

4. Inundation results

The results from the modelling of inundation from potential tsunamigenic sources are discussed in the subsections below. Results from all three scenarios (the South American and the two Tonga-Kermadec subduction zone sources) are presented. The largest tsunamis for the Whangarei Harbour region generally occurred in response to the South American scenario.

4.1. Model outputs

Maximum water depth and maximum water speed for tsunami from each source and each sea level scenario are presented in maps (Figures 4-6), and firstly for the whole Whangarei Harbour region, then for 6 specific locations (Marsden Bay, Takahiwai, Oakleigh, Otaika, Whangarei, and Bream Head) as shown in Figure 4. These results are also provided in ASCII and ArcGIS shapefile formats. Arrival times for the first wave and the times of maximum water level for tsunami from each source are discussed in Section 4.10.

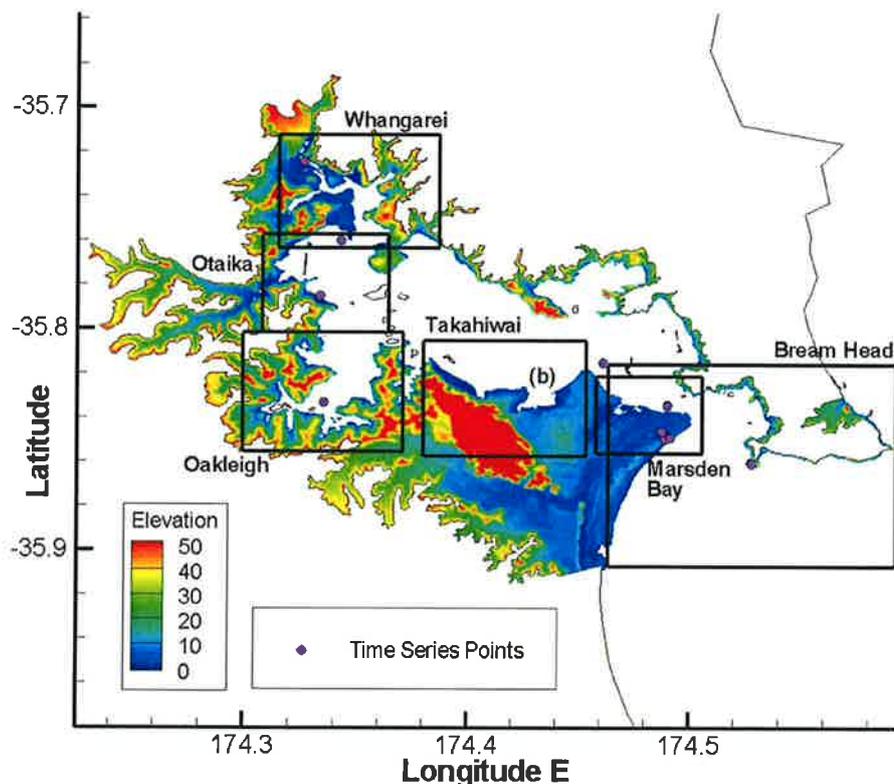


Figure 4: Land area elevations (m above MSL) for areas in Whangarei Harbour included in inundation modelling, showing the six named sub-areas mapped in more detail. Locations for time series inundations and points of interest (Bercich Drain and Hatea – Town Basin) are shown by purple dots.

