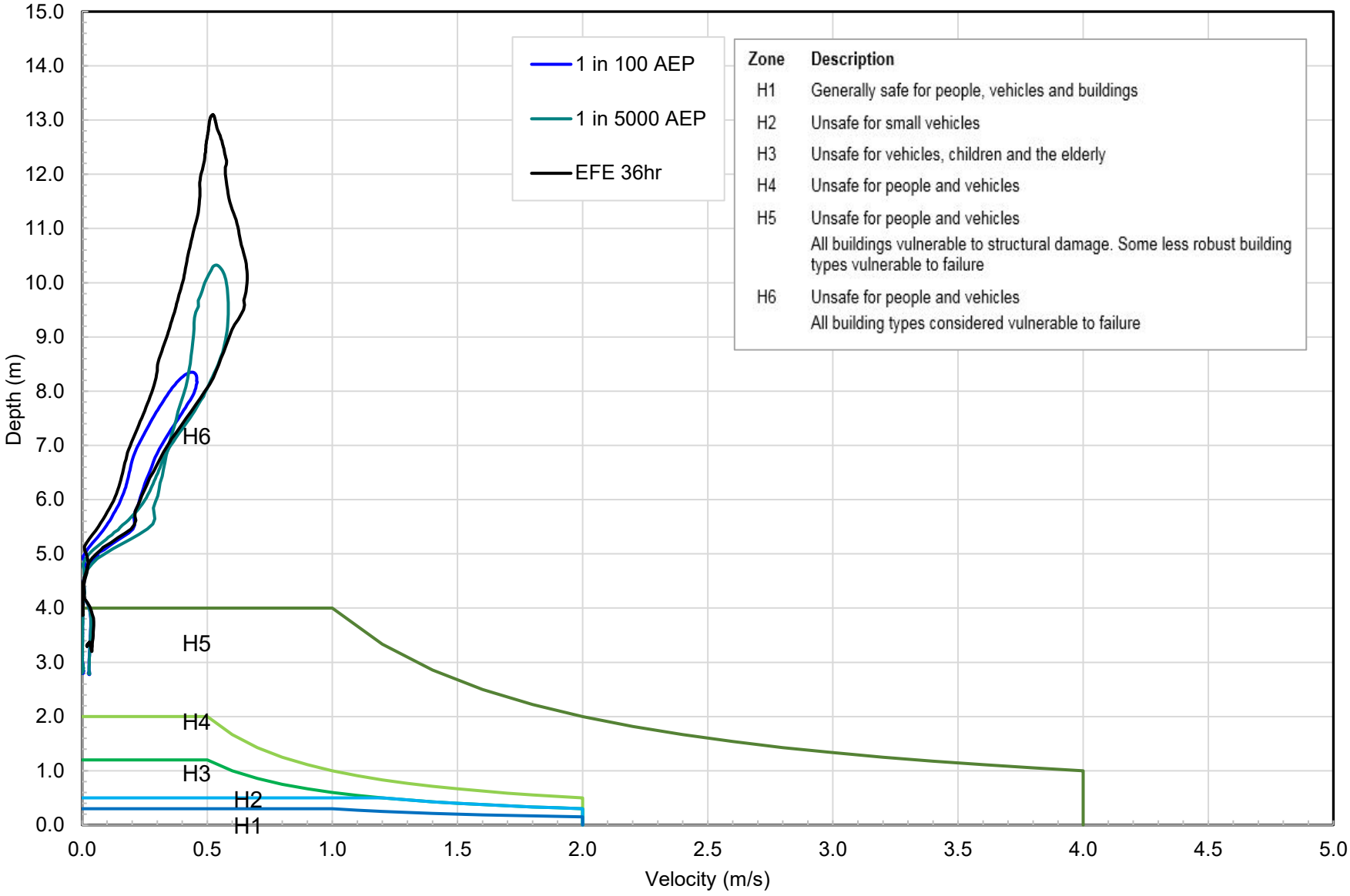
Hazard Categories @ Location GC1 - Proposed Conditions



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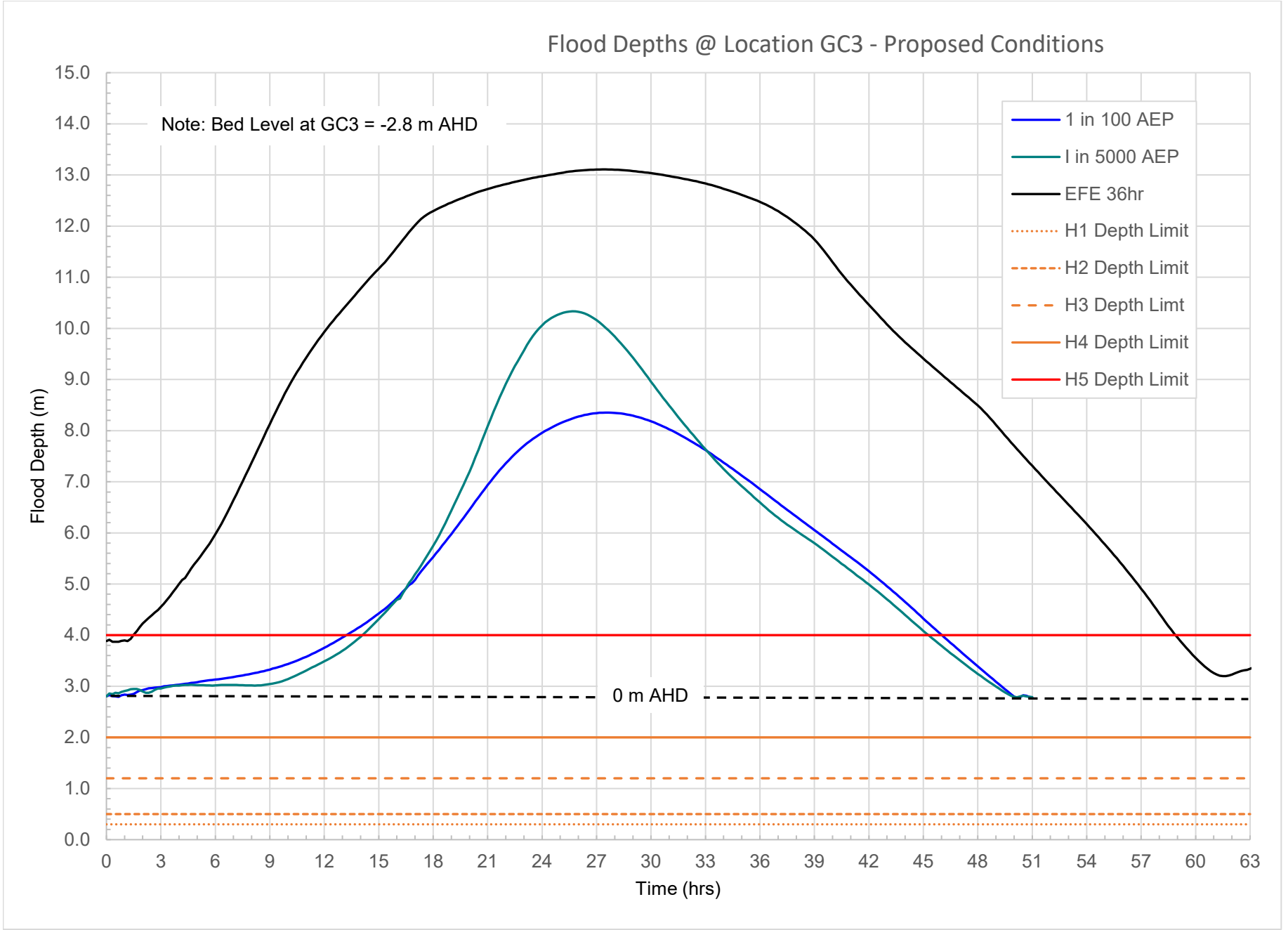

