Puke Kapo Hau
Stage 2

Fire Management Plan

October 2025

Contents

1 Introduction

1.1 Project Summary

Tararua Wind Power Limited **("TWP")**, a fully owned subsidiary of Mercury NZ Limited, is progressing Stage 2 of the Mahinerangi Wind Farm which is to be known as "Puke Kapo Hau" **("the Project", "Puke Kapo Hau"** or **"MWF Stage 2"**).

The project site is located approximately 50 km west of Dunedin and approximately 5 km north of Lake Mahinerangi, at the eastern foothills of the Lammermoor Ranges (refer to Figure 1).

Figure 1: Project site location

Included in the project's supporting infrastructure are a substation, new transmission line and Battery Energy Storage System ("**BESS**"). The substation will comprise a security-fenced hardstand platform approximately 100m x 55m (3,850m2). It will contain gantries and electrical 'bus-work', ground mounted 33kV/110kV transformers, and ancillary equipment. The identified location is centrally located between WTGs 27 and 31.

The BESS will similarly comprise a security-fenced hardstand platform containing 32 battery containers mounted on concrete foundation pads. The impervious platform will be approximately 70m x 60m (4,200m^2). The battery containers are roughly similar in size to shipping containers (up to approximately 3m high).

Figure 2 below shows the general location of the new substation, the BESS and temporary site compound.

