

The Property Group
Level 1
4 Akersten Street
Nelson 7040

Attention: Victoria Woodbridge

Dear Victoria

Gore District Council Proposed Plan Change Industrial Zones - Flooding Assessment

Introduction

Gore District Council (GDC) has engaged Tonkin & Taylor Ltd (T+T) to provide expert evidence for the GDC's Proposed District Plan (PDP). T+T have specifically been engaged to provide expert evidence relating to the Natural Hazards chapter and possible upzoning of areas subject to flooding.

This letter provides initial advice relating to identification of areas potentially at significant risk of flooding within specific 'Industrial' zone areas (the "Zones") of the PDP. This advice was requested by The Property Group (TPG) on 30/4/2024.

This work has been undertaken in accordance with T+T's Letter of Engagement, '*Gore District Council – Proposed District Plan Review*', dated 29 February 2024 and is limited to the following proposed Industrial Zone areas near:

- McNab; and
- South Gore/Charlton.

Flooding information

Our assessment is based on several available information sources, including:

- Proposed District Plan Zones: Spatial data set layer from TPG, dated 13/5/2024.
- Southland Significant Floodplains: Spatial dataset layer from Environment Southland (ES). It is not clear how this layer has been derived but it appears to be broadly based on historical flood observations. https://data-esgis.opendata.arcgis.com/datasets/c87d07751ee84076b874f4b443c56672_7/explore
- ES Environmental Data Hydro Statistics: <https://envdata.es.govt.nz/>
- NIWA New Zealand River Flood Statistics: Regional flood estimation tool which provides peak flood flow estimates for a range of exceedance probabilities. <https://niwa.maps.arcgis.com/apps/webappviewer/index.html?id=933e8f24fe9140f99dfb57173087f27d>
- Digital Elevation Model (DEM): Southland LiDAR 1m DEM (2020 – 2024) sourced from Land Information New Zealand (LINZ).
- Indicative flood extents from T+T national flood model: 2-dimensional rain-on-grid hydraulic model. Model estimates potential flooded areas based on present climate rainfall from

NIWA's HIRDS database and Southlands (2020 – 2024) DEM. The model excludes stopbanks and/or any other hydraulic control structures.

- 1:50k scale New Zealand topographic maps.

Significant risk definition

Our assessment adopts the definition of “Significant Risk” from the Southland Regional Policy Statement (RPS) 2017, which states:

Areas potentially at significant risk include but are not limited to:

- *areas that have flooded to a depth of more than 100 millimetres previously (marine and riverine inundation but excluding urban stormwater inundation in reticulated areas) and for which the likelihood of inundation has not been reduced by flood alleviation works designed to protect the area from floods with a 2% or less annual exceedance probability (AEP);*
- *spillways, secondary flowpaths and ponding areas;*
- *areas immediately downstream of large dams (dams over 3 m in height and more than 20,000m³ in volume);*
- *unprotected areas less than 800 mm higher than land that has been previously been inundated by the sea;*
- *areas in close proximity to the coastline that, on the basis of past trends and/or the erosive effect of projected sea level rise, could erode in the next 100 years;*
- *areas prone to slipping, slumping, landslides, landslide runout, avalanche or rockfalls;*
- *areas subject to multiple hazards, none of which in themselves would constitute a significant risk;*
- *geomorphic floodplains of small watercourses whose flood history is unknown;*
- *alluvial fans and river deltas especially in steep, fast flowing, dynamic watercourses;*
- *areas in close proximity to identified active faults;*
- *land adjacent to lakes and less than one metre higher than the previous highest lake levels*

We have assessed only flooding aspects of the RPS Significant Risk definition that are related to the first bullet point.

We have assumed that water depths within flooded areas (first bullet point above) relate to the 1% Annual Exceedance Probability (AEP) event. This is also consistent with ES opinion on the definition which has been recently discussed with ES. Therefore, the focus of our assessment is flooding from significant watercourses, streams and rivers in the 1% AEP flood event.

We have not undertaken an assessment of other potential flooding sources such as dams, spillways, secondary flowpaths, ponding areas or urban pipe drainage systems.

We have removed indicative flooding extents estimated from T+T's national flood model when the estimated flood depth is less than 100 millimetres as this is the threshold depth above which flooding during a 1% AEP is considered “likely” and not potentially an artefact of inaccuracies in the model (e.g. DEM, rainfall depth and duration, soil type and moisture content, vegetation etc).

