INTEGRATED CONSULTANCY LIMITED

Wither Hills Farm Park

Wildfire Risk Management Analysis

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May 2023

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1. Introduction

Refer to Appendix 1. The wildfire risk analysis area of interest is the Wither Hills Farm Park managed by Marlborough District Council. For the analysis the Marlborough District Council Bluegums Landfill site, Harling Park and Sutherland Stream Reserve have been included. The analysis will inform the upcoming Marlborough District Council *Wither Hills Park Management Plan*, and guide subsequent work related to fire planning including activity control triggers based on the New Zealand Fire Danger Rating System. The *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement* informs and supports the analysis. Prometheus software was used to model fire spread through the vegetation under both High and Extreme fire dangers.

Wildfire is considered a risk to the park, its users, and facilities as well as neighbouring properties. Wildfires burning under extreme or greater fire intensities are not able to be extinguished using direct attack methods. Over the past 10 years ignitions have occurred both within and outside the park that either threatened or damaged it. Climate change has been considered as it relates to a change in the annual average number of Low to Extreme fire danger days for the park.

Reducing the likelihood of ignitions is priority followed by reducing the consequence should one start. Reducing the likelihood of ignition requires increasing the awareness of fire risk with users and neighbours and the application of activity controls for spark hazardous operations including access controls. For properties that boundary the park a fire prevention (reduction) awareness program is required, and this would be done in conjunction with FENZ. Reducing the consequence from a fire looks at the safety of people, protection of assets, reduction in a fire's damage potential through early detection, fast response, and reduced rate of spread and fire intensity. This aims to minimise injury and asset damage, reduce potential financial impacts and environmental damage, and maintain organisational reputation.

The park comprises the valleys, slopes, and ridges on the southern boundary of Blenheim Township and is approximately 1100 hectares with a 21-kilometre boundary. The boundary is shared with private property and other land that can be classified as either rural land, rural urban interface (RUI), rural intermix (RI), roads and other reserves. It is a dominant landscape with strong community interest in its management, draws around 300 thousand visitors each year and is viewable from Blenheim and surrounding parts of the wider District.

The landscape is highly modified with its original forest cover burnt and recovered to tussock which in turn was burnt and replaced with exotic grasses. It had (and still does have) serious tunnel gully erosion problems that saw mechanical intervention to collapse affected areas re sow and fertilise them. In recent times native revegetation and exotic amenity plantings were introduced with a mind to integrate farming, recreation, and erosion control. A fire on boxing day 2000 destroyed much of this revegetation including a covenant area on the true right side of Sutherland Stream. Subsequently revegetation took place using native species, exotic amenity trees, and harvestable forest species to complement the various land uses.

For this analysis, three future time points were considered. These time points represent possible scenarios for changes in park vegetation that aim to increase biodiversity, ensure soil stability, reduce fire risk, and improve amenity value in the park. Firstly, the current vegetation cover, followed by estimated concept covers at 20-years and 100-years. Restoration planting is occurring in

various locations including the Sutherland Stream Covenant area with some existing vegetation being used to shelter new plantings, with other exotic trees either cleared or tidied up.

Currently Park usage includes a range of recreational pursuits including walking/running, mountain biking, pastoral farming, erosion and flood control, some small block forestry, restoration projects, and concessions for commercial operators. Additionally, there are communication assets including associated structures and overhead powerlines, and the Bluegums Landfill operation.

The analysis presented here can be used to inform near and long-term strategic planning related to reducing wildfire risk through interventions such as vegetation restoration or maintenance, use of tracks and roads as fire barriers, and activity controls related to fire danger levels.

2. Assumptions and Limitations

The Analysis is specific to the vegetation fire environment at the Wither Hills Farm Park.

Wildfire ignitions can either be natural or human caused from many activities and their associated heat sources. It is not possible to have control over natural occurring ignitions or activities of those not directly related to the area of interest including deliberate ignitions with or without malicious intent.

There are numerous limitations and assumptions within the vegetation fire behaviour fuel models and systems. They are however based on sound science and best practice and have been adjusted to represent the observed fuels in the park.

Weather data from the Woodbourne remote automatic weather station (RAWS) was used to produce a 30-year long-term fire climate analysis. Some data errors may affect averages and data for specific hours on specific days. Topography will influence local weather due to elevation, steep slopes, valleys, ridges and proximity to water bodies and the coastline.

Grass curing levels were applied based on the general Blenheim and Woodbourne areas grass curing monthly percentages to determine grassland fire danger levels. The 20- and 100-year concept vegetation covers were developed by Council staff as potential examples based on current biodiversity and amenity goals with allowances made for practical growing considerations on the various dry Wither Hills landforms. They do not represent any Council policy but stand only as potential examples.

The climate change findings from the Scion report titled *Adapting and mitigating wildfire risk due to climate change: extending knowledge and best practice* uses 'Ranking' criteria for fire risk and identifies a percent increase in fire season length and number of days with increased fire intensity. The study is relatively broad landscape scale except for some larger population areas. For the WHFP risk process the report ranking levels 4 and 5 have been aligned to Very High and Extreme fire danger levels with rank 4 also applied to the Moderate and High fire danger.

The New Zealand Fire Weather Index System has its own assumptions and limitations that in turn inform fire danger.

The assumptions and limitations outlined in the *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement* apply.

Not all fire occurrences may have been recorded. The ones used are those that were notified to Fire and Emergency New Zealand (FENZ). Further the exact location of some of the ignitions may not have been accurately recorded.

Quantifying risk based on likelihood of ignition and spread uses wildfire occurrence return periods and assumes an ignition will spread. The consequence uses a range of descriptive terms that identify damage levels. A final risk level is determined by combining likelihood and consequence. The setting of the data ranges and descriptors is somewhat subjective and can be adjusted for organisational risk tolerance if necessary.

3. Stakeholders

FENZ

CDEM

Community groups

Neighbouring property owners

Concessionaires

Farm Management

Blue Gum Landfill Management

Marlborough District Council

4. Abbreviations

FDC Fire Danger Class

FWI Fire Weather Index

HFI Head fire intensity

ISI Initial Spread Index

MDC Marlborough District Council

ROS Rate of fire spread

RI Rural Urban Intermix

RUI Rural Urban Interface

WHFP Wither Hills Farm Park

5. Definitions

Escape routes. Are routes that can be used to get to a safety zone if the primary route being used is cut off.

Entrapment. Are unexpected situations in which a wildfire poses an immediate threat to peoples' lives because the use of escape routes and safety zones are difficult or impossible. In such situations last resort sheltering may be required to increase survival probability.

Evacuation point. Is a specified assembly location accessible by helicopter or vehicle where people, trapped or otherwise, can be picked up and transported to safety. Evacuation points are not safety zones and do not provide protection from all levels of fire behaviour.

Isolated. Residential dwellings or other structures that don't fit the definition of rural urban interface or intermix and are a long way apart from other dwellings and structures.

Rural Urban Interface. An area where structures directly border vegetation fuels to form a line between urban and adjacent rural land.

Rural Urban Intermix. An area where structures are scattered in vegetated land.

Safety Zone. Safety zones are places of refuge, places a person can be assured of their safety. Safety zone size is dictated by the fuel, terrain, weather conditions, and worst-case fire behaviour. Escape routes would lead to safety zones.

Wildfire. Unplanned vegetation fire. A generic term which includes grass fires, forest fires and scrub fires both with and without a suppression objective (https://knowledge.aidr.org.au/glossary/).

Wildfire Risk. The likelihood and consequence of a wildfire at a specific location under specified conditions.

Wildfire Management. All those activities directed to prevention, detection, damage mitigation, and suppression of wildfires (https://knowledge.aidr.org.au/glossary/)

6. Risk Context

The analysis sets out to identify wildfire risk associated with the park, and to recommend strategies and risk treatments to manage the current and future risk. Managing the risk of ignition (likelihood) is primary followed by managing damage potential (consequence). Managing the likelihood of ignition would aim to reduce risk through treatments informed by the history of occurrence and the presence of ignition sources. Managing consequence would aim to reduce risk through vegetation, track and visitor management treatments that reduce damage and injury potential. From the point of view of vegetation management, the current cover is considered along with the view of long-term revegetation including native and mixed exotic species, environmental management such as erosion and flood control, and ongoing farming practices.

The modification of risk (controls and treatments) must consider the concept of residual risk, as it is not possible to reduce risk to zero. The risk assessment process follows the AS/NZS ISO

31000:2018(E) – Risk management – Guidelines and utilises the New Zealand Fire Danger Rating System.

Wildfire is dynamic in that it moves across a landscape. Because a wildfire starting outside the park boundary could travel inside, risk must be considered from both within and adjacent. Treatments aimed at reducing risk must therefore be applied within and adjacent to the park.

Collaboration with neighbouring land managers, utility companies, community, emergency services and other organisations is needed to ensure optimum risk management outcomes. Some aspects of risk may be shared through the sharing of relevant risk information and determination of risk treatments and their ownership.

The tools and techniques to be employed are the New Zealand Fire Danger Rating System (Anderson 2005), Prometheus Fire Growth Modelling program (Tymstra et al. 2010), NZ Fire Behaviour Toolkit (Scion 2012) and Field Manual for Predicting Fire Behaviour in New Zealand Fuels (Pearce et al. 2012), representative remote automatic weather station (https://fireweather.niwa.co.nz/), fuel flammability guidelines (e.g. Clifford et al. 2013; Scion 2018), and existing Nelson/Marlborough activity control guidelines for spark hazardous operations (MKRFA 2016, Pearce et al. 2016, FENZ 2019) and forestry operations (WRFA 2016, Pearce et al. 2016).

Wildfire management is regulated by the Fire and Emergency Act 2017, the Resource Management Act 1991 and the Local Government Act 2002 and subsequent amendments.

7. Report Scope

7.1. In scope

Advice in the form of an analysis and report outlining the wildfire risk for the area of interest along with strategies and risk treatment recommendations.

7.2.Out of scope

Implementation of treatment recommendations including compilation of management processes and procedures.

8. Risk Criteria

The risk assessment process and determination of risk treatments will consider risk Reduction, Readiness, and Response in the context of wildfire.

8.1. Overall objective

To provide management recommendations for the Wither Hills Farm Park and connected reserves, including the Blue Gums Landfill, aimed at reducing wildfire risk.

8.2. Likelihood and consequence

The risk assessment process will consider the park's fire environment and likely fire behaviour and damage potential. Ignition likelihood is based on the presence of ignition sources, fuel receptiveness, and history of fire occurrence.

8.2.1. Likelihood

Likelihood is concerned with whether a wildfire can ignite within or adjacent to the park and spread. Ignitions that occur on land adjacent are only of interest if there is continuous vegetation that could spread fire to the park.

To determine likelihood level, the return period of ignition from annually to 10 years is considered along with ignition sources. The return period ranges are assigned a descriptor from Almost Certain to Rare.

Fire will spread when fire danger levels are Moderate or greater. High fire danger has been used for a likely scenario, and Extreme for a worse scenario (not the worst case) as presented in the *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement* Report.

8.2.2. Consequence

Consequence is concerned with the impact on values including visitors. A wildfire's intensity or energy release determines damage potential which includes injury to people. Radiant and convective heat as well as smoke and ember hazards will impact values. The consequence assessment requires an understanding of how a fire will behave once ignited, followed by its potential impact.

To determine the consequence level, the most likely location of ignitions and subsequent fire spread are identified, and fire behaviour modelled. Refer *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement*. Consequence levels range from insignificant to catastrophic with each considering the effects to people, the environment, and fixed assets.

8.3. Approach to evaluating risk

8.3.1. Risk level

Risk likelihood would consider wildfire ignitions within and adjacent to the park. For adjacent ignitions risk treatment approaches may need to include shared risk based on either a proportion of the risk, or fully transferred risk. For example, private properties on the park boundary or power supply and communication infrastructure within the park.

The likelihood and consequence levels are combined using the risk level matrix to determine a risk level. The risk levels have designators of Low to Extreme with each having a range based on multiplying the likelihood and consequence level scores, refer Appendix 16.

The risk level outputs can be skewed if necessary to account for organisational risk tolerance. Likelihood and consequence weightings could be adjusted or rather than using a multiplier for risk levels they could be assigned based on likelihood and consequence descriptors that in turn align with acceptable risk tolerance.

8.4.Risk treatment planning

8.4.1. Specific risk treatment objectives

Risk treatments can be considered under one or more specific objectives and where applicable assigned a function of reduction, readiness, and response. The combination of treatments from across these objectives would aim to reduce risk to a tolerable level.

1) To reduce the likelihood of ignitions.
2) To reduce the consequence on values.
3) To share the risk with other parties.
4) To retain or accept the risk.
5) To avoid the risk.

9. Risk identification

Wildfires are a threat in areas of vegetation and develop based on the environment in which they are burning. The fire environment consists of three components that interact to determine how a fire will behave. The three components are the fuel available to burn, the topography the fire is burning in, and the prevailing weather with its cumulative effect on the underlying level of dryness. The ability of a fire to ignite, develop, spread, and do damage is dependent on the environmental conditions at any one time and place. These conditions vary in time and space, with weather (air temperature, relative humidity, wind speed and direction, and rainfall) the most dynamic, and fuel condition (moisture content) close behind. Fuel is the one component that can be easily manipulated to reduce relative fire behaviour.

A heat source of high enough temperature is required before a wildfire can ignite and develop. Once again this is dynamic in regards fuel condition and weather. To have a wildfire there must be a capable heat source, a receptive fuel bed, and a mechanism that brings these two things together.

In New Zealand, more than 98% of wildfires are caused by human activity, whether through careless use or poor maintenance of machinery or cooking equipment, discarding of lit material, accidental circumstances, or malicious activities. Because of the human factor there is an excellent opportunity available to control activities that are sources of heat, sparks or flame that could cause a wildfire.

9.1. Vegetation Fire Environment

WHFP is predominantly a dry grassland environment that is north and west facing. It is dissected by several short valley systems with very steep slopes, long steep ridges, and spurs, and exposed to the prevailing weather. The park has and will continue to have a range of land uses. Future risk reduction treatment works, including revegetation and track locations, will need to consider the range of land uses to achieve overall best outcomes.

Normally the fuel component of the vegetation fire environment is considered fixed but in this analysis it will be variable. This is due to ongoing maintenance and revegetation of specific parts of the park and as already stated, there are three vegetation cover time points considered, being the current cover as at the time of compiling this report, followed by 20-year and 100-year concept covers.

Topography (terrain) changes very slowly over time and remains a fixed component apart from terrain barriers such as tracks, with weather the most variable with its hour to hour and day to day changes.

9.1.1. Topography

The park is approximately 5.6 kilometres at its widest generally northeast through southwest and 3.4 kilometres at its widest running generally from north to south from behind Blenheim to the skyline ridge.

The land generally faces west through north to east with some side stream slopes facing more south. The landscape is dissected by several valley systems running south to north with many short side creeks and spurs that often lead to steep broad open faces and subsequently to long sloping ridges. Slope steepness varies with steep to very steep side slopes.

From the lower boundary the landscape rises from around 25-55 meters above sea to the skyline ridge. The west end skyline ridge is around 300 metres elevation and runs east, with a kink to the south at the head of Sutherland Stream, to reach the high point of Mt. Vernon at 422 metres. From here the ridge descends northeast to Cob Cottage Road.

Features include the skyline ridge with its high points and saddles, the long variable inclined ridgelines running from south of Blenheim to the skyline ridge, the long sloping ridgeline from Cob Cottage Road via the Mount Vernon Lookout to Mount Vernon, the two main valley systems of Quail and Sutherland Streams and several other shorter valleys, the west facing slopes of the mountain bike park, and the lower flats and toe slopes with concentrated recreation activity.

There are several barriers to fire spread including carparks, hard-stand around some reservoirs, the worked section of Blue Gums Landfill, the Maxwell Pass Road Quarry, the Taylor Dam, and many roads and tracks surrounding and dissecting the park.

Depending on their form, roads and tracks offer defences to fire spread and can assist with containment and control of fire. Those that are sealed, metalled or bare earth (nonfuel) can slow or prevent fire spread depending firstly on a fire's intensity and secondly their width.

Refer to Appendix 4 for categorised roads and tracks including.

1. Road 8 metres wide. This applies to formal roadways that are generally sealed and are a barrier to fire spread. They include Redwood Street, Taylor Pass Road, Grigg and Forest Park Drives and the main park access point roads. Additionally, it includes the road leading to the larger reservoirs off Grigg Road and the Blue Gums Landfill access road and upper loop.

2. Roads 5 metres wide. This applies to roadways that are either sealed or unsealed and are a barrier to fire spread. This applies to the subdivision roads leading off Wither Road, Elisha Drive, Dry Hills Lane, and Dry Hills Rise as well as the upper section of the access road to reservoirs off Grigg Road.

3. Bare earth tracks 4x4 - 3 metres wide. This applies to tracks that are accessible to vehicles including tracks limited to 4x4 vehicles and that have little to no vegetation cover and are a barrier to fire spread depending on fire intensity.

Tracks include.

- Tracking within the Blue Gum Landfill.
- The formed metal surface track just behind the southern end residential properties off Taylor Pass Road and extending around behind those on Grigg Drive but not connecting to the road leading to the reservoirs.

  Note for the fire growth simulations at 20-year and 100-year vegetation covers, this track was conceptually extended to connect with the track at the base of the hill near the Rifle Range.
- The formed metal surface track running along the base of the hills from near the Rifle Range to Redwood Street (Forest Hills and Lower Farm tracks). And continuing from a point off Redwood Street to Cob Cottage Road (Mapp Track).
- The Short Loop Track/Taylor View track running from the base of the hill near Forest Hills Track to the skyline ridge. Note a few small sections at higher elevation are grassed and these were excluded as barriers to fire spread for fire growth simulations.
- The Lower Quail Stream Track from the end of Forest Hills Drive to the point at the Intersect Track.
- The Reservoir Ridge Track including around the reservoir from near the end of Weld Street to the skyline ridge.
- Short section running up Wither Stream.
- Three tracks running from Redwood Street, with one to the farm structures and the other two into Sutherland Stream where they meet up and split into three.

