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SAFEGUARDING YOUR ENVIRONMENT + KAITIAKI TUKU IHO

Kopuawhara and Opoutama Flood Hazard Analysis

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Engineering Section

**Kopuawhara and Opoutama
Flood Hazard Analysis**

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Kopuawhara and Opoutama Flood Hazard Analysis

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Kopuawhara and Opoutama Flood Hazard Analysis

1 Summary

The Kopuawhara and Opoutama Catchments are located on the east coast of the North Island at the Mahia Peninsula. The catchments are in an area that is known for high intensity, short duration flash flooding.

A hydrologic and hydrodynamic model has been created for the catchment in order to assess the likely runoff from a design storm, and to assess the likely extent of flooding in the isthmus area of the Mahia Peninsula, around the Mangawhio Lagoon during the design flood event.

This report provides a description of the methods used in the analysis, and provides the results in terms of flood levels that form the basis for a map showing the flood hazard zone.

2 Catchment Description

The Kopuawhara Catchment area is about 54.3 km², the Opoutama Catchment area is about 13.1 km², and the Mangawhio Lagoon catchment is an additional 26.3 km². Elevations range from about 530 m in the Kopuawhara, and 300 m in the Opoutama, down to and below sea level in the Mangawhio Lagoon (see Figure 1). The invert level of the stream at the water level recorder on the Kopuawhara Stream is at approximately RL 13 m (datum msl = 10 m).

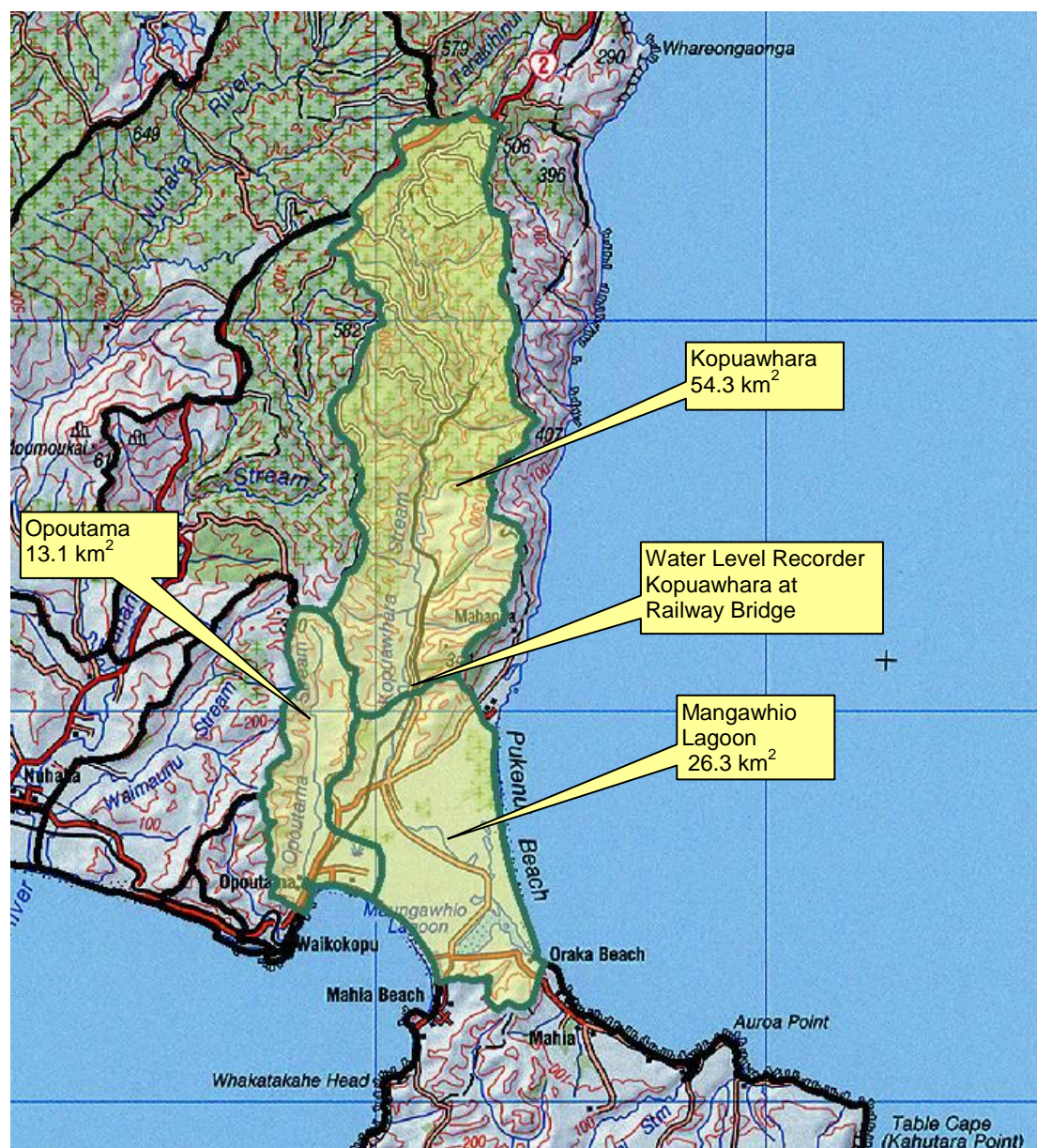


Figure 1: Catchment Location

The Kopuawhara Catchment length is approximately 20 km, with another 9 km from the water level recorder to the mouth of the lagoon. The Opoutama Catchment length is approximately 9 km from the headwaters to the outlet on the western side of the isthmus.

The Kopuawhara and Opoutama catchments are relatively long and narrow, with steep sided valleys. During extreme rainfall, the steep valleys contribute large amounts of runoff fairly quickly, which accumulates in the main valley causing flash flooding in the valley floors, and then widespread surface flooding in the flat area around the Mangawhio Lagoon.

2.1 Land Use

Land use in the Opoutama catchment is predominantly open hill country, with about 30% in forestry while the Kopuawhara catchment is about 70% forestry, and the remaining open hill country.



Figure 2: Opoutama (13.1 km²)

Kopuawhara (54.3 km²)

3 Hydrologic Analysis

The Kopuawhara and Opoutama catchments are located in an area that has a history of receiving very intense rainfall. This intense rainfall, combined with the very steep catchment, results in flash flooding that occurs with very little warning. The water level records at the recording gauge on the Kopuawhara Stream show two events since 1982 with discharges of over 300 m³/s. In 1997 the discharge increased from 9 to 330 m³/s in 12 hours, and in 2003 the discharge increased from 5 to 327 m³/s in 20 hours (Figure 3).