It is expected that when the Zones are developed, they will require a drainage and/or overland flow path system to collect and convey stormwater runoff. The design of these systems would typically be undertaken during the consenting and design phase of development.

We have assumed that activities likely to take place in an Industrial Zone do not include Sensitive Activities as per the PDP. In general, we recommend that industrial activities are assessed on a discretionary basis, which considers the intended function of the building/structure, frequency at which any proposed building is predicted to be flooded, the extent of damage likely to occur, whether any mitigation measures are proposed, their effectiveness and environmental effects, and any benefits to the wider area associated with flood management. At a minimum, we recommend that floor levels of industrial buildings are located at or above the 1% AEP flood level to provide a reasonable level of protection. We recommend that other industrial activities and ancillary industrial buildings (e.g. open storage shed) would in most cases not require mitigation provided the activity/building itself does not have a significant adverse effect on flooding.

Flood hazard

Flood hazard refers to the potential danger and adverse impacts associated with flooding, encompassing not just the depth of water but also flow velocity and the resulting effects on human safety, infrastructure, environment, and the economy.

This assessment adopts the Australian Emergency Management Institute (AEMI) Guideline which provides six (H1 to H6 shown below) hazard categories based on the product of flood depth and velocity as shown in Table 1. Further detail regarding the hazard categories is included in Appendix A to this letter.

Table 1: AEMI hazard categories

Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and all vehicles.
H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

Indicative flood hazard has been estimated from the T+T national flood model depth and velocity outputs. The flood hazard maps have been used to inform the feasibility of potential flood mitigation options and assess residual flood risk¹ for zones identified to potentially be at Significant Risk. Flood hazard maps include hazards where depth is less than 100 mm due the nature of how the hazard is calculated in the model.

¹ Residual flood risk is the remaining risk of flooding that persists despite the implementation of flood mitigation measures.

Assessment Summary

Our assessment has been separated into two geographic areas within the Gore District, comprising, South Gore/Charlton and McNab. Figure 1 shows the proposed Industrial Zones considered in this assessment.



Figure 1: Proposed Industrial Zones

Table 2 shows a summary of our assessment. Further assessment summaries of the specific zones are included at Appendix B to this letter.

Table 2: Assessment summary

Area	Flooding issues	Industrial Zones potentially at Significant Risk	Potential mitigation measures or alternative activities
South Gore/Charlton	Potential flood risk from Mataura River & Charlton Stream. Indicative flood depths within eastern areas (adjacent to SH1) of the proposed Industrial Zones are in the order of 1 to 2 m and up to 0.5 m within central and western areas.	Most areas of the proposed Industrial Zones.	Raising building floor &/or ground levels could be feasible for industrial buildings within the proposed Industrial Zones except for eastern areas adjacent to SH1 where expected flood depths are high. Other industrial activities (not including buildings) or ancillary industrial buildings could be suitable within the significant risk area provided they do not have an adverse effect on flooding. A stopbank along the east boundary of the proposed Industrial Zones could be feasible but due to the uncertainty of when it could be constructed, we recommend that it is not relied upon as a mitigation at this time.
McNab	Potential flood risk from the Pukerau Stream. East, south and west areas of the proposed Industrial Zones are likely located within a geomorphic floodplain of the Pukerau Stream. Indicative flood depths within the geomorphic floodplain are in the order of 3 to 5 m.	East, south and west areas of the proposed Industrial Zones.	We recommend that the development of industrial buildings is avoided within the geomorphic floodplain area. Other industrial activities could take place in this area provided they do not have an adverse effect on surrounding flooding. A stopbank along the east, south and west boundary of the proposed Industrial Zones could be feasible but due to the uncertainty of when it could be constructed, we recommend that it is not relied upon as mitigation at this time.

Limitations

Part of our assessment has been informed by T+T's national flood model. The flood levels estimated by the model have not been verified or calibrated to actual historical flood events. The purpose of the model is to provide a high-level indication of broad scale areas that could be flooded or not flooded in a 1% AEP present day climate rainfall event. The model results are not suitable for any other purpose other than stated above. The model is not suitable for design purposes of any form, assessing flooding at a property level scale or assessing potential damage to existing infrastructure. The model does not include stopbanks or other flow control structures which could affect flood depths.

We recommend that our assessment is updated should more detailed flooding modelling become available for the proposed zone areas.