  One is a switchback track linking to the Mount Vernon Track, one is the Sutherland Stream Track that narrows to 2 metres before it meets the Covenant Loop Track and then grass before it meets the higher farm track. The last is the farm track running higher up on the Sutherland Stream true left, converging to become the Sutherland Stream Track, and running to the point before it leaves the valley bottom.

  There is a small section that runs past the old dam in the higher catchment.
- Split Apple Peak Track from the saddle below the peak to the top of Mount Vernon Track and down the Mount Vernon track to the junction with the track coming from Sutherland Stream.
- Middle Track and most of the Cob Cottage Track excluding the very upper section that is grass.
- Two short sections off Cob Cottage Track, one turning the top of Eastern Boundary Gully and the other turning the top of Simmons Gully.

4. Recreation tracks -2 metres wide. These are either narrow or vegetation encroached 4x4 tracks or walking tracks. These tracks were used as barriers to fire spread.

   Tracks include

   - Two small sections linking to the Forest Hills Track from the Rifle Range carpark.
   - Track from the Rotary Lookout down to Forest Hills Track.
   - The 4x4 track on the true right side of the upper Quail Stream to just below the skyline ridge near the Reservoir Ridge Track.
   - The Upper Harling Track from Lower Farm Track to Reservoir Ridge Track.
   - Covenant Track and a short section of Sutherland Stream Track.
   - Short section of the Covenant Loop Track.
   - The Mount Vernon Summit Track.

5. Recreation tracks - 1 metre wide. These are either surfaced or formed mountain biking or walking tracks

   Tracks include.

   - The Mountain bike track network.
   - Twin Tanks Walk from twin tanks near Taylor View Track to Quail Stream.
   - Upper Quail Stream Track from junction with Twin Tanks Walk to skyline ridge and the top of Reservoir Ridge Track.
   - Rifle range and Rifle Range Mountain Bike tracks running along the base of the hills to the end of Forest Hills Drive where the Mountain bike section carries on to Withers Stream and exits to Fyffe Street.
   - Sutherland Stream, and Dry Hills Lane to Wither Hills walkways.

6. Grassed tracks 4x4 & 3 metres wide. These are any track section that is grass covered.

   Tracks include.

   - Upper sections of Taylor View Track, the Loop and Intersect Tracks.
   - The skyline section of Taylor View track to Reservoir Ridge Track.
   - Several track sections in the upper Sutherland Stream.
   - Most of the Covenant Loop Track.
   - Split Apple Peak Track from the top of Reservoir Ridge to the track from Sutherland Stream that passes the old dam.

- Very upper section of the Cob Cottage Track.
- Mapps Gully West Track.
- Track running down ridge from Cob Cottage Track to Mapps Track between Simmons and Cathcart Gullies (powerline).
- Track running down the southern ridge of Eastern Boundary Gully to the water tanks at which point it is outside the park.

7. Proposed tracks and routes. Consideration is being given to new or ungraded tracks as well as possible routes that could be used to exit the park during an emergency.

   Examples are

   - Re-establish track on western side of Quail Stream
   - Extend the track along the ridge between Sutherland and Wither Streams.
   - Upgrade of the Mount Vernon Traverse 4x4 track to 6-metres wide (not shown on map).
   - Emergency exit routes to the south from the Taylor View track and Mount Vernon ridgeline.

9.1.2. Weather

The park comprises a range of hills and dissecting valleys rising 400 meters or so above the Wairau Plains. To the east it is close to water bodies, being approximately 7 kilometres from the eastern coastline and 5 kilometres from the Waikarapi/Vernon Lagoon. To the west is the wide and open Wairau River valley, and to the north and south are high elevation ranges.

The Metservice climate zone (NZMS 1983) for the location is C2, which is characterised by very warm summers, day temperatures occasionally rise above 30-degree C with dry Foehn northwesterlies. Annual rainfall mainly 1,500 to 2,500mm with a marked decrease in amount and reliability of rain in spring and summer but with very heavy rain at times from the south and southeast. Moderate to cooler winter temperatures with maximum rainfall in this season.

Refer to Appendix 15. The Woodbourne RAWS was used to produce a long-term fire climate analysis for the park. The RAWS was selected due to its long-term data record and was considered representative of the area. Other nearby RAWS had shorter historic data records.

The Woodbourne RAWS long-term fire climate analysis was used to select days that aligned with High and Extreme fire danger and that were subsequently used for wildfire growth modelling, refer *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement*.

Climate change projections have been considered based on information from the Scion report *Adapting and mitigating wildfire risk due to climate change: extending knowledge and*

best practice, and the NIWA report *Climate Change projections and impacts for Marlborough*.

The reports suggest weather parameters will change giving reduced rainfall, increased wind, higher temperatures and possibly more lightening. Forest areas could be affected through faster growth, drought, pests, and wildfire.

Issues related to wildfire are longer periods of warmer and drier conditions with vegetation drying out and available to burn. Conditions when wildfire can be damaging will extend to earlier in spring and later in Autumn, with more days in the Very High to Very Extreme Fire Danger Classes. Wildfires under these fire danger classes can be difficult to suppress, burn larger areas, and cause increased damage and injury.

9.1.3. Fuel

The park is a dry grassland landscape that is currently farmed, with farming expected to continue. Revegetation of sections of valley bottoms, side slopes and flats were undertaken through the 1980s guided by a concept plan, until a wildfire destroyed large areas of vegetation on Boxing Day 2000. Following the fire, revegetation began again with the planting of both native and exotic tree and scrub species.

The Wither Hills Farm Park Management Plan was compiled in 2003 and gives guidance on native restoration and amenity planting areas and includes a master tree planting plan. The planting guidance had regard for multiple land use including grazing, forestry, soil erosion, flood protection and drainage, amenity areas for recreation; and considered wildfire hazard.

Most of the park is farmed and is therefore grassland except sensitive areas where environmental conditions are more conducive to successful revegetation. Revegetated areas include, valley bottoms, slopes and flats including the covenant area in Sutherland Stream and the mountain bike park. The flood channel from Quail Stream running beside Forest Park Drive is also grazed.

Stock grazing effectively reduces the grassland fuel load and decreases potential fire intensity. In areas where grazing is to be removed and revegetated, initially expect an increase in higher flammability fuel load of grass or grass/scrub mix before domination of lower flammability cover.

Areas excluded from grazing have a range of characteristics from dense multi species mix to forestry plantings of medium stocking, to open park with grass understory. In most cases trees have limbs close to the surface that would carry a surface fire to the tree crowns.

The three vegetation cover time points of current, 20-year and 100-year have had their vegetation classified to align with the fuel requirements of the New Zealand Wildfire Growth Modelling software, Prometheus, and those within the Manual for Predicting Fire Behaviour in New Zealand Fuels. Refer Appendix 9. The detail of each of the fuels can be found in the *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement*.

Landforms have been identified to give direction to revegetating with associated species lists for each landform, refer Appendix 10.

Table 1: Landforms

Landforms to guide native species selection			
1	Dry Flats	2	Damp Flats
3	Short Valleys	4	Long Valleys
5	Hillslopes (Fans)	6	Hillslopes (Toes)
7	Hillslopes (mid elevation north and west facing)	8	Hillslopes (mid elevation east facing
9	Hillslopes (mid elevation south facing)	10	High Ridges and Summits

Below is a summary of the three vegetation fuel covers.

Current vegetation cover

Current vegetation cover can be broadly classified into grazed pasture with a range of height and cover, conifers (pine and fir) from 10 years to mature, mixed eucalyptus species, mixed deciduous hardwood trees, native and exotic scrub hardwoods including broadleaf species, some podocarp, blackwood, tree lucerne, manuka/kanuka, scattered gorse, sedges, cabbage trees and flax.

Grazed pasture covers most of the park and is located on landforms consisting high ridgelines and summits, mid and high elevation hillslopes, flats, and toe slopes. In some locations grazing extends to near the bottom of short valleys.

There are conifer stands or pockets on the western slopes facing Taylor Pass Road and in valleys east of Sutherland Stream, with the odd tree or pocket in other valleys. Conifer weed species control in the upper reaches of Mapps Gully-West has increased the fuel load there, and conifer mortality is occurring in and around the mountain bike park stands with some trees laying on the ground. Native and other exotic species are mixed within conifer stands and pockets.

There are small mature Eucalyptus stands on the western slopes facing Taylor Pass Road near the reservoirs, in mid Quail Stream, in Eastern Boundary Gully and on private land near the entrance to Sutherland Stream. Eucalyptus trees are also scattered in pockets or individually in most valleys and mixed with other species. These trees have large amounts of ribbon bark varieties with collections of this and branch material at tree bases. These trees have a propensity to produce material for prolific ember transfer downwind to start new fires.

Amenity and recreation areas on toe-slopes and flats behind Blenheim are of mixed species and consist of conifer, eucalyptus, deciduous hardwoods such as Oak, Poplar, and Ash, as well as blackwood and tree lucerne.

The covenant area in Sutherland Stream is young kanuka with a high grass load. This will eventually mature and would produce high fire intensities.

Some revegetated areas have pockets of cabbage tree and flax. Whilst these may not be a problem when young they produce a large amount of dead base and stem/trunk material that is high flammability and produces easily transported embers to start new fires.

20-year concept vegetation cover

This essentially builds on existing revegetation initiatives in consideration of continued farming as well as forestry.

The broad vegetation changes from current to 20-years are

- Eucalyptus species replaced with broadleaf hardwoods or grey scrub (smaller leafed native up to 10 metres) depending on terrain aspect and landform.
- Young exotic forest stands have matured and are ready for harvest. Replacement species to be discussed but should where possible be a low to medium flammability option.
- Kanuka areas that were grass dominated become mature Kanuka with canopy closure and are expected to remain this species.
- Grass in and around open exotic forest areas has changed to broadleaf hardwoods or grey scrub. Existing trees used for shelter and shade and some reliance on specific landforms such as damper gullies or cooler aspects.
- Gorse replaced with broadleaf hardwoods or grey scrub, with gorse either weed controlled or used as nursing for shelter and shade.
- Some areas of the RUI have a buffer of broadleaf hardwood low flammability species.
- Existing native regenerating areas in valleys have been extended with broadleaf hardwoods. These extensions depend on the feasibility of excluding stock and application of weed control.

100-year concept vegetation cover

The 100-year vegetation cover is a long-term projection building off the 20-year cover. The express purpose is to provide a rough vegetation framework to enable comparison of fire spread data for each of the three time points as well as to inform priority planting areas.

The key changes for the 100-year cover are

- Farming remains a predominate land use and therefore grassland vegetation continues to cover large areas.
- Exotic forest has been replaced with broadleaf and podocarp forest. To achieve this grazing exclusion, underplanting and weed control would be needed. It is more likely the transition vegetation will become mixed exotic and native forest.
- Damper and cooler areas have transitioned to broadleaf with some broadleaf buffering podocarp areas.

- Deciduous hardwood pockets remain in amenity and recreational areas on the flats and toe-slopes behind Blenheim with some scattered through the lower valley openings.
- Three areas of mature kanuka have been considered with one being the covenant area in Sutherland Stream and the other two in Mapps Gully West. The larger of the two in Mapps Gully West cover the area where pines were removed in the upper reaches of the valley. This area of vegetation was included for fire growth simulation only and would not be recommended in such proximity to the Middle Track, considering the track would act as a barrier to fire spread in some situations.
- The RUI buffer has been extended to reflect ongoing risk reduction through lower flammability planting.

9.2.Ignition sources

Heat sources are those with high enough temperature to ignite vegetation fuel, with around 300˚C required. Heat sources have been categorised below and include those that may be present in the park or nearby.

9.2.1. Motorised equipment, heavy machinery, and motor vehicles

1) Chainsaws, mowers and cutters/slashers striking solid material such as rocks, wire and cable.
2) Welding, heating, steel cutting (gas and manual) and other spark hazardous operations.
3) Engine exhaust emission of hot carbon.
4) Exhaust system failures resulting in very hot parts that can break away (catalytic converters).
5) Liquid fuel and hydraulic fluid igniting on hot exhausts.
6) Direct vegetation contact with hot exhaust parts.
7) Friction on accumulated vegetation within vehicle systems.
8) Electrical failures resulting in fire.
9) Vehicle and machinery accidents.

9.2.2. Railway

1) Mechanical related ignitions from locomotives and rolling stock such as carbon emissions or faulty wheel bearings or brakes.
2) Line maintenance activities such as cutting, grinding, and welding (also refer 8.2.1).

9.2.3. Open air burning or cooking

1) Use of outdoor barbeques, braziers, stoves (liquid and gas), and other oven types. This includes freedom camper activities.

2) Traditional cooking fires and bon fires

3) Private dwellings in the vicinity burning rubbish or tree trimmings, etc.

4) Land clearing burns

9.2.4. Natural

1) Lightning.

2) Spontaneous combustion e.g., stacked hay, landfill, commercial compost heaps, and bark heaps.

9.2.5. Powerline infrastructure

1) Line breakages and line strike.

2) Line disconnects from insulators and arcs on poles and cross arms.

3) Transformer and fuse failures.

9.2.6. Gas flaring equipment

1) Naked flame and ignition equipment.

9.2.7. Careless discarding of hot material

1) Lit cigarettes discarded.

2) Home fire ashes discarded.

3) Fireworks and other incendiaries.

9.2.8. Deliberate lighting of fire

1) Malicious lighting of fire.

9.2.9. Mountain bikes and personal accessories

1) Electric bike battery failure (generally home built systems), or any system whilst on charge.

2) Electrical device battery failures such as mobile phones, etc.

9.2.10. Structure fire

1) Structure fire spreading to vegetation (includes electrical cause).

9.3. People and activities

People and their activities are the most prevalent mechanism that bring heat sources into contact with a receptive fuel bed causing a fire. This may be contractors and visitors within the park or someone causing a fire further away that later impacts the area.

The park operates 4 activity zones with activities categorised as permitted, advisory, discretionary, and prohibited. The park has boundaries with other parks, public roads, residential dwellings and lifestyle properties, private farmland, and the Bluegums Landfill.

The Bluegums Landfill is part of this analysis and is an operating landfill. Vehicles and heavy machinery operate at the fill site, with other vehicles including trucks coming and going throughout a day. Additionally, the landfill operates a methane system that requires maintenance or servicing and there is an overhead powerline along the lower access road.

Electricity overhead lines supply communication infrastructure in the eastern part of the park with maintenance and servicing undertaken on both. Water supply reservoirs are located within the park and require maintenance and servicing. The park is operated as a working farm with routine farming activities and maintenance undertaken on most days.

Private property surrounds most of the park and includes residential dwellings, lifestyle size properties and large farms.

The following categorises people by activity who are likely to be within or adjacent to the park and whose activities may cause a fire.

9.3.1. Recreation visitors

Recreation activities occur throughout the park with concentrations in the mountain bike park, the Quail and Sutherland Streams, and along the base of the hills directly south of the built-up boundary of Blenheim. There are several access points from roads at the Blenheim Township boundary and from Harling Park and Sutherland Stream Reserve. The major access points have car parking facilities.

The park is well tracked for walking and other pursuits including mountain biking, with a concentrated area of mountain bike tracks at the western side.

Visitor numbers are extremely high with an estimate of around 300,000 per annum. The visitor metrics are presented in the analysis section and include monthly, and time of day numbers, refer Tables 9 and 10.

9.3.2. Motor vehicle use

Several 4 x4 vehicle tracks give access around the perimeter, as well as into Quail and Sutherland Streams and along prominent ridgelines. Unauthorised vehicle access is not permitted in the park but may be approved from time to time. Emergency services can access the 4x4 track system from the main access points and other road ends.

There are 4x4 tracks on private property south of the skyline ridge with one or two at the park boundary. Access to the park from these tracks is not authorised but they could be considered for emergency routes out if required.

9.3.3. Bluegum Landfill

There is approximately a 4-kilometre boundary with the Blue Gums Landfill. The operation uses heavy machinery with waste material delivered by a range of trucks and other motor vehicles. Waste is dumped, compacted, and covered daily at a working tip face and gas is collected and disposed of through flaring. The gas flare is located lower down near one of the stormwater ponds. There are overhead power lines running from the Taylor Pass Road entrance to the stormwater ponds.

9.3.4. Wither Hills Farm Park operations

Farming will remain a long-term land use with the park retaining a grassland dry-hill environment. The farming operation utilises most of the park except for fenced revegetation areas, some lower toe-slopes, and flat areas at the base of the hills, and the mountain bike park zone. Presently the grazing management effectively reduces wildfire risk through fuel reduction resulting in reduced fire intensity.

Farm management utilises motorised equipment and motor vehicles for day-to-day operations. 4x4 and all-terrain vehicles access the park, with other spark hazardous equipment likely to be in use for example chainsaws, generators, and grinders etc. There is a reticulated water system across the park to service stock and visitor drinking water consisting of water tanks, piping, troughs, and other outlets.

Farm contractors undertake weed and pest control and fencing.

9.3.5. Council operations

Council staff, volunteers, and contractors' undertaking work within the park including, revegetation, spraying and mowing, tree maintenance, tree felling and removal, track construction and maintenance, and soil conservation.

9.3.6. Commercial and other approved operators

Concessionaires operate within the park and include those responsible for infrastructure and equipment related to electrical power supplies, communications, water storage and reticulation, and seismic monitoring. Responsible organisations staff and contractors access these sites for servicing and maintenance. APL Property is the council property manager and holds details on concessionaires and their specific concessions.

The local mountain bike club undertake track construction and maintenance and there are those operating event type activities such as school outings and planting days.