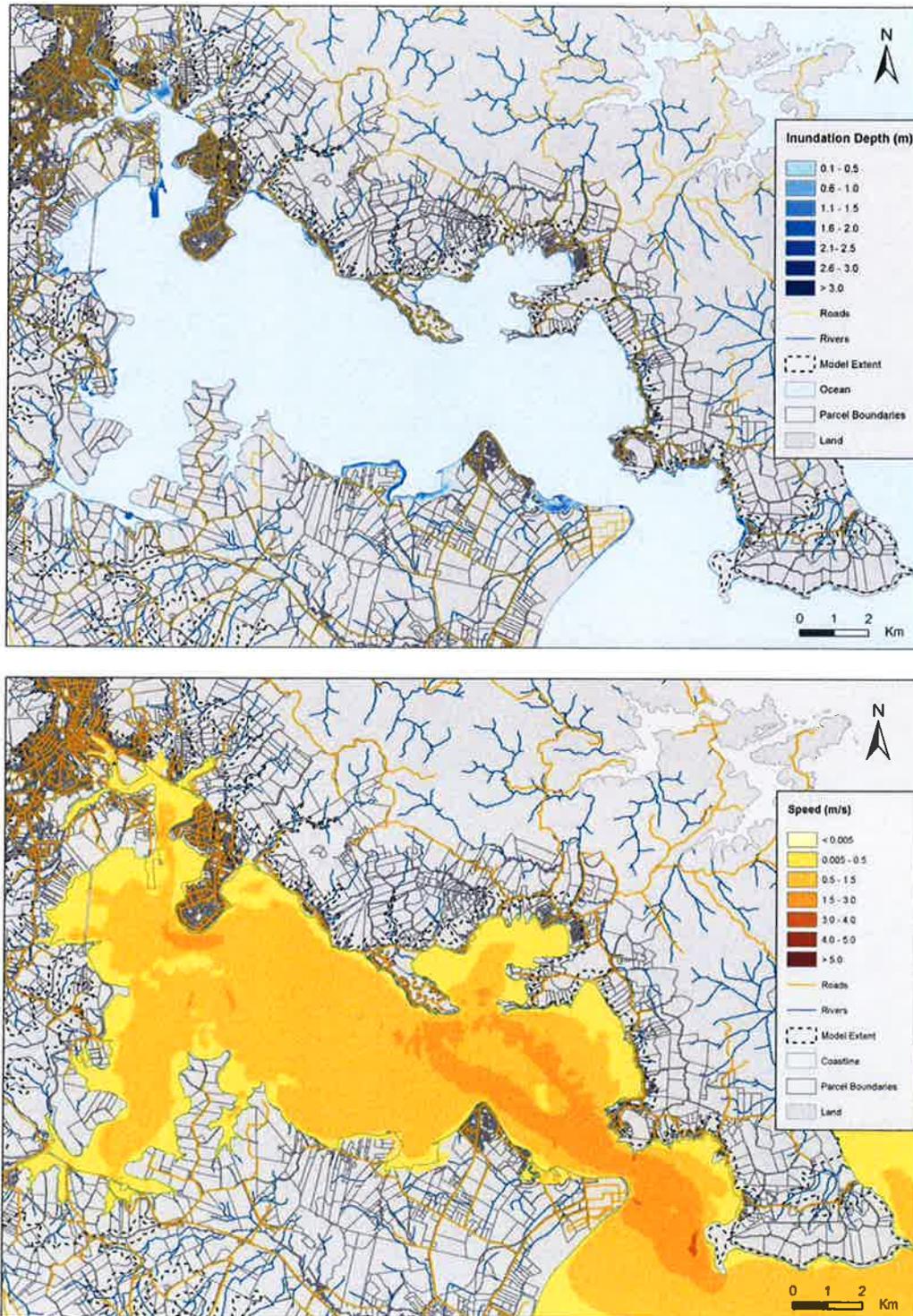


Figure 5: Harbour overview: Maximum inundation depth (upper) and speed (lower) plots for the South American tsunami scenario at MHWS (to extent of LIDAR) for Whangarei Harbour.