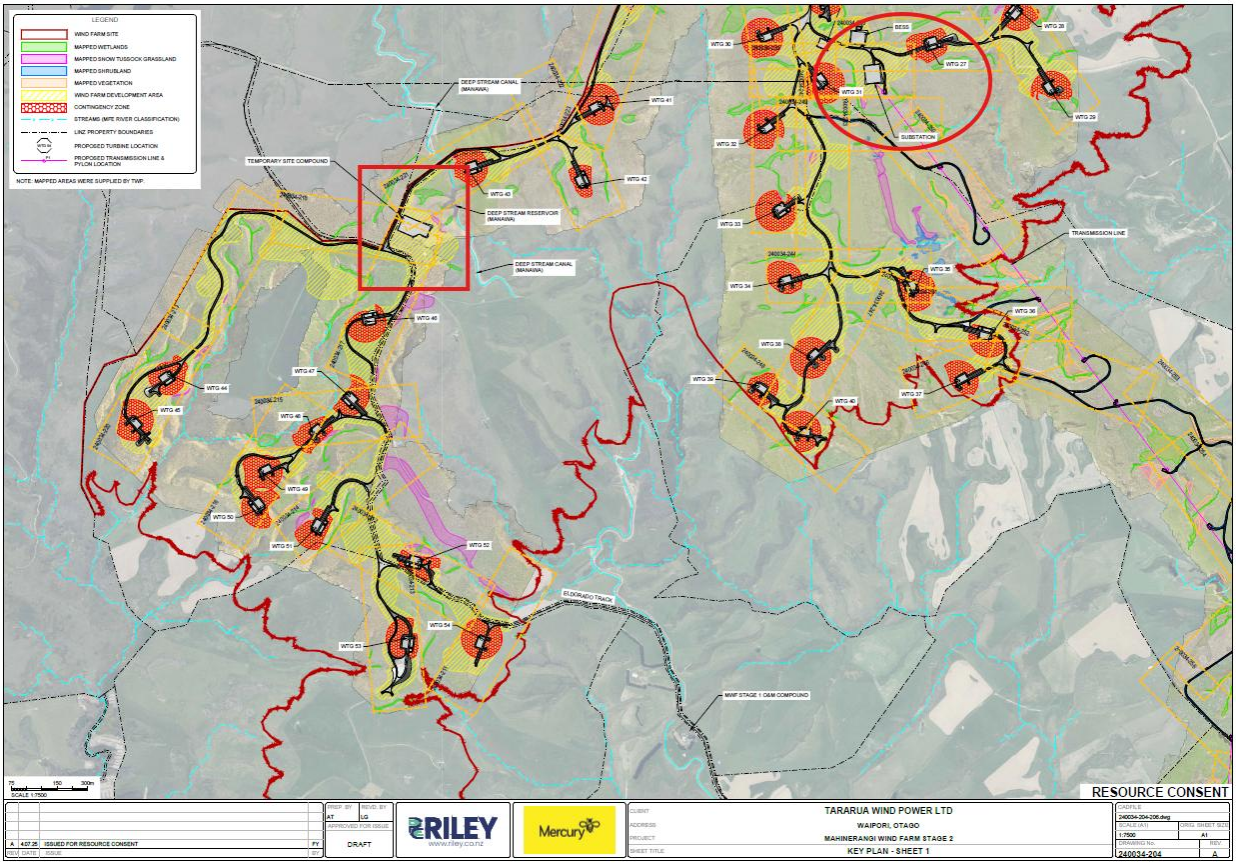

Figure 2: MAH2 BESS and Substation location (Red oval). Temporary Site Compound (red square).

2 Objective

The purpose of this Fire Management Plan is to establish management procedures to ensure that the fire risk associated with the Mahinerangi Wind Farm, transmission line and associated infrastructure is minimised and, should fires occur, that immediate and appropriate action is instigated.

3 Potential Ignition Sources

3.1 Turbine Ignition Potential

Fire damage to wind turbines can occur in the nacelle, tower, transformer of the wind turbine. Lightning strikes are among the most frequent causes of fire in wind turbines. The special risk of lightning strikes arises from the exposed locations and the large height of the structures, amongst others. Other typical and previously reported causes of fire include:

- Lightning strike.
- Bearing failure.
- Cable damage during rotation.
- Over current in cables.
- Earth fault/short circuit.
- Arcing.
- Overheating following overloading.
- Mechanical brake – high temperatures/sparks.

- Oil leakage/dirt.
- Spontaneous ignition through dirty cleaning cloths.
- Work involving fire hazards – hot works (e.g., welding, grinding, etc.); and
- Transformer insulation breakdown/dirt.

3.2 Site Ignition Potential during Construction

Fire damage on the construction site can occur in all construction plant being used on the project e.g. Excavators, Construction Cranes, Dump trucks, Truck & trailers, Site Offices and the Concrete Batching plant. Other typical and previously reported causes of fire include:

- Lightning strike.
- Moving plant failure.
- Equipment engine compartment fires due to bird nesting
- Hard rock groundbreaking sparking
- Hitting or damaging power cable overhead and underground.
- Over current in power cables.
- Earth fault/short circuit.
- Overheating following overloading.
- Construction plant's mechanical brake – high temperatures/sparks.
- Fuel / Oil leakage.
- Spontaneous ignition through dirty cleaning cloths.
- Work involving fire hazards – hot works (e.g., cutting, welding, grinding, etc.); and
- Power Generators for the site offices and/or concrete batching plant breakdown.

3.3 BESS Ignition Potential

Fire risk at a BESS facility is typically associate with a thermal runaway event. While these are rare it remains the primary risk with Li-ion batteries. Thermal runaway occurs when where a cell enters a state of self-heating due to the failure of one cell or multiple cells. The thermal runaway process can be separated into three main stages (Rappsilber, et al., 2023) as displayed in Figure 3:

- Stage 1: If the heat generated in a cell or multiple cells due to a failure cannot be dissipated, the temperature of the cell(s) will continue to rise, potentially initiating a sequence or range of exothermic reactions.
- Stage 2: The solid electrolyte interphase (SEI) is damaged (usually at 80 to 100 °C), leading to an exothermic reaction between the electrolyte and charged anode. It is at this stage, off gassing due to the volatilization of the electrolyte begins. The mechanical breakdown of the separator (at 120–150 °C) leads to an internal short circuit (ISC) and an exponential temperature rise. Above 180 °C, the cathode begins to decompose exothermically and release oxygen.
- Stage 3: The resulting oxygen-containing atmosphere leads to a rapid, largely exothermic reaction with the electrolyte, causing further rapid temperature rise. The reaction is

accompanied by gas production, which can be accompanied by flame formation and/or an explosion.