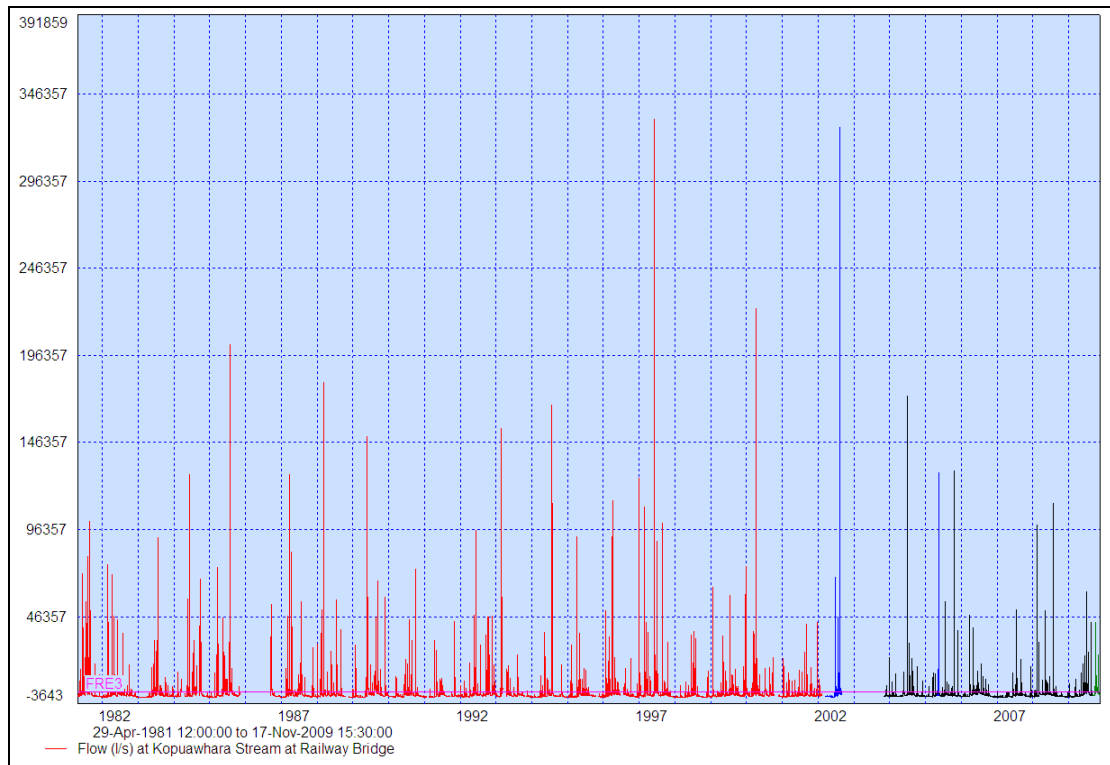


Figure 3: Discharge Hydrograph, Kopuawhara Stream at Railway Bridge

A frequency analysis of the available discharge data was performed, using a Generalised Extreme Value (GEV) shape curve fit to the data. The results indicate a 100 year return period discharge of approximately 420 m³/s.

A hydrologic computer model was created using the Mike11-NAM computer software (Danish Hydraulic Institute). The rainfall input to the model was derived from HIRDS Version 3 (Niwa). Climate change factors were not used in this model, as the objective of the present analysis is to derive current flood extents. Further work could be done in the future to include climate change factors and produce flood extents for future scenarios. The rainfall pattern used in the model is shown in Figure 4.

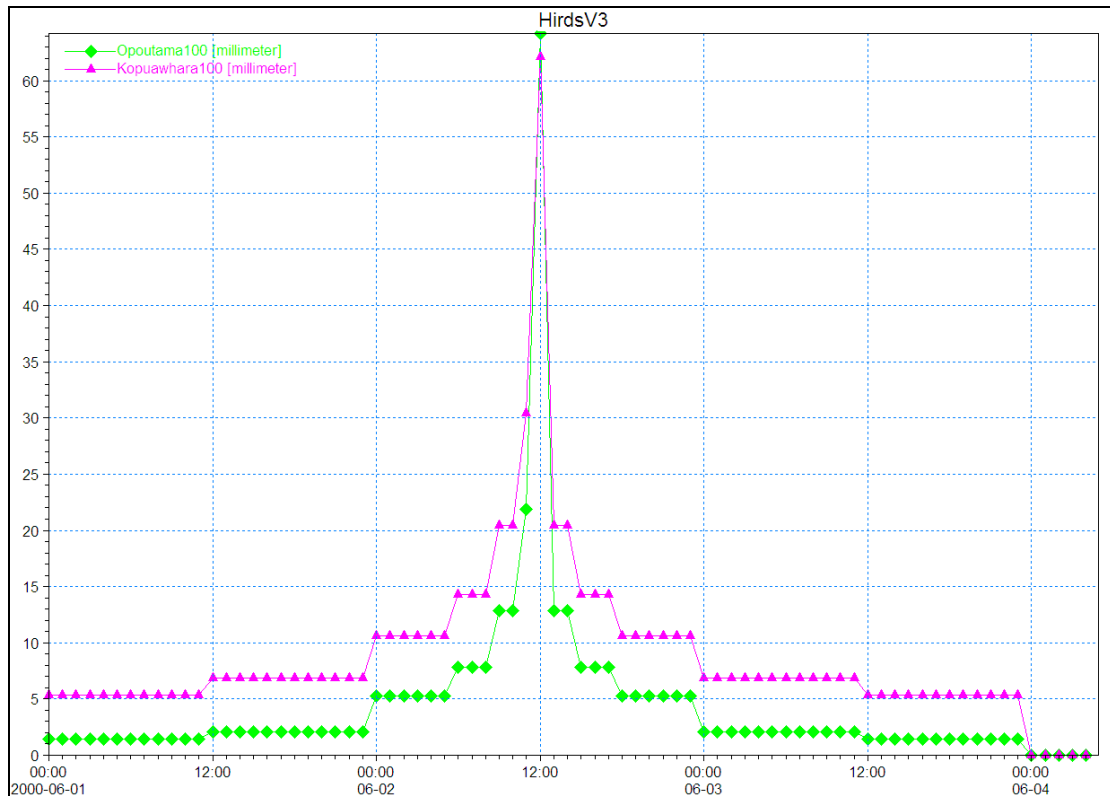


Figure 4: Kopuawhara and Opoutama Design Rainfall (100 year, derived from Hirds V3)

A test was done to determine the likely effects of rainfall and runoff from the Mangawhio Lagoon area. The test results indicated that additional runoff from the lagoon did not cause significant differences in the flooding extents which occurred from the discharge from the main catchments. The results did show several areas which may suffer from surface flooding from such rainfall, however these areas are not included in the flooding extents from the river flood. The validity of the additional floodable areas would need to be examined in more detail in order to provide a robust flood extent map which includes flooding caused by poor drainage at very localised scales.