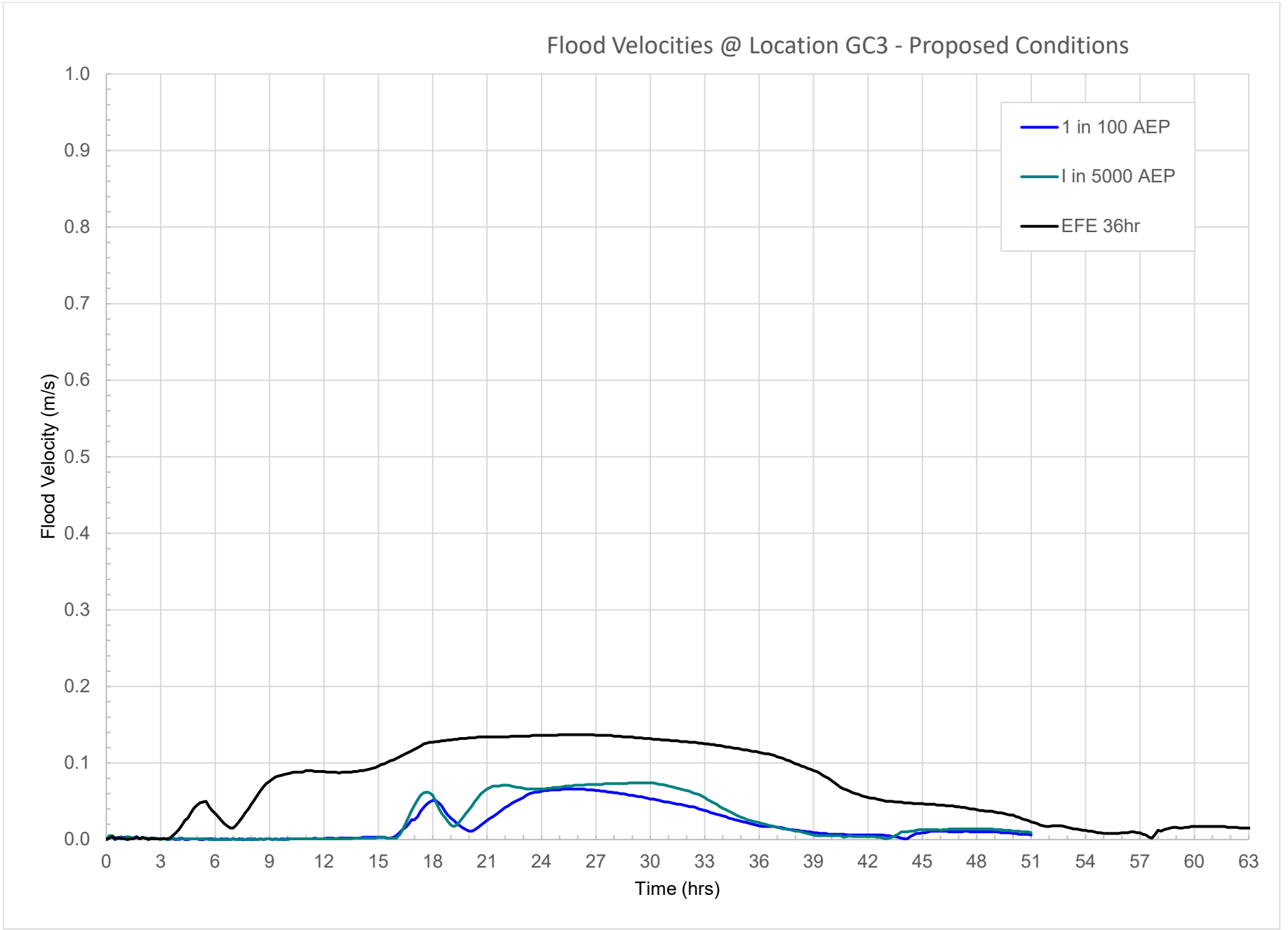
Flood Velocities @ Location GC3 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
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0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
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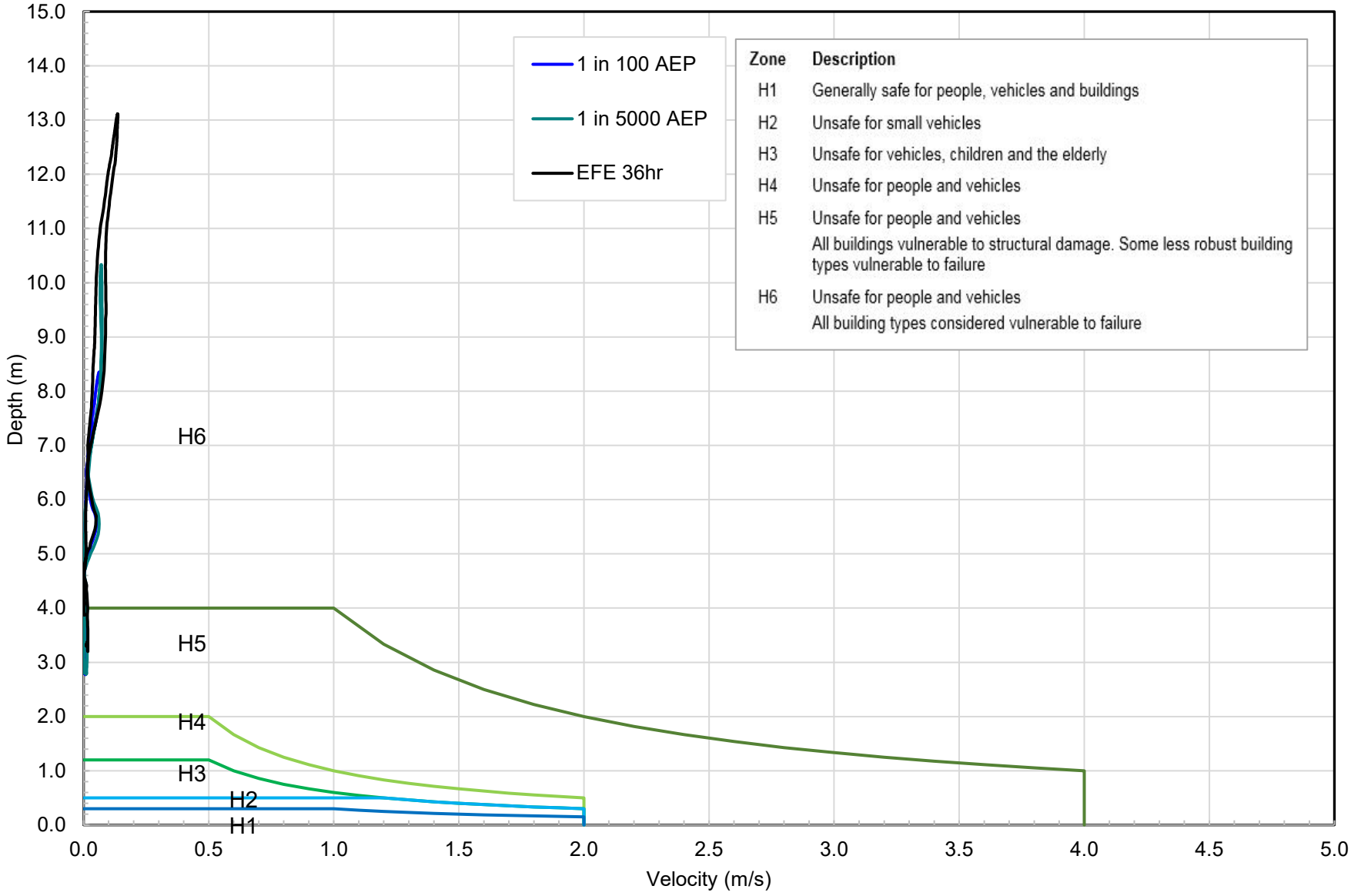
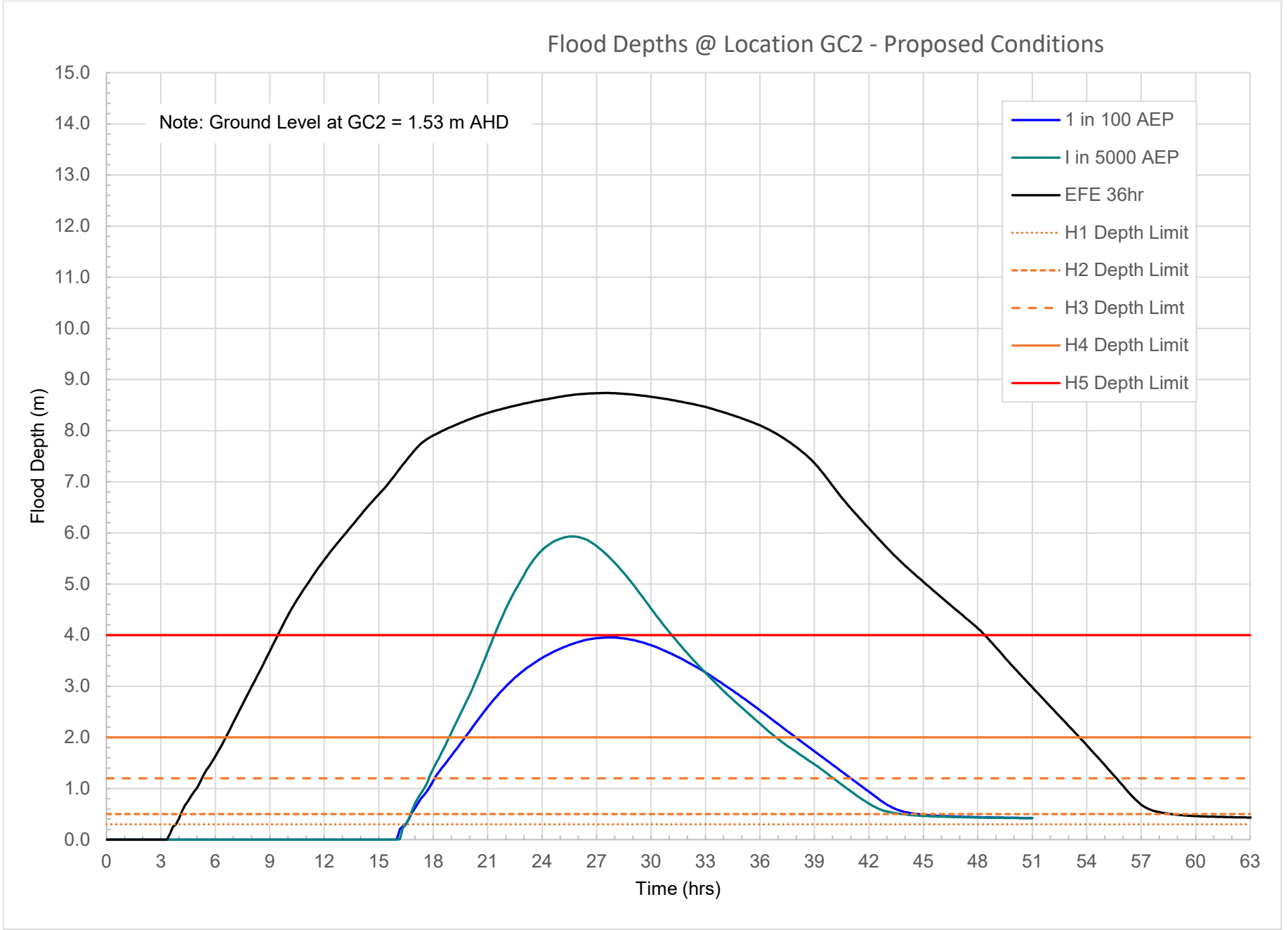
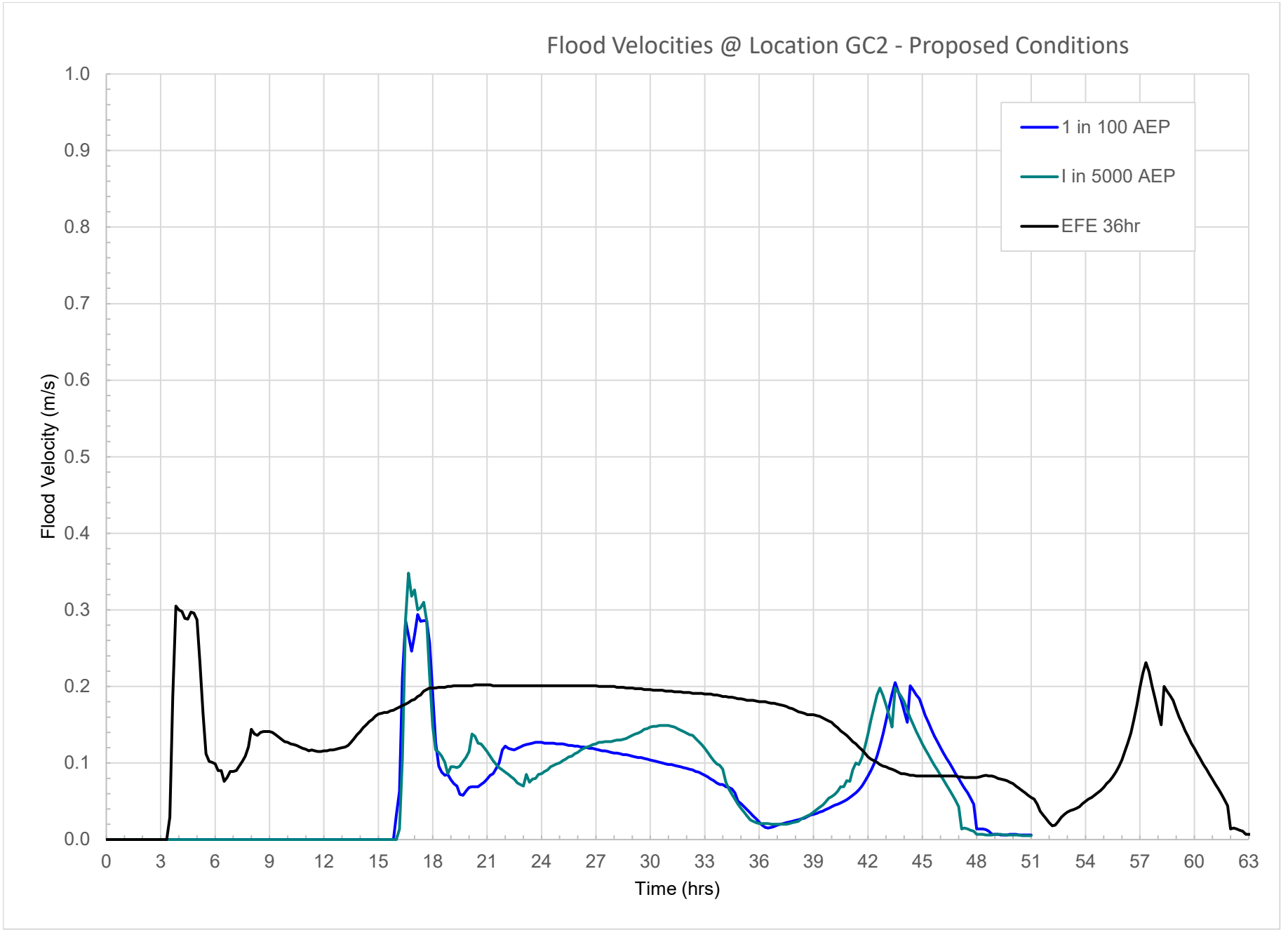
Hazard Categories @ Location GC3 - Proposed Conditions