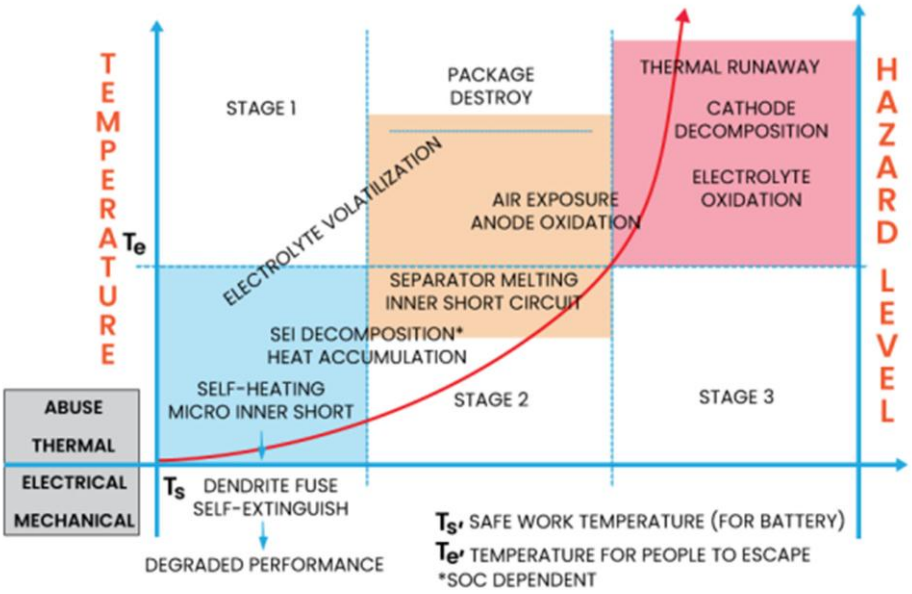

Figure 3 - Stages of Thermal Runaway Process in Lithium-Ion Batteries (Sino Voltaics, 2020)

The causes of thermal runaway can be categorised broadly into three areas, namely mechanical abuse (for example vehicle impact), electrical abuse (for example overcharging) and thermal abuse (for example external fire).

If flammable gases ignite during the thermal runaway process it leads to battery fire and flaming. Although thermal runaway is generally contained to one battery module, some recent fire incidents in global BESS facilities have shown propagation of up to two battery units. It should be noted that although battery fire intensity may be the same for a larger battery container/modules with higher energy storage capability compared to smaller battery containers/modules, the duration of the fire would be lower in a smaller battery and therefore reduce chance of propagation to other adjacent units.

4 Risk Management

4.1 Turbine Fire Risk Management

The best way to prevent fire damage in a wind turbine is an appropriate maintenance and inspection procedure including annual inspection of the lightning protection system. The following actions are recommended to prevent/minimise fires:

- Regular maintenance according to the operating manual.
- Regular inspections.
- SCADA monitoring system.
- 5-yearly gas and oil in transformer insulation analysis.
- Dry-type transformers – annual surface control (cleaning).
- Recurring electrical inspections (2-yearly).
- Thermography (i.e., infrared imaging detection of radiation/heat) of:
  - Connection areas and, if possible, contacts of the LV HRC fuse switch disconnectors.
  - Clamping devices and terminal strips.
  - Connection areas and, if possible, contacts of bus bars, contactors, capacitors etc.
  - Connection areas and surfaces of transformers and converters.
  - Power cable and cable bundles; and
  - Surfaces of equipment which may pose a risk of heating.
- Mobile devices (e.g., welding or power tools) which are applied in the course of maintenance and repair have to be inspected on a regular basis (semi-annually) according to national requirements.
- Inspect lightning protection system annually or more frequently and after a severe storm/lightning event. Visual inspection of all air terminals and down conductors as well as measuring the contact resistance of the conduction path from the air terminals in the rotor blades to the ground terminal lug and measuring the ground resistance of the foundation.
- Document and report findings and remedy.
- Installation of an automatic fire detection system; and
- Installation of an automatic fire suppression system.

By ensuring appropriate inspection and maintenance, installing fire detection and fire suppression, and considering turbine components as potential causes of fire and fire loads when selecting turbines, the likelihood of a fire igniting from a turbine is considered unlikely to occur during the project life.

4.2 Construction Fire Risk Management

Reducing the likelihood of a fire starting or spreading on the site during construction can be achieved by preparing the site and site staff appropriately.