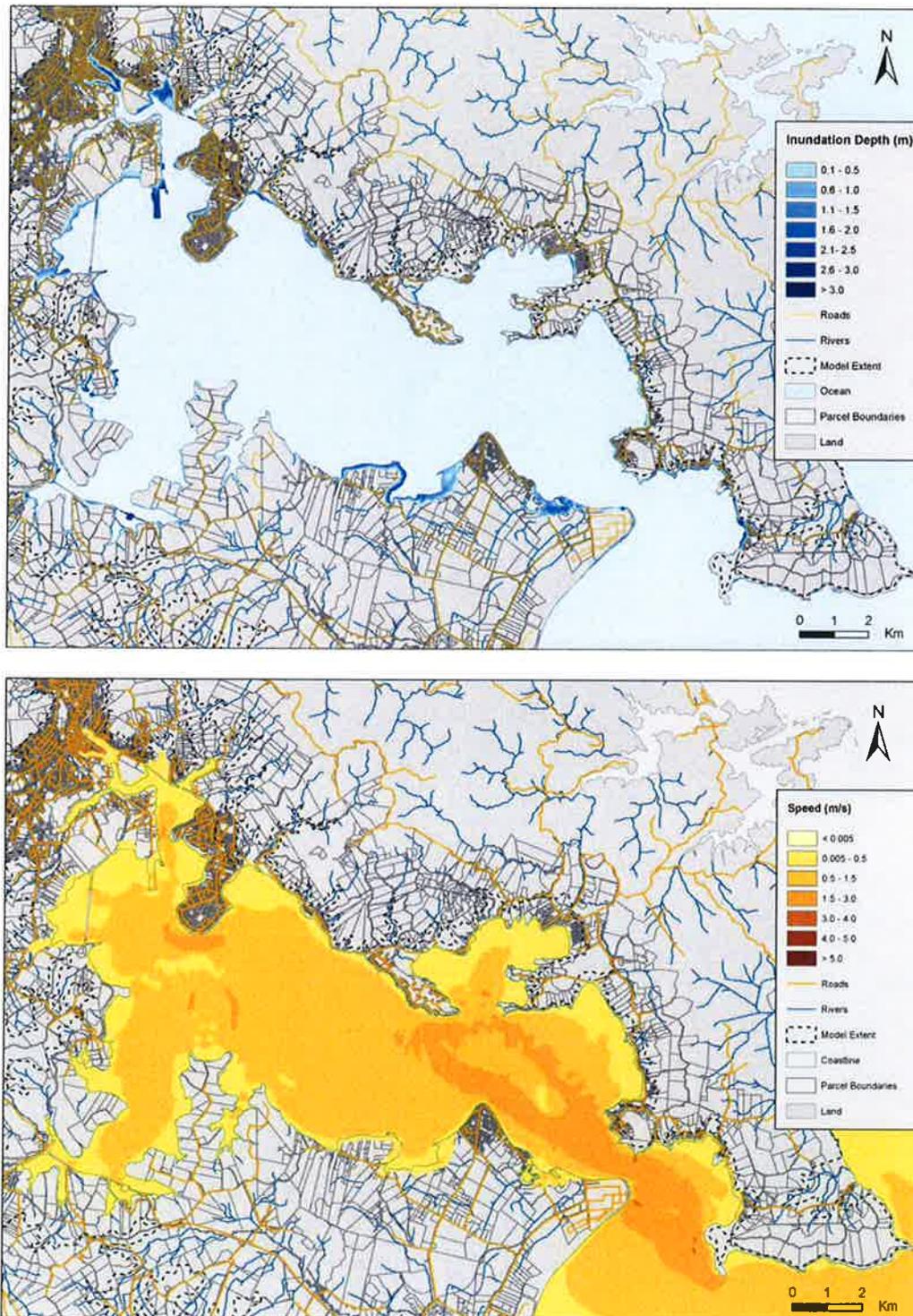


Figure 6: Harbour overview: maximum inundation depth (upper) and speed (lower) plots for the South American tsunami scenario at MHWS + 50cm (to extent of LIDAR) for Whangarei Harbour.

Sea areas in the maps are blanked to emphasize the predicted land inundation. The inundation depth represents the maximum depth of water on land (depth above the land surface after accounting for land surface elevation) that results from the tsunami. The dashed lines in the maps show the spatial extent of the modelled inundation on land, based on land elevations derived from LiDAR data; inundation may extend inland of these lines, but were not modelled because appropriate land elevation data were not available. Maximum water speed predicted during the entire model simulation is typically associated with tsunami arrival and in-flowing water, but, in some cases, may be associated with outflow.

4.2. Overview

Maps of predicted inundation depth and maximum water speed for the modelled area in Whangarei Harbour are presented in Figures 5-10. Inundation from the South American tsunami is evident near Whangarei, Otaika, Oakleigh, Takahiwai, Marsden Bay and Bream Head. Maximum current speeds within Whangarei Harbour (Figure 5) ranged from 0.006 to 3 m s⁻¹. When sea level rise is included in the scenario, there is an increase in the inland area inundated in all of the specific sub-areas (Figure 6).

The TKSZ M_w 8.5 scenario results in inundation in Whangarei, Otaika, Oakleigh, Takahiwai, Marsden Bay and Bream Head (Figure 7). In general, maximum current speeds in the harbour are in the range 0.006 - 0.5 m s⁻¹, but reach 0.6-1.5 m s⁻¹ in the harbour entrance and some other areas. Sea level rise causes an increase in the extent and depth of the inundation (Figure 8).

