Environment Canterbury Regional Council
Kaunihera Taiao ki Waitaha

Customer Services
P. 03 353 9007 or 0800 324 636

PO Box 345
Christchurch 8140

P. 03 365 3828
F. 03 365 3194
E. ecinfo@ecan.govt.nz

www.ecan.govt.nz

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Philip Morton
phil@gilberthaymes.co.nz

Dear Phil

FLOOD HAZARD ASSESSMENT – LOT 1 DP 10540, 849 SH1, KAIKOURA

The property is adjacent to the southern banks of the Hāpuku River, near the Puhi Puhi River confluence and on the Hāpuku River floodplain (see Location map). It is potentially susceptible to flooding from the Hāpuku River during large flood events.

Hāpuku River

The 130 km^2 Hāpuku catchment drains the Seaward Kaikoura Range to the coast via the Hāpuku River, and the large Puhi Puhi River tributary which enters the Hāpuku River upstream of the SH1 road bridge. In major flood events, the steep and braided Hāpuku and Puhi Puhi rivers transport large quantities of gravel. Consequently, a change in the Hāpuku River course (to follow previously abandoned river channels on the floodplain) is quite possible. This has occurred historically to form the Hāpuku River floodplain.

River control works on the Hāpuku River include stopbanks, echelon (flow return) banks and vegetated berm areas. However, the dynamic nature of the Hāpuku River means the works are only designed to provide 'protection' from floods with an Average Recurrence Interval (ARI) of up to around 20 years. In larger events these works are likely to be overwhelmed, with aggradation further increasing the likelihood of flows onto the floodplain. Vegetated berm areas, forming part of the river control works, run along the northern boundary of the property, and include the northernmost portion of the property closest to SH1.

LiDAR and computational modelling

In 2012 and 2016/17 LiDAR (Light Detection and Ranging) data was acquired for the Kaikoura area. This LiDAR data was collected using a scanner mounted on an aircraft that measures the ground level at approximately one point every square metre, enabling high resolution digital elevation maps to be generated (see LiDAR map for 2017 land elevations).

LiDAR data for the property (see LiDAR map) indicate that the southern portion of the property is on a more elevated terrace. Geomorphic and flood hazard mapping indicates that this elevated terrace has the lowest risk of future flood damage.

LiDAR data has also enabled detailed flood modelling to be undertaken. A computational hydraulic model of the Hāpuku River is summarised in an Environment Canterbury Technical Report (Kekerengu, Hāpuku and Oaro floodplain investigation, Report No. R19/04, January 2019) that is available online (https://www.ecan.govt.nz/data/document-library/?Search=PU1C%2F8569).

This report indicates that a 500 year ARI flood flow (incorporating climate change to 2120) in the Hāpuku River should be reasonably well contained by the existing fairway and adjacent floodplain, and flood water should not reach the property. However, it also states …

Our Ref: 23460
Contact: Michelle Wild

"Given that the models used in this study have fixed beds, it is not possible to determine all possible 500 year ARI flood scenarios – particularly now that there is a considerable supply of additional sediment being stored in the upper catchment of these rivers due to the 2016 Kaikōura earthquake sequence. Climate change and sea level rise may also have an impact on rivers and their outlets to the sea. Care should therefore be taken when interpreting these model results.'

The large volume of Hāpuku landslide material entering the Hāpuku River system post-2016 Kaikoura Earthquake Sequence could potentially cause the bed levels in the Hāpuku River to rise, and consequently increase flood levels.

As scour, erosion, aggradation, and avulsion (movement of the main river channels) are not included in the fixed bed model, it is not possible to properly determine the likelihood of a river avulsion and floodwater being diverted towards the property for a 500 year ARI flood event based on this model.

Floor level
The property is within the Kaikoura District Plan 'Non-Urban Flood Assessment Overlay'. Constructing a new dwelling within this overlay is a permitted activity under the district plan if it is located on land outside of High Flood Hazard Areas and has a finished floor level that is at least 300 mm above the 500 year ARI flood level. High Flood Hazard Areas are defined as areas where the water depth (m) x velocity (m/s) is greater than or equal to 1 or where depths are greater than 1 m in a 500 year ARI flood event.

Based on the modelling, previous geomorphic/flood hazard mapping, and LiDAR data:

- the elevated southern terrace on the property is likely to be outside the High Flood Hazard Area. Any future dwelling located on this elevated terrace should be constructed outside of any depressions and swales and meet the NZ Building Code standard. A setback of at least 15 m from the terrace edge is also recommended.

- The area below the elevated southern terrace is more susceptible to flood inundation. The likelihood of flood inundation, and whether this area should be considered a High Flood Hazard Area, is currently unknown due to the considerable uncertainty regarding the Hāpuku landslide material travelling along the river system. This landslide material is likely to exacerbate channel aggradation, channel avulsion (movement of the main river channel location) and floodplain scour/erosion in the Hāpuku River. It is therefore recommended that a geomorphic assessment be undertaken for any proposed dwelling located on this less elevated area of the property.

Any additional increase in height that the floor is built to will provide additional protection against extreme flood and aggradation events.

When using the information provided in this letter, it is important that the following points are understood:

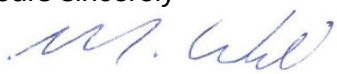
- The information is limited to what Environment Canterbury currently has available. The District Council or local residents may have further information about flooding at the property.
- Environment Canterbury's understanding of flooding at the property may change in the future as further investigations are carried out and new information becomes available.
- It is assumed that any flood protection works will be maintained to at least their current standard in the future.
- Stopbank failure can occur at flows less than the design standard, and the location of bank failure/overtopping may affect flood depths at the property.
- Flood depths can also be affected by changes to the bed levels in the water courses (e.g. aggradation or scour), floodplain topography (e.g. roads, earthworks, aggradation or scour),

structures on the floodplain (e.g. fences, buildings, culverts), vegetation (e.g. hedges, crops), and antecedent soil conditions.

The prediction of flood depths requires many assumptions and is not an exact science.

If you have any concerns or questions please contact me.

Yours sincerely



Michelle Wild
SENIOR SCIENTIST (Flooding)

Cc: Kaikoura District Council

Encl: Location map
LiDAR (ground level) map

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