The hydrologic model takes into account a range of parameters such as volumetric runoff coefficient, depth of layers of soil, and timing of runoff, as well as several parameters which account for groundwater flow. The values used for the model parameters were based on similar catchments modelled in other studies completed by the HBRC. Further calibration was done using a comparison of the model output with recorded flow data from the water level gauge at Kopuawhara at the Railway Bridge. The actual peak discharges derived from the 100 year return period event for the NAM model is 415 m³/s for the Kopuawhara and 93 m³/s for the Opoutama. These values represent specific discharges of 7.6 m³/s per km², for the Kopuawhara Catchment and 7.1 m³/s per km² for the Opoutama Catchment, which are typical for many catchments along this coast. The lesser value for the Opoutama Catchment is a result of the design rainfall being slightly less for the catchment closer to the coast.

4 2D Hydrodynamic Model

A 2 dimensional hydrodynamic model of the streams and floodable areas was created using the Mike21-HD computer software (Danish Hydraulic Institute). The

model uses ground elevation derived from a LiDAR (aerial laser survey) completed in 2003. Invert levels in the streams were also included in the model based on cross sections surveyed in 2004. Upstream input to the model was the discharge derived from the hydrologic model for the Kopuawhara and Opoutama Catchments. The downstream boundary condition was set to the sea level, with a normal tidal boundary ranging from RL 9.0 to RL 11.0 m. The timing was set such that the peak of the flood roughly coincides with high tide. The model area is shown in Figure 5.

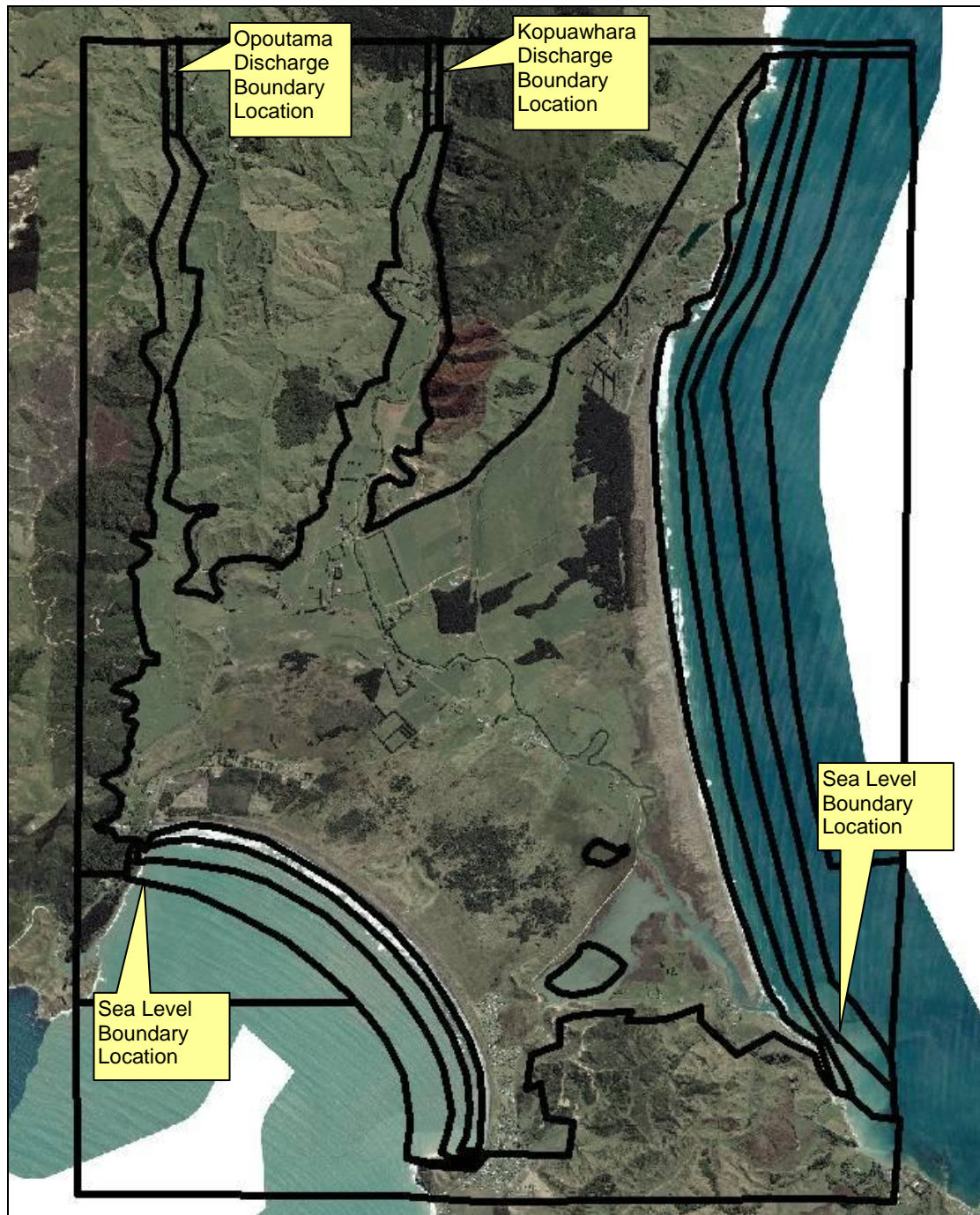


Figure 5: 2D Model Area

5 Discussion and Results

There are several factors such as the vegetative state of the channels, the changing conditions of the mouths of the streams, and the state of the sea at the time of any heavy rain which may have an influence on the results. However, a relatively conservative approach has been taken during the modelling of this area, with results which show the potential flood extents, given average conditions that may exist at the time of heavy rain.

The result from the computer model indicate a significant flood hazard exists in the floodplain area, as well as the valley floors.

The 100 year discharges hydrographs were applied to the hydrodynamic model, with the results in Figure 6 showing the maximum water depth. Larger scale maps showing more detail may also be produced from the results.

