

Lake Matahina Flood Management Plan

**Trustpower Limited
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1 Introduction

The Matahina Hydroelectric Power Scheme ('Matahina HEPS' or 'the Scheme') is located on the Rangitaiki River and was constructed in 1967. Trustpower Limited ('TPL') purchased the Scheme from the Electricity Corporation of New Zealand in 1999.

The Matahina Dam is approximately 80 metres high and impounds Lake Matahina. The Lake is some 6km long, has a surface area of approximately 2.5km², and a volume of approximately 55,000,000m³. The Scheme's spillway operates during floods; when inflows exceed the capacity of the Scheme and Lake Matahina is full; when the powerhouse is not, or cannot, operate; or when Bay of Plenty Regional Council ('BOPRC') request lowering of the dam in advance of anticipated floods. The dam is capable of passing the PMF (probable maximum flood) primarily via the gated spillway which has a capacity of 2300 cumecs. The flood capacity of the dam is well in excess of the downstream Rangitaiki-Tarawera Rivers Flood Protection Scheme ('RTRFPS') capacity, which is intended to be upgraded to a design inflow of approximately 800m³/s (approximately 1 in 100 year flood).

The main purpose of the Matahina Dam is to store water for the Matahina HEPS. The dam storage is small in comparison to flood volumes and is not primarily for flood control purposes, although its presence has significantly reduced the frequency and magnitude and severity of small to medium floods in the Rangitaiki Plains and as such has a positive influence on downstream flood effects. The intention of this flood management plan is therefore to provide ongoing guidance to the boundaries of co-operation within which BOPRC and TPL can work within while optimising the storage and reducing the impacts on downstream RTRFPS during floods.

The Matahina HEPS was granted new resource consents (RC65750) as part of a reconsenting process during 2013. The new consents stipulate that the consent holder shall, following consultation with the Natural Hazards Group ('NHG') of the Bay of Plenty Regional Council, issue, for certification by the Chief Executive of the Bay of Plenty Regional Council, a flood management plan ('**the FMP**'). The FMP shall be in general accordance with the Draft Flood Management Plan, and shall include protocols in relation to flood management strategies and communication with the Environmental Hazards Group of the Bay of Plenty Regional Council to give effect to Conditions 42, 42A and 43 of RC65750. The Chief Executive shall only issue the certificate if he/she is satisfied that the FMP accords with the relevant obligations of this Resource Consent, the Building Act 2004 and the Building (Dam Safety) Regulations 2008, or any subsequent revisions to the Act. The Matahina Hydroelectric Power Scheme shall, subject to Condition 45 of RC65750 and upon the FMP being certified by the Chief Executive, be operated in accordance with the FMP. This flood management plan has therefore been prepared in accordance with resource consent RC65750.

For the purposes of implementing the FMP, the Chief Executive of Bay of Plenty Regional Council may delegate their authority to BOPRC's Natural Hazards Group Manager, Rivers and Drainage Manager, Engineering Manager, Duty Flood Manager, or other Council Officers as delegated by the Chief Executive.

2 Objective and Application

The objective of this document is to set operating guidelines and procedures in order to provide a balance between Trustpower's needs for the controlled discharge of floodwaters from the Matahina Dam such that the effect of the discharge is kept to a practicable minimum and the integrity of the Matahina Dam structure is maintained, and BOPRC's main interests to provide flood protection to the community and minimising damage to the RTRFPS.

The procedures set in this document will generally be observed and applied by Trustpower to meet the flood management conditions of RC65750. However, action to be taken or procedures to be followed will also be influenced by the conditions applicable at the time.

In the event of flood conditions, Trustpower will maintain close liaison with BOPRC and consult on action to be taken. Where a major or minor flood has been forecast, Trustpower is committed to undertake reasonable requests by BOPRC, such as lowering water levels behind the dam. However, where dam safety is potentially at risk, the final decision will remain Trustpower's and action other than in accordance with this document cannot be precluded.

Bay of Plenty Regional Council (under its statutory functions for flood management and as Group Controller for the Civil Defence Group Emergency Operations Centre) has overall responsibility for coordinating regional response to flood events, which includes warnings to the public in the affected areas.