Applicability

This report has been prepared for the exclusive use of our client Gore District Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:



Richard Brunton
Water Resource Engineer

Authorised for Tonkin & Taylor Ltd by:



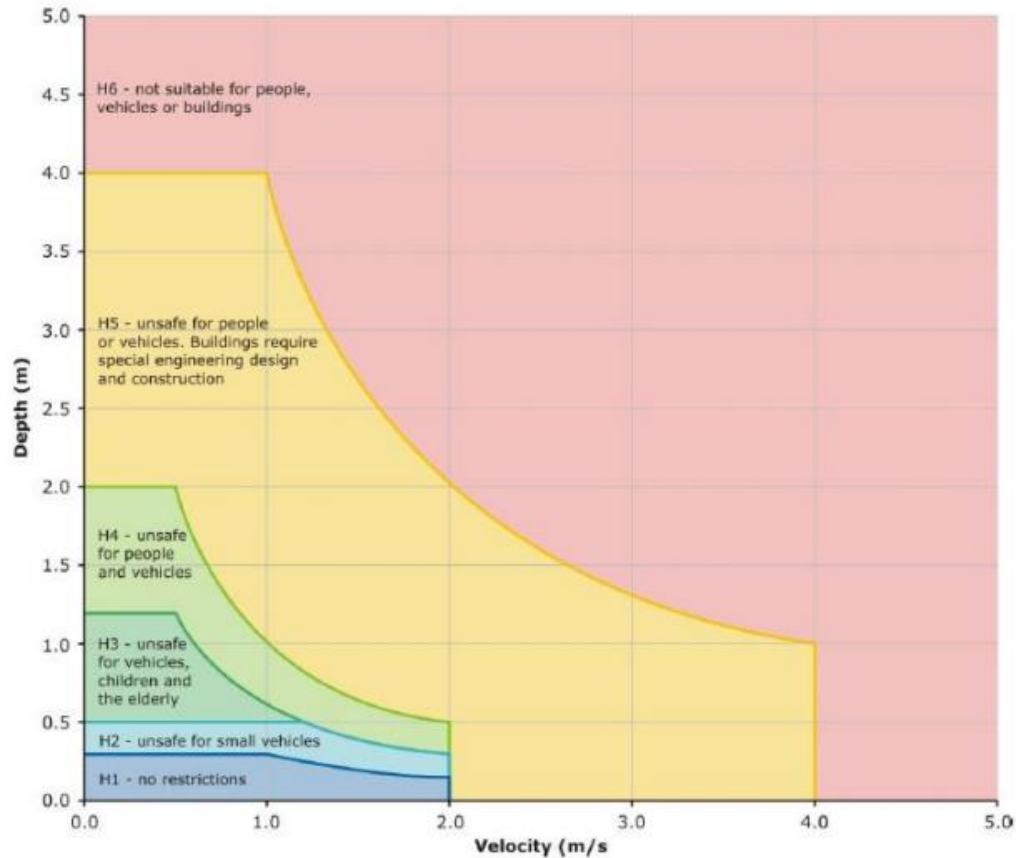
Tim Morris
Project Director

18-Jul-24

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Appendix A AEMI hazard categories

Australian Emergency Management Institute Guideline 2014 – Risk categories.



Hazard Classification	Description
H1	Relatively benign flow conditions. No vulnerability constraints.
H2	Unsafe for small vehicles.
H3	Unsafe for all vehicles, children and the elderly.
H4	Unsafe for all people and all vehicles.
H5	Unsafe for all people and all vehicles. Buildings require special engineering design and construction.
H6	Unconditionally dangerous. Not suitable for any type of development or evacuation access. All building types considered vulnerable to failure.

Appendix B Specific Zone Assessment Summaries

South Gore/Charlton

The Maitura River and Charlton Stream pose potential flooding risk to the South Gore area. The Maitura River flows through the town in the north to south direction. The Maitura River has a catchment area of approximately 4300 km² and ES Hydro Statistics estimates the 1% AEP flood flow at Gore in the order of 2,700 m³/s. The Charlton Stream has a catchment area of approximately 30 km² and NIWA Flood Statistics estimates the 1% AEP flood flow at Gore in the order of 35 m³/s.

The Maitura River has a long history of flooding, most notably the 1978 and 1984 floods which flooded a significant area of the Gore District. After the 1978 floods, the process started to construct a series of stopbanks to protect the district from further floods. In February 2020 a large flood saw Gore's stopbanks tested to near capacity with the largest volume of water to pass under the Gore and Maitura bridges in recorded history.