9.3.7. Private property

The park has approximately 8.3 kilometres of boundary with residential properties of which 2 kilometres is lifestyle properties and 1.5 kilometres has a road barrier between the park and the properties. These properties require protection from fire but are also locations of ignition sources including outdoor fires, or the use of spark hazardous machinery such as motorised lawnmowers and chainsaws as wells as incendiary fireworks.

9.3.8. Activities outside the park boundary

Several activities occur outside the park boundary that could result in a fire starting and spreading to the park. Activities relate to roadside and carpark mowing, motor vehicle movements on and near roadways, overhead powerlines, land clearing fires, the main railway line, Riverlands Industrial Estate and Cloudy Bay Business Park to the east, and other recreation parks and reserves.

9.4.Values at risk

9.4.1. People

All park users including those in the activity categories stated above, maybe at risk from a spreading wildfire especially those located nearby, uphill, or up valley from where a fire starts.

Those living or operating adjacent to the park maybe at risk from a spreading wildfire depending on a fire's ignition location and prevailing environmental conditions.

9.4.2. Livestock

Animals belonging to the Wither Hills Farm Park, and those located on neighbouring farms and other properties that run livestock including lifestyle size properties.

9.4.3. Grazing and crops

Once grass and other crops such as grains begin to cure, they become vulnerable to being damaged or destroyed by fire. This is somewhat seasonal, but grass can be available for burning at any time of the year depending on drought levels and rain.

9.4.4. Fencing and debris dams

Residential property and lifestyle fences including planted barriers, and the many kilometres of farm fences may be impacted by fire.

Debris dams located in some catchments may be damaged or destroyed depending on underlying dryness in a particular area.

9.4.5. Buildings

Buildings can be categorised as being within the park or on or near the park boundary. Consideration is given to possible ember transfer that could affect properties located further into the built-up area (up to 500-metres) than those right on the boundary. Burning conditions and wind direction would determine the scale of such an impact.

<u>Buildings on or near the park boundary,</u>

1) There are two residential dwelling and farm structures at 257 and 309 Taylor Pass Road.

2) Along the park's western boundary from the Rifle Range to the mountain bike carpark there are 46 residential dwellings and 2 sections that are consider RUI. A fire spreading towards this location, especially under moderate to strong wind from the easterly quarter, could spread embers on to properties west of Taylor Pass Road.

3) Rifle Range Place and Forest Park Drive create a road barrier between the park and residential dwellings. There are 38 residential dwellings with this barrier between them and the park.

4) Along the boundary from Quail Stream carpark north to Harling Park there are 21 residential dwellings that are considered RUI.

5) Along the Harling Park boundary there are 23 residential dwellings that are consider RUI.

6) Along the boundary east of Solway Drive around to Redwood Street there are 31 residential dwellings that are consider RUI.

7) There are 3 dwellings at the park end of Redwood Street on the western side that are considered RI.

8) The southern end of Sutherland Stream Reserve connects to the WHFP with continuous vegetation. There are 28 residential dwellings in Sutherland Stream Reserve that are considered RUI and could be impacted by wildfire spreading from the WHFP under mainly easterly quarter wind directions.

9) From the Sutherland Stream Reserve to the eastern end on the WHFP there are 14 lifestyle properties with continuous vegetation to residential dwellings. Some of these properties have undeveloped land plots between them and the WHFP boundary and are considered RI.

10) Farm structures at the end of Cob Cottage Road are considered RI.

Buildings within the park

11) At the bottom of the road leading to the landfill is a kiosk structure.

12) Rotary Lookout structure where the Rotary Lookout Track meets the ridgeline.

13) Wither Hills Farm Park operation - residential dwelling and 6 farm buildings off or near Redwood Street including the structure and stockyards at the end of Redwood Street.

14) Amenity structures at the Rifle Range carpark including toilet.

15) Other toilets are located at the Quail Stream carpark, Quail Junction, and the track junction Sutherland Stream/Covenant tracks.

16) Two locations on the main ridge northeast of the Mt Vernon Lookout, at the head of Eastern Boundary Gully, have 4 structures associated with communication tower infrastructure and pumping water. The towers are covered under utilities subsection.

9.4.6. Utilities

Electricity

There are overhead powerlines (lines) within and nearby the park.

- Lines run along Taylor Pass and Maxwell Pass Roads with other lines running off these to the west and south. The line is sometimes on the park side of the road, but not within the park.

- There is a line within the park that follows the south side of the Landfill Road, crossing it and terminating at the stormwater ponds and gas flaring equipment. This line is approximately 500 metres long with around 6 poles.

- There is a short line running into number 309 Taylor Pass Road.

- A line within the park runs from Redwood Street to the WHFP homestead dwelling and is approximately 180 metres long with around 4 poles.

- Further south along Redwood Street another line runs within the park to the reservoir and then south up Reservoir Ridge to water tanks. The line is approximately 500 metres long from Redwood Street to the reservoir, with around 9 poles.

- The Redwood Street line then travels south for approximately 200 metres to the lifestyle properties and has around 4 poles.

- There is a short section line approximately 20 metres long running from 206 Wither Road to 8 Lowther Drive with around 4 or 5 poles. There is continuous vegetation from the line to the park boundary.

- The longest line within the park starts from the right-angled bend on Alabama Road at number 324 and runs to the base of the Wither Hills. The line then divides before entering the park with one terminating at the dwelling on 340 Alabama Road in McCormacks Gully, and the other passing through 163 Dry Hills Lane and crossing Cathcarts Gully to the ridgeline east of Simmons Gully.

  From here the line runs up a spur to the ridgeline and on to the first communication facility, thence on to the ridge south of Eastern Boundary Gully. At this point the line divides in two with one travelling southwest to the second communication facility and in the other direction down the ridge and into the valley south of Eastern Boundary Gully to terminate near number 90 Cob Cottage Road. There are around 44 poles and 2km of overhead line within the park.

- There are two other lines running from State Highway 1 towards the northeastern end of the park. One is along Cob Cottage Road to near number 84, and the other crosses horticultural land to numbers 50 and 54 Cob Cottage Road. There is continuous vegetation from these lines to the park boundary.

Communications

There are two communication sites high on the eastern end of the Mount Vernon ridgeline. The upper site is at Lat Long -41.548167 173.985194 and has three tower/masts and the lower site is at Lat Long -41546044 173984943 with two masts. Note the associated structures are identified in section 9.4.5 #16.

There is a Civil Defence tower on Reservoir Ridge.

Water supplies

The are many water reservoirs and water tanks within the park and some outside it. Construction is generally concrete and fire resistant, or plastic and fibreglass compounds that may be damaged by fire. Any plastic piping and fittings that are above ground may be damaged by fire as may exposed pump and power systems.

- The three large town water supply reservoirs are concrete, with two located on the west facing slopes off Grigg Drive and another on the toe-slope of Reservoir Ridge.

- There is a group of 4 plastic tanks located on the toe-slope of the ridge between Quail and Harling Streams and two more on the lower end of the ridge between Sutherland and Wither Streams.
- There is a group of 4 tanks on the toe-slope of the ridge between Mapps Gully East and Simmons Gully with a number of tanks at the upper communication site.
- There are many water assets associated with the farm operation. These include several water tanks, stock drinking troughs, and the many kilometres of pipes and associated fittings.

9.4.7. Environmental

The WHFP is characterised as high amenity landscape and feature area due to its visibility from Blenheim, the colour contrast of golden grass and vineyard greens, and the recreational use. It is highly modified landscape with multiple land uses including farming, forestry, biodiversity, waterway management, and recreation.

The park is susceptible to soil erosion. The initial purpose for procuring the land was to control serious soil erosion issues. The farm park was initially known as the Wither Hills Soil Conservation Reserve. Soil erosion control must remain as a primary objective of the farm park to protect downslope assets. Wildfire will remove vegetation cover leaving the land even more susceptible to erosion especially in the immediate aftermath of fire when the ground surface is exposed to rain and wind. The level of biomass removal, or fuel consumed by a fire, will depend on the prevailing environmental conditions at the time. High intensity fires can be expected to consume most if not all surface and subsurface fuel leaving a scorched landscape. Subsequent soil erosion and landslides will further damage the landscape and may threaten properties some distance away.

Biodiversity values include QEII National Trust Open Space Covenant located in Sutherland Stream and is a protected natural area of dryland forest. The area was being revegetated before being destroyed by wildfire in December 2000. Subsequently community replanting has taken place with native beginning to dominate in some parts. Management conditions are stipulated within the Sutherland Stream, Wither Hills QEII Management Statement 1997.

Other valleys and gullies have remnant indigenous vegetation species some of which are being enhanced through revegetation. This is often mixed with exotic evergreen and deciduous tree species. Some areas of commercial forest exist in small blocks with the largest on the western slopes facing Taylor Pass Road. Around access points, and the lower elevation recreation areas, are stands of mixed exotic tree species of varying age.

Habitats for native fauna exist in the valley and gully systems with many bird species present including pipit, fantail, Tui, and bellbirds as well as invertebrates such as butterfly and spiders.

9.4.8. Cultural, historic, and archaeological

Polynesian settlement dates to the 13th century at Wairau Bar with Māori history indicating tribal migration from the North Island to the South Island. European arrival dates to the late

18th century with the establishment of whalers, miners, sawmillers and pastoral farmers. The Wither Hills were burnt pre-European and subsequently burnt post European.

Values are limited within the park however there are 2 historic sites in the Quail Stream catchment and recorded with the New Zealand Archaeological Association. Both sites are recorded as Meteorite Pits with the following metric site numbers, P28/15, and P28/16.

9.4.9. Park facilities and other assets

Park assets not previously covered include interpretation and track signage, bridges, gates, styles, seating, playground, exercise equipment and walking and mountain bike infrastructure.

9.4.10. Landscape or Amenity Values

The Wither Hills form a distinctive backdrop to Blenheim and the wider Wairau Plain. The golden undulating form of the hills are mostly free from buildings with noticeably clear ridges and spurs. The Marlborough Environment Plan (MEP) recognises this by including this area within the High Amenity Landscapes and Significant Ridgelines layers with associated development controls.

Some areas within the Farm Park also have considerable aesthetic value, including the QEII covenant area. Plantings on the lower slopes around Quail Stream and the Gentle Annie have created a woodland effect which provides shade for Park users.

10. Risk Analysis

To analyse the risk of a fire starting, spreading, and doing damage, three factors must be present, i.e., enough dry fuel adequately arranged, a heat source, and a way to bring them together (in most cases human activities).

10.1. Fuel (vegetation) condition

The fire environment determines fuel condition and the ability for fuel to burn. The New Zealand Fire Danger Rating System is used to help determine how fuels will burn under given conditions. The New Zealand Fire Danger Class Criteria are used to give qualitative ratings of fire danger based on available fuel to burn and its propensity to spread in the three broad New Zealand fuel types being forest, scrub, and grass.

The current fuel cover is predominantly grass with a mix of scrub and forest in valley bottoms and their lower sides and in recreation areas on the flats and lower slopes including the mountain bike area. Grass will remain predominant in the long-term, with existing scrub and forest transitioning to native species of broadleaf, grey scrub, or podocarp forest. Around the park access points for Quail and Sutherland Streams, the mountain bike carpark and slopes close to the Rifle Range a mixed forest of exotic evergreen and deciduous tree species will remain.

The three Fire Danger Classes are therefore relevant for the park out in to the long-term. Refer to the *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement* for detailed current, 20-year, and 100-year projected vegetation covers.

Topography also affects wildfire behaviour with slopes increasing the spread rate and intensity of a fire, thereby increasing the damage potential. The fire danger classes do not account for these slope effects.

An analysis of the annual average number of days in a year that each fire danger class prevails is presented at Tables 2 through 5 using 30 years of fire climate data from the Woodbourne RAWS up to the 15th of February 2022.

Table 2 - 5 summarise the annual average number of days per year each fire danger class prevails for each of the three New Zealand fuel types (plus hardwood scrub) using the 30-year fire climate analysis record and climate change projections to 2080/90.

The following tables present fire danger class average annual days based on the current Woodbourne RAWS long-term fire climate data, and modelled projections to 2080/90 with reference to the 2021 Scion report *Adapting and mitigating wildfire risk due to climate change: extending knowledge and best practice*. Note for the modelled projections to 2080/90 the extreme and very extreme fire danger classes have been combined.

The 2080/90 projections were derived from the report *Adapting and mitigating wildfire risk due to climate change: extending knowledge and best practice*. The report uses a ranking system with associated Fire Weather Index System values that in turn can be aligned with fire danger levels. Ranks 4 and 5 align with very high and extreme fire danger classes respectively. The report presents data for Blenheim at rank 5 and the Marlborough District at rank 4. For this analysis, the percentage increase in the number of days under the two rank levels were applied to current monthly annual average days in each fire danger class. For rank 5 (extreme fire danger) an additional 31% increase was applied, and a 34% increase for rank 4 (very high fire danger). In the absence of data for ranks 2 and 3 the 34% increase was applied to high and moderate fire danger levels. Because the increased number of days sometimes exceeded days in a month, the days were adjusted by firstly reducing the number of days in low fire danger class followed by moderate. Put another way the low days became moderate and moderate days became high where required.

The Fire Danger Classes occurring are low through very extreme for forest, grass, and scrub with very extreme dominating for scrub fuels. In Tables 2 through 5 the very extreme class is combined with the extreme class as both classes produce fire behaviour that precludes successful direct fire suppression. The very extreme class frequency is presented at Appendix 14 for the current climate.

The coloured cells in the Fire Danger Class column of Tables 2-5 below indicate the fire danger classes used for Prometheus scenarios. Refer to Appendix 13 and 14.

The following data are annual averages and will differ year to year.

Table 2: Forest fuel fire danger class current and projected climate

Fire Danger Class	Number of days - current	Months of occurrence	Number of days – projected 2080/90	Months of occurrence
Low	173	All months	123	April through November
Moderate	104	All months	125	All months
High	42	September through May	56	September through May
Very High	17	October through May	23	September through May
Extreme	29	October through April	38	October through May

Table 3:Scrub fuel fire danger class (standard) current and projected climate

Fire Danger Class	Number of days - current	Months of occurrence	Number of days – projected 2080/90	Months of occurrence
Low	58	All months	3	June through August
Moderate	0	NA	0	NA
High	28	All months	21	May through September
Very High	35	All months	34	April through October
Extreme	244	All months	307	All months

Table 4: Scrub fuel fire danger class (Indigenous hardwoods) current and projected climate

Fire Danger Class	Number of days - current	Months of occurrence	Number of days – projected 2080/90	Months of occurrence
Low	58	All months	0	NA
Moderate	21	All months	2	November and February
High	85	All months	98	All months
Very High	71	All Months	94	All months
Extreme	130	All months	171	All months

Table 5: Grass fuel fire danger class current and projected climate

Fire Danger Class	Number of days - current	Months of occurrence	Number of days – projected 2080/90	Months of occurrence
Low	50	All months	22	August through June
Moderate	171	All months	154	March through December
High	86	All months	110	All months
Very High	33	September through April	50	September through April
Extreme	26	October through March	34	October through March

The degree of curing is a measure of the proportion of dead grass fuels present, which affects the ease of fire spread. The lower the percentage the more live green component is present.

Table 6: Degree of grass curing (DoC%)

Month	J	A	S	O	N	D	J	F	M	A	M	J
DoC%	45	55	65	70	80	85	90	95	80	65	55	50

10.1.1. Forest fire danger class

The forest fire danger class data shows most days (277) in an average year for current climate are Low to Moderate and projected to decrease (248) in favour of higher classes by 2080/90. Fires starting under these conditions would be generally controllable.

For the current climate, high or greater fire danger occurs in the months September through May. Projections to 2080/90 indicate the very high class extends its shoulder of occurrence to include September and the extreme extends its shoulder to include May. For the current climate there is a range of 13 - 19 days in high to extreme fire danger for the months of December through March, increasing to a range of 18 to 24 days projected to 2080/90. January records the largest number of days in very high and extreme followed by February, December, and March respectively.

10.1.2. Scrub (standard) fire danger class

The current scrub standard fire danger (representing mainly gorse and manuka/kanuka vegetation) shows very few days in low to moderate classes and almost zero days when projected to 2080/90. Therefore, nearly all days in an average year will be in the high to extreme fire danger class. By far the extreme fire danger class dominates over the other classes, with the current climate analysis indicating an average annual number of days is 244 and projected to increase to 307 by 2080/90.

The current climate analysis shows there are 20 or more days in extreme fire danger during the months of October through April with this extending to September through May when projected to 2080/90. Worse still, the projection to 2080/90 shows the months November through March to be extreme for all days. This needs to be qualified by the fact that it may rain on some of these days, but vegetation will rapidly dry.

10.1.3. Scrub (hardwood) fire danger class

The scrub hardwood fire danger is less severe that the scrub standard as it uses half its rate of spread in the fire intensity equation. This class represents the native broadleaf vegetation, which will burn when sufficiently dry.

For the current climate the scrub hardwood data shows 80 days in an average year are low to moderate and projected to decrease to near none in favour of higher classes by 2080/90. As for the standard scrub most days in an average year will be in the high to extreme range however the number of extreme days for scrub hardwood will reduce in comparison thereby increasing the number of days in the high and very high classes. In saying this there is still around a third of the days of every month in the extreme class with this increasing to half the days in each month when projected to 2080/90.

10.1.4. Grassland fire danger class

For the current climate the grassland fire danger data indicates the annual average number of days in low and moderate fire danger is 220, reducing to 176 by 2080/90 in favour of higher fire danger classes.

From November through March the current climate data indicate around 2 thirds of each month is in the High to Extreme fire danger classes with a range of 19 – 25 days. This increases for the projected 2080/90 climate to a range of 25 – 31 days.