When a flood is forecast, **Trustpower and BOPRC** (and where appropriate other river users) agree to work collaboratively to manage the impending flood event. For the purpose of this plan, floods have been separated into minor and major flood events; a minor flood being an event where the peak inflow is forecast to exceed 300 cubic meters per second (m^3/s or 'cumecs') but not to exceed $500 \text{ m}^3/\text{s}$, and a major flood being an event where the peak inflow is forecast to exceed $500 \text{ m}^3/\text{s}$.

Where a major flood is forecast, the Matahina HEPS will be operated to maximise available storage provided such operation does not induce dam safety risks or place public safety at risk.

Where a minor flood is forecast, the Matahina HEPS will be operated to maximise flow capture for the purpose of attenuating flood discharge and maximising generation.

3 Lake Management

Management of Lake Matahina levels requires a balance between ensuring adequate water storage to meet generating requirements and minimising the need to spill water during flood events. Such spillage is not in the interest of Trustpower as it represents wasted energy, in addition to the potential for downstream flooding. Management procedures over the years have ensured that few spillages have occurred.

The resource consent conditions regulating the operation of the Scheme during floods (Conditions 42, 42A & 43), particularly those that exceed 500 cumecs, are aimed at employing the Matahina HEPS to provide some flood attenuation by providing storage in Lake Matahina, potentially reducing flood impact on the downstream environment (wherever practicable) and preserving the integrity of the RTRFPS.

Due to the relatively limited storage capacity of the Dam, containing large floods is not possible, and flood management becomes focussed on optimising the available storage and reducing the effects of the flood peak. Discussions with BOPRC may allow the timing of spillage to account for issues within the RTRFPS and community at risk. For example, accounting for the water travel time from dam to Te Teko, timing of peak spill discharges with low tides and during daylight hours would be optimal.

It is important to note that management of the lake during flood events therefore is not simply about reducing the peak flood flow, rather the focus should be on managing the potential flood hazard at times when the communities protected by the RTRFPS are most vulnerable.

4 Review

The Lake Matahina Flood Management Plan will be reviewed by both parties (Trustpower and the Natural Hazards Group) at least every five years, and may be amended, following approval in writing from BOPRC, in order to better provide for the following objectives:

- (a) Compliance with resource consent conditions.
- (b) Continual flood preparedness.
- (c) Monitoring and control during the rise, peak and fall of floods.
- (d) The provision, use and restoration of flood storage capacity in Lake Matahina.

5 Operating Guidelines and Procedures

The following section describes the information available to guide decision making during flood events. Nothing in this section is intended to exclude other forms of data, warning systems or forecasting methods that may be available or developed in the future. Figure 1 and 2 below demonstrates how the various sources of information are used in the flood management decision process for the Matahina HEPS.

5.1 Rainfall Forecasting

Rainfall forecasting will utilise information from sources such as; established meteorological models, extreme weather warnings, satellite maps and where practicable rainfall radar information to provide advanced warning of flood events.

5.2 Flood Forecasting

A flood forecasting system shall be maintained by either (both) BOPRC and / or Trustpower and utilised in a collaborative manner. The forecasting system will, in conjunction with rainfall forecasts and direct hydrological monitoring, help inform flood management decisions.

5.3 Hydrological Monitoring

Trustpower and BOPRC operate a number of river flow and rainfall gauges in the Rangitaiki Catchment. These are listed below in Table 1. These sites provide real time verification of rainfall and flood forecasts and allow for a finer resolution of flood management once the flood is underway.

5.4 Scheme Inflow

Real time inflows into Lake Matahina are primarily calculated using data from upstream river flow sites. Flows from the Aniwhenua and Waihua (x 2) gauges provide a close approximation to actual lake inflow. Gauges further up the catchment provide details on separate sub-catchment yields which allow greater advanced warning on rising flood flows. These flows are displayed in CITECT (the operational software) and monitored by the Trustpower staff manning the 24hr Operation Centre based at Te Maunga and site staff located at the dam. As a crosscheck, TPL use a volumetric calculation using lake level and rate of change over a 24hr rolling period (updated every 15mins).

Further it has been agreed to jointly fund (BOPRC and Trustpower) the installation of a river gauge upstream of Lake Matahina. This gauge, once calibrated and verified, will provide real time inflow data. It is recognised that it may be some years before this gauge is accurately calibrated for larger flood flows.