Figure 2 shows a map of the South Gore area and the proposed Industrial Zones, ES floodplain layers and indicative flood extents from T+T's flood model (which excludes stopbanks).

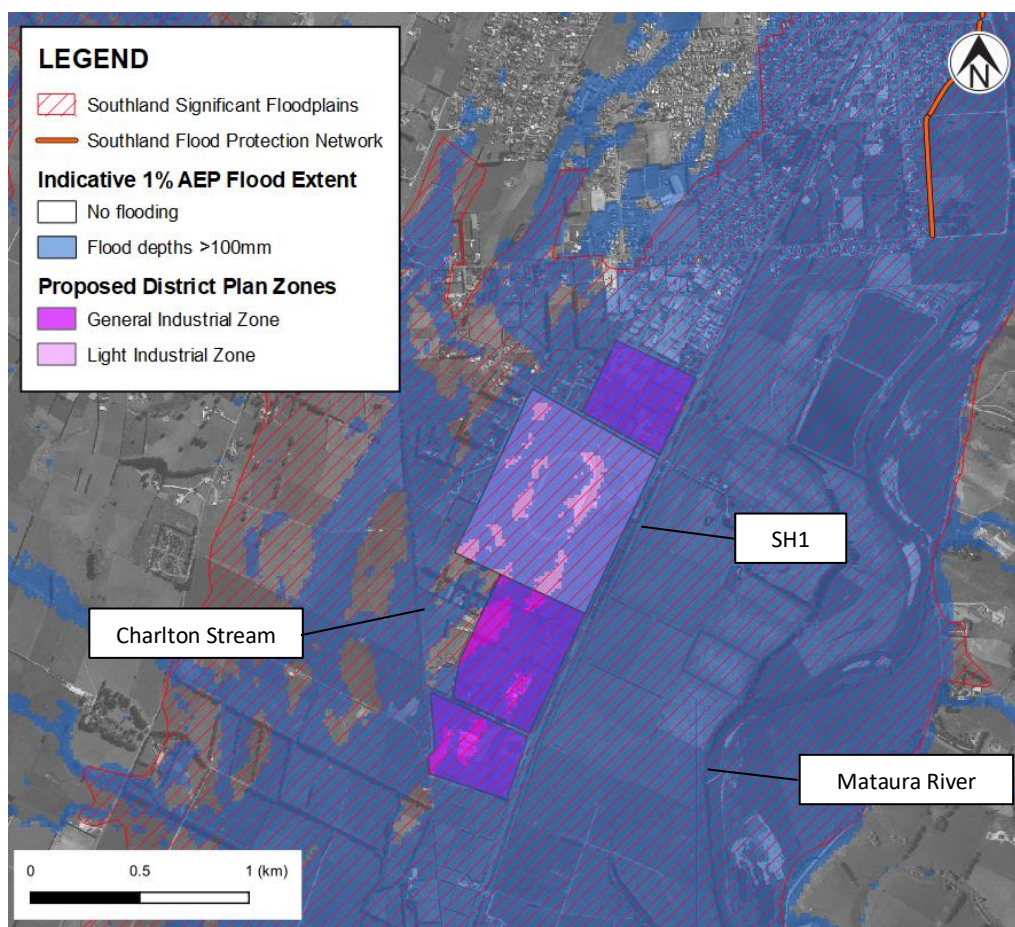


Figure 2: South Gore indicative 1% AEP flood extent

Figure 2 shows that most of the proposed Industrial Zone areas are located within a Significant Floodplain identified by ES and T+T's flood model indicating that the Zones may be flooded in a 1% AEP event, and therefore potentially meet the significant risk definition. The primary source of flooding is likely to be the Maitura River with some contribution from the smaller Charlton Stream.

Indicative flood depths within eastern areas (adjacent to State Highway 1) of the proposed Industrial Zones are in the order of 1 to 2 m and up to 0.5 m within central and western areas. T+T's flood

model does not include stopbanks but given the stopbanks are located some distance upstream, they are unlikely to provide significant protection for the proposed Industrial Zones in a large flood event.

Figure 3 shows a map of the indicative flood hazard in the South Gore area and the proposed Industrial Zones.