Extreme days currently occur from October through March, and this does not change for the 2080/90 projection. Very high fire danger currently occurs September through April with this extending into May for the 2080/90 projection.

10.2. Wildfire history - ignitions

The following tables present FENZ incident occurrence data from the last ten years up to February 2022 with 3 additional fires added from October 2022. The incidents occurred either within or near to the park with some having potential to spread in continuous fuel. A ten-year data set has been used to ensure the information is applicable to current human behaviour related to ignition risk.

Table 7: Fire incident notifications by location

Date	Fire type	Fire cause	General location
27/02/2013	Vegetation Fire		In the Hills south of railway near Kendrick Road
28/04/2013	Vegetation Fire		In the Hills south of railway near Cloudy Bay and powerlines
21/11/2013	Vegetation Fire	Deliberately Lit Fire	Gentle Annie and Rotary Lookout Tracks
01/03/2014	Outside rubbish fire	Other or Undetermined Cause	Bluegums Landfill
02/09/2014	Vegetation Fire		Private property Sutherland Stream entrance
27/09/2014	Vegetation Fire	Deliberately Lit Fire	Corner Taylor Pass and Maxwell Pass Roads
19/10/2014	Vegetation Fire	Deliberately Lit Fire	Lower Quail Stream below Twin Tanks Walk
16/12/2014	Power line down		Private property bordering Harling Park
25/12/2014	Outside rubbish fire	Deliberately Lit Fire	Private property bordering Harling Park
25/05/2015	Structure Fire	Operating Failure	Private property bordering WHFP close to Harling Park
06/09/2015	Outside rubbish fire	Deliberately Lit Fire	Private property bordering WHFP in McCormacks Gully
19/03/2016	Vegetation Fire	Deliberately Lit Fire	Gentle Annie and Rotary Lookout Tracks
20/03/2016	Vegetation Fire	Deliberately Lit Fire	Taylor Pass Road near Taylor Dam
15/04/2016	Vegetation Fire	Deliberately Lit Fire	Harling Park near carpark
18/10/2016	Vegetation Fire	Other or Undetermined Cause	Cob Cottage Road
21/12/2016	Vegetation Fire	Carelessness with Heat Source	Private property bordering WHFP in Simmons Gully
25/02/2017	Vegetation Fire	Deliberately Lit Fire	Private property bordering WHFP Lower Harling Track
24/05/2017	Other Fire - not classified		Maxwell Pass Road near Homebrook
16/06/2017	Other Fire - not classified	Other or Undetermined Cause	Taylor Pass Road near landfill entrance
26/10/2017	Other Fire - not classified	Deliberately Lit Fire	Private property bordering WHFP in Simmons Gully
05/11/2018	Vegetation Fire	Vegetation Cause	Taylor Pass Road Taylor Dam entrance
4/02/2019	Other Fire - not classified	Natural Causes	Entrance to landfill

Date	Fire type	Fire cause	General location
05/02/2019	Mobile Property Fire	Mechanical Failure or Malfunction	Entrance to landfill
15/06/2019	Vegetation Fire	Vegetation Cause	Private property south of MTB southern carpark
10/02/2020	Vegetation Fire	Vegetation Cause	Taylor Pass Road Taylor Dam entrance
10/05/2020	Vegetation Fire	Vegetation Cause	Entrance to landfill
15/09/2020	Vegetation Fire	Vegetation Cause	Lifestyle property off Wither Road (some distance from park boundary
19/03/2021	Structure Fire	Carelessness with Heat Source	Private property Taylor Pass Road near WHFP boundary north of Grigg Drive Track
2/10/2021	Vegetation Fire	Vegetation Cause	Cobb Cottage Road
23/12/2021	Other Fire - not classified	Other or Undetermined Cause	Entrance to landfill
15/10/2022	Vegetation Fire	Deliberately Lit Fire TBC	Gentle Annie Track
15/10/2022	Vegetation Fire	Deliberately Lit Fire TBC	Gentle Annie Track
22/10/2022	Vegetation Fire	Deliberately Lit Fire	Lower water reservoir off Grigg Drive

Table 8: Summary - general location of recorded fires

Ref	Location	Number of reports	Occurrence year
1	Along Taylor Pass and Maxwell Pass Roads	6	2014, 2016, 2017 (2), 2018 & 2020
2	Properties along or near the western park boundary	2	2019 & 2021
3	Bluegums Landfill including entrance	5	2014, 2019 (2), 2020 & 2021
4	Near Gentle Annie Track, Twin Tanks, and reservoirs	6	2013, 2014, 2016 & 2022 (3)
5	Near Harling Park	5	2014 (2), 2015, 2016, & 2017
6	Private property Sutherland entrance	1	2014
7	Private property off Wither Road	1	2020
8	Private property below Simmons and McCormacks Gullies	3	2015, 2016 & 2017
9	Cob Cottage Road, Riverland Estate and Cloudy Bay Business Park	4	2013 (2), 2016 & 2021

Table 9: Summary of recorded fire types

Vegetation	21
Outdoor rubbish	3
Electrical network	1
Other not classified	5
Mobile Property	1
Structure	2
Total Recorded Fires - 10 years	**33**

Table 10: Summary of recorded fire causes

Deliberately lit	13
Other or undetermined cause	15
Operating failure	1
Carelessness with Heat Source	2
Natural	1
Mechanical Failure or Malfunction	1
Total Recorded Fires - 10 years	**33**

10.3. Fire Behaviour

Once a wildfire ignites, it goes through an acceleration phase before reaching its optimal forward rate of spread (equilibrium ROS) and head fire intensity (HFI) for the fuel, weather, and topographical conditions. It is the HFI at the equilibrium ROS that determines damage potential. Fuel loads are estimated in tonnes per hectare (t/ha), ROS in metres per hour (m/h) and HFI in kilowatts per linear metre (kW/m). ROS is determined using the Initial Spread Index (ISI) component of the New Zealand Fire Danger Rating System.

HFI has been calculated using the Prometheus Fire Growth Modelling software with fuels (vegetation) aligned to the model's available fuels, adjusted for slope angle, and using selected days with actual weather and fire danger ratings observed from the Woodbourne RAWS weather 30-year historical record. Fires were modelled for scenarios of 'likely' based on fire weather within the high fire danger class, and for a 'worse' within the extreme class. The 'worse' is not the worst possible fire potential as the modelling does not account for spot fires, and certain environmental conditions may create even more damaging fire potential. The two scenarios provide estimates of fire behaviour when fires may be challenging to control during hot, dry, and windy periods as well as when grass curing percentages indicate fast fire spread and other fuel types are dry and susceptible to combustion.

The predominant wind directions selected for fire growth modelling were in the vicinity of north-northwest through west (hotter and drier) and incorporated wind direction changes within this range.

10.3.1. Prometheus fire growth modelling

Prometheus fire growth modelling was undertaken from four ignition points identified using historic fire locations and local knowledge. Fire growth modelling was applied to the high and extreme fire danger classes, using weather data from Woodbourne RAWS.

The modelled inputs and outputs have been compiled in a separate report supplement titled *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement*.

10.4. Park users

The park borders on the southern boundary of Blenheim township (est. popn. 29,000). The park is very popular with the community and visitors to Marlborough, offering a range of recreation opportunities including walking, running and mountain biking. The location and elevation of the park offers superb views across the Wairau Plains and local ranges all the way to the southern North Island. The annual visitor numbers are estimated to be around 300,000 and increasing.

Tables 11 and 12 present visitor use data from Rotary Lookout counters and is considered indicative for the high use sections of the park. The high use areas are mainly on the western side of the park and include the mountain bike park, Rotary Lookout, Rifle Range, and Quail Stream.

Table 11: Indicative visitor numbers for high use areas

Daily seasonal peak	Visitor number
Daily peak - summer (anecdotal)	600 - 800
Daily peak - winter (Rotary Lookout counter)	400- 500

Table 12: Peak usage times during the day

Days of the week	Usage time
Weekend	Usage starts around 4:30am peaking at 9am and easing back before a second lower peak around 4pm and tailing off 730pm.
Weekdays	Usage starts around 5:30am peaking at 10am and easing back before a second lower peak between 2pm and 3pm, tailing off 6pm
Saturday and Sunday	These are the two busiest days of the week, with Sunday the busiest.
Wednesday and Friday	These are the second busiest days of the week, with slightly different peak times of the day.
Monday, Tuesday, and Thursday	These days have the lowest usage with Thursday being the lower of the three.

Additionally, volunteer groups are engaged in revegetation as well as track building and maintenance. Power, communications, farming, and council personnel access the park for routine checks and maintenance of their respective infrastructure.

The Bluegums Landfill personnel are onsite for rubbish disposal.

10.5. Structures and infrastructure

Table 13 summarises the number of dwellings on or near the park boundary that can be considered either RUI, RI, or isolated and whether there is an existing barrier to fire spreading from or towards them. Refer Appendix 6 for map showing numbered sections of RUI and RI.

A 500-metre buffer from the park boundary to inside the urban area accounts for embers transferring downwind of a spreading fire burning in New Zealand fuels except for grass. For the structure count, the spot fire zone includes structures on the RUI and RI.

Table 13: RUI and RI – dwellings outside the park

#	Location and category	Boundary length	Number of Dwellings	Barriers to fire spread
1	Isolated – Taylor Pass Road	Scattered	2	Taylor Pass Road and property driveways
2	RUI-1 & 2 – NE of mountain bike carpark to Rifle Range	1.4km	46	Some length has a 3-metre metal 4x4 track Grazed area between the boundary and the slope
3	RUI-3 – along Forest Park Drive	1.2km	38	Separated by 8-metre sealed road Grazed or managed grass
4	RUI-4 Quail carpark to Harling Park	0.65km	21	Partially grazed with walking tracks through scrub
5	RUI-5 - Harling Park	0.95km	23	Dissected by recreation tracks Mown grass
6	RUI-6 - Solway Drive to Redwood St.	1.1km	31	3-metre-wide metal 4x4 track away from the boundary. Buffer strip along the boundary not grazed but supposed to be kept tidy by neighbours. Other areas are grazed
7	RUI-7 - Sutherland Stream Reserve	0.85km	28	Recreational track divides the reserve Mown grass
8	RI-1 - Redwood Street	Cluster	4	Redwood St and driveways Mown or grazed grass
9	RI-2 – Sutherland Stream Reserve east to last lifestyle property	2.1km	14	3-metre-wide Mapp Track along the lower slope above the boundary Grazing
10	Isolated – End of Cob Cottage Road	Cluster	3	Cob Cottage Road and residential driveways Grazing and mowing
11	Urban - Spot fire zone. Wither Rd/Taylor Pass Rd intersection south – all dwellings and other structures east and west of Taylor Pass Rd	500m off park the boundary	~400	Roads and driveways Mown grass
12	Urban - Spot fire zone. All dwellings south of Wither Rd	500m off the park boundary	~1100	Roads and driveways Mown grass
13	Urban - Spot fire zone. All dwellings both sides of Dry Hills Lane	500m off park the boundary	~40	Roads and driveways Mown grass

Table 14: Structures inside the park

#	Location and category	Number of Structures	Barriers to fire spread
1	Isolated - Kiosk at entrance to Landfill	1	Roads and mown grass
2	Isolated - Rotary Lookout	1	Recreation tracks and grazed
3	Isolated - WHFP farm structures	5	Driveway, farm tracks Grazing and mown grass
4	Isolated - Rifle Range amenity	1	Carpark
5	Isolated – Toilets at Quail and Sutherland Streams	3	Carpark and tracks and cleared ground
6	Isolated – communications and pumping on Mt. Vernon ridgeline	4	4x4 metalled access track Grazing
7	Isolated –Pumphouse on Reservoir Ridge	1	Recreation tracks and grazed
8	Remote Automatic Weather Station	1	Managed grass.

Overhead powerlines cross the park in 4 locations and are also adjacent the park with continuous fuel to the park boundary. Wooden poles would be impacted by spreading fire. In the powerline corridors vegetation should be managed with low volume and where possible have bare earth areas at the base of poles.

Communication towers and pump houses are located high on the Mount Vernon ridgeline and Reservoir Ridge and there are numerous water reservoirs and tanks across the park.

Other infrastructure supports recreation and includes, playground, exercise equipment and toilets.

Table 15: Infrastructure inside the park

#	Location and type	Measure	Barriers to fire spread
1	Power – Landfill access road	~500-metre line ~6 poles	Access road
2	Power – Redwood Street to farm structures	~180-metre line ~4 poles	Roads, 4x4 tracks, driveway Grazing
3	Power – Redwood Street to lifestyle properties	~ 200-metre line ~4 poles	Road and driveways
4	Power – Redwood Street to reservoir	~ 500-metre line ~9 poles to the reservoir	4x4 track on the ridgeline Grazing

#	Location and type	Measure	Barriers to fire spread
5	Power – communication sites and end of Cob Cottage Road	~2.6km ~44 poles	3-metre metalled track Grazing
6	Communication towers/masts at the Mount Vernon upper site	3	4x4 track on the ridgeline Grazing
7	Communication towers/masts at the Mount Vernon lower site	2	4x4 track on the ridgeline Grazing
8	Communication tower/mast on Reservoir Ridge	1	Recreation tracks and grazed
9	Water reservoirs (concrete) off Griggs Road and on the toe of reservoir ridge	3	4x4 track on the ridgeline Grazing
10	Water tanks (plastic/fiberglass/concrete) on the ridge toe between Quail and Harling Streams, on the ridge toe between Sutherland and Wither Streams, and on the ridge toe between Mapps Gully East and Simmons Gully	~10	4x4 track on the ridgeline Grazing
11	Water tanks, piping, and fittings for farm operation	Large number	4x4 track on the ridgeline Grazing
12	Park fencing both boundary and internal	Many kilometres	Private property maintenance Grazing
13	Recreation infrastructure • Toilets • Playgrounds • Exercise equipment sites	 3 1 1	 Tracks Carpark and tracks Carpark and tracks

Table 16: Summary of structures and infrastructure

#	Location and type	Number
1	RUI dwellings	187
2	RI dwellings	21
3	Isolated dwellings	14
4	Spot fire buffer – dwelling estimate	~1,540
5	Recreation infrastructure – toilets, playgrounds, and exercise equipment	5
6	Overhead power (inside park boundary) • Line length estimate • Pole number estimate	 ~4 kilometres ~67
7	Communication towers	6
8	Public Road length on the park boundary	1.5 kilometres
9	Pumphouses	2
10	Water reservoirs and tanks (excluding farm assets)	~13
11	Farm water reticulation assets	Large number
12	Farm and park fencing	Many kilometres

10.6. Wither Hills farm operation

WHFP is a working farm with the land use expected to continue through the long-term. The pasture and crops are considered a value requiring protection, with any loss being a direct economic impact for the farm operation.

Farming is a major contributor to reducing fuel load in the grassland environment as well as maintaining access routes throughout the park landscape. On the other hand, some farming activities are spark hazardous and care is required during hot and dry conditions.

10.7. Bluegums Landfill

The Bluegums landfill operates under a management plan and is inspected weekly by the contractor and monthly by council. The landfill's operational area has a pressurised water delivery system available.

There is also a gas collection and destruction system operating all year round that is connected to a call out system should the flare develop a fault.

The landfill operates Monday through Saturday with Sunday and public holidays discretionary to the landfill contractor.

10.8. Existing treatments

10.8.1. Plans and awareness

1) Marlborough District Council (MDC) manage the park under the Wither Hills Farm Park Management Plan which is presently under review. There are other complementing plans to guide work or actions related to fire risk including evacuation, signage, and access restrictions. MDC work closely with FENZ to manage aspects of wildfire risk especially the response function.

2) Risk treatment recommendations from the report Wither Hills Farm Park Fire Management Review (Thompson, R. (2001)) have been considered with subsequent work undertaken.

3) There are numerous ecological reports guiding park restoration including soil assessment, catchment management and vegetation species. Revegetation is a continuous activity as is the removal of unwanted species or the dead/dying vegetation.

4) Grazing occurs over much of the park thereby reducing fuel load and lower fire intensity. Existing recreation and 4x4 tracks are maintained vegetation free in a lot of places. The mountain bike track network dissects the vegetation cover thereby slowing fire spread under the less severe fire danger conditions.

5) MDC issue fire awareness advice via numerous mediums include their website.

10.8.2. Operating guidelines and regulation

1) Fire and Emergency New Zealand (FENZ) in collaboration with industry have compiled activity guidelines for organisations undertaking spark hazardous or hot works in the open air. These include specific guidelines for forestry operations, general spark hazardous operations such as roadside mowing, welding, as well as power reclosure systems. Organisations involved in activities covered in the guidelines are strongly encouraged to adopt them as standard practice.

2) FENZ also have community guides related to evaluating and preparing private properties for wildfire.

3) FENZ regulate the use of fire in the open air using a tiered system of personal responsibility (Open fire season), permits required (Restricted fire season), and fires totally banned (Prohibited fire season). As fuels dry out the restrictions on activities that could start fires become stronger.

4) Electricity supply companies undertake line and tower/pole maintenance which reduces the likelihood of failures that can cause fires. They also maintain fuel reduced corridors for their overhead powerlines.

5) MDC maintain concessions for industries operating within the park.

6) MDC operate an approval system for groups wanting to undertake events within the park. Groups wanting to use the Farm Park for events use an online booking system which outlines a set of conditions for the event. Event organisers are informed of a total ban on lighting fires. An assessment is also made by a Parks Officer on whether there is a fire risk given the fire danger indices. Permission may be refused outright if conditions are very dry or an event organiser may be alerted to the fact the Park may close if dry conditions continue.

7) MDC can close areas to the public, contractors, and concessionaires, or restrict operations when fire dangers exceed their risk tolerance, or an event occurs that impacts the ability to deal with a wildfire. Examples of restrictions are the use of chainsaws or other motorised machinery, limited operating hours starting and finishing early before the hot and dry part of a day, or operating on colder damper locations on more southerly aspects. FENZ can also regulate activities and close areas.