The TKSZ M_w 9.0 scenario produces inundation in all six sub-areas (Figure 9). Current speeds in the harbour range from 0.006 to 1.5 m s⁻¹. Approaching the harbour entrance, maximum current speed is in the 0.6 to 1.5 m s⁻¹ range, and exceeds >5 m s⁻¹ in some areas near Busby Head. Inundation depth and extent both increase when sea level rise is included in the scenario (Figure 10).

More detailed descriptions of inundation and speed are given for Marsden Bay, Takahiwai, Oakleigh, Otaika, Whangarei, and Bream Head (Figure 4) in the next sections.

Sea level rise has a large effect on inundation. At the present day MHWS sea level, the greatest predicted inundation is from the South American tsunami scenario, followed by the TKSZ M_w 9.0 scenario, then the TKSZ M_w 8.5 scenario. In comparison, the TKSZ M_w 8.5 scenario with 50 cm sea level rise causes greater inundation than the South American scenario at present day MHWS sea level.

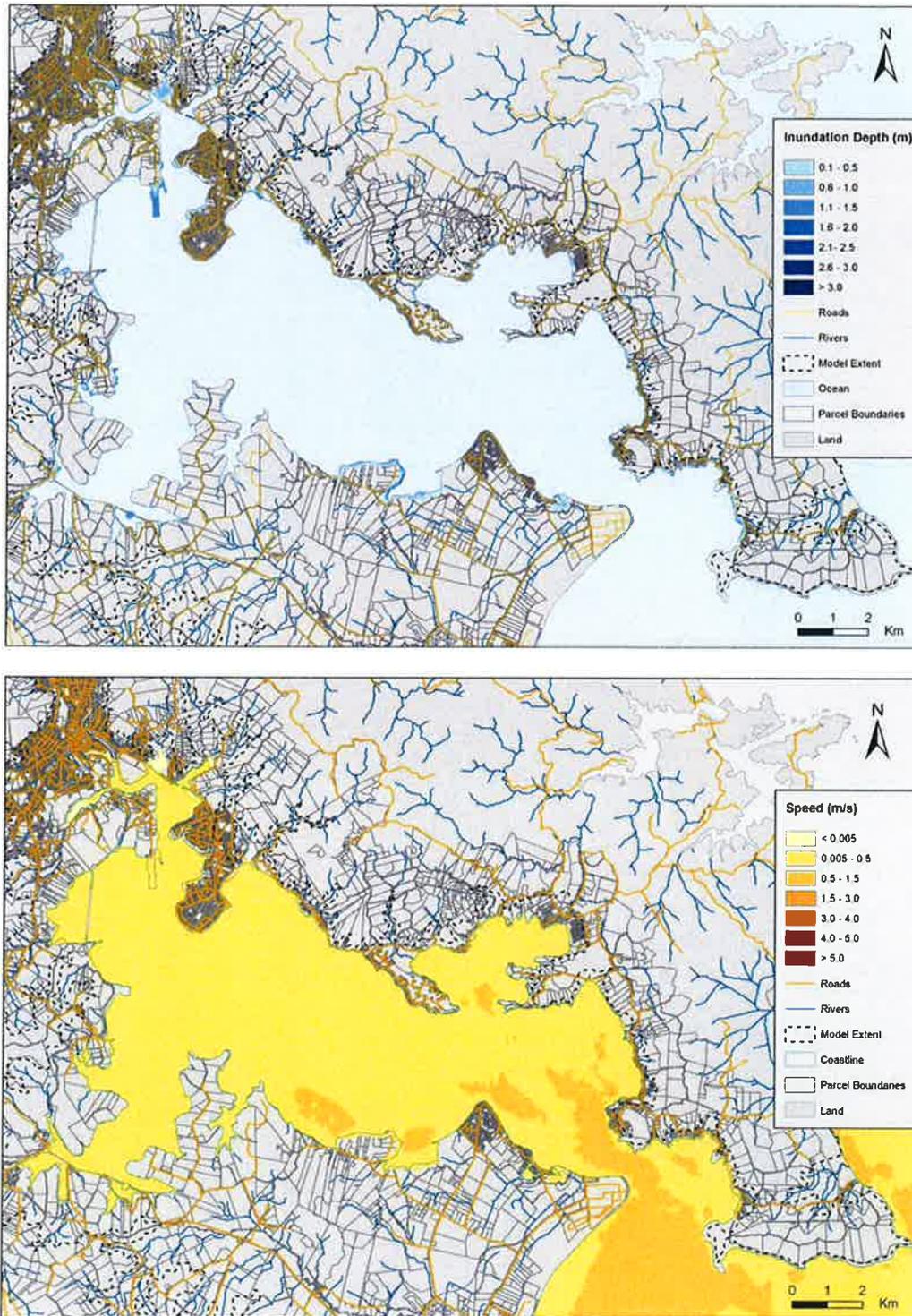


Figure 7: Harbour overview: maximum inundation depth (upper) and speed (lower) plots for the M_w 8.5 Tonga-Kermadec subduction zone scenario at MHWS (to extent of LIDAR) for Whangarei Harbour.