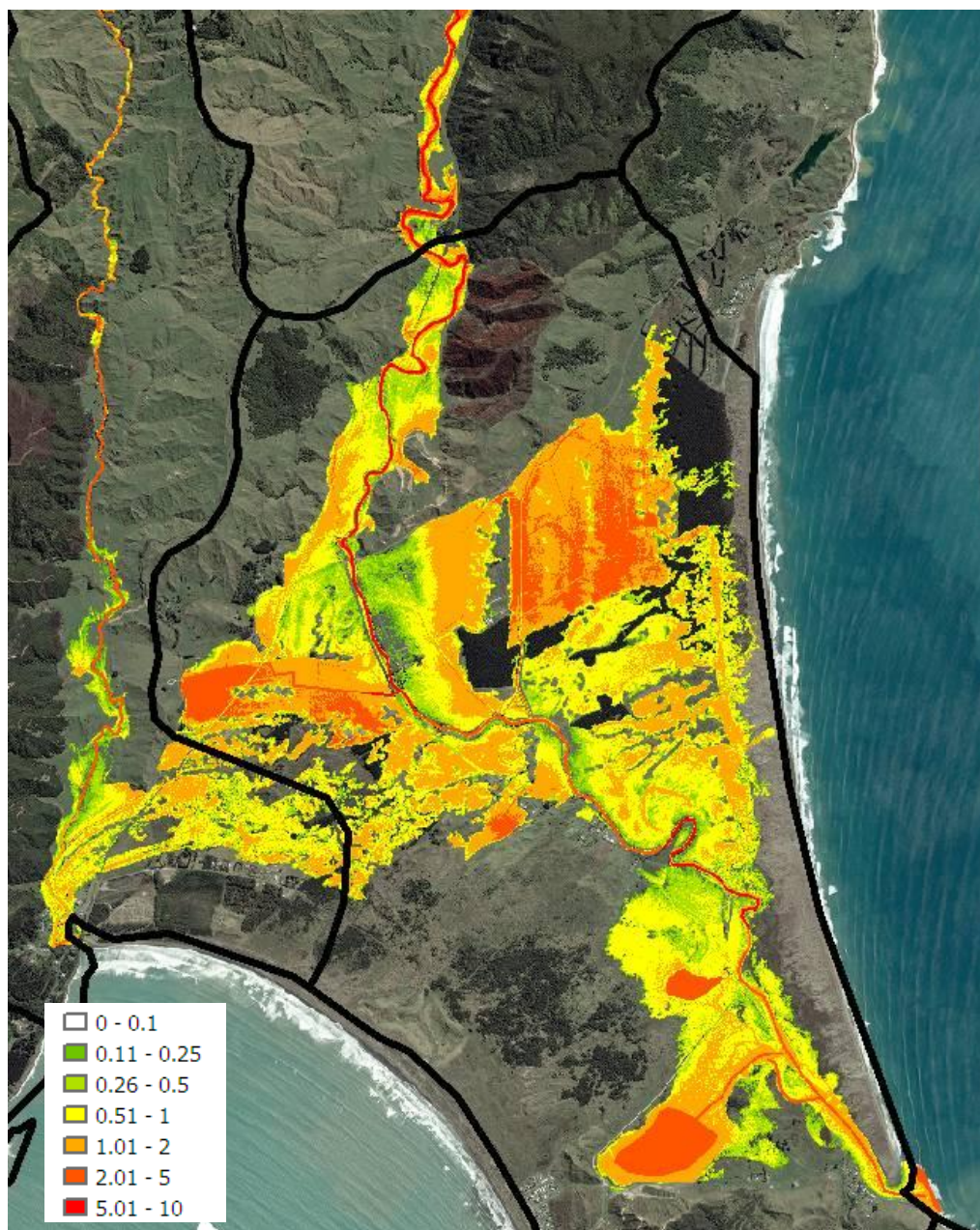


Figure 6: Flooding Extents for 100 year Return Period event (100 mm or deeper)

5.1 Limitations

The flood extent mapping in this analysis is based on flooding occurring from high flows in the Kopuawhara and Opoutama Streams. The results do not take into account flooding that could be generated from localised rainfall which may occur on side valleys or hillsides.

6 Conclusion

The Kopuawhara and Opoutama Streams flow onto the Mahia isthmus, causing widespread flooding during times of high flow. The 100 year return period flood extents have been derived with the use of a 2-dimensional hydrodynamic model.