5.5 Data and Information Share

Except as required by condition of resource consent, real time data, recorded by either party, will be made available to the other party for flood management purposes. When a flood is not forecast it is agreed that such data will remain confidential to both parties.

For the purpose of this flood management plan, relevant data will be shared between parties directly involved in flood management. Unless otherwise agreed or required (e.g. by resource consent) such data should be treated as confidential to each party.

In particular, data such as machine output and lake level is commercially sensitive to Trustpower during normal operating conditions. It is agreed therefore that this data will only be provided in real time once a flood has been forecast.

For the avoidance of doubt, no restriction shall be applied to data shared between the parties if such restriction might compromise public or personnel safety.

5.6 Dam Operation - All Floods

- a. Trustpower shall advise the Chief Executive of BOPRC if it is proposed, as a consequence of a flood event, to increase the level of Lake Matahina above RL¹ 76.2 meters (max control level). In all but exceptional circumstances, this advice shall occur in advance of the lake level exceeding RL 76.2m.
- b. In all except “Emergency Condition²” situations, the level of Lake Matahina shall not exceed RL 76.8m (design flood level).
- c. Lake Lowering - The maximum rate of lake drawdown shall not exceed 0.3m per hour (equivalent to 180 m³/s greater than inflow), except when a “Flood Event”³ arises (e.g. where inflow to Lake Matahina is forecast to exceed 500m³/s) a drawdown rate of up to 0.5m per hour is permitted (equivalent to 300 m³/s greater than inflow).
- d. Lake Filling - The maximum rate of river level drawdown shall not exceed 1.2m per 8 hours at the tailrace of the dam. Drawdown to such a maximum may be made in a period of 30 minutes, provided the outflow is kept constant for the following 7.5 hours.
- e. More detailed instructions in relation to the main stages of flood management are provided in Figure 1 below. Figure 2 demonstrates the process for estimating minor or major flood flows.

5.7 Dam Operation - Minor Floods (> 300m³/s) - RC65750 Condition 42A

- a. Where a minor flood is forecast within 24 hours to exceed 300m³/s, lake drawdown will be managed by Trustpower to reach and maintain a lake level below RL 73.15m (i.e. at the bottom of the normal operating range) before inflow is expected to exceed 300m³/s.
- b. The minimum lake level will be RL 73.15m unless it is agreed with BOPRC that it is necessary to reduce the level further. The absolute minimum level during a minor event will be RL 71.60m.

¹ As highlighted in RC65750 Condition 8, all Reservoir Levels ('RL') are stated in metres above Moturiki Datum.

² “Emergency conditions”, as identified by resource consent RC65750 condition 8, occur when:

- a. Plant within the Matahina Hydroelectric Power Scheme has failed;
- b. The electrical network or transmission system has become constrained or unavailable;
- c. A natural event, such as a flood, restricts the ability to operate all or any aspect of the Matahina Hydroelectric Power Scheme safely; or
- d. When a flood event is forecast, storage needs to be provided in accordance with Conditions 42, 42A and 43 of this resource consent and with a methodology set out in a flood management plan that is certified under conditions 44 or 45 of this resource consent.