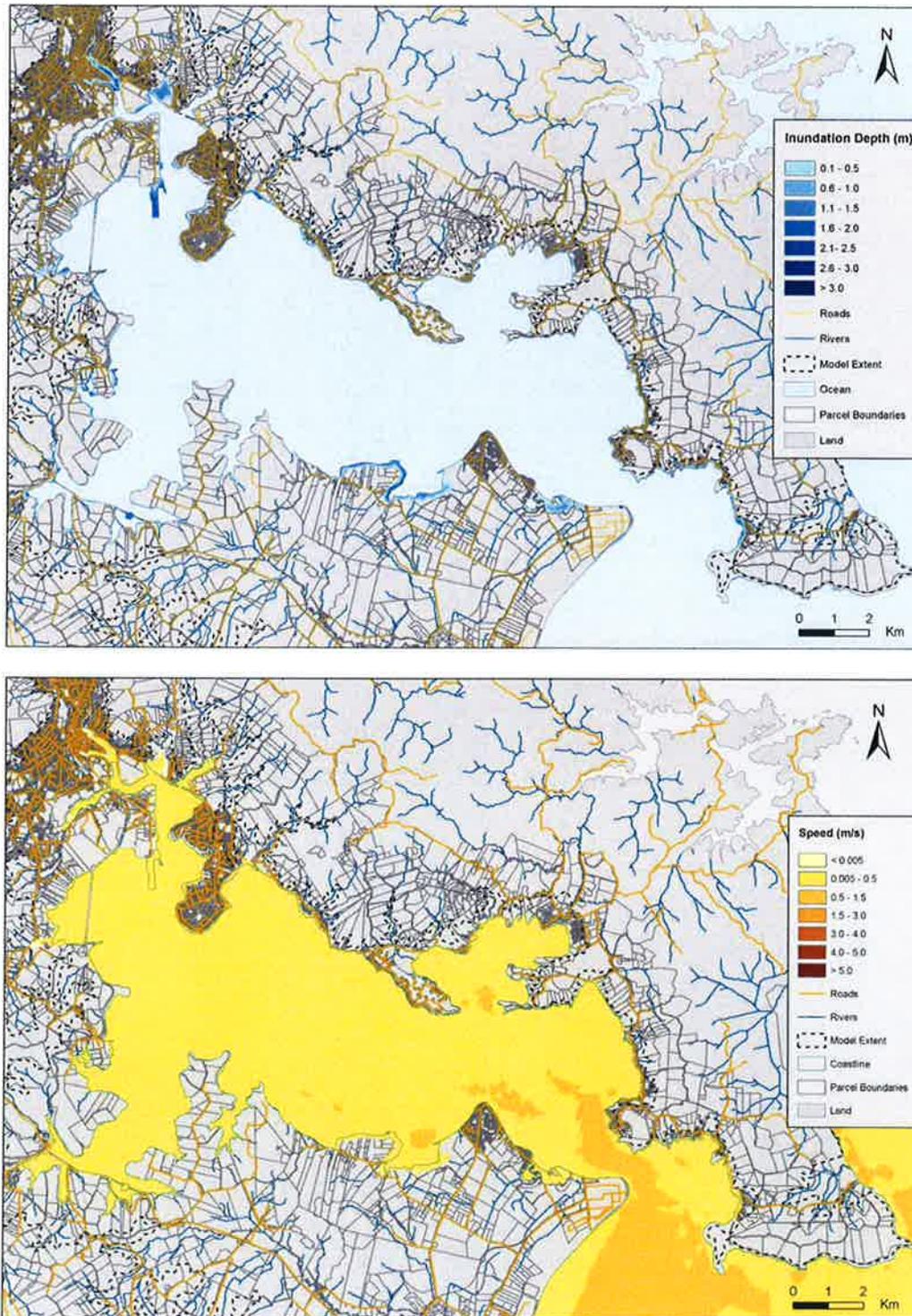


Figure 8: Harbour overview: maximum inundation depth (upper) and speed (lower) plots for the M_w 8.5 Tonga-Kermadec subduction zone scenario at MHWS + 50cm (to extent of LIDAR) for Whangarei Harbour.