Attachment A5




Flood Velocities @ Location GC2 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
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0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
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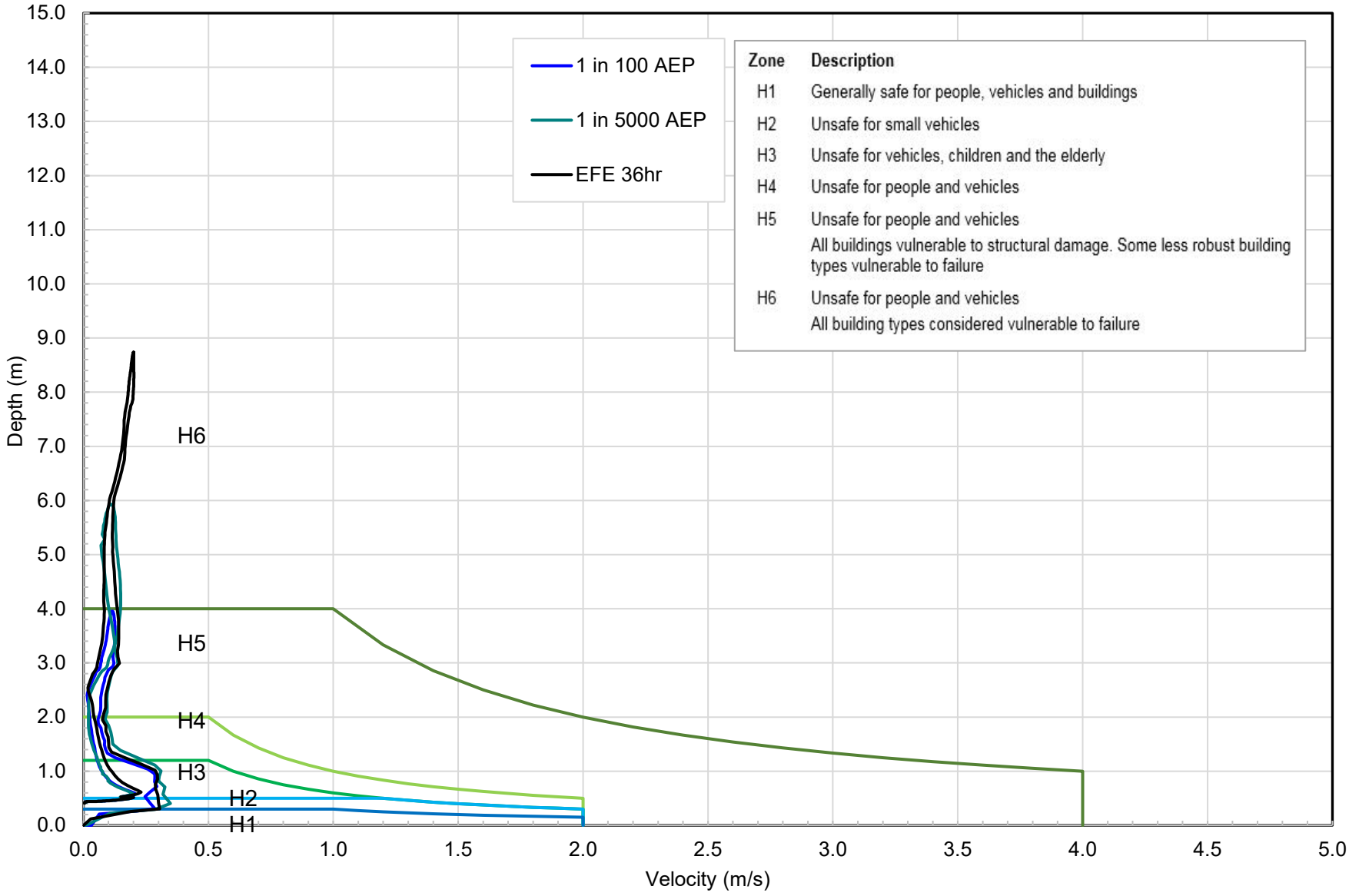
Hazard Categories @ Location GC2 - Proposed Conditions



ANNEXURE B

Structural Engineering Assessment

Building Stability in Floods

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Tel: +61 468 468 692
Email: enquiries@epsptyltd.com.au

27 August 2024

Enquiries: Paul Moore
Proposal No: 24121

Tanlane Pty Ltd
c/o PO Box 431
Frenchs Forest, NSW 1640

Attention: Ernest Dupere

Dear Nicole

RE: Georges Cove Marina Development
Flood Assessment

This letter report is prepared in support of a planning proposal by Mirvac for a residential development at Georges Cove, to be located above the podium level (RL7.60m AHD) already approved as part of the Georges Cove Marina in Moorebank. The site is subject to potential flooding and an assessment has been carried out of likely flood forces and their potential impact on the structural integrity of the proposed buildings.

A copy of preliminary plans for the site are appended to this letter report, referenced Figure 4 to Figure 8 respectively. The proposal includes a large podium over an underground car park, and above the podium it is proposed to construct four residential apartment buildings and a series of townhouses. The podium level is proposed to be constructed at RL7.60m AHD, with the basement car park at RL 3.95m AHD. Beneath part of the car park it is proposed to include a voided zone for mitigation of flood water.

An assessment of the flooding characteristics has been carried out by Stantec (formerly Cardno) and their results are also included as an Appendix to this letter report. These plots show flood depth against a datum of -2.8mAHD. The assessed flood water levels demonstrate the following parameters:

Flooding Return Period	Max Flood Level (m AHD)	Flood flow velocity (m/s)
100 years	5.55	0.46
5000 years	7.4	0.58
PMF (EFE 36 hour)	10.3	0.66

Whilst the void beneath the basement will become inundated during a significant storm event, it is proposed that the basement car park area will be fully tanked beneath and alongside to prevent the ingress of water either from below or from through the walls. The level of the podium has been set such that it will not become inundated in the event of a 1 in 5000 year storm, which provides a significant degree of risk mitigation to residents against the hazard of flooding. In the event of a Probable Maximum Flood, it is anticipated that water levels could rise to RL 10.30, some

2.7m above the podium level. The Authorities require an assessment to verify that the structure can be designed to withstand forces from such a flood. The structural assessment is therefore focussed on the construction of the podium, basement walls, low level columns and footings.

Reference has been made to the information handbook, 'Construction of Buildings in Flood Hazard Areas', published by the Australian Building Codes Board', which provides guidance and advice on designing building structures within flood zones. This document considers flood velocity below 1.5m/s to be 'deemed to satisfy', or that it creates forces of such magnitude that the hydrostatic forces are not significantly magnified. The low velocity also reduces significantly the potential for forces arising from debris mat loading. Debris mat loading is commonly associated with bridges and AS5100 provides guidance on calculating associated forces. Force applied is a function of the square of flow velocity. Hence low flow velocity results in a low force. Based on this, we are satisfied that columns above podium level which support the super-structure of apartments, and the lower walls of townhouses which are below habitable rooms, will be adequate to resist lateral forces.

The podium slab will be designed as a post tensioned concrete slab, to support the imposed load of 2.70m head of water above it. Whilst this load (27kPa) is significant, it is comparable with design forces arising in certain storage and industrial buildings, which demonstrates that the design and implementation can be satisfactorily achieved.

The basement walls will be constructed of reinforced concrete and tanked to exclude water. The flood level during the PMF event is at RL10.30m AHD, which is 6.35m above the level of the car park slab. Whilst the depth of water is significant, the very low level flow velocity means that the walls can be designed to withstand hydrostatic pressures. The hydrostatic forces arising are high, but the span of the walls between basement and podium is only 3.65m. We are satisfied that a reasonable solution using reinforced concrete walls approximately 300mm thick can be achieved. It is also anticipated that water depth will be relatively equal along both long sides of the basement structure, hence global hydrostatic forces on the building will be equal and opposite, hence neutralised. This balancing of global forces on the building as a whole also applies in the 1 in 5000 year event and 1 in 100 year event.

During all flood events the flood compensation void will be full of water and imposing a hydrostatic uplift force on the underside of the basement car park slab. In the event of the Probable Maximum Flood, the magnitude of this force will be approximately 6.5m head, or 65kPa. This is a high design load, but it can be accommodated. We propose that column spacing supporting the basement slab only be decreased from a nominal 8m x 8m grid to a 4m x 4m grid. This span will allow the slab to be designed for the extreme imposed load, using post tensioning and reinforcement in the normal approach. As this is an ultimate loading scenario, we do not consider that load factors provided in AS1170:part 2 should be adopted.

There is potential for a slightly increased velocity of water in the flood mitigation void, as water flows in. This will impose additional lateral forces on structures internal to the void, including columns supporting the superstructure and basement slab. Based on the proposed height of the building we would anticipate column sizes to be of the order of 500mm x 500mm. Increasing the size within the flood compensation zone to approximately 750mm x 750mm will provide additional resilience to withstand flood forces. Intermediate columns which support only the basement slab are likely to be sized at approximately 400mm x 400mm. These specific sizes are subject to detailed design requirements to be carried out during later phases of the project.

