Otago Regional Council

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MEMORANDUM

To: **Warren Hanley, Resource Planner - Liaison**

From: **Jean-Luc Payan, Manager Natural Hazards**

Date: **14/07/2016**

Re: **Hazards evidence La & RJ Prattley LUC-2016-110**

This memorandum provides a summary of technical hazards information that the Otago Regional Council (ORC) holds with respect to land use consent application LUC 2016-110.

Flood hazard

1. Figure 1 shows the topography in the vicinity of the proposed development site.
2. Coloured dots on this elevation map depict surveyed flood depths based on debris marks left on fences, power-poles etc. after the June 2015 flood event (ORC, 2015).
3. The red arrow shows the location of the property (38 Richmond Street) with respect to flood depths, which range from 10 cm to 30 cm in the local area.
4. In addition to observed surface flooding, the groundwater in the local area has an average level only ~40 cm below the ground surface (Figure 2).
5. During the June 2015 flood event, the groundwater level rose sharply by as much as 70 cm at groundwater level recorders at Tonga and Bathgate parks (ORC, 2015).
6. The lack of natural drainage in the South Dunedin area during heavy rainfall events has been analysed in a report that will be presented at the ORC Technical Committee on the 20/07/2016.
7. The report explores the natural hazards in South Dunedin, especially with respect to groundwater levels and flooding (ORC, 2016).