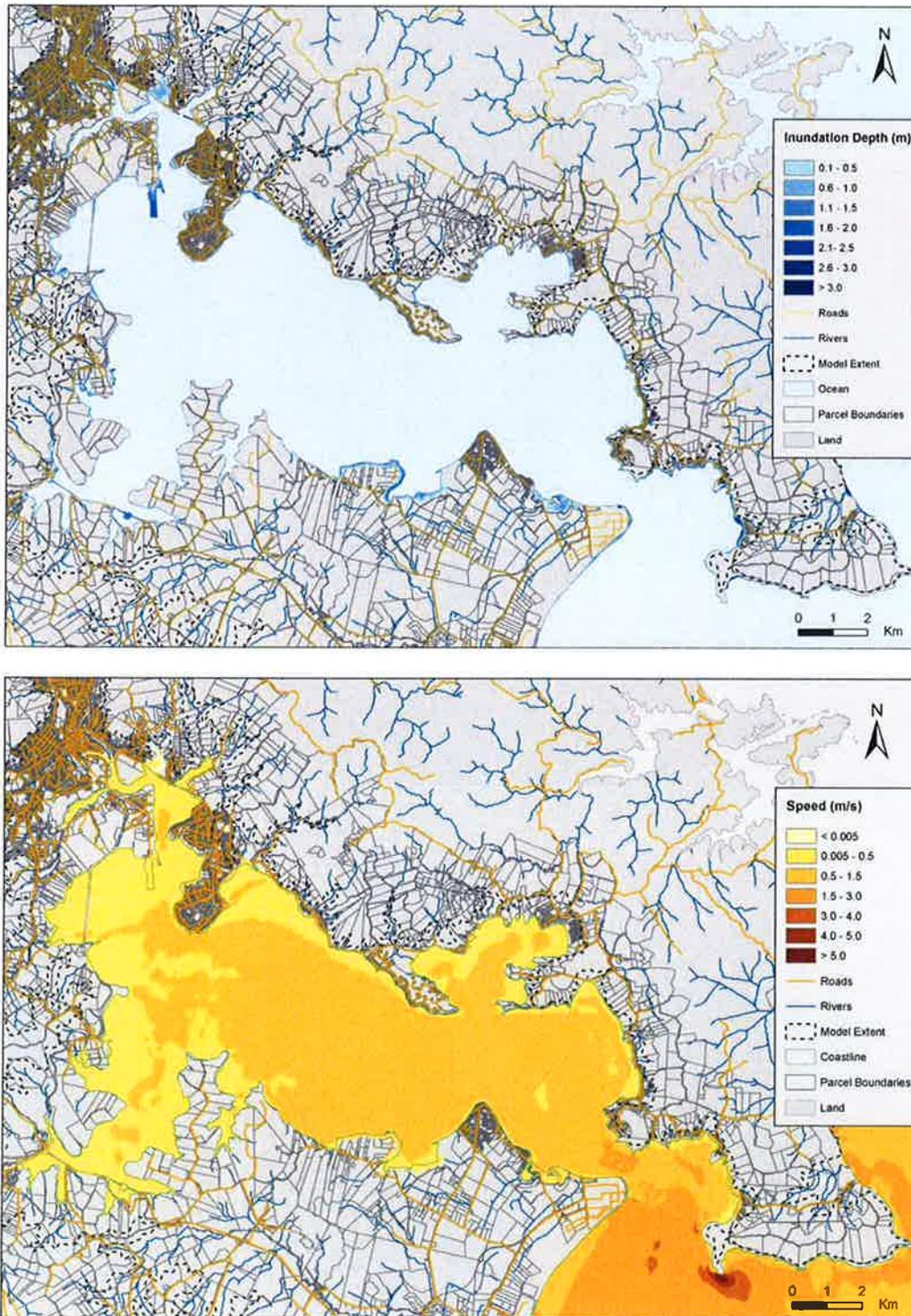


Figure 9: Harbour overview: maximum inundation depth (upper) and speed (lower) plots for the M_w 9.0 Tonga-Kermadec subduction zone scenario at MHWS (to extent of LIDAR) for Whangarei Harbour.