Footings beneath the building are expected to be large diameter insitu concrete piles. Provided that these are designed in accordance with appropriate Australian Standards we see no reason why these should not be suitable to withstand flood forces in the circumstances assessed above. Flow velocity is very low, such that erosion or scour of ground beneath the building is very unlikely to be a concern. In the detailed design stage, this issue will be examined again in detail. If deemed necessary, a concrete slab can be installed in front of the basement wall to minimise any potential for bed scour.

In summary, EPS is satisfied that the proposed development structure can be designed to resist the forces resulting from flood waters arising from the PMF storm event. The type and form of structures that will achieve this outcome are standard practice in NSW and commonly adopted for similar medium and large scale developments.

We trust these comments are helpful, but if you have any queries, please do not hesitate to contact the writer.

Yours sincerely

Engineering Project Solutions Pty Ltd

Paul Moore
BEng(Hons), CPEng, FIEAus, NER, RPEQ
Director

FIGURE 4

MIRVAC DESIGN

1. Terrace Homes
2. Apartments
3. Dry Dock
4. Broadway
5. Jetty
6. Landscape Park
7. Carparking

Georges Cove Marina

0 18.75 37.5 75

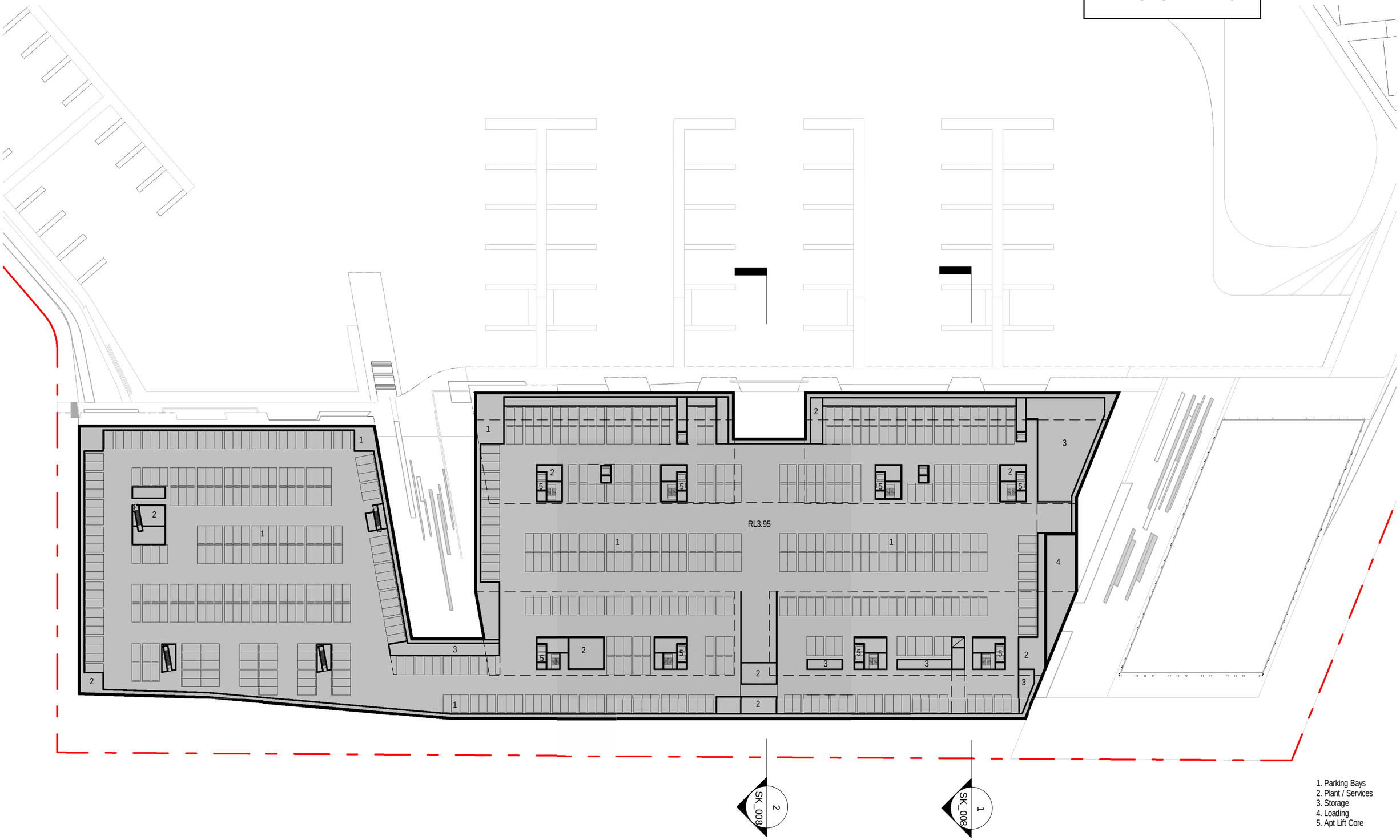
Scale 1 : 1500

SITE PLAN

SK_001

MIRVAC
DESIGN

FIGURE 5



1. Parking Bays
2. Plant / Services
3. Storage
4. Loading
5. Apt Lift Core

Georges Cove Marina

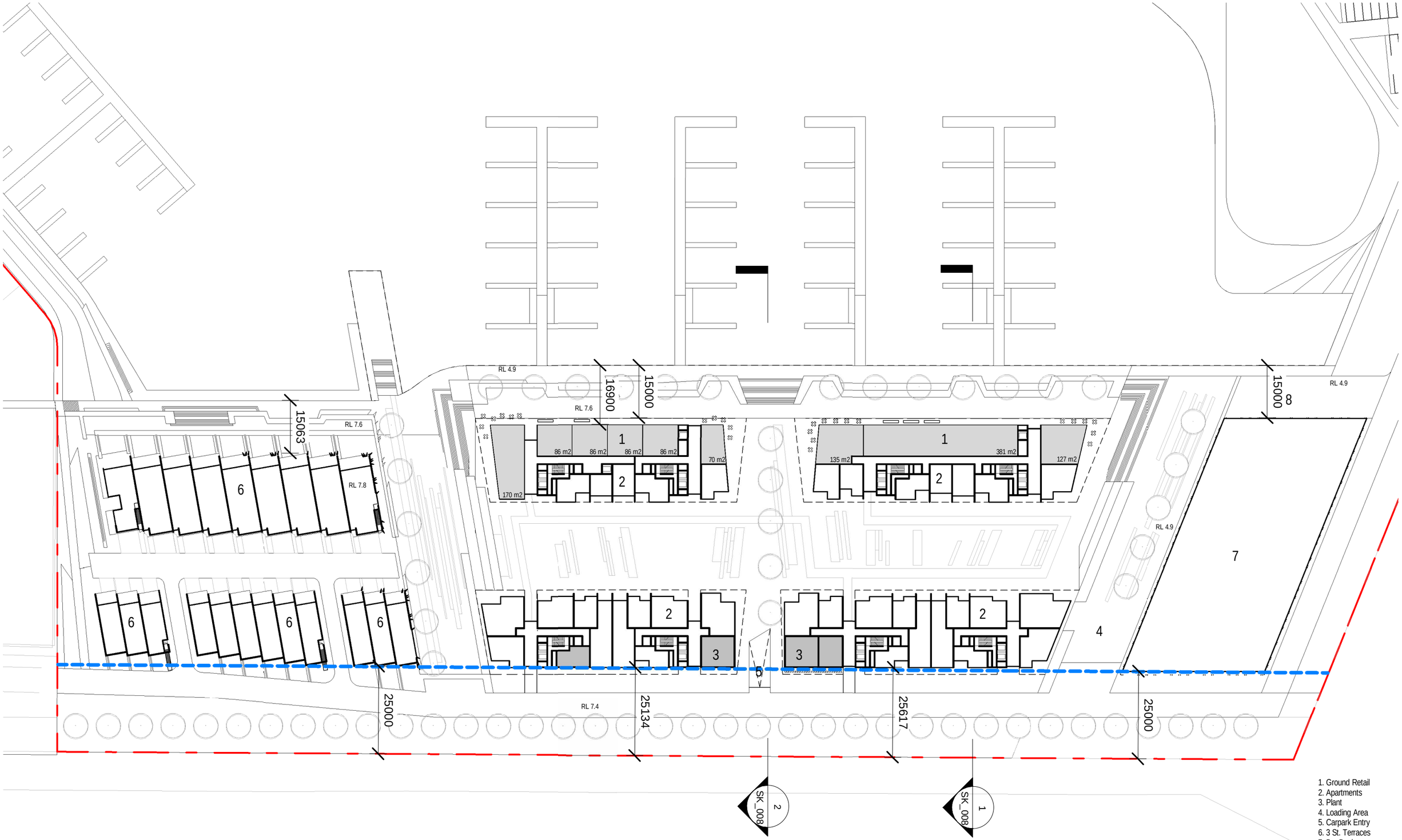
0 12.5 25 50
Scale 1 : 1000

BASEMENT

SK_002 E

FIGURE 6

MIRVAC DESIGN



1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

Georges Cove Marina

0 6.25 12.5 25

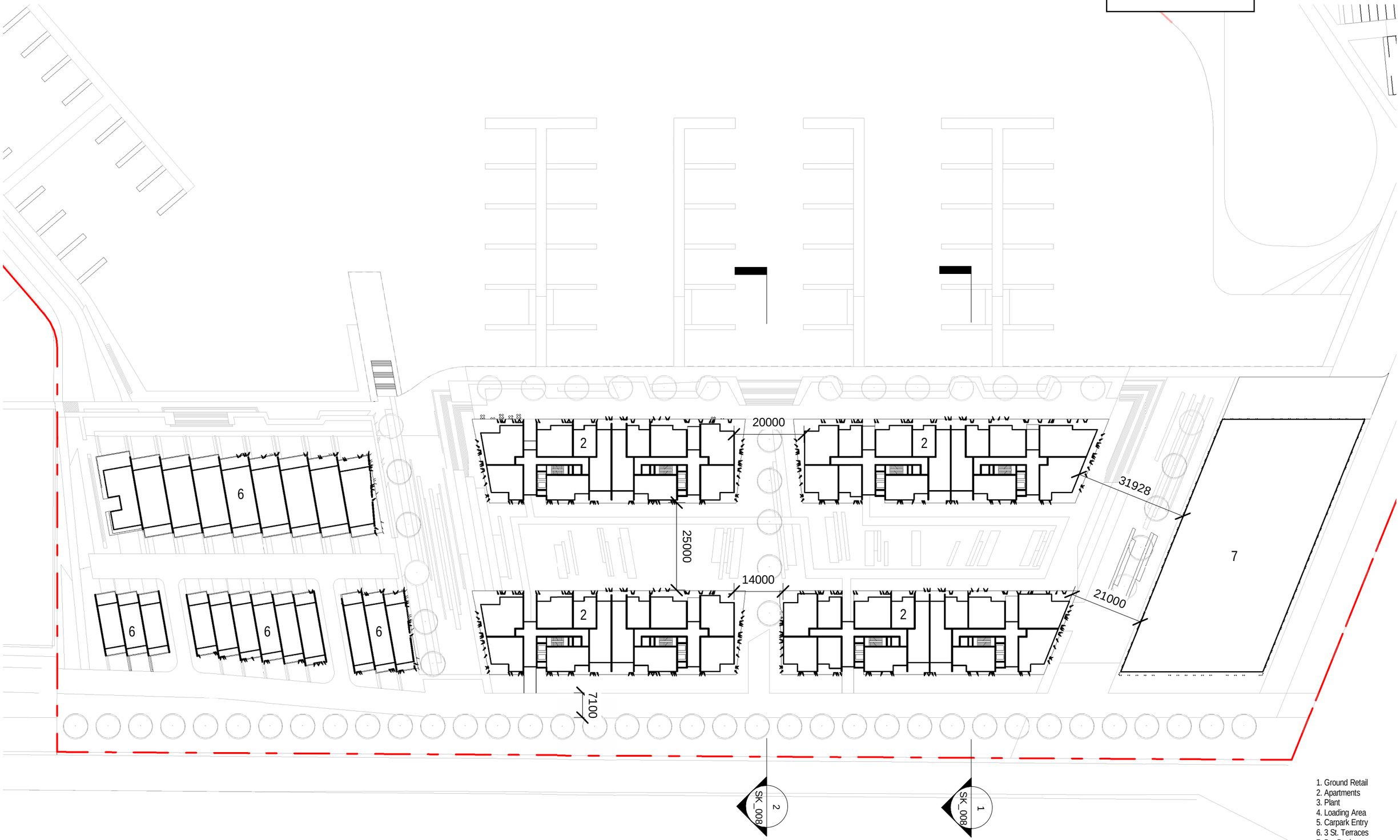
Scale 1 : 500

LEVEL 1

SK_003 E

MIRVAC DESIGN

FIGURE 7



1. Ground Retail
2. Apartments
3. Plant
4. Loading Area
5. Carpark Entry
6. 3 St. Terraces
7. Dry Dock
8. Dry Dock Loading

Georges Cove Marina

0 6.25 12.5 25

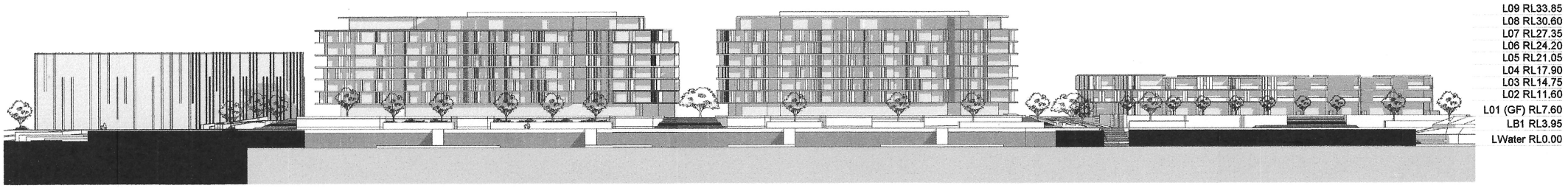
Scale 1 : 500

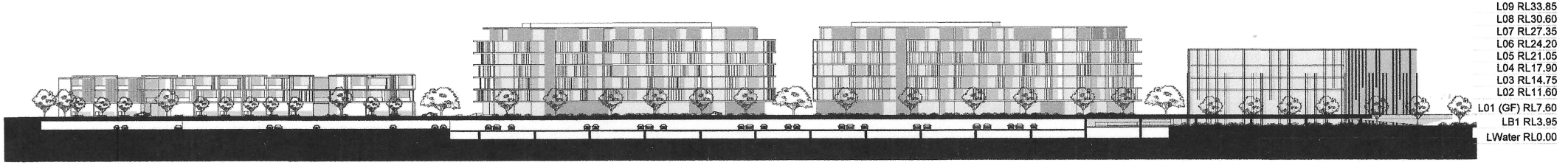
LEVEL 2-6 (excl. Terraces)