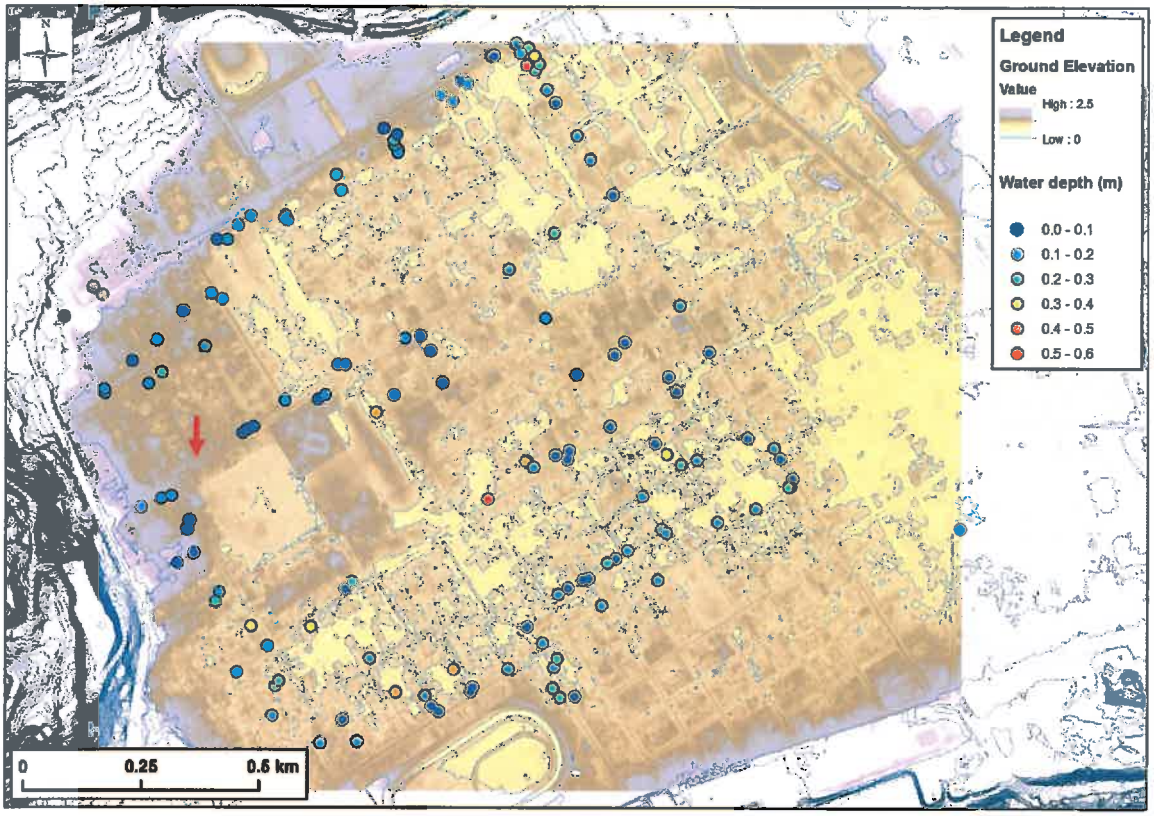

Figure 1. Map of South Dunedin flat area, showing the maximum depth of above-ground surface ponding during the June 2015 flood. Depths calculated by determining the difference between the elevation of the surveyed debris marks and the underlying ground level at that location. Elevation colour scale shows ground elevation between 0 and 2.5 m above MSL, contour interval is 1 m (ORC, 2015). Red arrow shows location of 38 Richmond Street.

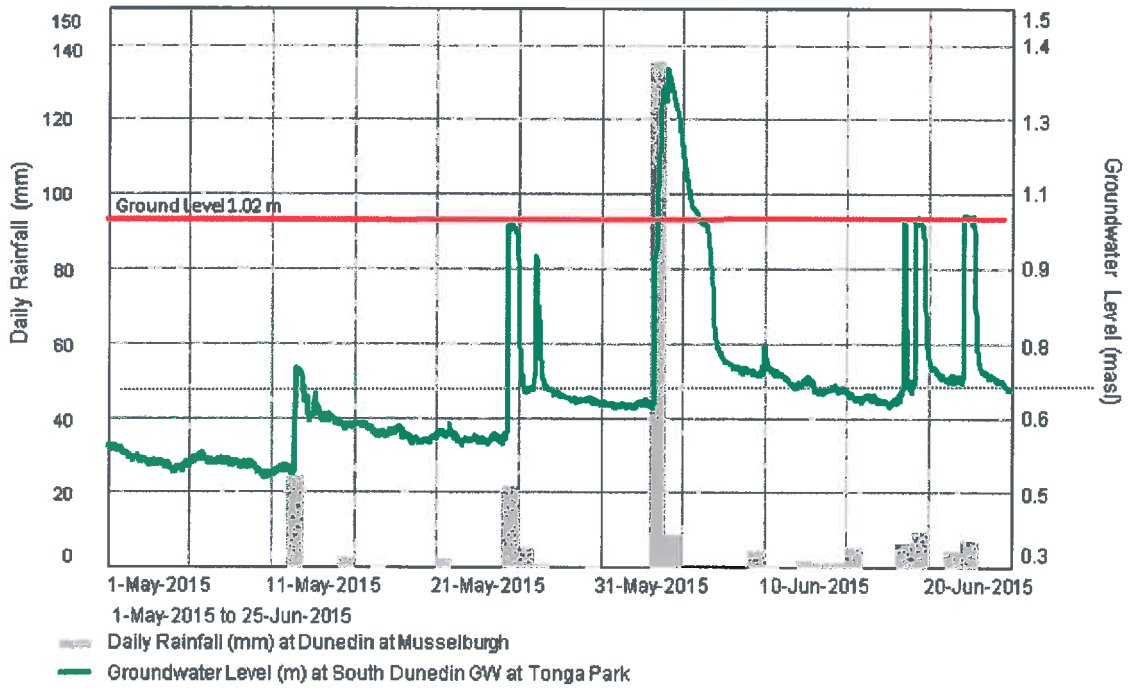

Figure 2. Tonga Park continuous groundwater record from 1 May to 25 June, 2015. Ground level is 1.02 metres above sea level, dashed black line shows average groundwater level, ~40 cm below the ground surface (after ORC, 2015).

8. The consequence of a high groundwater table and large catchment area with no natural drainage is regular flooding.

9. As groundwater level is connected to sea level and tends to rise with the sea, for example during storm events and high tides, the natural flow of water that infiltrates the ground during a heavy rainfall event will become slower and more difficult as sea level rises in coming decades (ORC, 2016).