8) CTV surveillance cameras are located at the Rifle Range and Quail Stream carparks, the Taylor Pass Road entrance to the landfill, and the landfill weighbridge. A 360° camera is planned for the landfill operational area.

9) MDC restrict access to the park when fire danger is high or above. The following approach is applied.

- Advice to undertake recreation pursuits in the morning and to do this at low elevation.
- Park is closed to the public.
- Vehicle access is for authorised organisations or persons, with access gates locked. Carparks are accessible.

10.8.3. Maintenance and development works

10) MDC manage a network of recreation tracks, 4x4 roads/tracks, roads, and hard surface carparks. These provide the following.

- Access for day-to-day management and recreation routes.
- Evacuation (escape) routes.
- Response to wildfire.
- Barriers to fire spread.

11) MDC maintain 6 access point carparks and 5 other access points to the park with most points displaying interpretation signage including fire risk information. Other signage is erected when access restrictions are put in place.

Access points with carparks

- Mountain bike park access off Taylor Pass Road.
- The Rifle Range.
- Quail Stream entrance off Forest Park Drive.

- Southern end of Harling Park with a recreation track to WHFP.
- Sutherland Stream entry at the end of Redwood Street.
- Eastern access to Mapp Track off Cob Cottage Road.

Other access points

- Off Grigg Drive to the reservoirs
- Off Forest Park Drive for the Short Loop Track
- Off the end of Weld Street to the Lower Farm Track
- Off Sutherland Stream Trail
- Via the public access corridor from Dry Hills Lane to Mapp Track

12) MDC maintain water supplies that can be used during a fire emergency. These include pressurised fire hydrants, constructed ponds and a large container for aircraft dipping at the top of Redwood Street. There are other ponds on adjacent properties. Refer to Appendix 5.

Fire hydrants are located along public roadways within Blenheim township at or near the park boundary, with one or two inside the boundary.

Open water supplies that could be used for firefighting either by helicopter or ground crews are limited. There are several stock drinking ponds outside the park with a range of water volume. During drier periods some of the ponds may unusable due to low or no water volume.

The present ponds that are either within or proposed for the park.

- The Taylor dam to the west of Taylor Pass Road (outside the park). The dam is surrounded by trees.
- Within the mountain bike park but needs evaluation for upgrade, vehicle and aircraft access, maximum and minimum water volume.
- In the lower Quail Stream valley bottom but needs upgrading.
- A proposed pond in the upper reaches of Quail Stream.
- Butane lined fire pond midway along Reservoir Ridge.
- Reservoir dam in Wither Stream below the town supply reservoir.
- The shipping container as a static aircraft dipping water supply located in a paddock next to Redwood Street.
- The pond in the upper reaches of Sutherland Stream. Requires maintenance and evaluation for access.
- Possible old pond in the bottom of Eastern Boundary Gully

10.8.4. Emergency response

13) FENZ supply an emergency service response to fires including coordinating the use of aircraft (fixed and rotary winged). They also coordinate with MDC for incident management. Table 17 gives an indication of FENZ response times to the Rifle Range and Cob Cottage Road entry points with an average drive speed of 60kph and a muster time of 5 minutes for town units and 7 minutes for rural units.

Table 17: FENZ emergency service response

Station/Resource	Estimated arrival time from notification
Blenheim Volunteer Rural Fire Force	• Total 6 minutes to the Rifle Range carpark, with 5-minute muster and approximately 1-minute drivetime. Distance is approximately 0.8km @60kph. • Total 13 minutes to Cob Cottage Road entrance with 5-minute muster, and approximately 8-minute drivetime. Distance is approximately 7.5km @ 60kph.
Blenheim Volunteer Fire Brigade	• Total 9 minutes to the Rifle Range carpark, with 5-minute muster and approximately 4-minute drivetime. Distance is approximately 4.2km @60kph. • Total 10 minutes to Cob Cottage Road entrance with 5-minute muster, and approximately 5-minute drivetime. Distance is approximately 5km @ 60kph.
Renwick Volunteer Fire Brigade	• Total 19.5 minutes to the Rifle Range carpark, with 5-minute muster and approximately 14.5-minute drivetime. Distance is approximately 14.5km @60kph. • Total 22 minutes to Cob Cottage Road entrance with 5-minute muster, and approximately 17-minute drivetime. Distance is approximately 17.2km @ 60kph.
Rarangi Volunteer Fire Brigade	• Total 29 minutes to the Rifle Range carpark, with 7-minute muster and approximately 22-minute drivetime. Distance is approximately 22km @60kph. • Total 30 minutes to Cob Cottage Road entrance with 7-minute muster, and approximately 23-minute drivetime. Distance is approximately 22.7km @ 60kph.
Koromiko Volunteer Fire Brigade	• Total 31 minutes to the Rifle Range carpark, with 7-minute muster and approximately 24-minute drivetime. Distance is approximately 24km @60kph. • Total 31.5 minutes to Cob Cottage Road entrance with 7-minute muster, and approximately 24.5-minute drivetime. Distance is approximately 24.7km @ 60kph.
Seddon Volunteer Fire Brigade	• Total 32.5 minutes to the Rifle Range carpark, with 5-minute muster and approximately 27.5-minute drivetime. Distance is approximately 27.5km @60kph. • Total 26 minutes to Cob Cottage Road entrance with 5-minute muster, and approximately 21-minute drivetime. Distance is approximately 21km @ 60kph.

Station/Resource	Estimated arrival time from notification
Waihopai Volunteer Fire Brigade	• Total 33 minutes to the Rifle Range carpark, with 7-minute muster and approximately 26-minute drivetime. Distance is approximately 26km @60kph. • Total 35 minutes to Cob Cottage Road entrance with 7-minute muster, and approximately 28.5-minute drivetime. Distance is approximately 28.5km @ 60kph.
Picton Volunteer Fire Brigade	• Total 37 minutes to the Rifle Range carpark, with 5-minute muster and approximately 32-minute drivetime. Distance is approximately 32km @60kph. • Total 38 minutes to Cob Cottage Road entrance with 5-minute muster, and approximately 33-minute drivetime. Distance is approximately 33km @ 60kph.

11. Risk Evaluation

Wildfire responds to fuel, weather, and topography, with fuel being the one component that is easily modified. To sustain fire, fuel (vegetation), oxygen and heat are all required. Removal of any one of these will result in no fire. In the presence of slopes and gullies, fires will travel faster and be more intense than those on flat ground. Fuel types and species have different flammability levels resulting in different ignitability, development and spread potential. Wildfires burning under extreme or greater fire intensities are not able to be extinguished by direct attack methods, and a fire environment change is required. Wildfire poses a risk to the park and will incrementally worsen as fire dangers increase and vice versa. As fire weather conditions increase so too does the probability of ignition and damage potential.

The WHFP is located on the mainly north facing aspects of the Wither Hills, with valley systems oriented south to north. The hills are very steep and rise behind Blenheim to an elevation of 422 metres. There is a very good network of tracks that can act as barriers to slow or stop fire spread depending on prevailing conditions. The wider tracks essentially divide and compartmentalise the park by catchment with the narrower tracks further dissecting the compartments. Consideration can be given to strengthening barriers to help contain wildfire to a single catchment. In saying this there will be times when no barrier is effective enough to contain a spreading fire.

Strengthening roads and tracks has the added advantage of increasing the security of egress for park users should there be a need to evacuate. The safest action for users in the event of a wildfire is to leave the park as quickly as possible away from the direction of fire spread. In the event users are trapped in the park, the next option is either rescue or locating to a nonfuel or very little fuel area as a shelter of last resort.

Fire growth modelling was undertaken for the current vegetation cover and conceptual 20-year and 100-year covers, refer *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement.* This helped understand fire behaviour and how fire may spread in the climate, terrain and changing vegetation in the park. It also assists in determining parameters required for barriers to be effective in containing or slowing fire spread including bare earth width and fuel reduced verges.

To suppress wildfires burning under extreme or greater fire intensities an environmental change is required that lowers fire intensity such as a change in weather, fuel (vegetation) or terrain. An advancing head fire will be the hottest section, with its flanks progressively reducing in intensity toward the back or heel of the fire. Often barriers will not contain a head fire but are effective enough to contain flank and backfire spread.

Weather in the Farm Park can sometimes be extreme with strong to gale force west to northwest winds, low relative humidity sometimes below 10%, and high daytime temperatures in the early to mid-thirties. Average rainfall is the highest during the months of June through August but on the annual average all months of the year record 40mm or more rain. There are however anomalies to this with minimum rain in a single month being only 2mm to 4mm. The annual average rainfall indicated in the MetService climate zone descriptions covered earlier, appear to overstate the annual range when compared with the Woodbourne RAWS climate analysis. The MetService description indicates 1,500mm to 2,500mm and Woodbourne 750mm to 1,250mm.

The current vegetation cover is primarily grassland with mixed exotic and native forest and scrub sections in the valley bottoms and sides as well as on the west to northwest slopes facing Taylor Pass Road and Forest Park Drive. Grass will remain the predominant fuel into the future and will continue to be grazed. Grass areas will reduce somewhat as the existing forest and scrub slowly expand from current locations and transition to a more native cover.

Grass curing levels (the percent dead/live) are 80% (dead) or higher from November through March. These curing levels indicate that when grass is sufficiently dry fire will ignite easily and spread quickly.

Presently there are high flammability tree species such as eucalyptus and conifer in pockets, small stands, or scattered across the park, mainly in the valleys and on the slopes facing Taylor Pass Road and Forest Park Drive. Eucalyptus species, especially those with ribbon bark, can produce embers that are carried aloft and dropped a very long distance ahead of a main fire, starting new fires. Multiple fires can then join to become one very large fire. Conifer species range in flammability and are also known to produce airborne embers, however ember travel distance is less than that of eucalyptus. Wilding pine control has occurred in the headwaters of Mapps Gully West with the dead down material increasing the fuel load.

High flammability kanuka and gorse scrub species are present with the gorse being controlled through spraying. Gorse is in the mid-reaches of Quail Stream, some in Sutherland Stream and Eastern Boundary Gully. Kanuka is found scattered among other species and in a couple of larger areas, with the largest area being the replanted covenant in Sutherland Stream.

Moderate and low flammability exotic and native tree species are found in most valleys and some slopes and include Tree Lucerne, Black Wood, a range of deciduous species and a range of native broadleaf hardwoods and grey scrub. Some of these plantings are at or reaching end of life with increased tree deaths followed by increased seedling density. They are established in the Quail and Sutherland Streams as well as the toe slopes and flatter areas from Quail Stream entrance to the Rifle Range and in Wither Stream around the reservoir pond and below the concrete reservoir. This vegetation is also scattered among conifer stands and is slowly establishing on cooler aspects of many side valleys.

The projected vegetation changes for 20-year and 100-year covers presented in *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement* aim for a more native and lower flammability vegetation cover in valleys and on the Taylor Pass Road/Forest Park Drive facing slopes. The vegetation covers were derived from discussions with council staff with expertise in farming, erosion control, parks and reserves management, landscapes, and biodiversity and are not defined in Council policy and are only considered likely possibilities.

Careful revegetation planning is required so that future fuel hazard is managed in such a way that it does not increase current wildfire damage potential within and outside the park. For example, when revegetating an area, the fuel hazard can initially increase due to rank grass and weeds before the planted species dominate and achieve full cover. Therefore, when determining areas for revegetation consider a mosaic or compartment approach where replanted areas have separation and are bound by existing barriers such as tracks, waterways, existing low flammability species, or grazed areas.

In erosion prone areas a rapid revegetation is desirable using higher density planting to help reduce sediment production and will require weed control.

The projected 20-year and 100-year vegetation covers have a focus on low flammability native hardwood scrub and podocarp forest. Revegetation will be challenging in the dry hill environment, and it is likely that moderate and higher flammability species may be used in some locations. Where this occurs compartments should be relatively small, separated, and not border the track system. Compartment shape can be utilized to reduce the ability of fire to reach its potential, for example a more triangle shape with the wider base lower on a slope running uphill to the apex.

The valley and gully systems offer shelter from wind, high temperatures, and direct sun strike, especially on the colder aspects. The valley and gully bottoms are generally damper and erosion control debris dams extend the area of dampness. Some of these dams have not been maintained and looking ahead they could be enhanced to catch and spread water over a larger area to support revegetation. Additionally, hillside seepage areas could be used to establish small islands of native species and overtime extend to a more continuous cover.

Pine is the predominant cover over the mountain bike park and towards the Rifle Range with trees over twenty years old and showing signs of mortality. Dead trees should be removed, and the vacant spaces used for replanting native with the surrounding forest used as cover to nurse new plantings. There are younger pine stands in other valleys that could also be used to nurse native plantings either by planting beside them or creating clearings within a stand.

All activities generally carry a level of ignition risk and people themselves can be at risk from a spreading fire. Park usage includes recreation, farming, council operations such as water supplies, park management including volunteer programs, concessionaires, and their contractors. The highest concentration of people undertaking recreation pursuits is in the Quail Stream, Rifle Range, the mountain bike areas, and Sutherland Stream/Mount Vernon circuit, with lower numbers on Mapp Track and on the Mt Vernon Traverse.

Wildfires burn at their hottest in the late afternoon (peak burning) and visitor data shows there are two peak times in a day, the highest in the morning with a slightly lower peak in the afternoon from 3pm to 5pm when ignitions would be easier and burning conditions at their highest. Areas with a high concentration of people should be given priority for risk treatment works. Activities on private properties, roads, and power corridors that boundary the park also have sources of ignitions that may start fires that spread to the park.

The assessment of reported ignitions within and near the park indicates there is an annual return of fire. Considering terrain shape, valley orientation, the predominant wind direction, and recorded ignition locations, fires are likely to start at the base of the hills and spread upslope and along valley corridors. This situation could result in valley entrances being involved in fire and trapping park users who are further up valley. This is not to say that a fire may be ignited anywhere within the park and recent fires have occurred mid-slope in the high use area of Gentle Annie Track.

Most ignitions have been recorded in the area from Quail Stream entrance around to the Rifle Range and from the Rifle Range to the mountain bike carpark and landfill entrance on Taylor Pass Road. This area should be the initial focus for risk treatment and would include the Quail Stream entrance

and a little way up the valley, Rotary Lookout, the Twin Tanks ridge to past the mountain bike park, the mountain bike park, and the landfill. Adding weight to this is the concentrated number of users in this area and the rural urban interface with private property.

The next focus area would be the flats and toe-slopes including valley and gully entrances east of Quail Stream to Cob Cottage Road. Essentially creating a multi-tiered defence to fire spread from private property boundaries to the low elevation track system. Treatment examples may include rural urban interface and intermix boundary of low flammability plantings, strengthening the Mapp Track through fuel reduction on its downslope side, fuel reduction of other track edges and continued grazing on the downslope side of Forest Hills Walk.

Following this the valley and ridge systems of Quail and Sutherland Streams can be the focus as well as asset protection within and adjacent the park where it has not already been addressed.

To assist the application of risk treatments the park has been compartmentalised into risk treatment zones to allow priority work to be focussed, refer Appendix 3. In all cases preventing ignitions is primary followed by actions aimed at limiting fire behaviour, then fire detection, early fire suppression and evacuation. Because wildfires develop and spread faster during higher fire danger the application of some treatments need to keep pace with increasing fire danger levels, for example triggers for access restriction linked to the Fire Weather Index System (FWI) and fire danger classes.

At risk are people's lives, the environment, utility infrastructure, built assets and park assets. With effective risk reduction treatments, risk rating can be lowered over the long-term but there will always remain a level of residual risk.

11.1. Fire Danger

Refer to section 10.1 for analysis of the annual number of days the fire danger is in each class, Appendix 13 for fire danger class criteria and Appendix 14 for frequency.

The predominant fuel type is grassland followed by mixed species forest and some scrub. Grassland is a fine flashy fuel that when conditioned to ignite fire will develop fast and spread rapidly responding quickly to changes in wind speed and direction and slope steepness. Forest fuels are slower to condition for burning and depending on species and structure can burn very hot but generally slower. Scrub on the other hand burns very hot and fast especially gorse and manuka/kanuka.

Because of the predominance of grassland in the park followed by forest, the Grassland and Forest Fire Danger classes are of interest for the current timeframe. There are however areas of scrub within the park notably the kanuka in the Sutherland Stream covenant and scattered elsewhere. The dry and sometimes windy environment contributes to conditioning scrub type fuel for burning, elevating it to Extreme fire danger class for many days in all months of the year. This is because of scrub's physical properties especially the larger volume of elevated fine fuel (up to 5mm diameter) that quickly dries out.

Grass fuels are not as available for burning for as many months as scrub due to green-up through late winter and spring before dying back ready for drying in summer through autumn. In saying this there is always 45% of the grass cover dead (including previous years of matted dead)

available for drying and burning. This 45% cured grass incrementally increases from August to peak at 95% cured (dead) in January and February.

Transitioning areas to native scrub and forest will overtime reduce fire behaviour including ease of ignition, speed of development and spread. Indigenous forest fuel requires more sustained periods of drying before it will burn extreme. This is not to say it won't burn, and the long-term climate analysis indicates there have been some very dry years where this fuel type would have done exactly that. The Fire Weather Index System long-term analysis data shows extremely high levels of dryness in the subsurface organic layers below the surface litter from January through May with a maximum dryness recorded in the month of April.

When considering climate change to 2080/90 the number of days each fuel type is in the very high and extreme fire danger classes increases by an estimated one-third. This increase elevates the gorse and manuka/kanuka type scrubs to extreme for nearly all days in the months of November through February indicating it is not a favourable vegetation cover.