SK_004 E

FIGURE 8

MIRVAC DESIGN





Georges Cove Marina

0 12.5 25 50

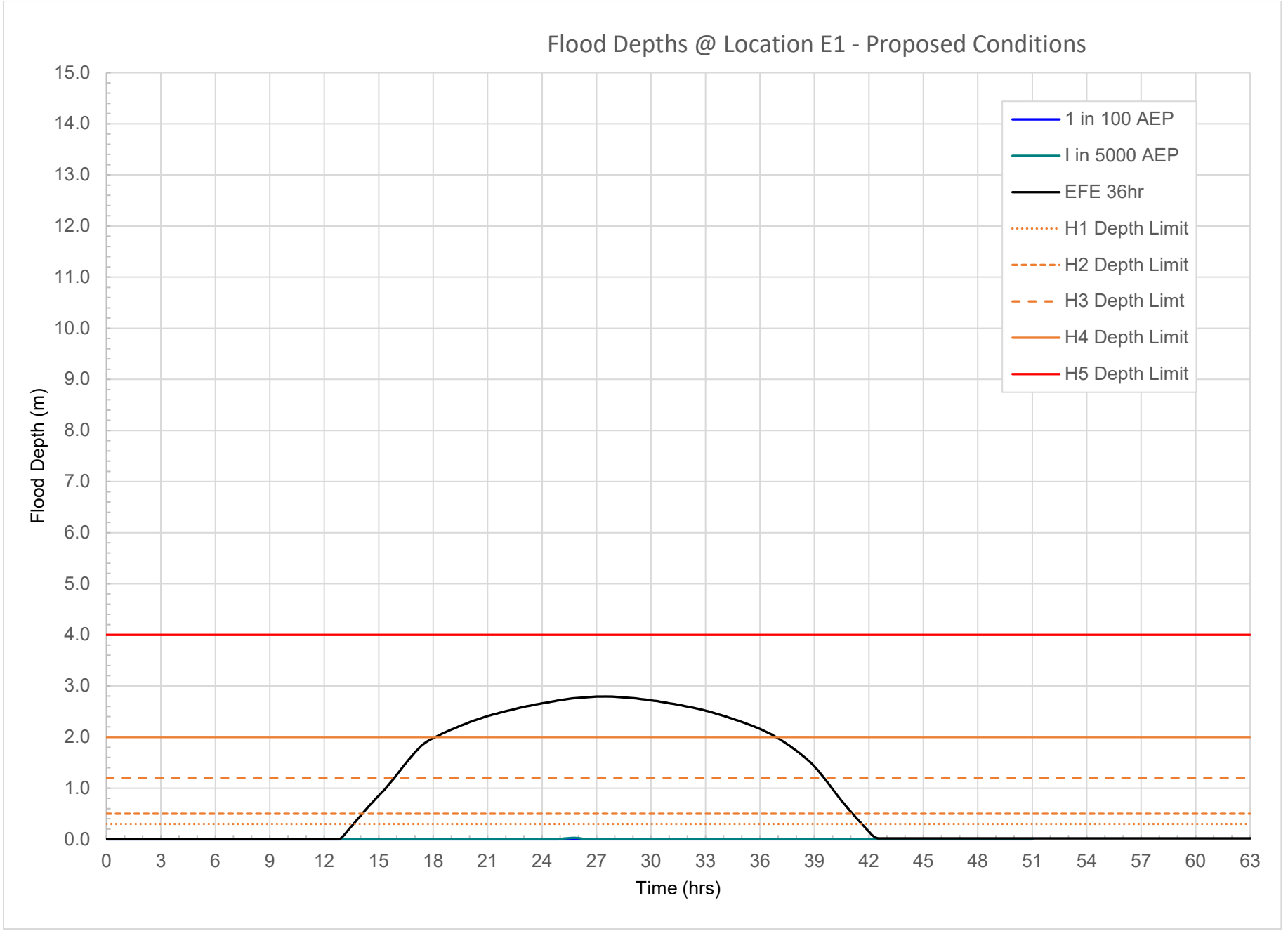
Scale 1 : 1000

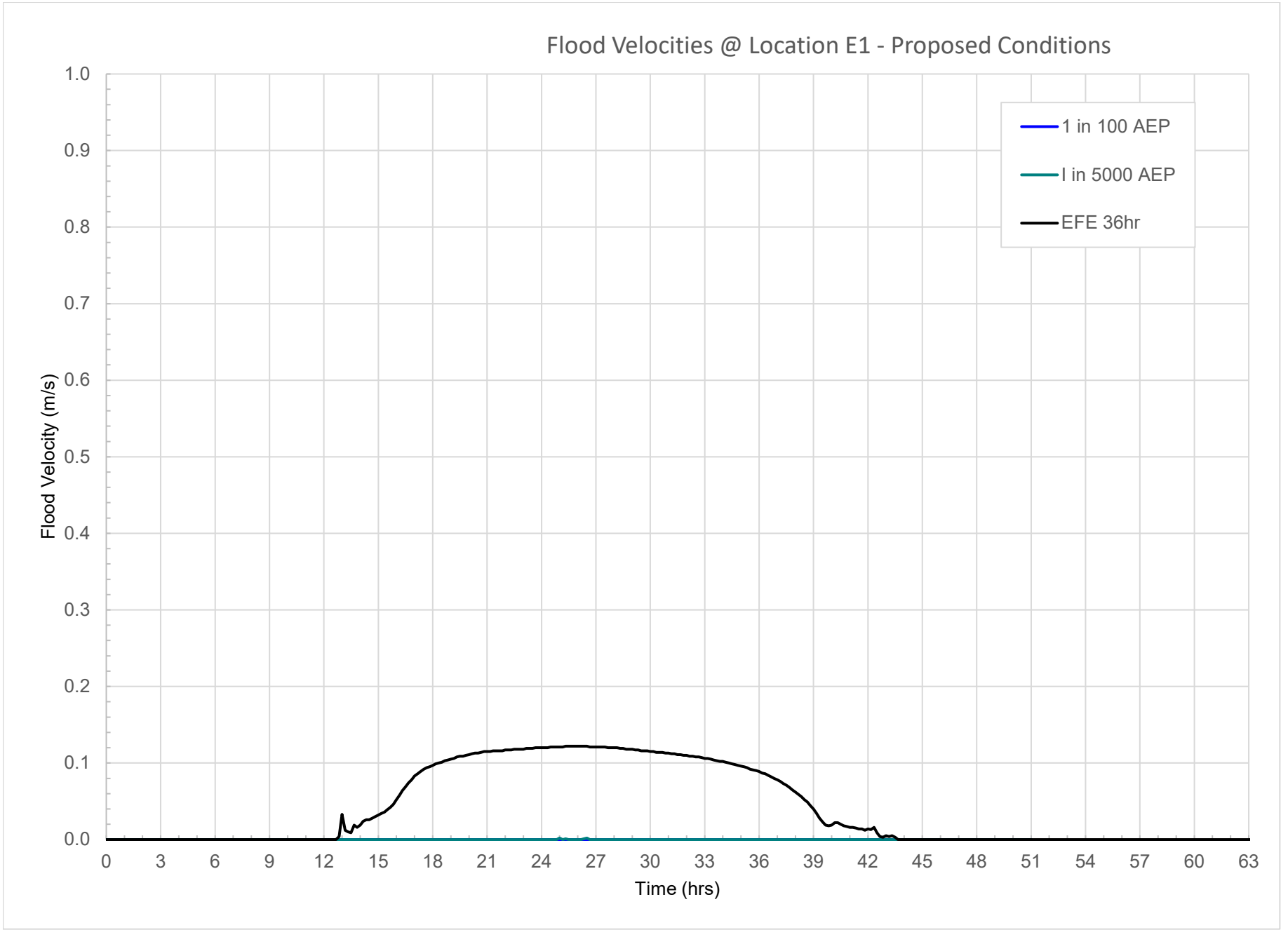
ELEVATIONS

SK_007 E

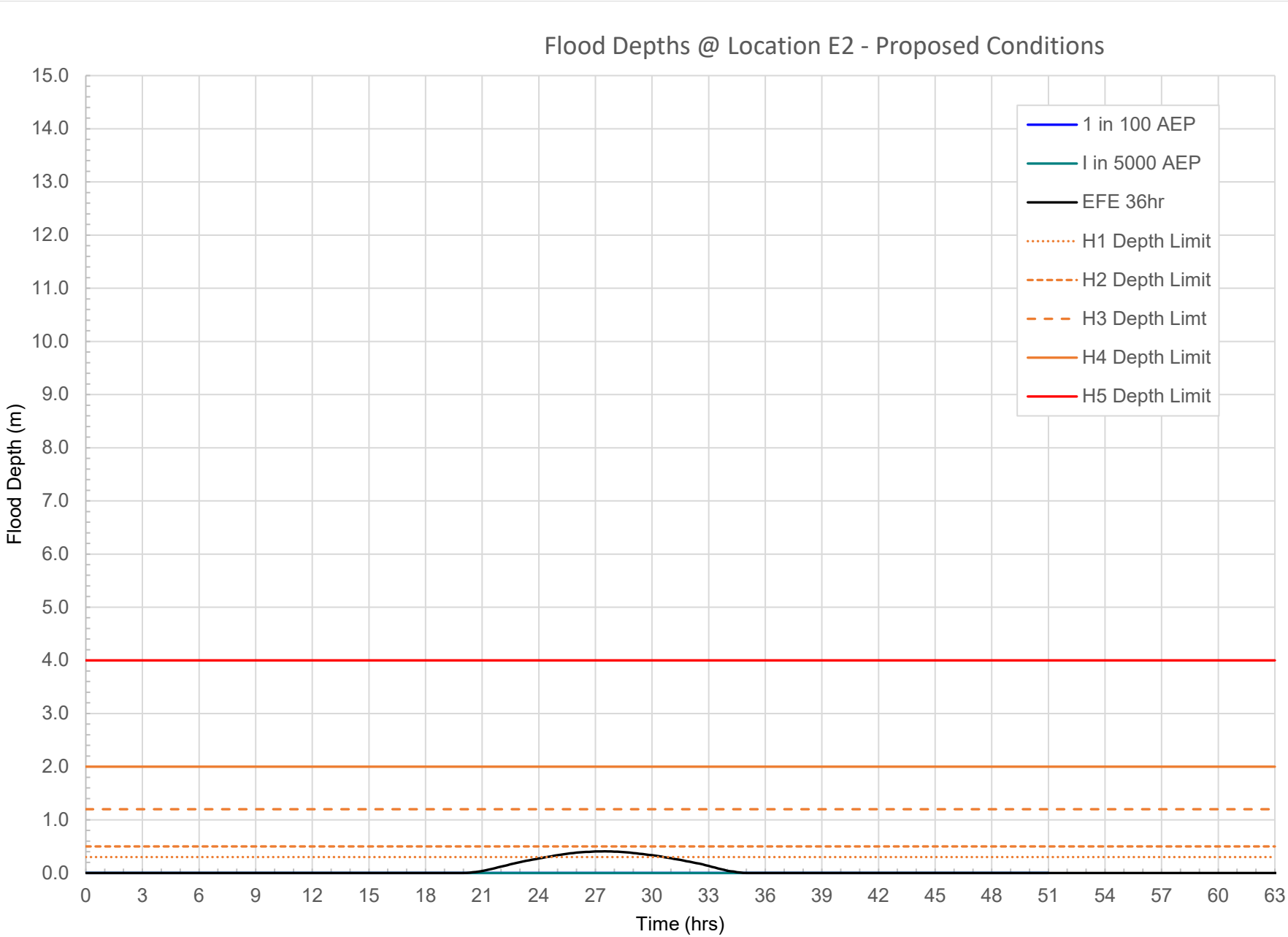
Appendix A Flood mapping locations