Prior to construction the following actions will be undertaken:

- Identify locations for muster points and emergency egress and provide appropriate signage.
- Confirm locations for static fire water tanks, in consultation with landholders and contractors.
- Install and fill static fire water tanks.
- Install appropriate signage.
- In extreme dry / high risk ignition conditions employ a spotter for groundbreaking, hot works, etc.
- Contact details for local landholders will be provided to the Site Manager to contact in the event of a fire. These details will be kept at the site office and accessible to the Site Manager.
- Ensure all permanent construction workforce at the work site are aware of the fire emergency response procedures and are trained in the use of on-site fire extinguishers; and
- Through the site induction process, all site personnel will be made aware of the activities that can and cannot be undertaken when the fire risk is high.

During construction and operation, the following will be undertaken:

- No smoking on site except in designated areas where there is a non-flammable surface (e.g., gravel).
- Monitor the fire risk at: https://fireweather.niwa.co.nz/region/Otago.
- Monitor the condition and level of static water supply tanks.
- Where practicable plant and heavy equipment will carry at 9.0L Water Stored Pressure fire extinguisher, in other situations the site foreman vehicle and/or portable site offices will have fire extinguisher available.
- Equipment pre-start checks of engine compartment for bird nests.
- All vehicles travelling beyond the site compound carry at least one 1kg powder fire extinguisher.
- All vehicles travelling beyond the site compound at any time to carry communications equipment; and
- Access tracks are regularly monitored to ensure no damage by heavy construction vehicles causes them to become un-trafficable for emergency vehicles.
- Implementation of hot works permitting system and protocols.
- During very high/extreme fire risk review working hours for high-risk task, i.e., early start, stop at midday.
- Review FENZ Section 52 restrictions that prohibit certain activities during very high/extreme fire danger.

4.3 BESS Fire Risk Management

As noted in section 2.3 the most likely cause of a BESS related fire is a thermal runaway event. Should this occur, the following steps should be observed when responding to such an event.

Step #	Action	Responsibility
1	If safe to do so, shut off the modules If an external E-Stop button or remote (BMS/SCADA) shutdown contact to the BESS is present, engage it. If the BESS is serviced upstream by an external AC breaker or disconnect, open the breaker or disconnect.	Site Manager or Representative
2	Evacuate the immediate area if necessary following the evacuation procedure	Site Manager or Representative
3	Contact FENZ (Call 111 or direct number TBC once operational)	Site Manager or Representative
4	Contact the BESS supplier technical support	Site Manager or Representative
5	Maintain a safe distance from the unit and monitor (at the muster point) • If fire has not developed and only smoke is visible, take a defensive stance toward the system and be prepared to apply water spray to neighbouring exposures and neighbouring battery modules. • If a fire does develop take a defensive stance and apply water to neighbouring battery enclosures following isolation of the stormwater.	Site Manager or Representative
6	Allow the BESS to cool down (minimum of 12 hours)	
7	Monitor the temperature of the affected BESS module and surrounding modules using a thermal imaging camera	Site Manager or Representative or QFES personnel
8	Arrange maintenance to enable safe return to service or, if unable to return to service, organise safe disposal of affected BESS	Site Manager or Representative
9	Completed incident investigation process	Site Manager or Representative

If a fire does occur in a BESS unit it is recommended to fight the fire defensively and the FENZ should follow the following directions:

- Maintain a safe distance of 20 m in any direction of the fire
- Allow the battery to burn itself out
    - It is important for FENZ and site personnel to understand that applying water directly to the affected BESS will not stop the thermal runaway event, as the fire will be located

behind several layers of steel material, and direct application of water has shown not to delay/stop escalation.

- Isolate the stormwater system to allow containment of fire water
- Recommended to apply water spray to neighbouring BESS modules following isolation of the stormwater system to avoid discharge of contaminated water to the environment.

Emergency responders PPE

For a thermal runaway event or a BESS fire, the emergency responder in this case it would be FENZ should have the following Personal Protective Equipment (PPE).

- Wear self-contained breathing apparatus (SCBA)
- Fire-protective turnout gear
- Any other standard FENZ PPE

4.4 Site Fire Risk Management

Reducing the likelihood of a fire starting on the site can be achieved by restricting the activities that are undertaken.