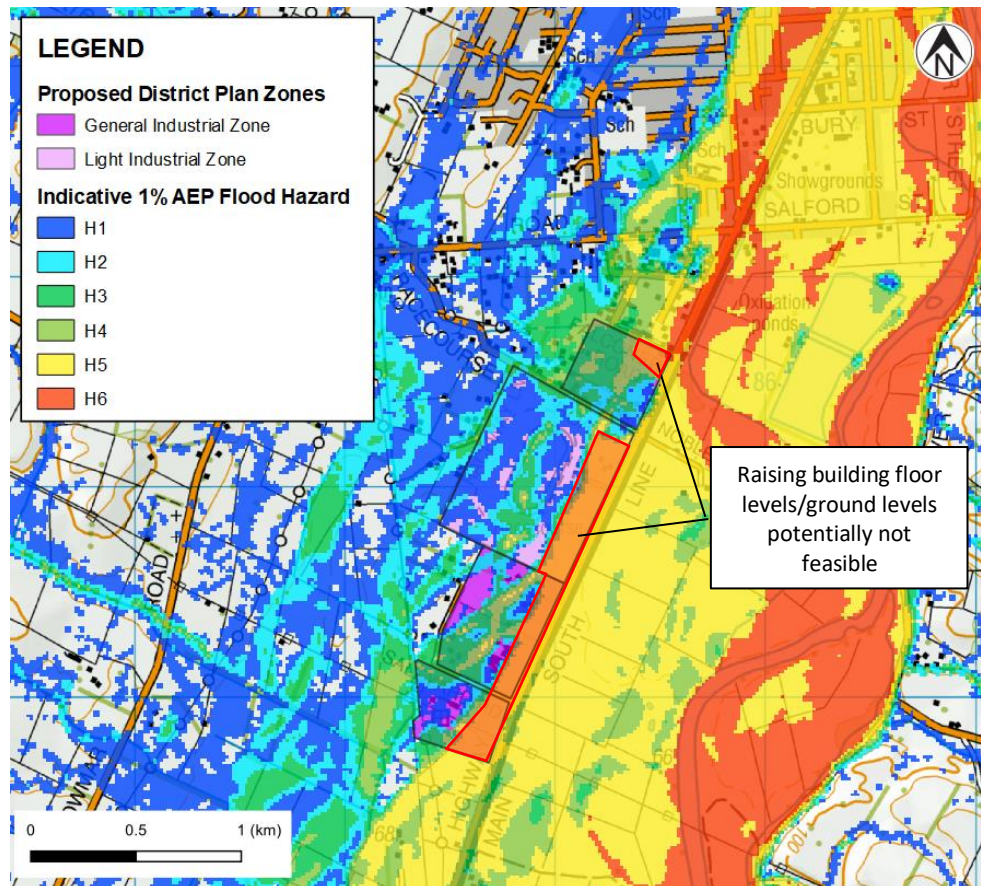


Figure 3: South Gore indicative 1% AEP flood hazard

Figure 3 shows that indicative flood hazards within the eastern side (adjacent to State Highway 1) of the proposed Industrial Zones are in the high range (H5). Flood hazards within remaining areas are in the low to mid range (H1 to H4).

Several mitigation measures were considered for the proposed Industrial Zones at potential significant risk, including raising building floor levels, raising ground levels and stopbanks. Raising building floor levels and/or ground levels could be feasible across most of the proposed Zone areas. However, it may be difficult to raise building floor levels and/or ground levels along the eastern side (High hazard H5 areas as indicated on Figure 3) as the expected flood depths are high (in the order of 1 to 2 m). Other industrial activities could take place in these areas provided they do not have an adverse effect on surrounding flooding.

A stopbank along the eastern boundary of the proposed Industrial Zones could be feasible to protect the proposed Zones from flooding but it would need to be constructed prior to development being undertaken to provide any flood protection. Given the uncertainty in the timing of this, we recommend that a stopbank is not relied upon as mitigation at this time. A stopbank may also affect surrounding flood levels which would need to be assessed.

McNab

The McNab area is located northeast of Gore near the confluence of the Waikaka and Pukearu Streams. The Pukearu Stream downstream of the confluence has a catchment area of approximately 440 km² and NIWA Flood Statistics estimates the 1% AEP flood flow in the order of 340 m³/s.

Figure 4 shows a map of the McNab area and the proposed Industrial Zones, ES floodplain layers and indicative flood extents from T+T's flood model.