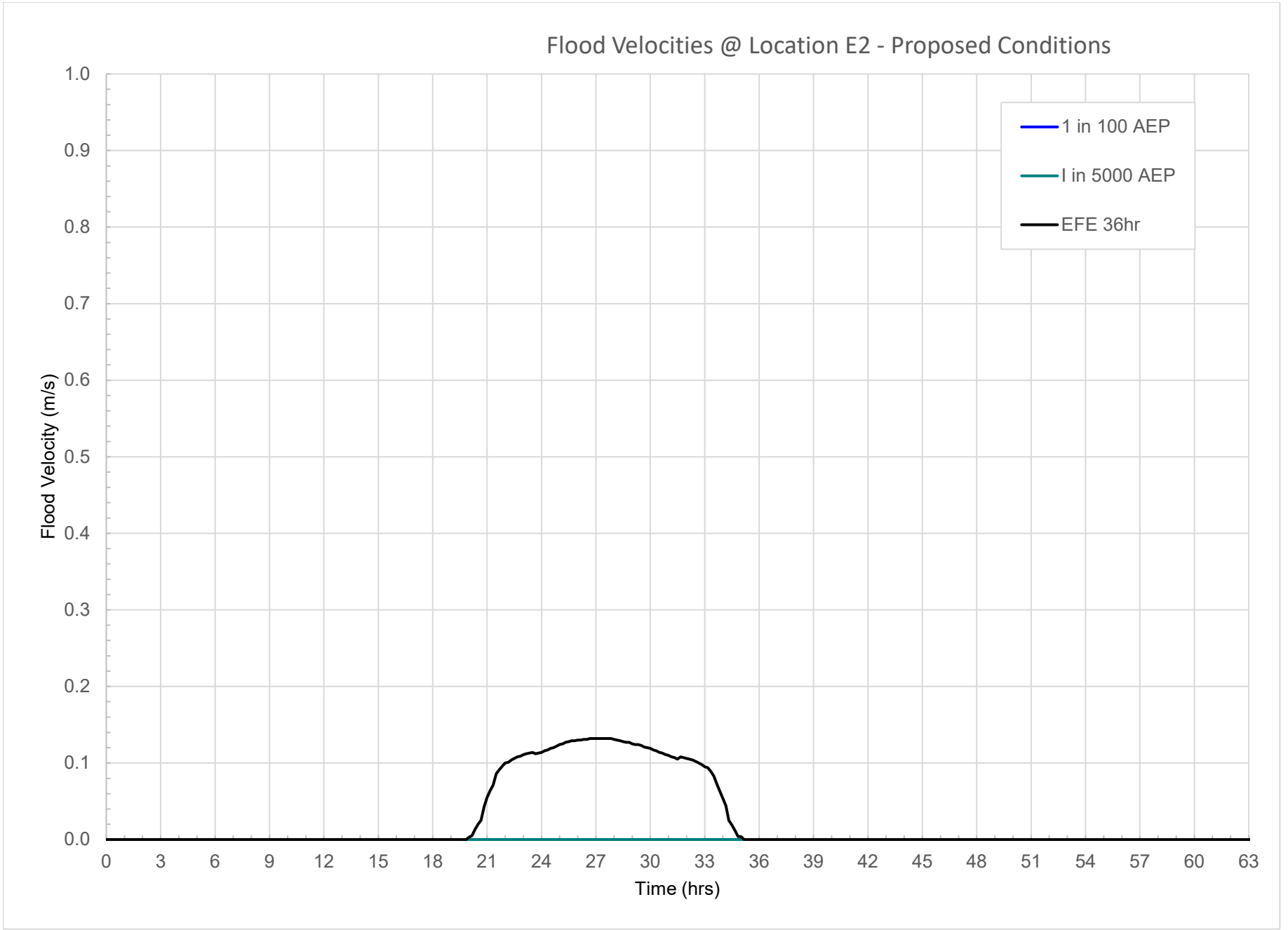
Attachment A1



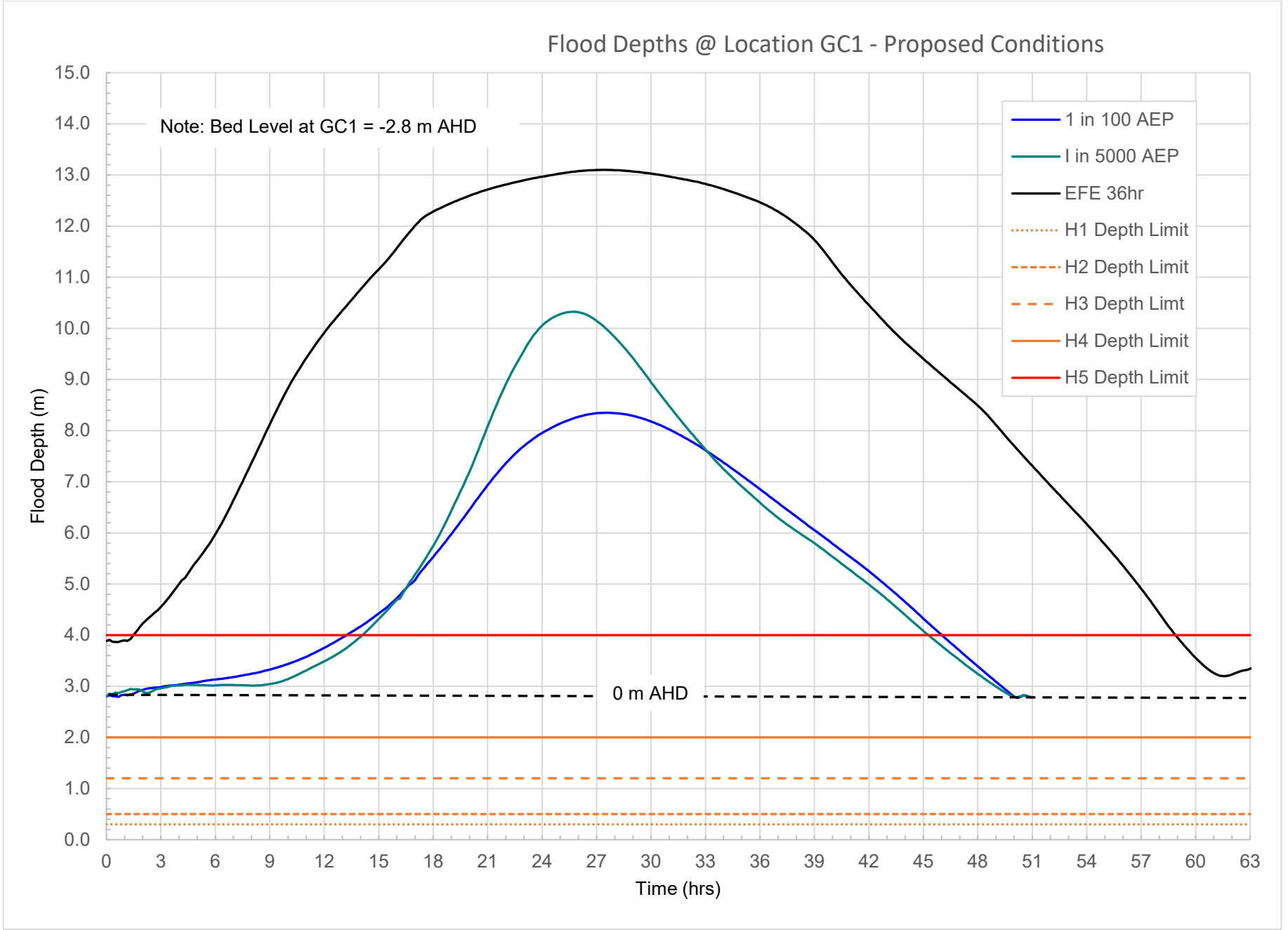

Flood Velocities @ Location E1 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63

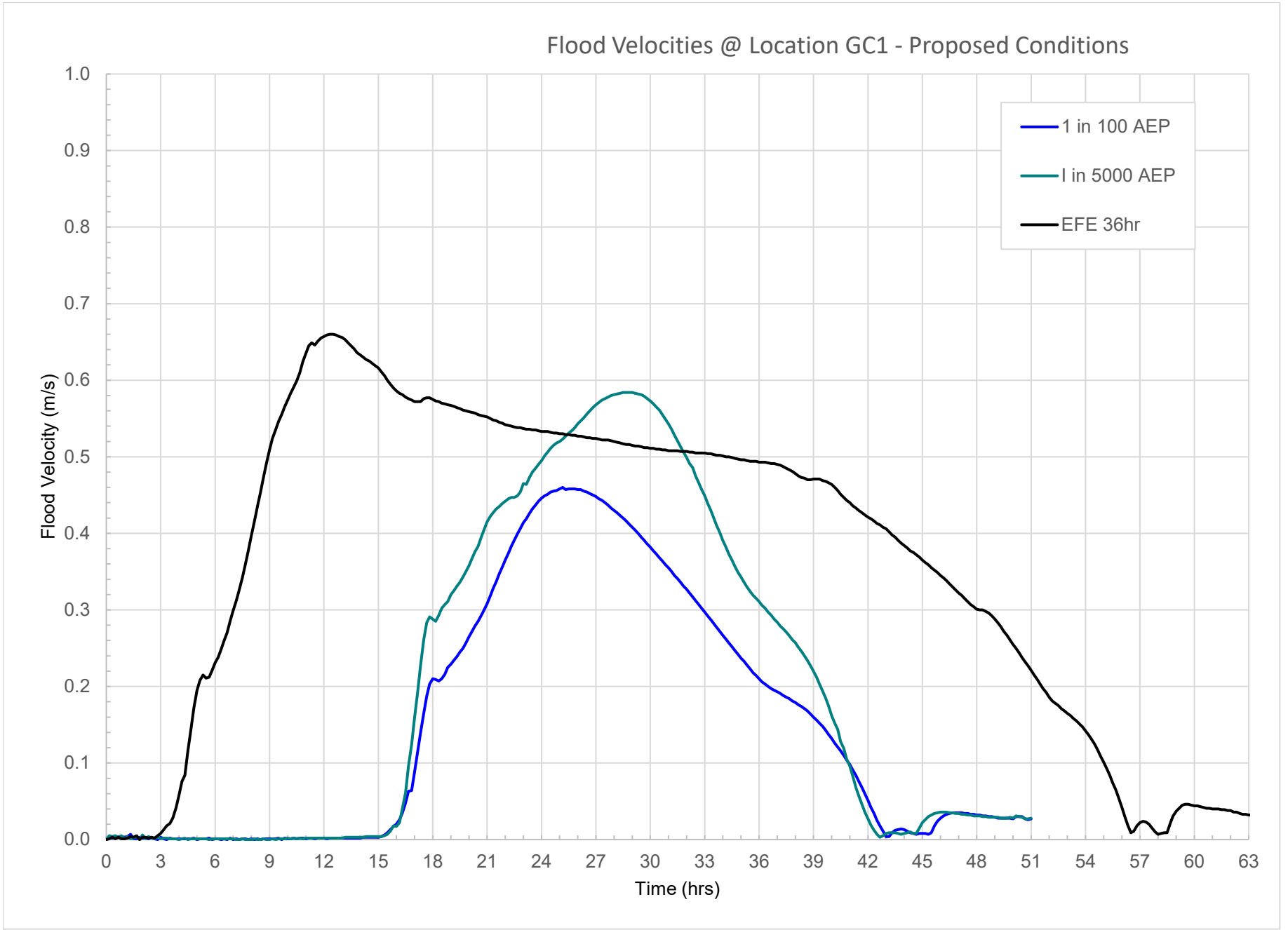
Attachment A2




Flood Velocities @ Location E2 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63