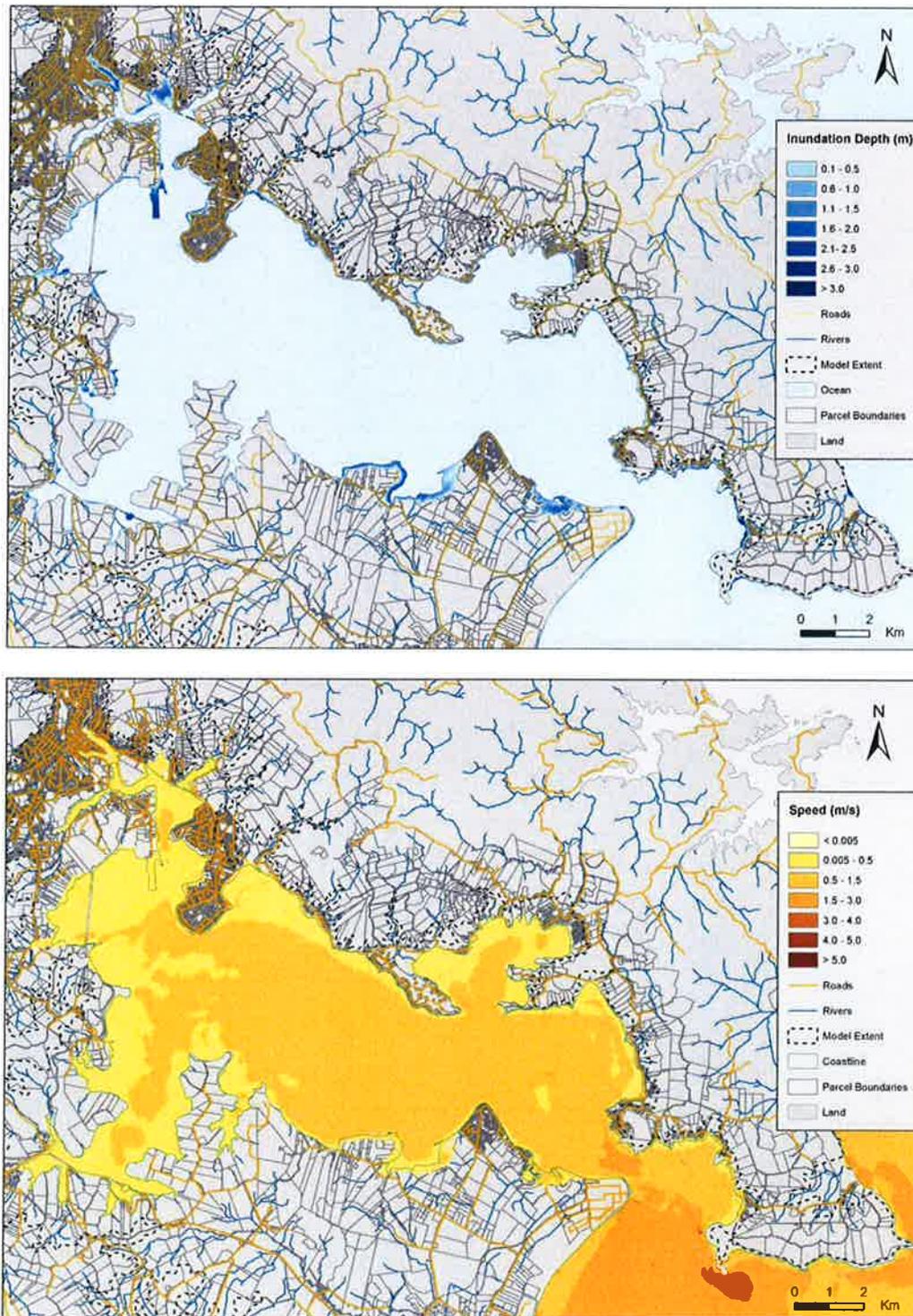


Figure 10: Harbour overview: maximum inundation depth (upper) and speed (lower) plots for the M_w 9.0 Tonga-Kermadec subduction zone scenario at MHWS + 50cm (to extent of LIDAR) for Whangarei Harbour.