Risk No.	Identified Risks With no consideration of *risk* mitigation treatments or controls in place	Risk Rating	Risk mitigation treatments	New Risk Rating
Construction Phase - The highest risk identified at the site is a grass fire during the construction phase				
1	Internal fires on site from welding, cutting and grinding or discarded cigarettes during the declared fire danger period: • Whilst these hazards will result initially in minor fires, in the absence of nearby / easily accessible fire firefighting equipment, i.e. water fire extinguisher, these fires could spread quickly, particularly under the influence of severe and above grass fire danger ratings; • Fire spread beyond the site threatening adjoining properties, livestock and fencing.	Med	• Standard construction management measures and restrictions will be applied on high fire risk activities (welding, cutting and grinding) during days the grassfire danger rating is high; • A 'hot work' policy will be adopted requiring a Hot Work Permit e.g. open flame work such as welding, cutting and grinding will not commence unless authority has been given by the Site manager or delegate. A "Hot Work Permit" will be completed prior to commencement of any work and remain current for 24 hours only'. • Will have a minimum two (2) x 9 litre stored pressure water extinguishers or firefighting capability (i.e. water tanker) available and ready to operate always when welding cutting and grinding. • Will adopt a work practice of no welding, cutting grinding or undertaking other work that emits a spark or flame during a high/extreme fire risk. • Smoking will only be allowed in designated areas.	Low
2	Vehicle, machinery and equipment causing a grass fire from mechanical fault, leaking fuel, etc causing: • Depending on the grass fire danger rating, spread quickly	Med	• Each vehicle and piece of machinery working on site will be: ○ free from faults and mechanical defects which could cause an outbreak of fire; ○ fitted with a spark arrester; and	Low

Risk No.	Identified Risks With no consideration of *risk* mitigation treatments or controls in place	Risk Rating	Risk mitigation treatments	New Risk Rating
	across the landscape threatening livestock and local residence; • Fire spread beyond the site threatening adjoining properties, livestock and fencing.		○ Where practical a minimum of one (1) 9L water or powder extinguisher will be available for the construction team carry in a site vehicle. • All site vehicles will only use the Site access tracks during a high/extreme fire risk period to minimise the likelihood of igniting grass (i.e. no driving across grass fields).	
Operation Phase				
3	Internal fires on site from lightning strikes or cigarettes during the declared fire danger period resulting in a grass fire could: • Depending on the grass fire danger rating, spread quickly across the landscape threatening livestock and local residence. • Fire spread beyond the site threatening adjoining properties, livestock and fencing.	Med	• The likelihood of a lightning strike to the ground without rain resulting in a grass fire is assessed as 'Very Low'. • Lightening conductors will be installed to ground strikes and to minimise ground ignition and damage to the WTG's. • The site will have a strict smoking policy with smoking only permitted in designated cleared areas.	Low
4	WTG mechanism failure causing a wind turbine fire causing burning material to drop to the ground causing a grass fire: • Depending on the grass fire danger rating, spread quickly across the landscape threatening livestock and local residence. • Fire spread beyond the site threatening adjoining properties, livestock and fencing.	Med	• A WTG mechanism failure causing a wind turbine fire or resulting in a grass fire is rare. • This is due to systems been designed to prevent or contain a fire through the following engineering designs: ○ The WTG nacelle is designed to isolate it electronically, immobilising it mechanically and allow the fire to internally burn itself out. ○ There is limited combustible material to burn, i.e., the oils used are non-hazardous and have a high flash point which can vary between 180ºC to 236ºC. ○ To prevent oils reaching their flash point temperature and other parts overheating, WTG's are fitted with a monitoring system which will ensure that electrical, mechanical	Low