7 Appendix 1: Flood Extent Maps

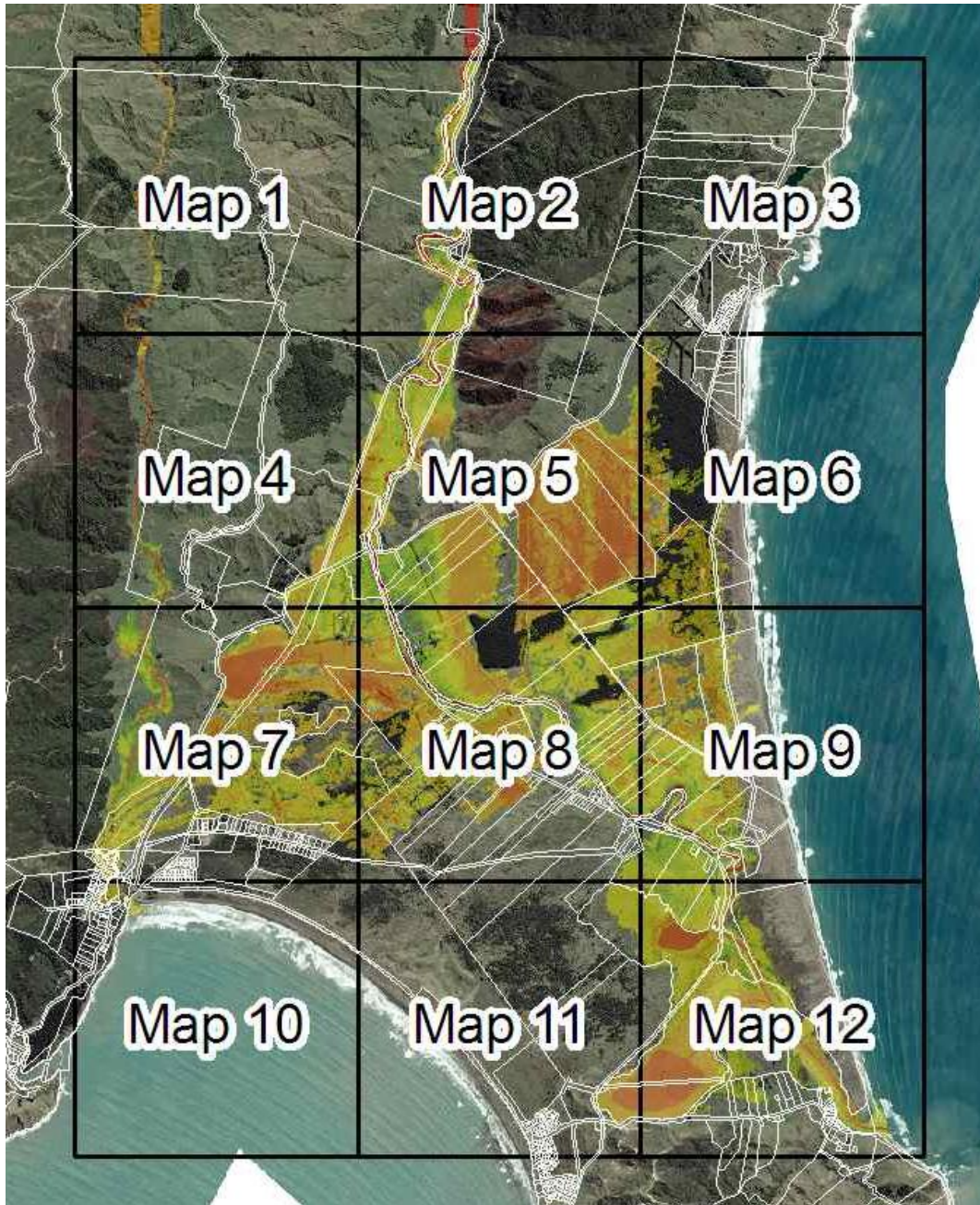


Figure 7: Flood Extent Map Index

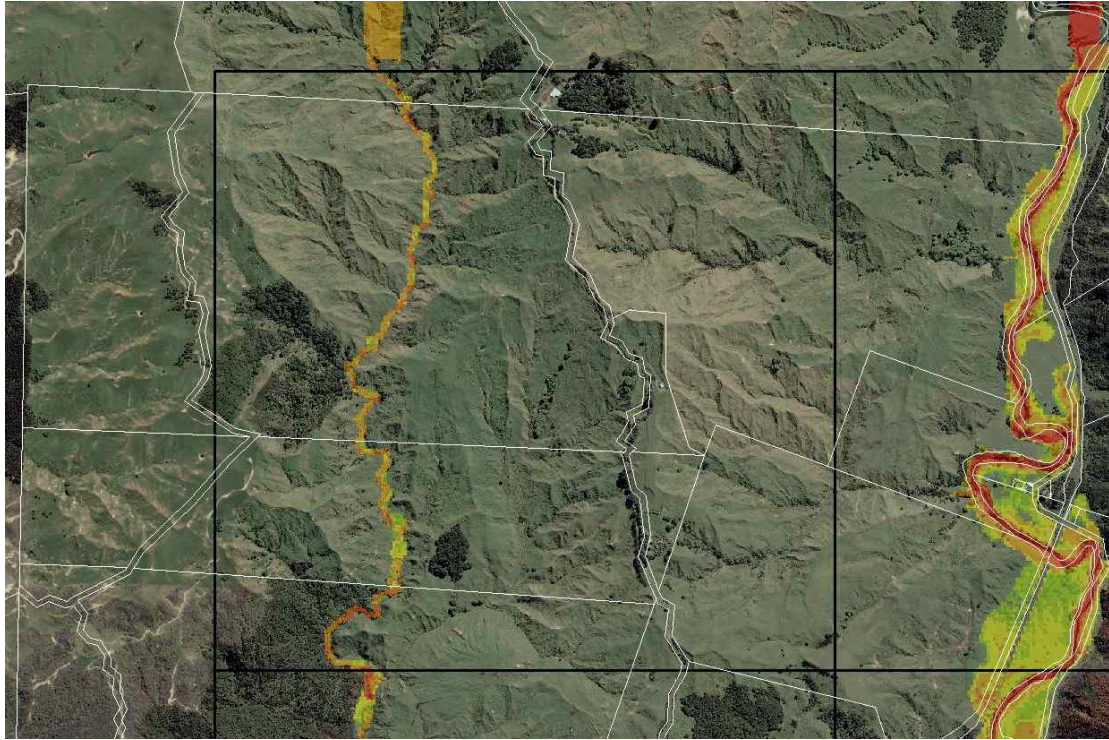


Figure 8: Map 1