Time (hrs)

Attachment A3




Flood Velocities @ Location GC1 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
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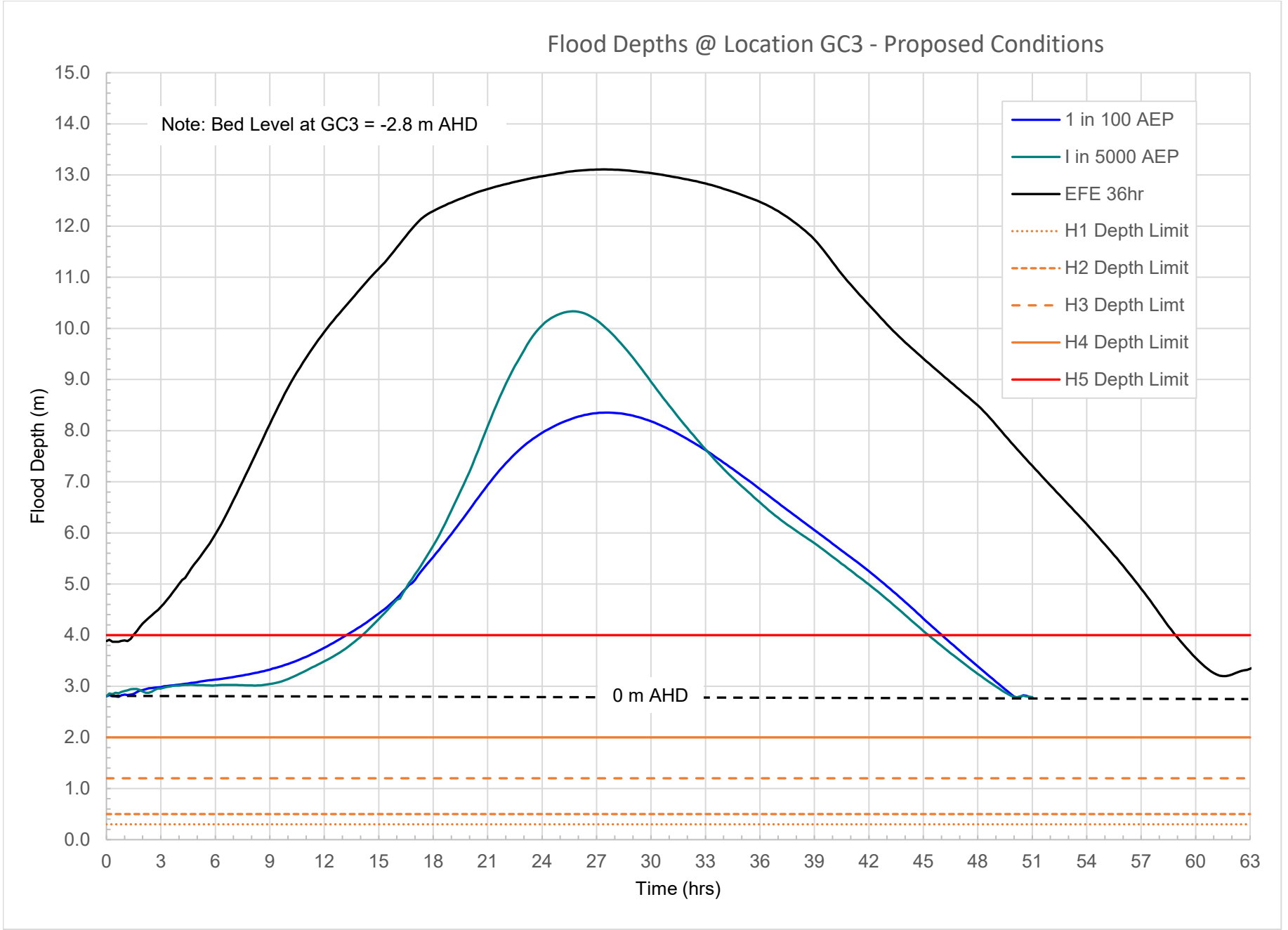
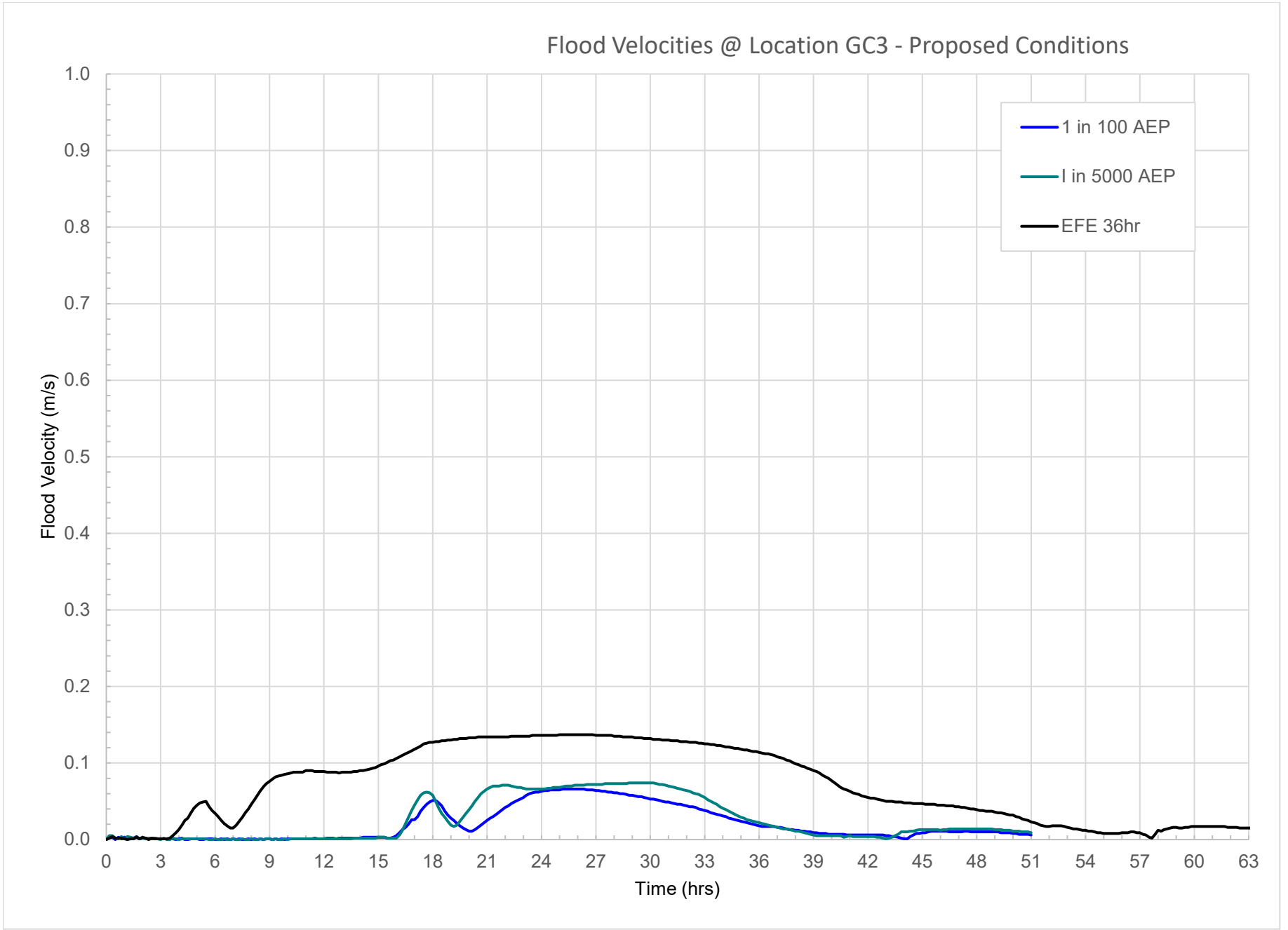
Attachment A4