Risk No.	Identified Risks With no consideration of *risk* mitigation treatments or controls in place	Risk Rating	Risk mitigation treatments	New Risk Rating
			and hydraulic systems are functioning correctly; ○ The system also allows for remote slow down or shut down of the WTG in the event the operating thresholds such as temperature or blade speed are reached, or an electrical fault is identified; and • Lightening conductors will also be installed to ground strikes and to minimise ground ignition and damage to the WTG's.	
	Thermal Runaway of a BESS Unit	Med	• Ensure design adopts appropriate minimum standards. • Li-ion batteries and associated equipment are tested and certified to ISO 9001. • Bollards/protective barriers around areas at risk from impact (a risk-based decision during design). • Separation distances between battery containers through appropriate thermal testing/modelling (e.g., UL9540A). • Battery Management System (BMS) to properly manage the batteries state of change, including battery balancing devices, to avoid deterioration and individual cell over/under voltage during operation. • Lithium-ion batteries protections and circuit controls, such as ○ integrated circuit control systems to avoid voltage drift. ○ Current sensing circuits to avoid short circuiting. ○ Built-in positive temperature coefficient to protect against current surges. ○ Circuit interrupt device that opens at excess pressure. ○ Safety vent to release gases on excessive pressure build-up. ○ Separator that inhibits ion-flow when exceeding a certain temperature threshold • Thermal sensing of the cells to avoid over heating of cells. • Deflagration control. • A fire detection and suppression system for the Li-ion batteries. • Onsite fire water	Low

4.5 Training

The following training of on-site personnel will be undertaken prior to construction:

- Weather awareness around wind, temp, relative humidity (drivers for elevated fire danger).
- Review of all fire prevention / control measures.
- Fire equipment familiarization and operation; and
- Emergency response procedures.

5 Water Sources

5.1 Water Sources

Onsite water availability is restricted. The water requirements for the concrete production will be sourced off site and stored in tanks on site. At the start of the project, a water conservation plan will be established that will involve implementing water conservation within the construction methodology.

In the event of a fire, it is envisaged that the below sources of water will be available on site for firefighting, based on the water facilities provided during the construction of the Kaiwera Downs Stage 2 Wind Farm (to be confirmed for the final version of this FMP):

<u>During Construction</u>
Site Compound Area – two 20,000 litre tanks.
Concrete Batch Plant – two 30,000 litre tanks.
Laydown Areas / Turbine Platforms – three 20,000 litre tanks (distributed around the site - transportable).
Construction Water Cart (mobile) – 30,000 litre capacity.
Construction Water Cart (mobile) – 15,000 litre capacity.

The 30,000-litre water cart will be on site during the earthworks with the 15,000-litre water cart on site post earthworks during the pavement works.

<u>Post Construction – wind farm operation</u>
O&M facility – two 30,000 litre tanks.