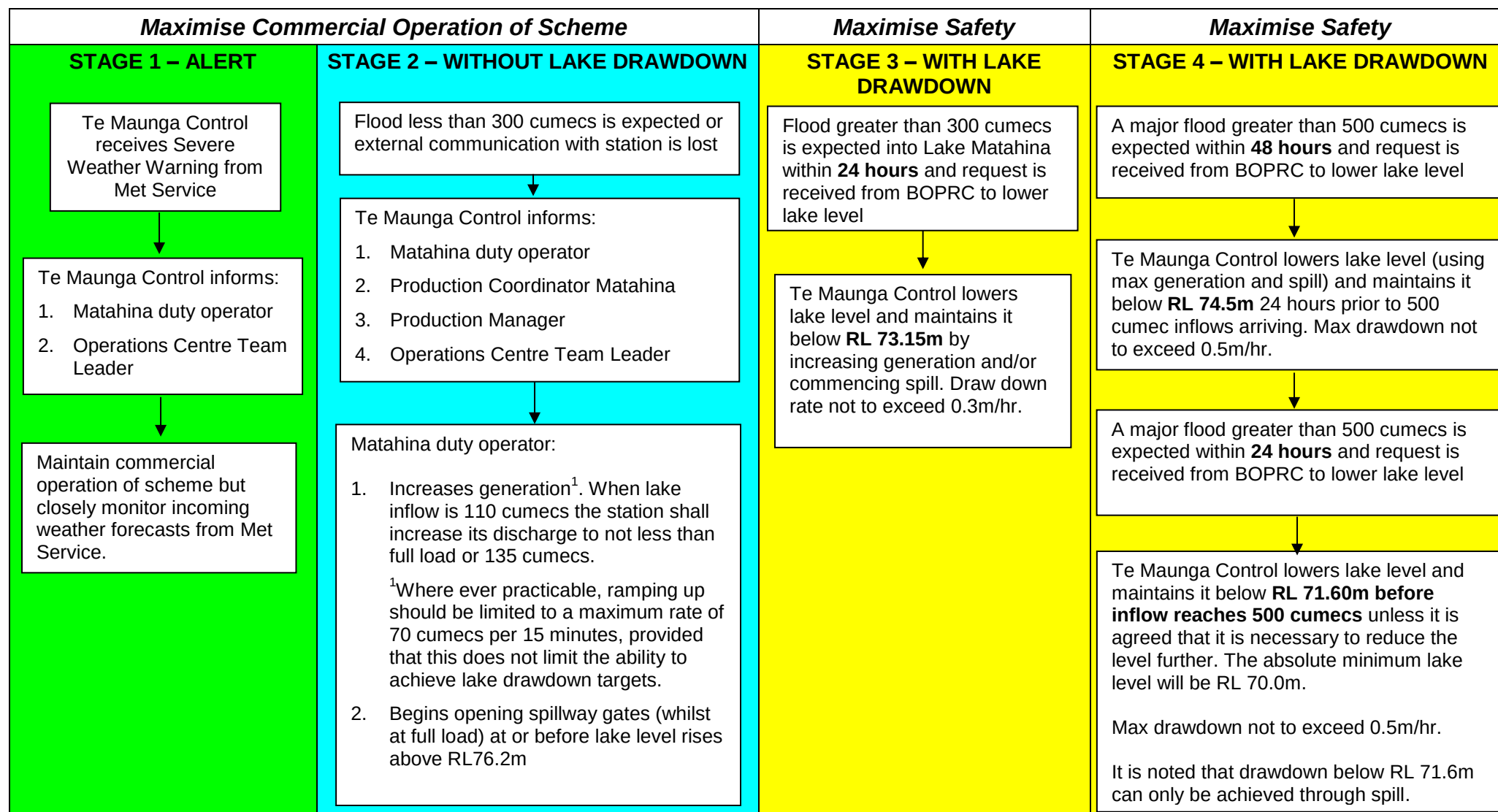
³ A “flood event”, as identified by resource consent RC65750 condition 19, shall mean a flood of greater than 500 cubic metres per second (cumecs) into Lake Matahina.

- c. For floods less than 500m³/s, refilling of lake storage should where practical be scheduled to reduce peak scheme discharge with particular focus on the hours of darkness or high tides.
- d. Trustpower shall advise the Chief Executive of BOPRC of the proposed lake drawdown strategy in advance of flood flows arriving at Lake Matahina.

5.8 Dam Operation – Major Floods ($\geq 500\text{m}^3/\text{s}$) – RC65750 Condition 42 & 43

- a. When a major flood is forecast, Trustpower shall, following a request from BOPRC or as part of Trustpower's own flood management purposes, provide storage in Lake Matahina.
- b. Where a major flood is forecast within the next 48 hours, lake drawdown will be managed by Trustpower to reach and maintain a lake level below RL 74.5m (i.e. within the bottom third of the normal operating range) at least 24 hours before the predicted time that inflow is forecast to exceed 500m³/s.
- c. Where inflow is forecast to exceed 500m³/s within the next 24 hours, lake drawdown will be managed by Trustpower to reach and maintain a lake level between RL 71.6m and RL 70.0m before inflows exceed 500m³/s.
- d. Trustpower shall not however, lower the lake level such that it falls below RL 71.6m without the prior approval of the Chief Executive of BOPRC.
- e. For floods greater than 500m³/s, as well as targeting peak discharge, liaison with BOPRC shall be undertaken to determine if there are any particular periods that, due to public safety or community vulnerability concerns, discharge should be minimised provided this does not compromise dam safety.
- f. Trustpower shall advise the Chief Executive or delegate of BOPRC of the proposed lake drawdown strategy, and provide regular updates, in advance of flood flows arriving at Lake Matahina.