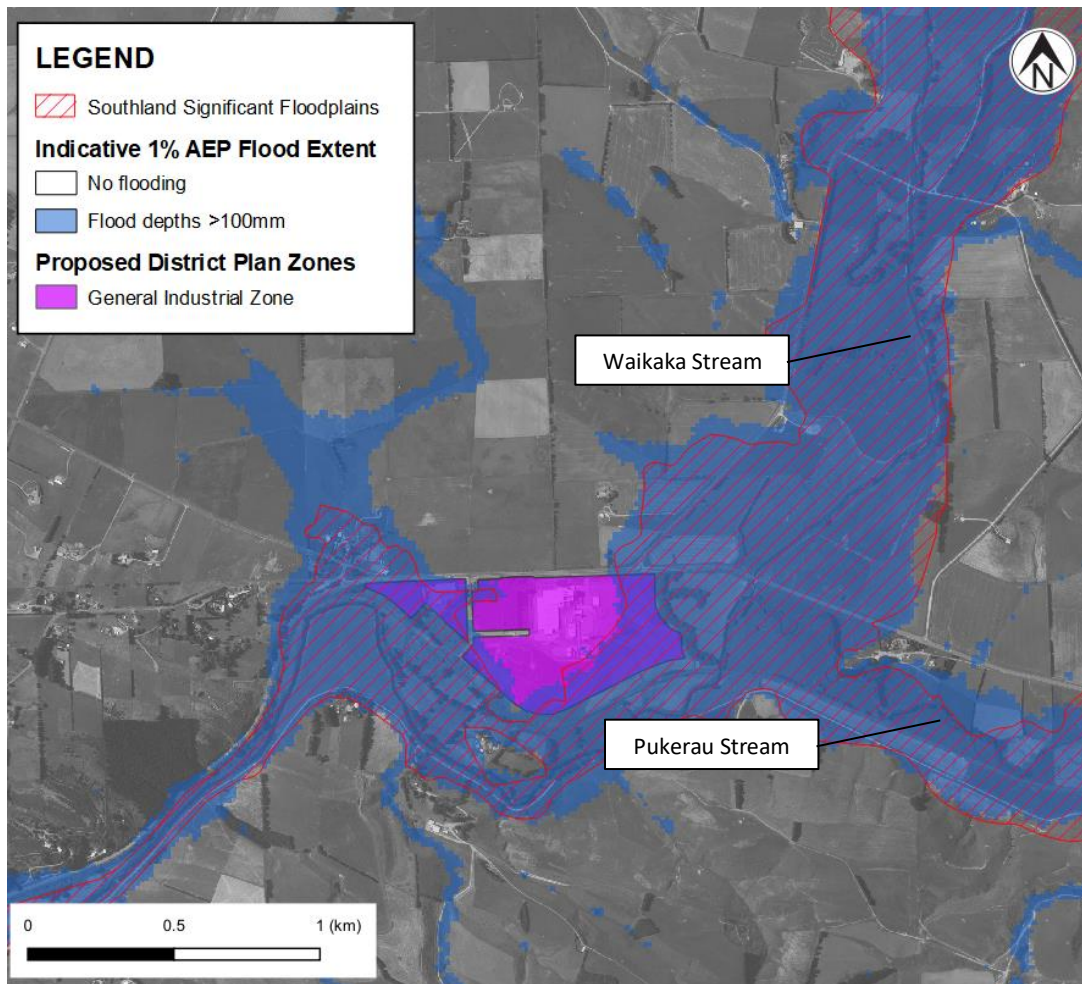


Figure 4: McNab indicative 1% AEP flood extent

Figure 4 shows that some of the proposed Industrial Zones are located within the ES Significant Floodplain and T+T's modelled flood extent indicating that the central portion of the proposed Zones may be flooded in a 1% AEP event, and therefore potentially meet the significant risk definition. Indicative flood depths in the proposed Zones near the Pukearu Stream are in the order of 3 to 5 m.

Topographic information indicates that the east, south and west areas of the proposed Industrial Zones are located within a geomorphic floodplain area of the Pukearu Stream. This aligns with the indicative flood extent shown in Figure 4.

Figure 5 shows a map of the indicative flood hazard in the McNab area and the proposed Industrial Zones.