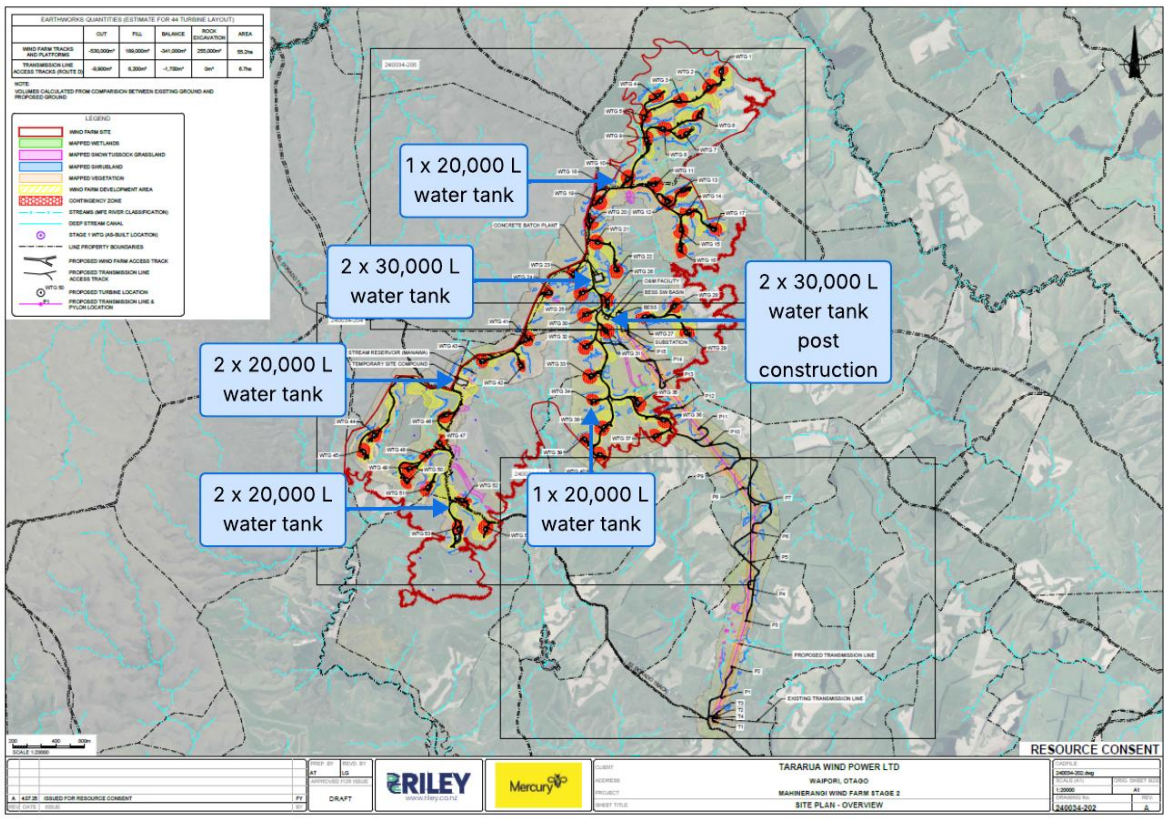

Figure 4: Water Supply Sources – Site Compound, Batch Plant and Laydown Areas

6 Emergency Response

6.1 Muster Point

The Muster Point will be at the car parking area at the Site Compound (see Figure 2). This will be clearly identifiable and marked accordingly and will form part of all site personnel inductions. In the event of a fire, site personnel must leave access tracks, passing bays, and turning bays clear to allow fire fighters rapid and unhindered access across the site.

6.2 Personnel Duties

Table 1 describes the duties of those present at the wind farm during the event of a fire either starting on site or entering the site from neighbouring properties during the construction or operation of the wind farm.

Job Title	Duties	
All personnel	1	On discovery of a fire that threatens the wind farm, raise the alarm.
	2	Inform the Person-in-Charge and give location, type and extent of fire.
Site Manager	1	Determine type, location and extent of fire.
	2	Direct visitors, contractors and service personnel to Muster Point.
	3	Call 111 and ask for fire.
	4	Advise landowners and neighbouring landholders.
	5	Use fire-fighting equipment only if safe and when appropriate to do so.
	6	Determine need for additional services or evacuation.
Other Personnel	1	Report to Muster Point immediately.
	2	Unless directed otherwise or part of the firefighting crew, stay away from the fire area.
	3	Assist or vacate the site as instructed.

Table 1: Personnel Duties

6.3 Evacuation Plan

This plan will be activated whenever a fire is reported either on or immediately threatening the work area.

In the case of a fire or any emergency persons working on the MWF are to assemble at the Muster Point. If it is unsafe to do so they are to assemble at the Secondary Muster Point. Here workers will be accounted for and instructed what to do next. It will be the responsibility of the Site Manager to decide whether they return to work or evacuate the site completely after the hazard has been reviewed. If it is decided that it is unsafe, workers are to evacuate the site via Isla Road.

Site Details:

A Muster Point will be established at the commencement of works on site. This will be clearly identifiable and marked accordingly. In the event of a fire, site personnel must leave access tracks in and around the muster point clear to allow fire fighters rapid and unhindered access across the site.

The primary access road into and out of the site is Eldorado Track. In emergency situations only, Davidson Road West may also be used to evacuate the site.

All gates into and out of the turbine sites will be unlocked therefore there will be unrestricted access in an emergency.

The Site Manager will be responsible for monitoring the fire risks and informing all persons of any additional risks on site. During an emergency they are to be informed of all information and will decide how to proceed.

7 Contact Details

7.1 Contact Details

Fire Emergency New Zealand

a) Group Manager: TBC
b) Local Brigade: TBC
c) Local Brigade: TBC

Mercury Staff

a) Site Manager

b) Site Coordinator

c) Mercury Project Manager

Higgins Contractors Ltd - Staff

a) Civil Works Manager – TBC
b) Earthworks Supervisor – TBC
c) Earthworks PD - TBC

7.2 Fire Call Questionnaire

Collect or pass on as much information as you can:

1. **Date, time and callers name:**

   Date: ..... *Time:* ..... *Person:* .....

   Contact Ph No: ..... *Callers address:* .....