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I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
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0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
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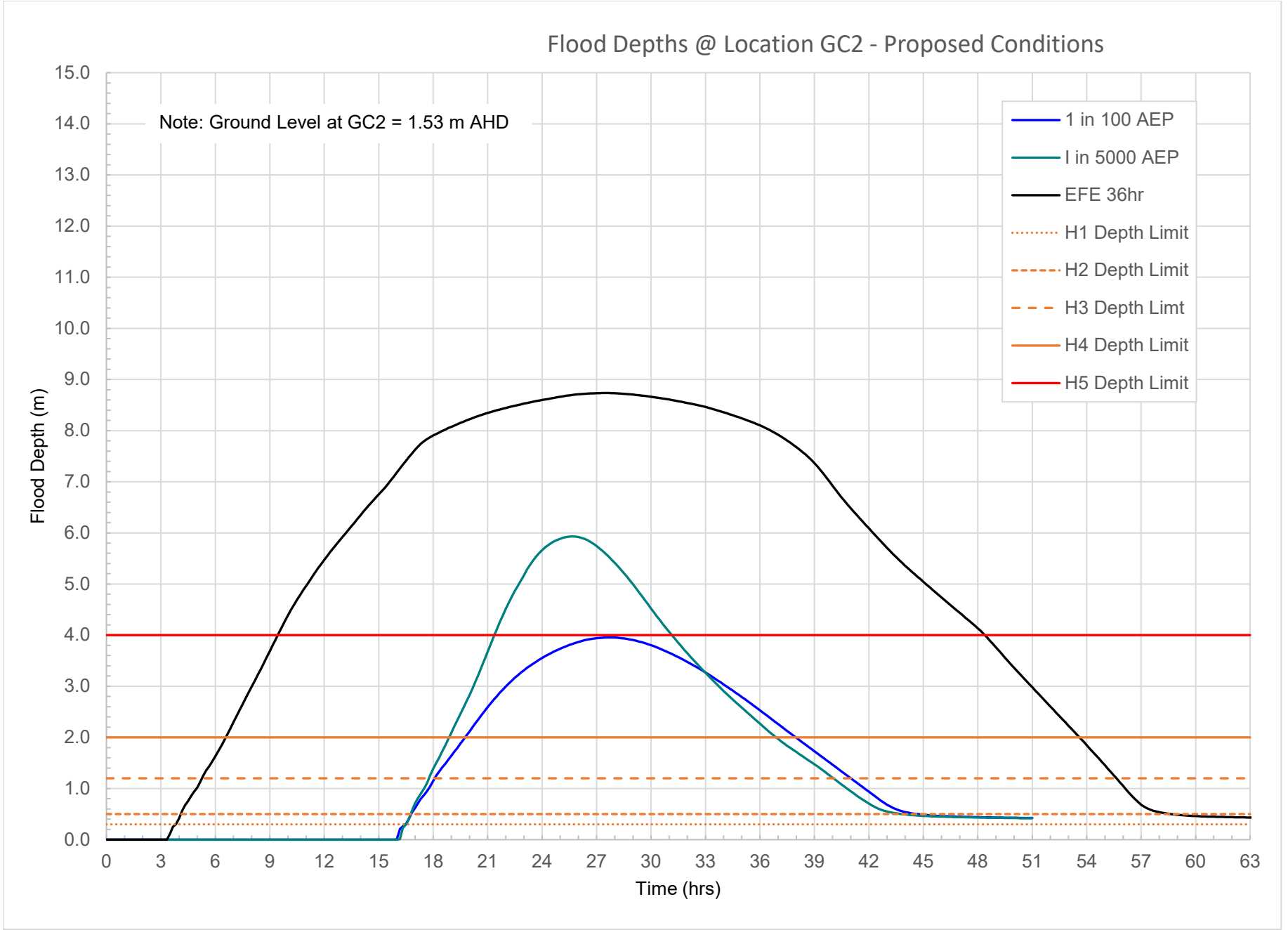
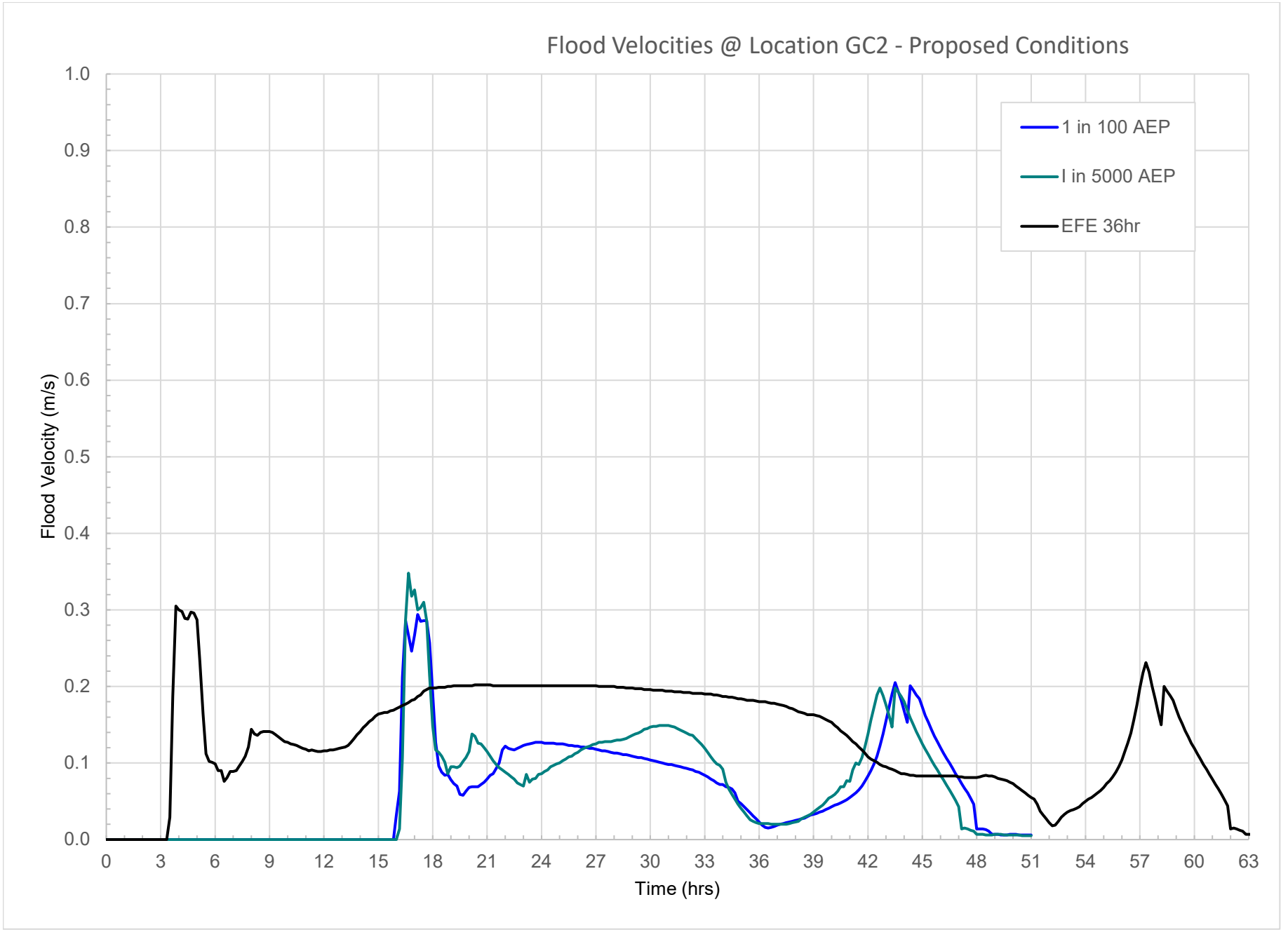
Attachment A5




Flood Velocities @ Location GC2 - Proposed Conditions
1 in 100 AEP
I in 5000 AEP
EFE 36hr
Flood Velocity (m/s)
Time (hrs)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
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