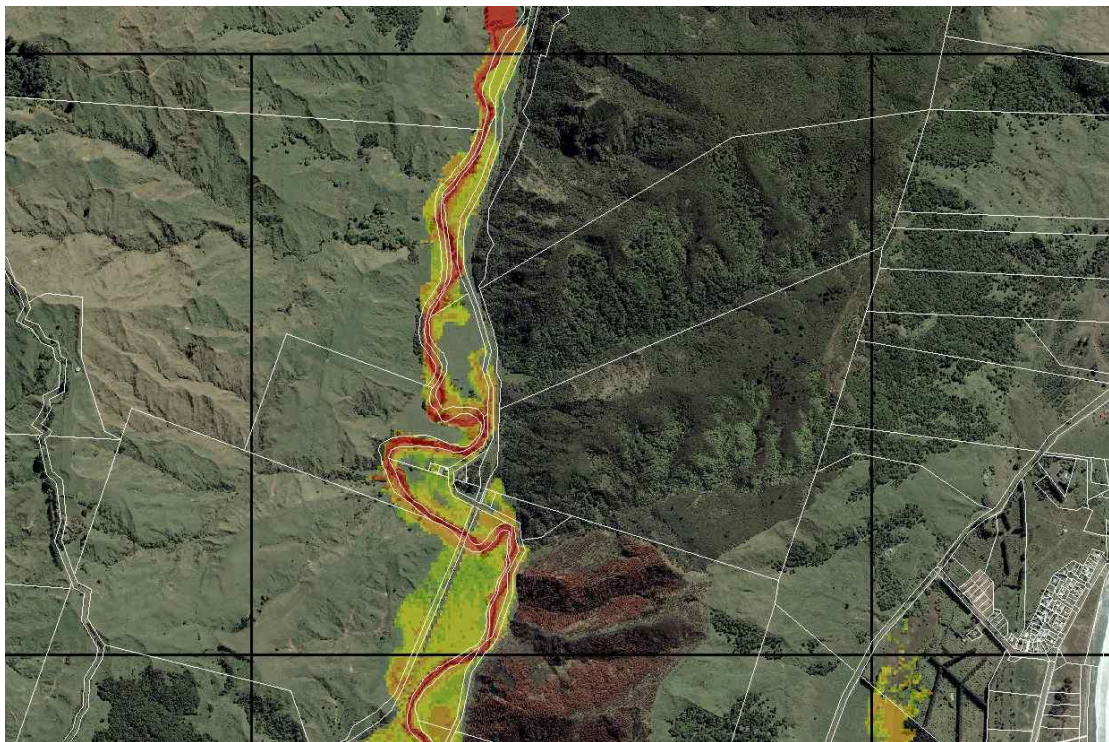


Figure 9: Map 2



Figure 10: Map 3

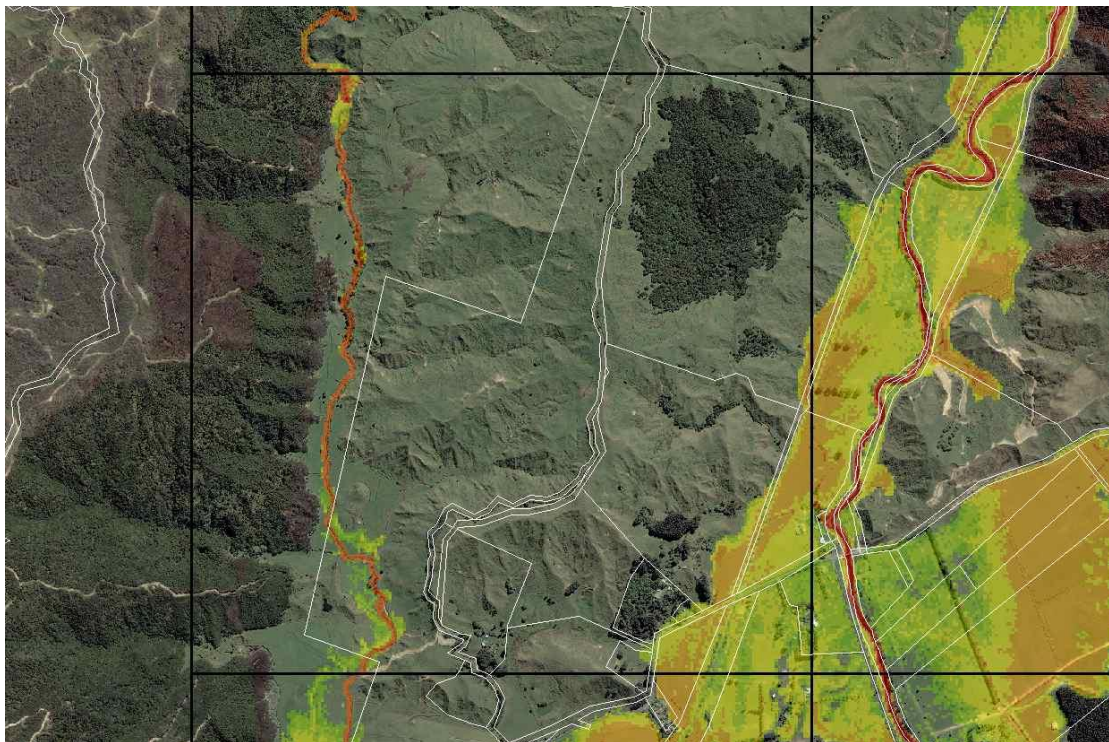


Figure 11: Map 4

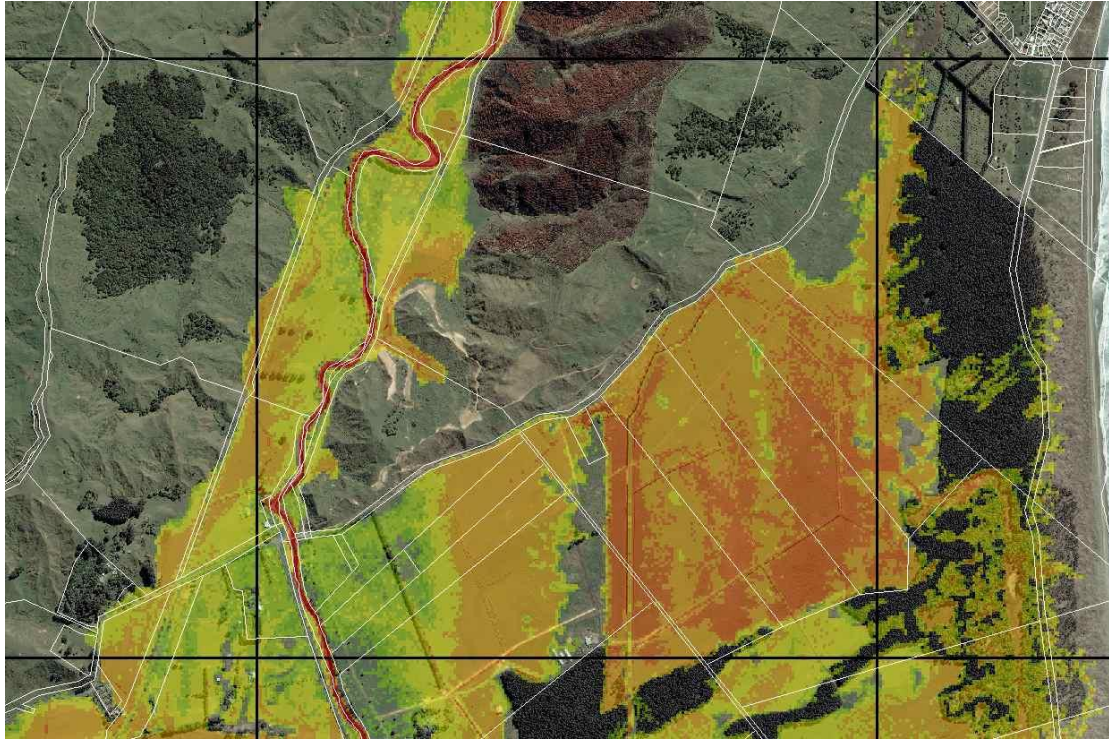


Figure 12: Map 5