10. There is a tendency for water to pond when the South Dunedin aquifer is at capacity, as was seen in the June 2015 flood event (Figure 3).

11. High tides (which are usually higher than normal during low-pressure storm events) delay gravity drainage of this water to the sea, whether via the stormwater system, or through the South Dunedin aquifer (ORC, 2012a).

12. Without the assistance of stormwater pumping, and the associated lowering of the water table by the Musselburgh and Tainui pumping stations this ponded water would take several days to naturally drain away.

13. It is important to note that the 3 June 2015 event was not an unusually heavy rainfall event, and similar events may be expected to occur on a regular basis into the future.

14. The Forbury area, where Richmond Street is located, naturally has a high water table that is sensitive to large volumes of runoff from the nearby hill catchments.

15. The stormwater system, even when working at full capacity, cannot be expected to remove all the runoff from the area (ORC, 2016). Groundwater data clearly show a sharp response to rainfall events, and a slow decay back to regular levels (e.g. Figure 2).

16. Because of higher rainfall, groundwater levels are naturally higher overall throughout the winter, and are typically within a few tens of centimetres beneath the ground surface.

17. As sea-level rises, groundwater is expected to rise and this will result in the difference between the water table and land surface throughout South Dunedin getting smaller. More properties may be put at risk of regular groundwater flooding and in some cases, permanent ponding (ORC, 2012a; 2016).

Figure 3. Annotated aerial photograph showing flooding in relation to 38 Richmond Street. Photo was not necessarily taken during peak of flooding. Source, Otago Daily Times.

Liquefaction hazard

18. ORC has carried out investigations into the susceptibility of different soil types around Otago to liquefaction (Barrell et al., 2014).

19. Figure 4 shows how all of the South Dunedin flat area (including 38 Richmond Street) falls within Domain C. Within Domain C there is a moderate to high likelihood of liquefaction-susceptible materials being present (i.e. poorly consolidated marine and estuarine sediment such as silts and sands, with a high water table).

20. When considered in conjunction with South Dunedin's origins as an estuarine/wetland environment, reclaimed through the addition of sand to raise the level of building foundations, this is an appropriate classification (ORC, 2016).