Figure 1 – Stages of Flood Management for Matahina Scheme



*BOPRC = Bay of Plenty Regional Council

Figure 2 - Derivation of Minor or Major floods

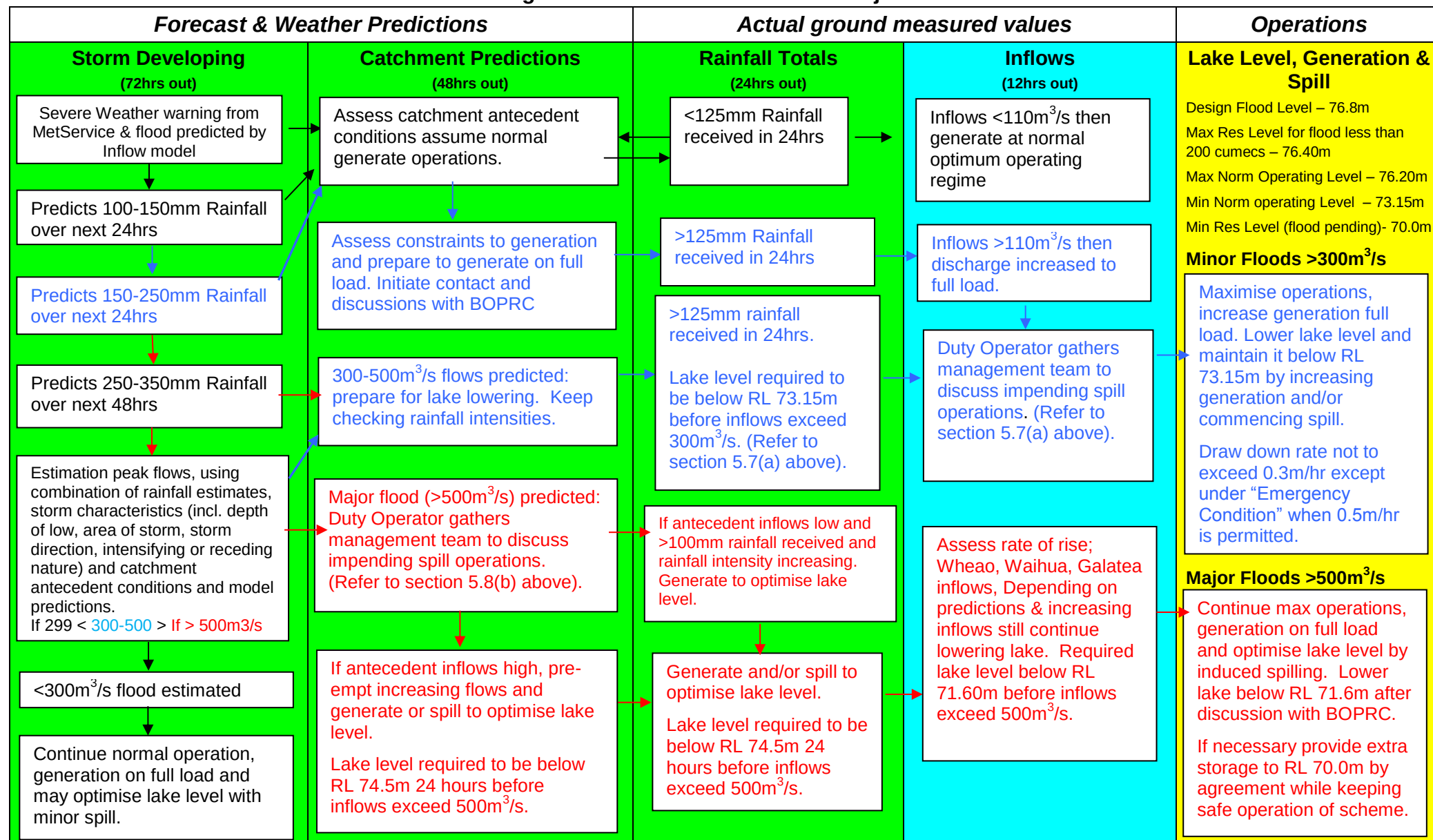


Table 1 - Monitoring Stations/Sites within the Rangitaiki catchment.