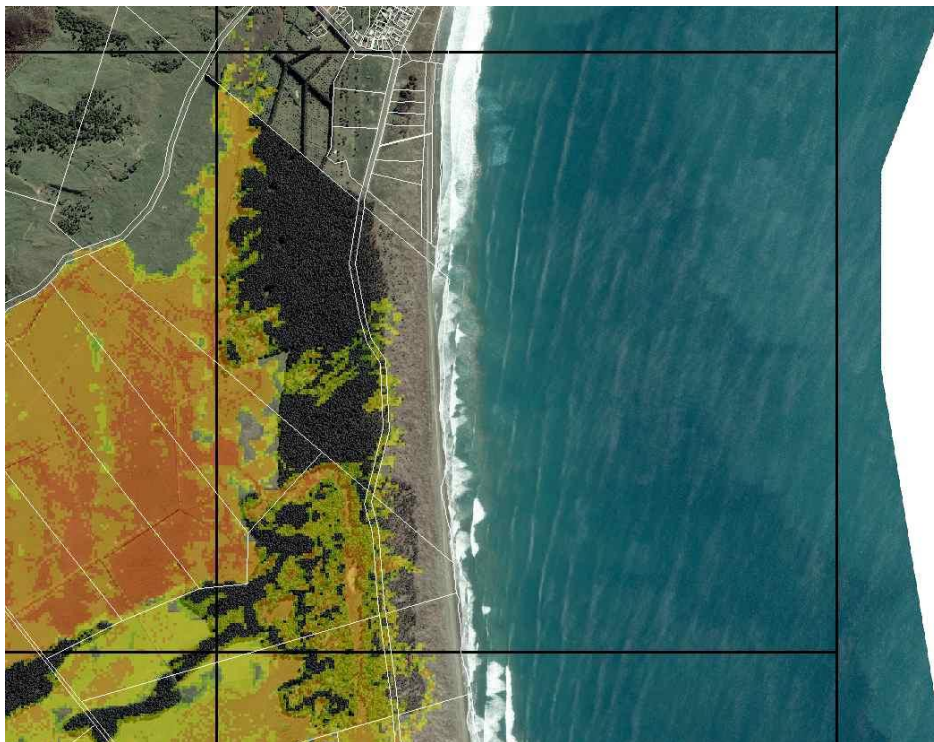


Figure 13: Map 6

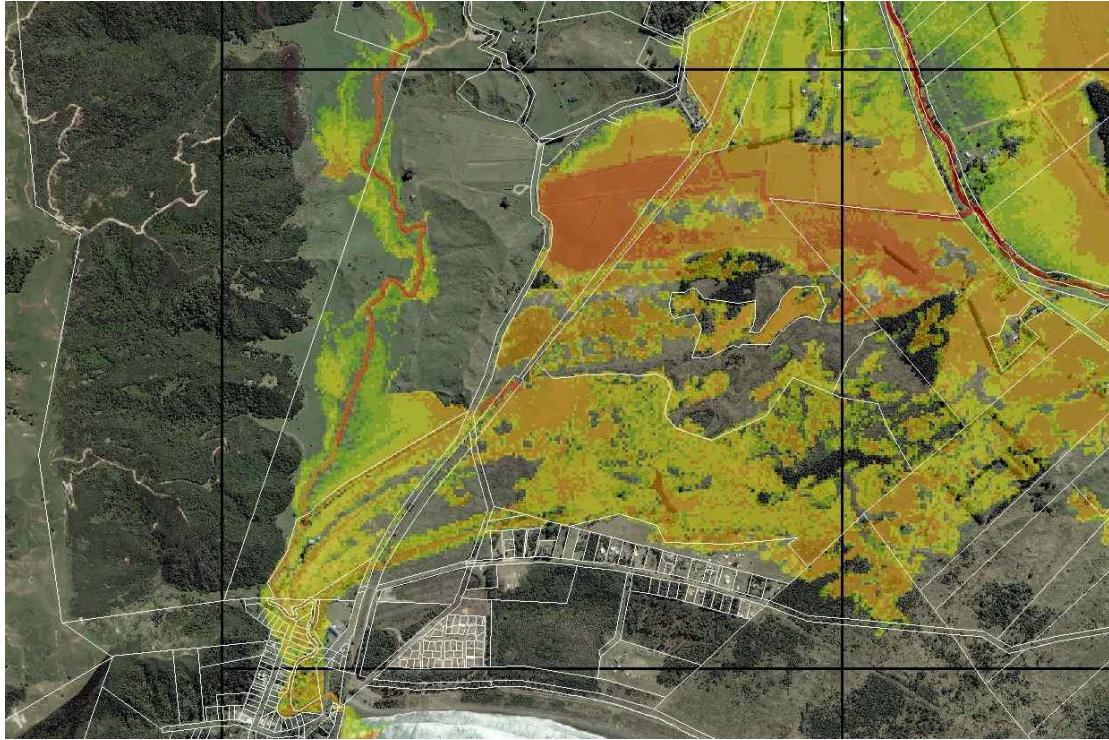


Figure 14: Map 7

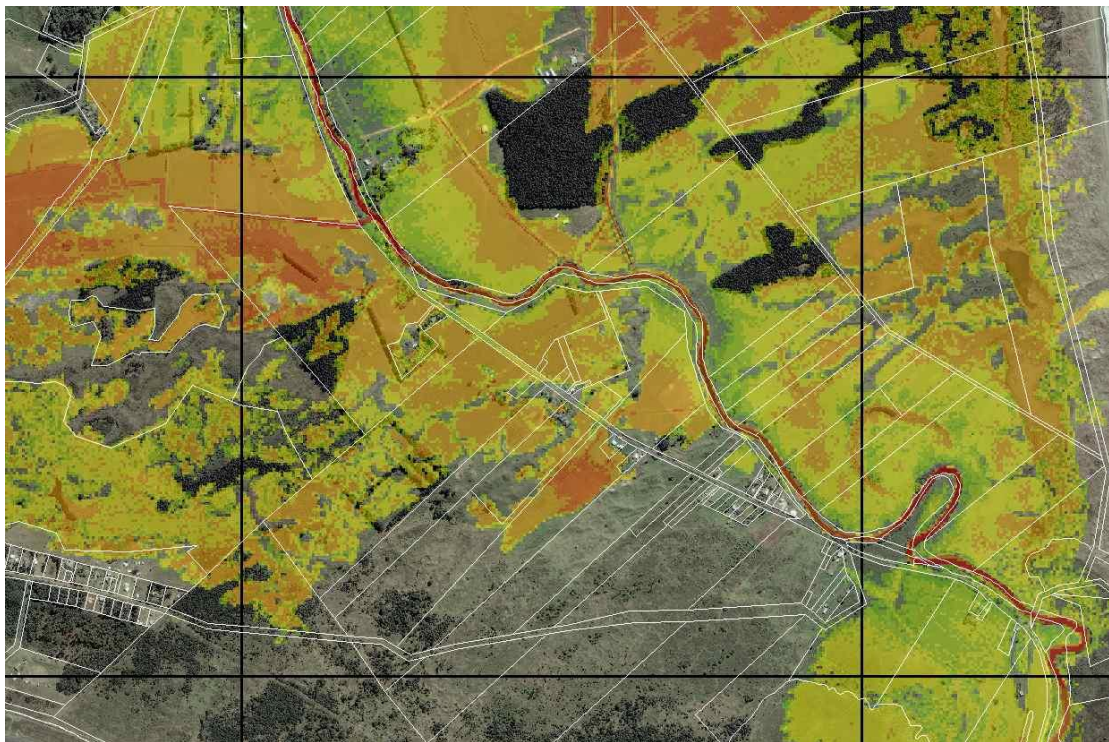


Figure 15: Map 8



Figure 16: Map 9