11.2. Ignition probability

Ignition may occur within or adjacent to the park. Over the past 10-years there have been 33 recorded fires in and near the park. Recorded fires are more concentrated in the area from Quail Stream entrance around past the Rifle Range and on past the mountain bike carpark and landfill entrance. Other fires have been on private property along the boundary with Blenheim. Depending on ignition location a spreading wildfire could threaten any vegetated part of the park as well as users, built assets and infrastructure.

Of the 33 recorded fires of interest, 15 have no assigned cause, 13 have been deliberate, 2 careless with heat source, and 1 each for natural and mechanical.

Fine fuel (up to 5mm diameter) ignitability data indicates the receptive fuel bed is conditioned for successful ignition in dead fuels from October through April with the odd day in other months. Data also shows there are days in the months of September through May where fuel moisture content in the fine fuel is sufficiently low enough to expect extremely easy ignition and rapid development of fire.

The lowest recorded fuel moisture content in the dead fine fuel is 4% translating to an FFMC of 97 (exceptionally dry). At this low moisture level, a spark is sufficient to ignite dead fine fuel, and if there is sufficient fuel cover and arrangement a fire would develop and spread rapidly exhibiting extreme fire behaviour.

11.3. Fire Behaviour

Refer to the *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement*. Within this report are timestep diagrams showing fire spread and tables that indicate fire suppression success based on fire intensity levels. These are presented for each ignition scenario under high, and extreme fire dangers.

11.4. Life risk

During a wildfire, consideration must be given to the safety of visitor and other users such as staff, volunteers, contractors, and concessionaires. The daily visitor numbers are very high and

likely to increase over time. The estimated daily number of visitors during summer is 600 – 800. Recreation users would be the most at-risk from wildfire as they undertake their pursuits. Visitor groups have a range of mobility, with some able to quickly move to safety and others much slower, especially young children and the elderly.

During a wildfire the safest option is to have all visitors and other users leave the park of their own accord. If this is not possible then they will need to be located and removed one way or another. If this is not possible, they should remove themselves from harm's way to an area that will not be affected by the fire, or to where the fire environment creates reduced fire intensity to a level not to cause harm. An example of an environment that could reduce fire intensity is very short grassland on flat terrain and a relatively large area.

If users become trapped by fire all fire suppression efforts must be concentrated on the entrapment area, with immediate medical attention and rescue provided.

The park has been zoned for the application of access controls, whether it be advice, restricted access, or closed access. Application of access control decisions will be aligned with relevant FWI System codes and indices and the New Zealand Fire Danger Class Criteria. Appendix 2 presents a map of proposed access control zones for further discussion based on the park's current risk. These zones will need to be reviewed from time to time following the ongoing implementation of risk treatments.

Access control zones

1) Flats, low elevation slopes and ridges: An area for walking and mountain biking recreation where visitors can leave the park relatively quickly to a safe location. This would be the area where a 'Go early and stay low' protocol could be applied during times when wildfire can start easily, develop, and spread quickly.

2) Mountain Bike Park: The area set aside for mountain biking, including skill development. This area may lag access restrictions in other zones due to the ability of bikers to leave that park faster than walkers and may mean different access restrictions apply to walkers and bikers. Enhancements to the track network could aid quicker exit.

3) Sutherland Stream Covenant area: This area has a high proportion of highly flammable kanuka vegetation. This vegetation is highly flammable for an average of nearly 250 days a year. It is therefore likely that this area would lead the application of access controls ahead of other zones.

4) Valleys and high elevation slopes and ridges: The area where visitors could become trapped by a rapidly developing and fast spreading wildfire.

5) Controlled access: Areas that are not for public access.

11.5. Asset risk

These include ecological, and recreational assets, WHFP farm assets including pasture and crops, Landfill assets, power and communication utilities and buildings, private properties, and farms on the park boundary.

11.5.1. Buildings

There are over 200 residential dwellings and farm homes that boundary with WHFP, Harling Park and Sutherland Stream Reserve. Forest Park Drive does create a barrier to some of these. There are around 13 other structures within the park including those on the Mount Vernon ridge.

11.5.2. Utility infrastructure

There is approximately 4 km of overhead powerline and 67 poles within the park. There are other overhead lines near the park along Taylor Pass and Maxwell Pass Roads, Redwood Street, Cob Cottage Road, and the ridge running down from Mount Vernon to the farm properties at the end of Cob Cottage Road.

There are 5 communication tower/masts on the Mount Vernon ridgeline with asset and commercial operating value.

11.5.3. Private and other land

Neighbouring land is at risk from wildfires starting in the park spreading to them. There is approximately 8.3km of RUI and RI, 4km with the Bluegums Landfill, and 9km with rural farmland. Rural farmland run livestock as do some intermix properties, and have fencing, water supply assets as well as pasture and crops.

11.5.4. Wither Hills Farm

The farm has many kilometres of fences with gates and is serviced by a reticulated water supply for stock water. The farm runs livestock and manages grass cover and crops for stockfeed.

11.5.5. Water supplies

There are three main reservoirs and several smaller tank systems for domestic water supplies. The reservoirs are concrete with some of the smaller tank systems plastic.

11.5.6. Environmental

This risk relates to the loss of biomass and contamination of waterways (water quality), soil (through erosion), as well as the invasion of pest plants. Heavy rain following fire could pose a significant erosion/landslide risk to downslope properties.

The Wither Hills Farm Park is a high amenity landscape and feature area due to its visibility from Blenheim. It is noted for the outstanding landscape values which would take some time to recover following a fire.

Ecosystems (fauna and flora) are at risk from fire including birds (habitat loss), lizards and invertebrates, freshwater fish if riparian margins are burnt with subsequent washdown of contaminates into waterways. Flora may be damaged or destroyed and incudes major investments in completed revegetation programs. These values are concentrated in the valley systems particularly Quail and Sutherland Streams.

Trail aesthetics can be damaged by fire through the removal of vegetation leaving a destroyed environment that would take many years to recover. Trails and tracks themselves

are more likely to be damaged during fire suppression operations or post-fire events through use of heavy machine operation or heavy rains washing them out.

11.5.7. Park facilities and other assets

There are many kilometres of 4x4, walking and mountain biking tracks as well as, bridges, styles, toilets, and carparks servicing the park. There are interpretation boards and track signage.

11.5.8. Cultural, historic, and archaeological

There are two Meteorite Pits in the Quail Stream catchment near spur tops.

11.6. Risk scoring

With reference to Appendix 3, the park has been divided into 9 zones for the application of risk scoring in consideration of the history fire occurrence including anecdotal fire occurrences, fire danger class, the vegetation fire environment, recreation activity, visitor numbers and ease of safe exit. Evaluating and scoring wildfire risk looks at the current and 100-year vegetation covers, and the worse-case fire behaviour scenario (not worst) presented in the *Wither Hills Farm Park Prometheus Wildfire Risk Report Supplement*.

The risk score for the 100-year assumes the same parameters as for the current situation except the conceptual 100-year vegetation change is applied as well as the increased number of days fire danger is Moderate to Extreme based on climate change to 2080/90.

Interpretation of a risk level score requires consideration of whether it is the ignition and fire spread likelihood or the consequence that is responsible for an elevated score. It may in turn be a combination of both. Refer to Appendix 16 for the risk scoring definitions.

Table 18: Risk scores

Risk zone	Vegetation	Likelihood descriptor	Consequence level	Risk level
Bluegums controlled access area	Current	5	3	High
	100-year	5	3	High
Farm controlled areas	Current	2	2	Low
	100-year	2	2	Low
Flats, low elevation slopes and ridges	Current	5	2	High
	100-year	5	2	High
Mountain Bike Park MTB users	Current	5	3	High
	100-year	5	2	High
Quail Stream and ridges	Current	3	6	Extreme

	100-year	3	3	Medium
Harling and Wither Streams and ridges	Current	2	4	Medium
	100-year	2	3	Medium
Sutherland Stream and ridges	Current	2	5	High
	100-year	2	3	Medium
Sutherland Stream covenant area	Current	2	6	High
	100-year	2	4	Medium
Eastern valleys and ridges	Current	4	6	Extreme
	100-year	4	6	Extreme

12. Risk Monitoring and Review

Because risk changes over time priorities need to be reviewed and updated from time to time. A review timetable should be setup and responsibilities assigned for components of the risk management process.

1) Regular monitoring of the effectiveness of risk treatments should be undertaken and may include

2) Risk controls remain relevant and are operating effectively

3) Information for decision making is the most current

4) Information from emergencies has been incorporated into decision making

5) Emerging risk is being considered.

13. Recording and Reporting

Outcomes from the risk management process should be documented and reported within the context of the MDC risk register and risk management plan.

Risk management outcomes would be communicated within the organisation and to stakeholders and become inputs for future risk management decisions.

14. Risk treatment recommendations

This section outlines wildfire risk treatments aimed at managing the WHFP wildfire risk. To enable prioritising of risk treatments the park has been divided into 9 risk treatment zones refer Appendix 3. As well as these zones WHFP has been divided into 5 areas for the application of Fire Weather Index System triggers for managing access restrictions, refer Appendix 2.

Appendix 6 map displays where the park shares a boundary with residential property. The boundary has been identified as either rural urban interface (RUI) and rural urban intermix (RI). The boundary has then been divided into seven sections of RUI and two sections of RI. The RUI and RI boundary sections are presented in their own risk treatment table and therefore need to be read in conjunction with other related risk treatment tables.

The risk treatments use a priority of medium to very high ranking to indicate which risk treatments should be undertaken first (very high) and last (medium). For example, the ranking medium does not mean the risk treatment should not be completed at some point.

Table 30 is a summary list of risk treatment recommendations, with tables 31 and 32 listing the order of implementation priority for the very high, and high-level risk treatments. During implementation planning, synergies should be identified from across the range of treatment levels. For example, if technical equipment is needed for a very high treatment and there is a nearby medium treatment requiring the same equipment it may be sensible to complete both.

Refer to appendix 8 for map of risk treatment locations that may be difficult to locate. Those with clear location descriptions may not appear on the map.

14.1. All WHFP

Table 19: All Wither Hills Farm Park risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
WH-1	VH	All WHFP	To reduce likelihood and consequence	Reduction Readiness Response	1. Establish a wildfire management working group with representation from parties affected by the risk treatments identified or hold crucial information related to reducing risk.	MDC, FENZ and relevant organisations and groups
WH-2	VH	All WHFP	To reduce likelihood and consequence	Reduction Readiness Response	2. Prepare a WHFP fire plan including but not limited to multiyear works for the following • Risk monitoring, review, recording and reporting (refer section 12) • Response to wildfire • FWI triggers for activity controls and access restrictions based on access zones. • Communication plan for disseminating fire danger levels and activity control status information to staff, contractors, volunteers, concessionaires, and the community. • Fire prevention signage • public awareness communications • security including detection and reporting of fire • interagency coordination and interoperability • Water supply plan and maintenance • Location of green belt planting	MDC and FENZ

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• Location of subsurface utilities • Vegetation management plan • Special operations such as the Bluegums Landfill. 3. Train a couple of council staff members in application and use of the New Zealand Fire Weather Index System (FWI). 4. Have critical initial response information compiled for FENZ to use in a 'Site Plan' for first responders.	
WH-3	VH	All WHFP	To reduce consequence	Response	1. Review Park firefighting water supplies and compile a water supply plan • location, include proposed new or reinstated pond • type (water pond, open water, fire hydrant). • Access • water volume and depth at time of year • inspection and maintenance schedule.	MDC and FENZ
WH-4	VH	All WHFP	To reduce consequence	Reduction Response	1. Prepare a road, track and firebreak maintenance schedule that includes track surfaces and vegetation as well as location of subsurface utilities.	MDC
WH-5	VH	All WHFP	To reduce consequence	Readiness Response	1. Prepare a park evacuation plan using the track/road system and aerial. The plan should • allow for visitor self-evacuation, followed through by emergency response actions	MDC and FENZ

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• provide direction signage that guides users to a nearest exit • track signage has location name and coordinates for advising emergency services • identifies locations of last resort sheltering	
WH-6	VH	All WHFP	To reduce consequence	Reduction	1. Prepare a medium to long-term revegetation plan that includes the replacement of high flammability species with high potential of airborne embers and the replacement of pine.	MDC
WH-7	H	All WHFP	To reduce consequence	Reduction	1. Incorporate within the Wither Hills Farm Management Plan recommendations for grazing as listed in the following treatment tables.	MDC and Farm Management
WH-8	VH	All WHFP	To reduce likelihood and consequence	Reduction	1. Build into Council and contractor hazard/safety plans and concessionaire agreements the relevant actions contained within the activity control guidelines listed below • *'Fire Prevention Guidelines for Forestry Operations'* are available from FENZ and New Zealand Forest Owners Association • *'Fire Prevention Guidelines for Heat and Spark Hazardous Activities / Hotworks'* is available from FENZ. 2. Review the current hazard and safety clauses related to wildfire in APL managed concession agreements.	MDC, contractors, and concessionaires

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					3. Promote the use of these with power companies, KiwiRail and the wider community.	
WH-9	VH	All WHFP	To reduce likelihood	Reduction	1. Confirm whether the power distribution companies are applying the FENZ *'Power Line Auto Re-Closure System Triggers - Fire Risk Guidelines'.*	MDC and power company
WH-10	VH	All overhead powerlines near and within WHFP	To reduce likelihood	Reduction	1. Encourage power distribution companies to maintain their overhead line infrastructure to a standard that minimises faults that may cause ignitions.	MDC and power company
WH-11	VH	Taylor Pass Rd and Forest Park Drive	To reduce consequence	Reduction	1. Maintain road verges and water tables as short grass.	MDC

14.2. Rural Urban Interface (RUI) and Intermix (RI)

Table 20: Rural Urban Interface and Intermix risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
R-1	H	All RUI and RI within 500-metres of WHFP boundary	To reduce consequence	Reduction Readiness	1. In conjunction with FENZ encourage Fire Smart self-checks in case of an ember attack	MDC and FENZ
R-2	H	All RUI and RI	To reduce consequence	Reduction Readiness	1. In conjunction with FENZ, encourage the use of low or non-flammable boundary fence materials.	MDC and FENZ
R-3	H	All RUI and RI	To reduce consequence	Reduction Readiness	1. Prepare a list of neighbouring properties requiring wildfire reduction and readiness advice. 2. In conjunction with FENZ, encourage these property owners to have minimal vegetation on their fence line or plant low flammability species (native or exotic), and apply the FENZ defensible space criteria.	MDC and FENZ
R-4	VH	RUI-1 Grigg Drive and Solomon Place	Reduce Consequence	Reduction Response	1. Maintain the existing 3-metre-wide metal track behind the residential properties as nonfuel surface and extend the track to tie in with the reservoir access road keeping it the same distance off the boundary.	MDC
R-5	VH	RUI-2 Reservoir access road to Rifle Range carpark	Reduce Consequence	Reduction Response	1. Continue the 3-metre-wide metal track behind the residential properties from the reservoir access road to tie in with the Rifle Range carpark. Keep the track the same distance off the boundary as for RUI-1	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					2. Maintain the fenced non-grazed buffer clear of flammable materials, keep grass short and plant low flammability species	
R-6	VH	RUI-1 Grigg Drive and Solomon Place to slope	Reduce Consequence	Reduction	1. Maintain grass as low as possible (grazing) from the residential boundary to the foot of the slopes with no new trees or scrub planted. 2. For existing trees in this area prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation • scrub fuels to be low flammability native and only in the odd pocket.	MDC and farm management
R-7	VH	RUI-2 Reservoir access road to Rifle Range carpark back to the slope	Reduce Consequence	Reduction	1. Maintain grass as low as possible (grazing) from the residential boundary to the foot of the slopes with no new trees or scrub planted. 2. For existing trees in this area prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away (along edge of the reservoir access road)	MDC and farm management

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation • behind #11 Payne Place either remove the trees/scrub or remove lower limbs to 2-metres and clear surface vegetation • The tongue of trees on the north side of the Reservoir Road near the entrance to be either removed, or lower limbs removed as per standard in first bullet above. • Rifle Range trees – keep these scattered as they currently are with lower limbs removed as they age to prevent fire spreading to the crowns (treetops).	
R-8	H	RUI-3 Forest Park Drive & Quail Stream carpark to the vehicle track (Forest Hills track)	Reduce Consequence	Reduction Response	1. Trees between Forest Park Drive and Forest Hills Track (4x4 track) prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away (along edge of the reservoir access road) • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation • maintain a short grass surface.	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					2. Forest Hills Track to be maintained 3-metres-wide nonfuel surface and to be tied into the RUI-2 track behind Taylor Pass Road residential properties.	
R-9	H	RUI-4 Quail Place & Elmwood Ave.	Reduce Consequence	Reduction	1. Continue to maintain short grass using grazing from the Quail Stream carpark to where the boundary meets Lower Harling Track. 2. From where the RUI meets Lower Harling Track to the Harling Park boundary including the boundary with Harling Park, prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and cleared away surface vegetation • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation • scrub fuels to be low flammability native • trees near or overhanging residential properties to be cut back to boundary especially where residential structures are very near the boundary such as 29 Elmwood Ave.	MDC and Farm management
R-10	VH	RUI-5 Harling Park.	Reduce Consequence	Reduction	1. Prevention signage displayed at carpark and other park entry points. 2. Maintain carpark edges so they are not overgrown.	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					3. Continue to maintain short mown grass. 4. Continue to maintain track system with short grass edges. 3. Maintain trees for open space park environment and prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation 4. Trees near or overhanging residential properties to be cut back to boundary especially where residential structures are very near the boundary. 5. If replanting the stream use only low flammability native species.	
R-11	H	RUI-6 Solway Drive to Redwood Street	Reduce Consequence	Reduction Response	1. Continue to maintain short grass between Lower Farm Track and the boundary. 2. Continue to maintain Lower Farm Track 3-metres-wide with nonfuel surface. 3. Maintain trees between Lower Farm Track and the boundary and prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					bark to 6-metres and the surface vegetation cleared away • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation • scrub fuels to be low flammability native. 4. Trees near or overhanging residential properties to be cut back to boundary. 5. Maintain defensible space around the farm building with minimal to no vegetation surrounding flammable maintenance materials such as fence post stacks.	
R-12	H	RUI-7 Sutherland Stream Reserve.	Reduce Consequence	Reduction	1. Continue to maintain short mown grass. 2. Continue to maintain track system, with short grass edges. 3. Maintain trees for open space park environment and prepare a maintenance plan for the following works • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation. 4. Trees near or overhanging residential properties to be cut back to boundary	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					especially where residential structures are very near the boundary. 5. If replanting the stream use only low flammability native species.	
R-13	VH	RI-1 WHFP farmhouse and top of Redwood St. properties	Reduce Likelihood & Consequence	Reduction Response	1. Powerlines to the farmhouse, stockyards, and private property • reduce fuel in the powerline corridor • remove trees at risk of falling on the powerlines • maintain 2-metre diameter nonfuel at base of poles • refer WH-9 treatment for infrastructure maintenance. 2. Encourage maintenance of defensible space around all structures (refer FENZ guidelines). 3. Encourage maintenance of driveways clear of vegetation to minimum 3-metres-wide and 4 metres-high with ability for turnaround of emergency response vehicles. 4. Maintain nearby trees and prepare a maintenance plan for the following works • Remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away • remove lower limbs of conifer to 3-metres and other species to 2-meters and clear away surface vegetation	MDC, Farm management and power company