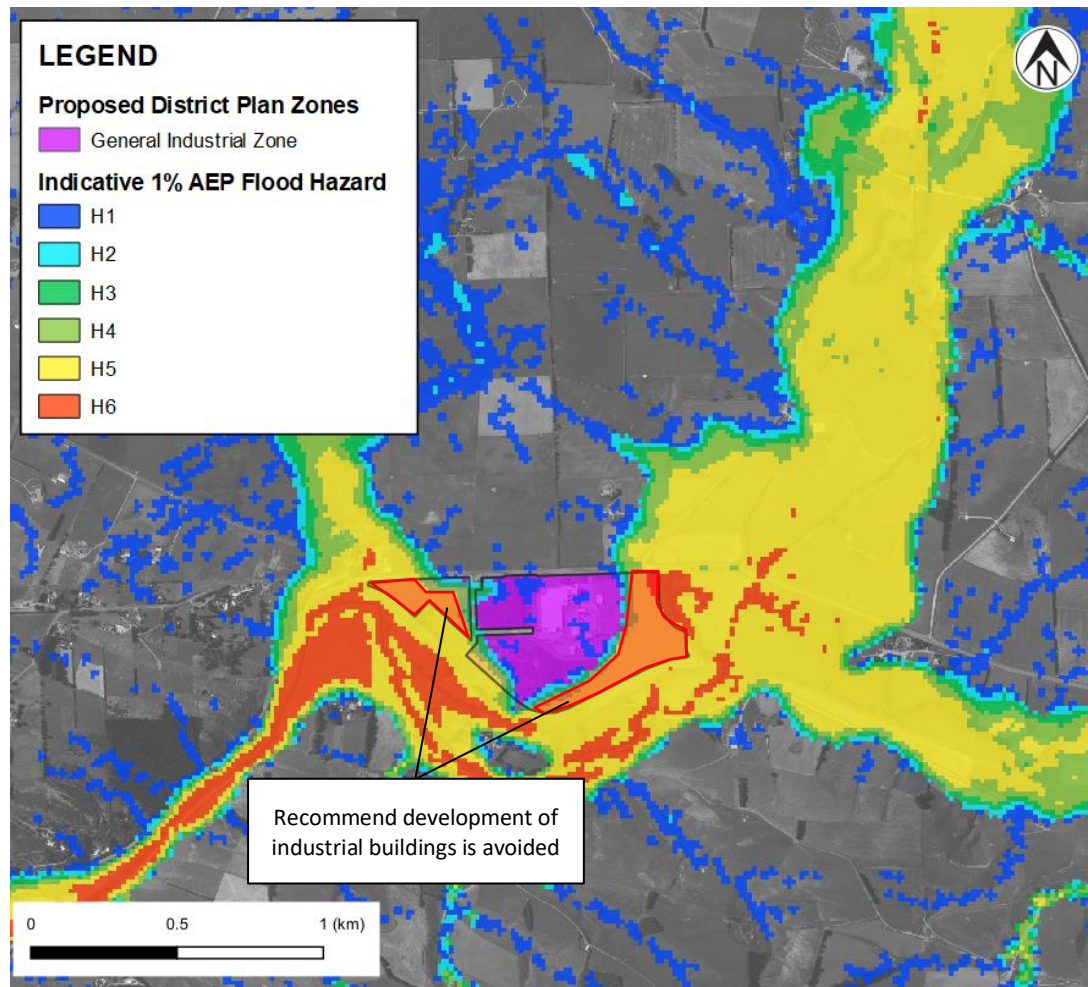


Figure 5: McNab indicative 1% AEP flood hazard

Figure 5 shows that indicative flood hazards within the proposed Industrial Zones located in the geomorphic floodplain area are generally in the high range (H5).

Several mitigation measures were considered for the proposed Industrial Zones at potential significant risk, including raising building floor levels, raising ground levels and stopbanks. Raising building floor levels and/or ground levels within the geomorphic floodplain area (high hazard areas H5) is potentially unfeasible given the depth of flooding is high (in the order of 3 to 5 m). In these areas, we recommend that the development of industrial buildings is avoided (as indicated on Figure 5). Other industrial activities could take place provided they do not have an adverse effect on surrounding flooding.

A stopbank along the east, south and west boundary of the proposed Industrial Zones could be feasible, but it would need to be constructed prior to development being undertaken to provide any flood protection. Given the uncertainty in the timing of this, we recommend that a stopbank is not relied upon as mitigation at this time. A stopbank may also affect surrounding flood levels which would need to be assessed.