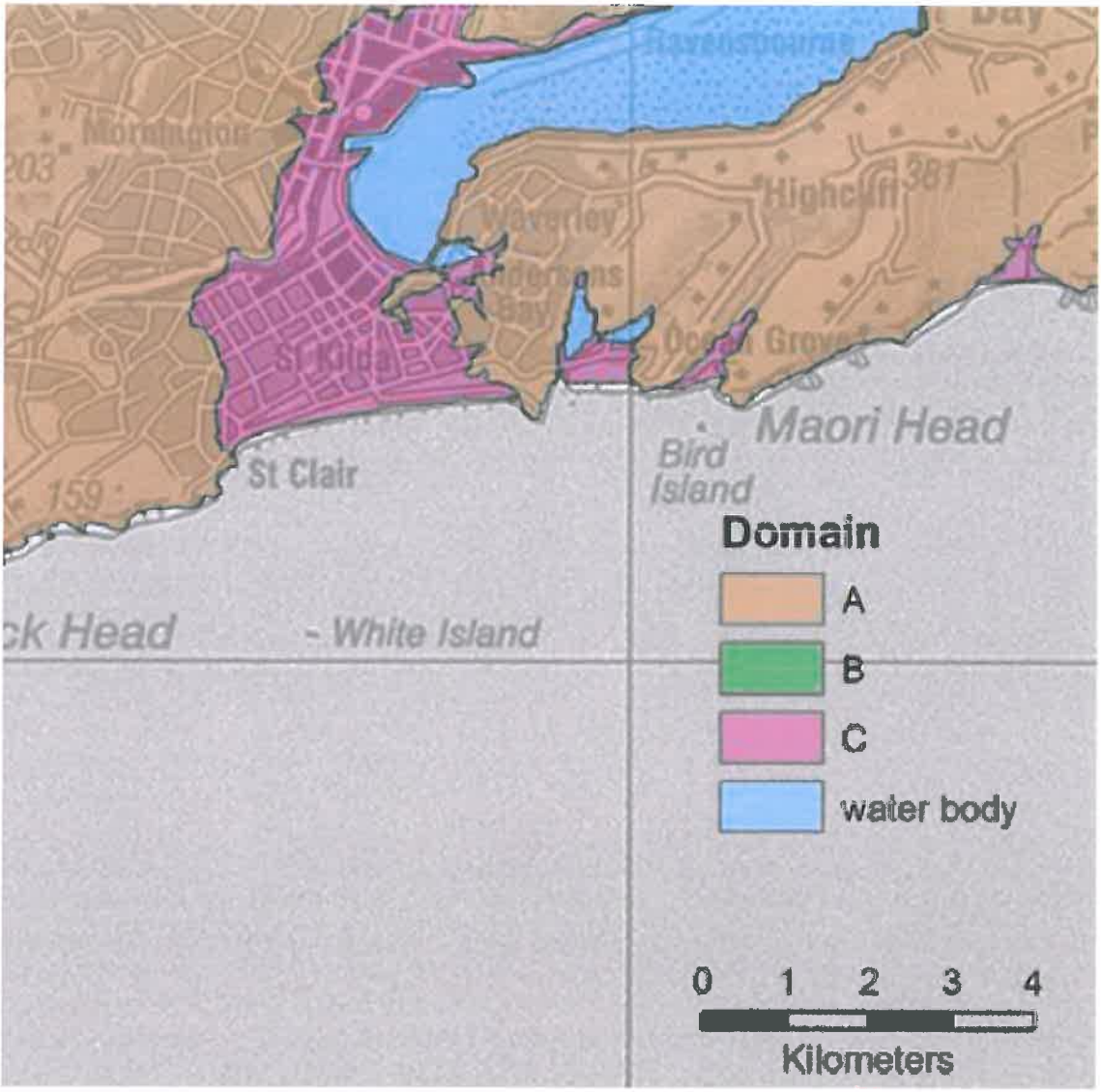

Figure 4. Liquefaction susceptibility in South Dunedin from Barrell et al. (2014).

Tsunami and elevated sea level events

21. The area in the vicinity of Richmond Street has been assessed by ORC as less likely to be directly affected by inundation from tsunami and elevated sea level events (e.g. storm surge) than parts of South Dunedin closer to the coast (ORC, 2012b). This is because any waves that breach coastal defences have more horizontal distance for energy to dissipate than areas closer to the coast.

Summary

22. The area in the vicinity of the proposed development site is likely to experience significant inundation, based on groundwater data that shows response to rainfall. Photographs showing the Richmond Street area from the June 2015 flood event corroborate these findings.

23. In the coming decades it is expected that sea level rise and associated groundwater rise will cause groundwater ponding, both naturally during the winter months and especially during heavy rainfall events.

24. The South Dunedin area is categorised as possibly highly susceptible to liquefaction, and this needs to be explored further.

Jean-Luc Payan

Manager Natural Hazards

References:

Barrell, D., Glassey, P., Cox, S., Smith Lyttle, B. *Assessment of liquefaction hazards in the Dunedin City district,* GNS Science Consultancy Report 2014/068

Otago Regional Council (2012a) *The South Dunedin Coastal Aquifer and Effect of Sea Level Fluctuations,* Otago Regional Council Publication.

Otago Regional Council (2012b) *Community vulnerability to elevated sea level and coastal tsunami events in Otago,* Otago Regional Council Publication

Otago Regional Council (2015) *The Coastal Otago flood event 3 June 2015,* Otago Regional Council Publication.

Otago Regional Council (2016) *South Dunedin's natural hazards,* Otago Regional Council committee report, July 2016.