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					5. Eucalyptus compartment on 271 Redwood Street. Encourage the landowner to reduce fuel by removing dead trees and grazing under the remaining.	
R-14	VH	RI-2 Sutherland Stream Reserve toward east end of WHFP	Reduce Consequence	Reduction Response	1. Maintain Mapp Track • 3-metres-wide nonfuel surface • tie the track into Redwood St. or the Sutherland Stream carpark • grass on downslope side to be cut short for 3-metres from track edge and grazed to the boundary. 2. Trees between Mapp Track and the boundary to have lower limbs removed to 3 metres for conifer and 2-meters for other species and clear away surface vegetation (or encourage this if trees are privately owned at the boundary). 3. Remove eucalyptus trees (or encourage private owners to do this), or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away. This applies to WHFP and the intermix private properties. 4. Confirm whether the powerline between 206 Wither Road and 8 Lowther Dive is energised. If it is, encourage the power company to run it underground.	MDC and Farm management

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					5. The planted area in Dungey's Gully below Mapp Track and prepare a maintenance plan for the following works • The tree/s right on the lower track edge to have lower limbs removed to 3-meters, surface vegetation removed, and any grass kept short • Maintain 3-meters cut grass on the downslope side of the Mapp Track • For 10-20-metres below the cut grass off the track ensure only low flammability native species are planted. 6. If tanks are plastic. Water tanks on spur between Mapps Gully East and Simmons Gully to have bare earth around them and the visual barrier of trees managed with shorter limbs to the tank sides and lower limbs removed to 1-2 metres. 7. The planted area in Simmons Gully below Mapp Track • For 10-20-metres below the cut grass off the track ensure only low flammability native species are planted. 8. In Cathcarts Gully in the damp areas below Mapp Track begin planting low flammability native species. 9. In McCormacks Gully	

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• For 10-20-metres below the cut grass off the track ensure only low flammability native species are planted. • Begin interplanting low flammability native amongst the existing open tree planting.	

14.3. Bluegums Landfill

Table 21: Bluegums Landfill risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
BG-1	VH	Entry kiosk area	Reduce Likelihood & Consequence	Reduction	1. Maintain existing cameras at the site	Bluegums
BG-2	VH	Bottom entry area and roads	Reduce Consequence	Reduction	1. Maintain mown short grass areas both sides of the entry road to the kiosk. 2. Maintain short mown grass verges along the access road and road to the gas flare.	Bluegums
BG-3	VH	Powerlines	Reduce Consequence	Reduction	1. Reduce fuel in the powerline corridors. 2. Remove trees at risk of falling on the powerline. 3. Maintain 2-metre diameter nonfuel at base of poles. 4. Refer WH-10 treatment for infrastructure maintenance.	Bluegums and power company
BG-4	M	Gas flare area	Reduce Consequence	Reduction	1. Further discussion on risk at the Working Group level.	MDC and Bluegums
BG-5	VH	Tip face and landfill area	Reduce Consequence	Reduction	1. Maintain mineral earth nonfuel firebreak around the entire site.	Bluegums
BG-6	H	Outer boundary of Bluegums property	Reduce Consequence	Reduction Response	1. Investigate a secondary firebreak (contingency) on the property boundary that includes the north and south ridges and the Taylor View track to Taylor Dam Lookout. The two ridges would also become evacuation routes from the upper ridgeline.	MDC and Bluegums

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
BG-7	H	Vegetated areas	Reduce risk	Reduction	1. Remove eucalyptus trees starting with ribbon bark species and replace with native. 2. Interplant existing pine with low to medium flammability native, using only low flammability within 10-metres of roads, tracks, and firebreaks.	Bluegums
BG-8	VH	Kiosk and Tip face operations	Response	Readiness Reduction	1. Maintain a 9kg dry powder or equivalent fire extinguisher at both sites. 2. Heavy earthwork machinery to carry a 2kg dry powder fire extinguisher.	Bluegums
BG-9	VH	Properties 257 and 309 Taylor Pass Rd	Reduce risk	Reduction Readiness	1. Advocate the application of the forestry and spark hazardous activity controls on these properties. 2. Encourage the application of FENZ defensible space guideline. 3. Include these properties in communication of fire danger levels.	MDC and Bluegums

14.4. Mountain Bike Park to Rifle Range

Table 22: Mountain Bike Park to Rifle Range risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
Note: Refer to the RUI-1, RUI_2, and BG-5 risk treatments that border or relate to this area.						
MTB/RR-1	H	MTB carpark	Reduce Likelihood & Consequence	Reduction	1. Consider installing surveillance CTV cameras	MDC
MTB/RR-2	VH	MTB and Rifle Range carparks	Reduce Consequence	Reduction	1. Fire Prevention signage displayed with detailed information about wildfire risk reduction including what is expected of users. As this is the main carpark signage can be larger and more detailed. 2. Maintain a wide short grass area around the MTB carpark boundary.	MDC
MTB/RR-3	VH	Grassed flats and toe slopes	Reduce Consequence	Reduction	1. Maintain flats and grassed toe-slopes as short grass (grazing) and consider • Green crops where appropriate • Low flammability planting in damp swales off the flats if fencing if feasible.	MDC and Farm management
MTB/RR-4	H	Gullies and tree cover area	Reduce Consequence	Reduction	1. Plant low flammability native species in colder gullies and on the more southern aspects. 2. Remove dead-down pine to leave a relatively clear understory. 3. Use spaces created by tree mortality as well as exiting spaces in the tree cover to plant native species (using existing trees to nurse). 4. In other open spaced trees begin interplanting with native.	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					5. Consider grazing parts to reduce the grass fuel load. 6. Remove eucalyptus trees or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away.	
MTB/RR-5	H	Ridge from Twin Tanks Walkway to the upper reservoir	Reduce Consequence	Reduction Response	1. Investigate upgrading the existing track line to 2-3-metres-wide from the ridgeline to the upper reservoir and tie into the reservoir road.	MDC
MTB/RR-6	VH	Reservoir Road	Reduce Consequence	Reduction	1. Maintain road verges as short grass and remove any overhanging tree branches.	MDC
MTB/RR-7	VH	Rotary Lookout Track	Reduce Consequence	Reduction	1. Maintain the track 2-3-metres wide and tie into Forest Hill Track at the base of slope.	MDC
MTB/RR-8	VH	Twin Tanks Walk ridgeline to Intersect track	Reduce Consequence	Reduction Response	1. Maintain track 3-metres-wide with nonfuel surface and short grass edges.	MDC
MTB/RR-8	VH	MTB track network	Reduce Consequence	Reduction	1. Identify tracks in the network that dissect the park and could be upgraded for quick egress. 2. In consideration of point 1 above and the overall landscape, consider how sections of the Park can be partitioned for grazing and closed while this is occurring.	MDC

14.5. Rifle Range to Quail Stream entrance and Harling Park

Table 23: Rifle Range to Quail Stream entrance and Harling Park risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
Note: Refer to the RUI-3 and RUI-4 risk treatments that boarder or relate to this area.						
RR/QS-1	VH	Western end of Forest Hills Track	Reduce Consequence	Reduction Response	1. Tie the end of Forest Hill Track into the firebreak along the boundary of RUI-2.	MDC
RR/QS-2	VH	Rifle Range and Quail Stream carparks	Reduce Likelihood & Consequence	Reduction	1. Encourage the continued use of surveillance CTV cameras. 2. Fire Prevention signage displayed. 3. Maintain carpark edges so they are not overgrown.	MDC
RR/QS-3	VH	Downslope of the Rifle Range MTB Track to Forest Hills Track (Rifle Range to spur with Harling Stream)	Reduce Consequence	Reduction	1. Tree and scrub management • maintain an open space tree area (limited or interrupted tree canopy closure). • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away. Prioritise ribbon bark eucalyptus species • remove lower limbs of conifer tree species to 3-metres and other species to 2-metres and clear away surface vegetation • maintain a clear understory including with short grass 2. Scrub fuels	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• to be low flammability native • planted in non-contiguous pockets • clear of track sides by at least 1-metre.	
RR/QS-4		Forest Hills and Rifle Range MTB Tracks	Reduce Consequence	Reduction Response	1. Develop a track maintenance schedule to include • Who is responsible for track maintenance • Maintain tracks as nonfuel surface • Maintain short grass edges 1-metre either side.	MDC
RR/QS-5	VH	Short Loop and Gentle Annie Tracks	Reduce Consequence	Reduction Response	1. Maintain the ridgeline and eastern spur as 3-metre-wide nonfuel surface with short grass edges, and tie into Forest Hills Track.	MDC
RR/QS-6	VH	Between Quail and Harling Streams	Reduce Consequence	Reduction	1. Lower Farm Track and alongside Harling Stream ensure 3-metre-wide short grass below the Lower Farm Track with low flammability native below that again.	MDC
RR/QS-7	H	Water tanks on Ridge between Quail & Harling Streams	Reduce Consequence	Reduction	1. Ground around tanks to be bare earth 2. Surrounding trees should have lower limbs removed to a height that surface fire cannot spread to the crowns and if eucalyptus remove ribbon bark. Surface under trees to be clear except for short grass.	MDC

14.6. Quail Stream and ridges

Table 24:Quail Stream and ridges risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
QS-1	VH	4x4 track to Quail Junction	Reduce Consequence	Reduction Response	1. Maintain track 3-metres-wide nonfuel surface with some turnout/turnaround points.	MDC
QS-2	H	4x4 track from Quail Junction to Reservoir Ridge junction with Mt. Vernon Ridge	Reduce Consequence	Reduction Response	1. Maintain track as 4x4 accessible keeping vegetation cut back from edges. 2. Provide vehicle turnarounds.	MDC
QS-3	H	Upper Quail, Twin Tanks, and Intersect Tracks	Reduce Consequence	Reduction	1. Maintain track surfaces as nonfuel surface and short grass edges.	MDC
QS-4	VH	Quail Stream	Reduce Consequence	Reduction	1. Tree and scrub management • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away. Prioritise ribbon bark eucalyptus species • remove lower limbs of conifer tree species to 3-metres and other species to 2-metres and clear away surface vegetation • in the large area of Tree Lucerne and Blackwood (true left at Quail Junction) begin replacement with low – medium native. Possibly small clearings at first and existing trees nurse new plantings	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• continue enhancing the riparian margins and where feasible buffer the track with low flammability native species and continue increasing the width. The wider area would be contingent to fencing and weed control • review debris dams and their enhancement to create extended areas of dampness for growing native broadleaf species • identify side streams with colder aspects slumps and seepages as places to begin or extend native planting.	
QS-5	VH	Quail Stream between carpark and Quail Junction	Reduce Consequence	Reduction Response	1. identify two or three points along the track for clearings large enough to land a helicopter to effect rescue (landing zones). These are not safe areas or safety zones they are rescue/evacuation points only. 2. following discussion with FENZ aircraft specialist decide on clear area metrics. 3. maintain sections of the track with open tree canopy to enable an aerial search to locate people on the track. 4. note for Upper Quail Stream track vegetation is generally open, and aircraft should be able to affect a hover pickup.	MDC and FENZ
QS-6	H	Quail Stream old true left track	Reduce consequence	Reduction Response	1. Explore the value of re-establishing this track for the purpose of vegetation	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					management and an additional egress route.	
QS-7	VH	Twin Tanks and Taylor View track (main ridgeline)	Reduce Consequence	Reduction Response	2. Reference BG-6, MTB/RR-8 and RR/QS-6 for other main ridgeline treatments. 3. Maintain as much of this track as possible with 4x4 3-metre-wide nonfuel surface and grazed hard on edges.	MDC
QS-8	VH	Taylor View track (main ridgeline) to Reservoir Ridge Track	Reduce Consequence	Reduction	1. Identify locations to safely exit the main ridgeline down to Maxwell Pass Road (part of evacuation route options). 2. Discuss routes with landowners and FENZ.	MDC, local landowners and FENZ
QS-9	M	Ridge between Quail and Harling Streams above water tanks	Reduce Consequence	Reduction	1. The tree line should have lower limbs removed to a height that surface fire cannot spread to the crowns and if eucalyptus remove ribbon bark. Surface under trees to be clear except for short grass.	MDC

14.7. Harling Park to Sutherland Stream (flats and toe slopes)

Table 25: Harling Park to Sutherland Stream (flats and toe slopes) risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
Note: Refer to the RUI-6 and RI-1 & RI-2 risk treatments that boarder or relate to this area.						
HS-1	VH	Sutherland Stream carpark and Reserve	Reduce Consequence	Reduction	1. Fire Prevention signage displayed at the carpark and other entry points to Sutherland Stream Reserve.	MDC
HS-2	VH	Land parcel true right of Harling Stream below Lower Farm Track	Reduce Consequence	Reduction	1. Continue to graze this land. 2. Consider planting green crops such as lucerne or similar. 3. Explore the use of the scour valve in the paddock for firefighting purposes.	MDC and Farm management
HS-3	H	Toe slopes of Harling, Wither and Sutherland Streams	Reduce Consequence	Reduction	1. Continue to graze above Lower Farm Track and Mapp Track up and over the MTB track	MDC and Farm management
HS-4	VH	4x4 track to reservoir	Reduce Consequence	Reduction Response	1. Maintain the track 3-metres-wide, nonfuel surface to and around the reservoir and on up the ridge line.	MDC
HS-5	H	4x4 track beside Wither Stream to past Reservoir Dam	Reduce Consequence	Reduction Response	1. Maintain the track 3-metres-wide, nonfuel surface to the stockyards past Reservoir Dam.	MDC
HS-6	H	Tree area surrounding the reservoir and Reservoir Dam	Reduce Consequence	Reduction	1. Tree and scrub management • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
		and in Wither Stream			vegetation cleared away. Prioritise ribbon bark eucalyptus species • remove lower limbs of conifer tree species to 3-metres and other species to 2-metres and clear away surface vegetation • begin replacing Tree Lucerne and Blackwood with low – medium native • continue enhancing the Wither Stream riparian margins and around the Reservoir Dam with low flammability native species.	
HS-7	VH	Powerline from Redwood Street to reservoir and along ridgeline	Reduce Likelihood & Consequence	Reduction	1. Reduce fuel in the powerline corridor. 2. Remove trees at risk of falling on the powerline. 3. Maintain 2-metre diameter nonfuel at base of poles. 4. Refer WH-9 treatment for infrastructure maintenance.	MDC and power company
HS-8	VH	Tracks from Sutherland Stream carpark & end of Redwood St.	Reduce Consequence	Reduction Response	1. Maintain the tracks 3-metres-wide nonfuel surface up the valley to opposite the Mt Vernon Track switchback. 2. The Mt Vernon track to the ridgeline - maintain 2-3-meters-wide nonfuel surface and 3-metres-wide backdown Mt. Vernon Ridge to Mapp Track.	MDC
HS-9	H	Bottom section of Sutherland Stream	Reduce Consequence	Reduction	1. Tree and scrub management from carpark to opposite where the MT Vernon Track	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					leaves the Stream and switches back to the north to climb to the ridgeline. • maintain an open space tree area (limited or interrupted tree canopy closure) • remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away. Prioritise ribbon bark eucalyptus species • remove lower limbs of conifer tree species to 3-metres and other species to 2-metres and clear away surface vegetation • maintain a clear understory with short grass 2. plant the riparian margins and where feasible buffer the track/s with low flammability native species and continue increasing the width. The wider area would be contingent to fencing and weed control. 3. review debris dams and their enhancement to create extended areas of dampness for growing native broadleaf species.	

