Waipoua River Flood Flows

Hydrology is one component of flood modelling. It measures and estimates flow in rivers, establishing data that is subsequently used in a hydraulic model. The hydrology recommendations developed for the Waipoua River use a combination of measured flows and modelled rainfall runoff.

Hydrology is not an exact science, it uses measurements and estimations that have a lot of uncertainty to create a recommended number with multiple possible outcomes. In practice this means that the scientists develop a range and look for a number within this range that is a realistic and reasonable estimate. The job of the councils is to accept or modify these recommendations, balancing impacts created by being too conservative or not conservative enough. The consequences of choosing a number too low are an unacceptable risk to life and property damage, the consequences of choosing a number too high are an overestimation of risk and can be perceived as having an impact on property values and development potential, as well as imposing unnecessary costs on development or insurance.

The catchment

The Waipoua catchment is very complex. It has a steep upper catchment opening out onto a flat gravel plain, both parts are similar in size. The flow gauge for the Waipoua River is situated at Mikimiki which is about halfway down the catchment, and captures the flow generated by the rainfall that falls in the steep hill country. The lower part of the catchment, downstream from Mikimiki, is the complex area that needs to be included in the hydrology estimates to enable accurate flood modelling and was the focus of the recently completed MWH rainfall runoff report.

Flow measurement and estimation

Records of flow for Mikimiki go back to 1979. The record has a gap in data between 1983 and 1996. Data was collected for a short period at Colombo Road between 2009 and 2011, and there are some supplementary sites that have been used to add further data to the flow record. In addition, flow estimates have been made at the State Highway 2 Bridge and the Colombo Road Bridge during high flow events.

Gaugings are complicated; several, sometimes different, flow measurements can come from a single flood event. These differences can be caused by damage to the gauges, changes in shape of the channel during the flood event, the speed of the water, and the method used to take the measurement. The 1998 flood is one such event where the numbers can be altered to be larger or smaller by small changes in estimated channel capacity or water velocity.

Through analysis of the data from the Mikimiki gauge, carried out by several different scientists, a range of 274m^3/s to 439m^3/s was developed for the 1998 flood. The uncertainties in the data have required a review of the modelling assumptions and a recommended value of 356m^3/s has been agreed upon. This range was then converted for use in the development of the design flows. In general flow increases the further down the river you are from its source. It collects water from the catchment around it, the further you are down the river the more catchment there is to contribute water. The river flow is measured at Mikimiki, which is about halfway down the catchment, and collects water from most of the hilly portion of the catchment. The hilly portion of the catchment will receive the most rainfall, however rain will also fall on the flatter plain areas. It is expected that this will be a smaller amount compared to that which falls on the hilly area, and therefore a smaller portion of the flow.

The difference in flow between Mikimiki and Colombo Road has been measured for a number of higher flow events ranging from 13% to 67%. This large range makes determining a design flow difficult.

Determining a design flow

A design flow has to be selected because no two floods are the same, yet councils have a responsibility to inform the community about natural hazards. All the presented data is considered and a sensible recommendation to balance risk with impact is made. The design flow is a combination of:

- Contribution of rainfall generated by the lower catchment; and
- The measured flow at the Mikimiki gauge scaled to a design period event.

The recommended design flows are shown in Table 1. Design flows are used for modelling floods and are chosen to balance risk with impact on the community.

Table 1: Design flows (m^3/s)

	1998 Flood Event	**50 ARI Design Flood**	**100 ARI Design Flood**	***Original 50 ARI Design Flood***	***Original 100 ARI Design Flood***
Mikimiki	356	363	406	*372*	*404*
Colombo Road	445	454	508	*454*	*533*

Table 1 shows that the 1998 flood event is estimated to be a 1-in-45-year event, without climate change.

A photograph taken after this event illustrates that there was up to 500 mm of stopbank freeboard at the lowest point on the stopbank.

The historic flood records have been checked, and proportionally 75% of past flood events would fall within the contribution range less than the design flow level. The community will need to account for the possibility of flood events greater than the recommended values in Table 1, and be aware of the risks that these might pose.

The recommended values will be used to refine the flood models for the Waipoua River for 1-in-100-year event with climate change. Model outputs will also compare the recommended value with the flow range uncertainty from the Mikimiki Gauge and the uncertainty created by the measured range in contribution from the lower part of the catchment. MDC and GWRC will continue to work together assess this and any further information to confirm the Waipoua flood risks.