Stn Nos	Station Name	Station	Parameter	Primary Source	Primary Telemetry	Secondary Source,	Secondary Telemetry	Logger type	Collected By	Funded By
15401	Rangitaiki @ Thornton	Thornton	Level & Rain	Shaft Encoder	HydroTel - GPRS	none	Nil	Campbell CR500	BOPRC	BOPRC
15408	Rangitaiki @ Murupara	Murupara	Flow	Kainga Encoder	Aquibel Remote	Greenspan Transducer	Nil	1, Aquibel, 2, Kainga	NIWA-Rot	TP / FRST
15453	Waihua @ Gorge	Gorge	Flow	Kainga Encoder	Aquibel Remote	Foxboro Chart	Nil	1, Aquibel	NIWA-Rot	TP
15499	Lk Matahina@ Dam	Dam	Level	Kainga Encoder	Aquibel Remote	nil	nil	1, Aquibel, 2, nil	NIWA-Rot	TP
15466	Rangitaiki @ Aniwhenua	Aniwhenua	Flow	Unidata Encoder	Aquibel Remote	Greenspan Transducer	nil	1, Starlogger, 2, Micrologger	NIWA-Rot	TP
15410	Whirinaki @ Galatea	Galatea	Flow	Sutron Sensor	Aquibel Remote	Kainga Transducer	nil	1, Starlogger, 2, Unidata Starlogger	NIWA-Rot	TP / FRST
15412	Rangitaiki @ Te Teko	Te Teko	Flow	Kainga Encoder	Aquibel Remote	Water pilot Transducer	nil	1, Aquibel, 2, Kainga	NIWA-Rot	TP
15464	Rangitaiki @ Western Weir	Western Weir	Flow	Kainga Encoder	Aquibel Remote	nil	nil	1, Unidata Starlogger	NIWA-Rot	TP
15462	Wheao @ Powerhouse	Powerstation	Flow	Transducer	Citect	Generation		nil	TP	TP
3250	Rangitaiki @ Matahina	Powerstation	Flow & Rain	Total	Citect	Generation		nil	TP	TP
	Wheao at Intake	Wheao River	Flow & Rain	Transducer	Harvest	nil		Harvest	TP	TP
				RG type	Bucket size	Storage gauge		Primary Telemetry		
876002	Whakatane	Huiarau Summit	Rain	Ota/TB3	0.5mm	Yes		HydroTel	BOPRC	BOPRC
873002	Whakatane	Huitieke	Rain	Ota/TB3	0.5mm	Yes		HydroTel	BOPRC	BOPRC

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Stn Nos	Station Name	Station	Parameter	Primary Source	Primary Telemetry	Secondary Source,	Secondary Telemetry	Logger type	Collected By	Funded By
868410	Rangitaiki	Kokomoka	Rain	Ota/TB3	0.5mm	Yes		HydroTel	BOPRC	BOPRC
860710	Rangitaiki	Te Teko	Rain	Ota/TB3	0.5mm	No		HydroTel	BOPRC	BOPRC
870201	Waimana	Ranger Station	Rain	Ota/TB3	0.5mm	Yes		HydroTel	BOPRC	BOPRC
769701	Tarawera	Awakaponga	Rain	Ota/TB3	0.5mm	Yes		HydroTel	BOPRC	BOPRC
863601	Pokairoa @ Pylon Rd	Pylon Rd	Rain	Ota	0.5mm	Yes		Aquitel	NIWA-Rot	FC
863701	Pokairoa @ Railway Culvert	Railway Culvert	Rain & Flow	Ota	0.5mm	Yes		Aquitel	NIWA-Rot	FC
866801	Whakatane @ Tarapounamu	Tarapounamu	Rain	Ota	0.5mm	Yes		Aquatel	NIWA-Rot	BOPRC/TP
1184	PRFA Goudies	Goudies	Rain	FTS/TB	0.1mm				PRFA	PRFA
	PRFA Matea	Matea	Rain	FTS/TB	0.1mm				PRFA	PRFA