2. **Location of fire (include rapid number and map reference if possible):**

   Location: ..... *Special Response Zone Number:* .....

   Rapid No: ..... *Map ref: NZTM2000 Sheet No.* ..... *Grid ref:* .....

3. **Values threatened (life, land, property, buildings etc.):**

   .....

4. **Accessibility:**

   Access Road: ..... *Gate No:* .....

   Nearest Highway or Road intersection: .....

5. **Material burning and topography:**

   Material: ..... *Topography:* .....

6. **Material ahead of fire:**

   .....

7. **Wind strength and direction:**

   .....

8. **Size of fire (hectares burnt, length of fire front, etc.):**

   .....

9. **Specific assistance required (manpower, equipment, helicopters, etc.):**

   .....

10. **Who is call passed on to and what action is taken:**

    .....

11. **Date, time and person recording the call:**

    Date: ..... *Time:* ..... *Person:* .....

8 Fire Danger Classes

8.1 Degrees of Readiness

The following degrees of readiness will be observed for each of the fire danger classes:

A. <u>Low/Moderate Fire Danger</u>:

1. Fire equipment to be kept in a state of readiness;
2. Daily weather readings to be taken; and
3. Welding and grinding operations must have fire equipment immediately available onsite and only be done when a fire permit has been obtained.

B. <u>High Fire Danger</u>:

1. Fire equipment to be kept in a state of readiness;
2. Welding and grinding operations must have fire equipment immediately available onsite and only be done when a fire permit has been obtained; and
3. All staff and contractors shall be advised of increasing level of fire danger.

C. <u>Very High/Extreme Fire Danger</u>:

1. Fire equipment to be kept in a state of readiness;
2. Welding and grinding operations must have fire equipment immediately available onsite and only be done when a fire permit has been obtained;
3. Patrols of worksite carried out as considered necessary by Site Manager;
4. All staff and contractors shall be advised of increasing level of fire danger;
5. All staff to be contactable by phone or radio; and
6. Regular weather readings.

Note: A "High" fire danger rating relates to days with high wind speeds and a high potential rate of fire spread and head fire intensity. Consideration must be given as to what types of operations are carried out, and at what hour of the day operations shall cease.

8.2 Fire Danger Class Interpretation

FIRE DANGER CLASS	DESCRIPTION OF PROBABLE FIRE POTENTIAL AND IMPLICATIONS FOR WILDFIRE SUPPRESSION*	NOMINAL MAX. FLAME HEIGHT
Low/Moderate	New fire starts are unlikely to sustain themselves due to moist surface fuel conditions. However, ignitions may take place near large and prolonged or intense heat sources (e.g., campfires, windrowed slash piles) but the resulting fires generally do not spread much beyond their point of origin and if they do, control is easily achieved. Mop-up or complete extinguishment of fires that are already burning may still be required provided there is sufficient fuel and it's dry enough to support smouldering combustion.	No visible flame
High	From the standpoint of moisture content, fuels are sufficiently receptive, to sustain ignition and combustion from both flaming and most non-flaming (e.g., glowing) firebrands. Creeping or gentle surface fires activity is commonplace. Control of such fires is comparatively easy but can become troublesome as fire damages can still result and fires can become costly to suppress if they aren't attended to immediately. Direct manual attack around the entire fire perimeter by fire fighters with only hand tools and back-pack pumps is possible.	up to 1.5 metres
Very High / Extreme	Running or vigorous surface fires are most likely to occur. Any fire outbreak constitutes a serious problem. Control becomes gradually more difficult if it's not completed during the early stages of fire growth following ignition. Water under pressure (from ground tankers or fire pumps with hose lays) and bulldozers are required for effective action at the fire's head.	1.5 + metres

9 Distribution

All persons working on the Mahinerangi Wind Farm site will attend a site-specific induction prior to work commencement. At the induction the Fire Management Plan and evacuation plan will be discussed with copies of the evacuation plan distributed.

Drivers on short term delivery assignments and site visitors will receive a short form induction. During this induction they will be made aware of the fire hazards on site and will be issued with a copy of the evacuation plan.

In addition, it is expected that all subcontractor employees and visitors will receive the subcontractor's briefing on the fire risks at the site.