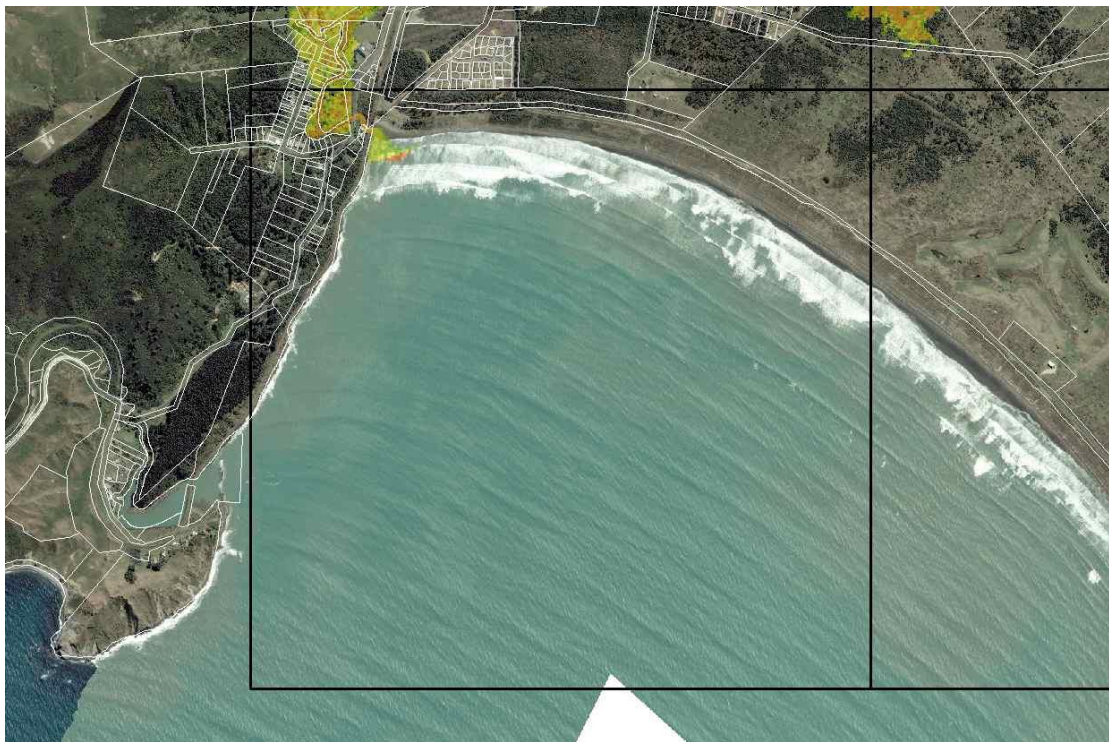


Figure 17: Map 10

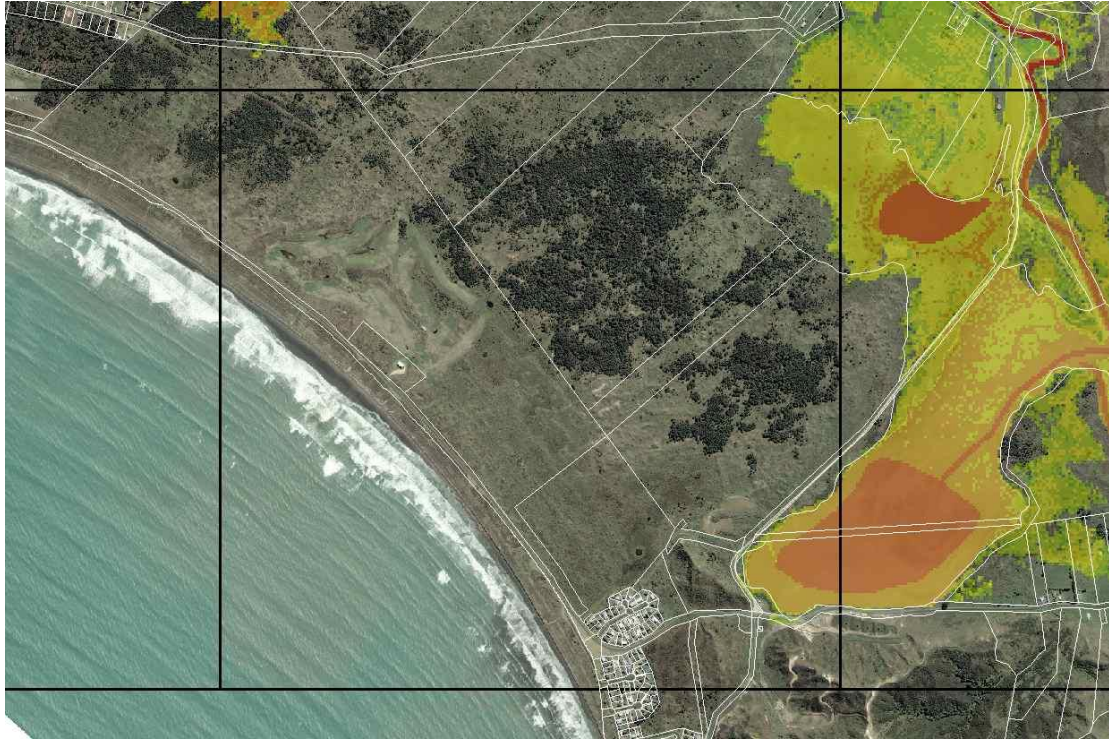


Figure 18: Map 11

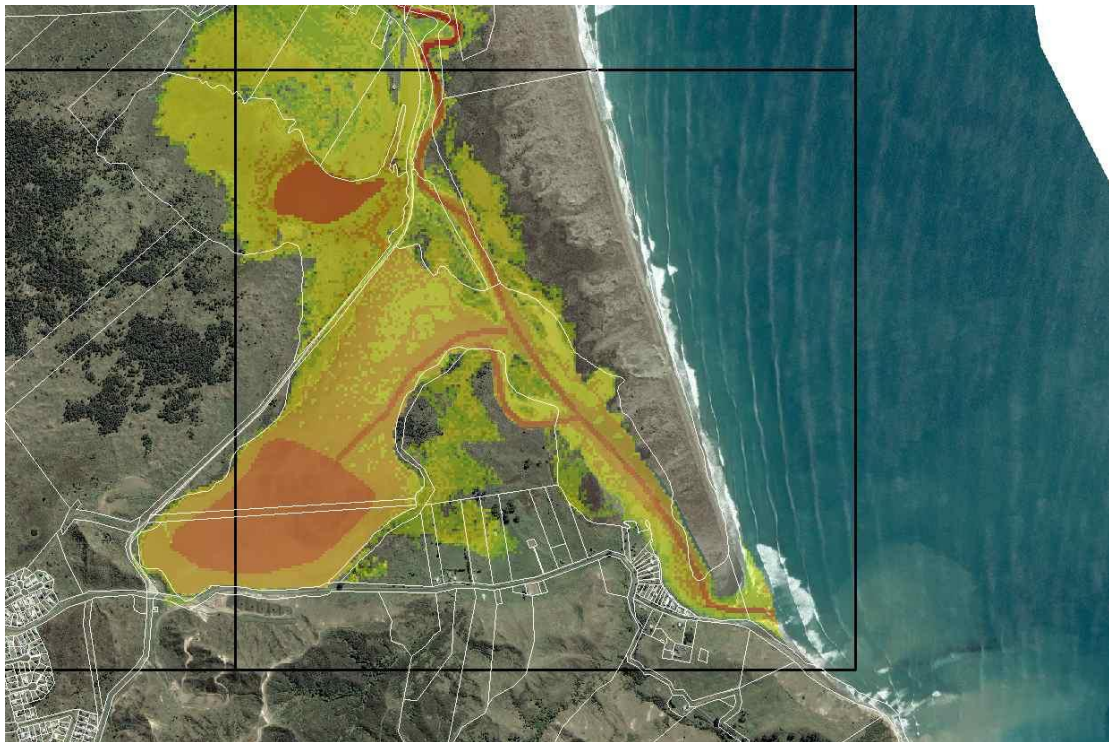


Figure 19: Map 12