14.8. Harling and Wither Stream and ridges

Table 26: Harling and Wither stream and ridges risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
HWSR-1	M	Mid to upper Harling and Wither Streams	Reduce Consequence	Reduction	1. Use existing isolated pockets of trees in the streams and side creeks to plant low flammability native species, extend this over time. 2. Maintain trees in the head of Harling Stream and near the junction with Reservoir Ridge to prevent fire spreading up trees to the canopy.	MDC
HWSR-2	VH	Upper Harling and Reservoir Ridge tracks	Reduce Consequence	Reduction Response	1. Maintain Upper Harling Track 2-metres wide nonfuel surface. 2. Maintain Reservoir Ridge Track as 3-metre-wide nonfuel surface.	MDC
HWSR-3	VH	Fire pond on Reservoir Ridge	Reduce Consequence	Response	1. Maintain pond operational and useable by aircraft and ground crews. 2. Maintain vegetation around the pond as short grass.	MDC

14.9. Sutherland Stream and ridges

Table 27: Sutherland Stream and ridges risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
SS-1	VH	Upper Reservoir and Mt Vernon Track ridges	Reduce Consequence	Reduction Response	1. Maintain 3-metre-wide nonfuel surface. 2. Maintain short grass track verges.	MDC
SS-2	VH	Split Apple Peak Track	Reduce Consequence	Reduction Response	1. Explore the best line to make the headwater section 3-metre-wide nonfuel surface. It is presently grass. 2. Maintain short grass track verges 3. Identify locations to safely exit the main ridgeline down to the farm at the end of Maxwell Pass Road (part of evacuation route options) 4. Discuss routes with landowners and FENZ	MDC and FENZ
SS-3	VH	Sutherland Stream track and the 4x4 farm track	Reduce Consequence	Reduction Response	1. Maintain both tracks 3-metre-wide nonfuel surface to the Covenant Track turnaround and toilet. 2. Provide vehicle turnarounds.	MDC
SS-4	H	Sutherland Stream	Reduce Consequence	Reduction	1. Plant the riparian margins and where feasible buffer the track/s with low flammability native species and continue increasing the width. The wider area would be contingent to fencing and weed control. 2. Maintain sections of the Sutherland Stream track with open tree canopy to enable an aerial search to locate people on the track	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					3. Review debris dams and their enhancement to create extended areas of dampness for growing native broadleaf species. 4. Identify side streams with colder aspects slumps and seepages as places to begin or extend native planting.	
SS-5	H	Sutherland Stream Covenant	Reduce Consequence	Reduction	1. Continue revegetation program and consider • Planting the Covenant Loop Track margins will low flammability native species • Maintain a 20-30-metre buffer of grazed or mown grass at the edge of the Mount Vernon Track • As part of the wider access control triggers consider closure of the Covenant Loop Track while it has a high fuel load and highly flammable vegetation.	MDC

14.10. Sutherland Stream Reserve to Cob Cottage Road (toe slopes)

Table 28: Sutherland Stream Reserve to Cob Cottage Road (toe slopes) risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
Note: Refer to the RI-2 risk treatments that boarder or relate to this area.						
SC -1	VH	Dry Hills Lane & Cob Cottage Road entrance	Reduce Consequence	Reduction	1. Fire Prevention signage displayed at the entrances	MDC
SC-2	VH	Cathcarts Gully to ridge between Simmons Gully	Reduce Likelihood &Consequence	Reduction	1. Powerlines leading to communication infrastructure • Maintain 2-metre diameter nonfuel at base of poles • Refer WH-10 treatment for infrastructure maintenance	MDC and power company

14.11. Eastern Valleys and ridges

Table 29: Eastern Valleys and ridges risk treatments

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
EV/R-1	VH	Cathcarts Gully to Communication infrastructure on Mt. Vernon Ridge to properties at end of Cob Cottage Rd.	Reduce Likelihood &Consequence	Reduction	1. Powerlines leading to communication infrastructure • For poles not on exposed ridgelines, maintain 2-metre diameter nonfuel at base of poles • Refer WH-10 treatment for infrastructure maintenance	MDC and power company

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
					• Communicate with landowners at the end of Cob Cottage Road for their section of the powerline.	
EV/R-2	H	Communication facilities (towers and structures) on Mt Vernon Ridge	Reduce Consequence	Reduction Response	1. Maintain vegetation clear areas around structures, towers, and tanks. FENZ guidelines for defensible space to be referred to. 2. First-aid firefighting equipment to be available at both locations. FENZ to advise minimum and this to be included in concessions	MDC, facility owners and FENZ
EV/R-3	M	Pine stands in all gullies except head waters of Mapps Gully West	Reduce Consequence	Reduction Response	1. Interplant or buffer existing pine stands with low to medium flammability native. 2. Harvesting plan could allow for small pine pockets to be cleared early and replaced with native planting. 3. Buffer pine stands with native planting using pine as sheltering protection and extend over time.	MDC
EV/R-4	H	Pine in the headwaters of Mapps Gully West	Reduce Consequence	Reduction	1. Wilding pine control area increases fuel load. There needs to be a short grass buffer 10-20-metres on the downslope side of Middle Track.	MDC
EV/R-5	M	All gullies except Eastern Boundary	Reduce Consequence	Reduction	1. Tree and scrub management • Plant the riparian margins with low flammability native species and continue increasing the width. The wider area would be contingent to fencing and weed control.	MDC

Ref #	Priority	Location	Treatment Objective	Function	Action/activity	Groups concerned
EV/R-6	M	Eastern Boundary Gully	Reduce Consequence	Reduction	1. Tree and scrub management • Remove eucalyptus trees, or remove lower limbs to 4-metres, remove ribbon bark to 6-metres and the surface vegetation cleared away. Prioritise ribbon bark eucalyptus species • Plant the riparian margins with low flammability native species and continue increasing the width. The wider area would be contingent to fencing and weed control. 2. Investigate the old pond near the eastern boundary true left for feasibility of reinstating.	MDC
EV/R-7	VH	Middle and Cob Cottage Tracks	Reduce Consequence	Reduction Response	1. Both tracks to be maintained 3-metre-wide nonfuel surface. 2. Track edges to be short grass.	MDC

14.12. Risk treatment summary

Table 30: Risk treatment summary

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
WH-1	19	VH	All WHFP	Working Group establishment	MDC, FENZ and relevant organisations and groups
WH-2	19	VH	All WHFP	Preparation of Fire Plan	MDC and FENZ
WH-3	19	VH	All WHFP	Firefighting water supplies	MDC and FENZ
WH-4	19	VH	All WHFP	Road, track, and firebreak maintenance schedule	MDC
WH-5	19	VH	All WHFP	Evacuation plan	MDC and FENZ
WH-6	19	VH	All WHFP	Revegetation plan	MDC
WH-7	19	H	All WHFP	Farm management plan for grazing	MDC and Farm Management
WH-8	19	VH	All WHFP	Application of fire prevention guidelines.	MDC, contractors, and concessionaires
WH-9	19	VH	All WHFP	Powerline auto reclosure guideline	MDC and power company
WH-10	19	VH	All WHFP	Powerline infrastructure maintenance	MDC and power company
WH-11	19	VH	All WHFP	Road verge vegetation maintenance	MDC
R-1	20	H	All RUI and RI within 500-metres of WHFP boundary	Property maintenance	MDC and FENZ

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
R-2	20	H	All RUI and RI	Property maintenance	MDC and FENZ
R-3	20	H	All RUI and RI	Property maintenance	MDC and FENZ
R-4	20	VH	RUI-1 Grigg Drive and Solomon Place	Track maintenance	MDC
R-5	20	VH	RUI-2 Reservoir access road to Rifle Range carpark	Track and vegetation maintenance	MDC
R-6	20	VH	RUI-1 Grigg Drive and Solomon Place to slope	Vegetation maintenance	MDC and farm management
R-7	20	VH	RUI-2 Reservoir access road to Rifle Range carpark back to the slope	Vegetation maintenance	MDC and farm management
R-8	20	H	RUI-3 Forest Park Drive & Quail Stream carpark to the vehicle track (Forest Hills track)	Track and vegetation maintenance	MDC
R-9	20	H	RUI-4 Quail Place & Elmwood Ave.	Vegetation maintenance	MDC and Farm management
R-10	20	VH	RUI-5 Harling Park.	Fire prevention signage and vegetation maintenance	MDC

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
R-11	20	H	RUI-6 Solway Drive to Redwood Street	Track, vegetation, and property maintenance	MDC
R-12	20	H	RUI-7 Sutherland Stream Reserve.	Vegetation maintenance	MDC
R-13	20	VH	RI-1 WHFP farmhouse and top of Redwood St. properties	Vegetation, property, and powerline maintenance	MDC, Farm management and power company
R-14	20	VH	RI-2 Sutherland Stream Reserve toward east end of WHFP	Track, vegetation, and powerline maintenance	MDC, Farm management and power company
BG-1	21	VH	Entry kiosk area	Surveillance	Bluegums
BG-2	21	VH	Bottom entry area and roads	Vegetation maintenance	Bluegums
BG-3	21	VH	Powerlines	Vegetation and powerline maintenance	Bluegums and power company
BG-4	21	M	Gas flare area	For the Working Group	MDC and Bluegums
BG-5	21	VH	Tip face and landfill area	Firebreak maintenance	Bluegums
BG-6	21	H	Outer boundary of Bluegums property	Suggested new firebreaks	MDC and Bluegums
BG-7	21	H	Vegetated areas	Vegetation maintenance	Bluegums

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
BG-8	21	VH	Kiosk and Tip face operations	Suppression equipment	Bluegums
BG-9	21	VH	Properties 257 and 309 Taylor Pass Rd	Property maintenance and activity controls	MDC and Bluegums
MTB/RR-1	22	H	MTB carpark	Surveillance	MDC
MTB/RR-2	22	VH	MTB and Rifle Range carparks	Fire prevention signage and vegetation maintenance	MDC and Farm management
MTB/RR-3	22	VH	Grassed flats and toe slopes	Vegetation maintenance	MDC
MTB/RR-4	22	H	Gullies and tree cover area	Vegetation maintenance	MDC
MTB/RR-5	22	H	Ridge from Twin Tanks Walkway to the upper reservoir	Track upgrade	MDC
MTB/RR-6	22	VH	Reservoir Road	Vegetation maintenance	MDC
MTB/RR-7	22	VH	Rotary Lookout Track	Track maintenance	MDC
MTB/RR-8	22	VH	Twin Tanks Walk ridgeline to Intersect track	Track maintenance and possible grazing	MDC
RR/QS-1	23	VH	Western end of Forest Hills Track	Track maintenance	MDC

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
RR/QS-2	23	VH	Rifle Range and Quail Stream carparks	Fire prevention signage and surveillance	MDC
RR/QS-3	23	VH	Downslope of the Rifle Range MTB Track to Forest Hills Track (Rifle Range to spur with Harling Stream)	Vegetation maintenance	MDC
RR/QS-4	23	VH	Forest Hills and Rifle Range MTB Tracks	Track maintenance schedule	MDC
RR/QS-5	23	VH	Short Loop and Gentle Annie Tracks	Track maintenance	MDC
RR/QS-6	23	VH	Between Quail and Harling Streams	Track and vegetation maintenance	MDC
RR/QS-7	23	H	Water tanks on Ridge between Quail & Harling Streams	Vegetation maintenance	MDC
QS-1	24	VH	4x4 track to Quail Junction	Track maintenance	MDC
QS-2	24	H	4x4 track from Quail Junction to Reservoir Ridge junction with Mt. Vernon Ridge	Track maintenance	MDC

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
QS-3	24	H	Upper Quail, Twin Tanks, and Intersect Tracks	Track maintenance	MDC
QS-4	24	VH	Quail Stream	Vegetation management and debris dams	MDC
QS-5	24	VH	Quail Stream between carpark and Quail Junction	Vegetation management and emergency response	MDC and FENZ
QS-6	24	H	Quail Stream old true left track	Suggested reestablishment of track	MDC
QS-7	24	VH	Twin Tanks and Taylor View track (main ridgeline)	Track maintenance	MDC
QS-8	24	VH	Taylor View track (main ridgeline) to Reservoir Ridge Track	Emergency exits	MDC, local landowners and FENZ
QS-9	24	M	Ridge between Quail and Harling Streams above water tanks	Vegetation maintenance	MDC
HS-1	25	VH	Sutherland Stream carpark and Reserve	Fire prevention signage	MDC
HS-2	25	VH	Land parcel true right of Harling Stream below Lower Farm Track	Vegetation maintenance and water supply	MDC and Farm management

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
HS-3	25	H	Toe slopes of Harling, Wither and Sutherland Streams	Vegetation maintenance	MDC and Farm management
HS-4	25	VH	4x4 track to reservoir	Track maintenance	MDC
HS-5	25	H	4x4 track beside Wither Stream to past Reservoir Dam	Track maintenance	MDC
HS-6	25	H	Tree area surrounding the reservoir and Reservoir Dam and in Wither Stream	Vegetation maintenance	MDC
HS-7	25	VH	Powerline from Redwood Street to reservoir and along ridgeline	Vegetation and powerline maintenance	MDC and power company
HS-8	25	VH	Tracks from Sutherland Stream carpark & end of Redwood St.	Track maintenance	MDC
HS-9	25	H	Bottom section of Sutherland Stream	Vegetation management and debris dams	MDC
HWSR-1	26	M	Mid to upper Harling and Wither Streams	Vegetation maintenance	MDC
HWSR-2	26	VH	Upper Harling and Reservoir Ridge tracks	Track maintenance	MDC

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
HWSR-3	26	VH	Fire pond on Reservoir Ridge	Water supply maintenance	MDC
SS-1	27	VH	Upper Reservoir and Mt Vernon Track ridges	Track maintenance	MDC
SS-2	27	VH	Split Apple Peak Track	Track maintenance and emergency exits	MDC and FENZ
SS-3	27	VH	Sutherland Stream track and the 4x4 farm track	Track maintenance	MDC
SS-4	27	H	Sutherland Stream	Vegetation maintenance and debris dams	MDC
SS-5	27	H	Sutherland Stream Covenant	Vegetation maintenance	MDC
SC -1	28	VH	Dry Hills Lane & Cob Cottage Road entrance	Fire prevention signage	MDC
SC-2	28	VH	Cathcarts Gully to ridge between Simmons Gully	Powerline maintenance	MDC and power company
EV/R-1	29	VH	Cathcarts Gully to Communication infrastructure on Mt. Vernon Ridge to properties at end of Cob Cottage Rd.	Powerline maintenance	MDC and power company

Ref#	Table #	Priority	Location	Action/activity	Groups concerned
EV/R-2	29	H	Communication facilities (towers and structures) on Mt Vernon Ridge	Property maintenance and fire suppression equipment	MDC, facility owners and FENZ
EV/R-3	29	M	Pine stands in all gullies except head waters of Mapps Gully West	Vegetation maintenance	MDC
EV/R-4	29	H	Pine in the headwaters of Mapps Gully West	Vegetation maintenance	MDC
EV/R-5	29	M	All gullies except Eastern Boundary	Vegetation maintenance	MDC
EV/R-6	29	M	Eastern Boundary Gully	Vegetation maintenance and water supply	MDC
EV/R-7	29	VH	Middle and Cob Cottage Tracks	Track maintenance	MDC

14.13. Risk treatment work priority

Table 31: Very High priority risk treatment order for implementation

The following table is the recommended order for implementing the Very High priority risk treatments with VH-1 being the first and VH-48 last.

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
WH-1	19	1	All WHFP	Working Group establishment	MDC, FENZ and relevant organisations and groups
WH-8	19	2	All WHFP	Application of fire prevention guidelines.	MDC, contractors, and concessionaires
WH-2	19	3	All WHFP	Preparation of Fire Plan	MDC and FENZ
WH-5	19	4	All WHFP	Evacuation plan	MDC and FENZ
QS-5	24	5	Quail Stream between carpark and Quail Junction	Vegetation management and emergency response	MDC and FENZ
SS-2	27	6	Split Apple Peak Track	Track maintenance and emergency exits	MDC and FENZ
QS-8	24	7	Taylor View track (main ridgeline) to Reservoir Ridge Track	Emergency exits	MDC, local landowners and FENZ
WH-9	19	8	All WHFP	Powerline auto reclosure guideline	MDC and power company
WH-10	19	9	All WHFP	Powerline infrastructure maintenance	MDC and power company

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
BG-3	21	10	Powerlines	Vegetation and powerline maintenance	Bluegums and power company
HS-7	25	11	Powerline from Redwood Street to reservoir and along ridgeline	Vegetation and powerline maintenance	MDC and power company
R-13	20	12	RI-1 WHFP farmhouse and top of Redwood St. properties	Vegetation, property, and powerline maintenance	MDC, Farm management and power company
R-14	20	13	RI-2 Sutherland Stream Reserve toward east end of WHFP	Track, vegetation, and powerline maintenance	MDC, Farm management and power company
SC-2	28	14	Cathcarts Gully to ridge between Simmons Gully	Powerline maintenance	MDC and power company
EV/R-1	29	15	Cathcarts Gully to Communication infrastructure on Mt. Vernon Ridge to properties at end of Cob Cottage Rd.	Powerline maintenance	MDC and power company
MTB/RR-2	22	16	MTB and Rifle Range carparks	Fire prevention signage and vegetation maintenance	MDC and Farm management
HS-1	25	17	Sutherland Stream carpark and Reserve	Fire prevention signage	MDC
R-10	20	18	RUI-5 Harling Park.	Fire prevention signage and vegetation maintenance	MDC
SC -1	28	19	Dry Hills Lane & Cob Cottage Road entrance	Fire prevention signage	MDC

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
BG-9	21	20	Properties 257 and 309 Taylor Pass Rd	Property maintenance and activity controls	MDC and Bluegums
BG-8	21	21	Kiosk and Tip face operations	Suppression equipment	Bluegums
BG-1	21	22	Entry kiosk area	Surveillance	Bluegums
WH-3	19	23	All WHFP	Firefighting water supplies	MDC and FENZ
HWSR-3	26	24	Fire pond on Reservoir Ridge	Water supply maintenance	MDC
WH-4	19	25	All WHFP	Road, track, and firebreak maintenance schedule	MDC
WH-6	19	26	All WHFP	Revegetation plan	MDC
WH-11	19	27	All WHFP	Road verge vegetation maintenance	MDC
R-4	20	28	RUI-1 Grigg Drive and Solomon Place	Track maintenance	MDC
R-5	20	29	RUI-2 Reservoir access road to Rifle Range carpark	Track and vegetation maintenance	MDC
R-6	20	30	RUI-1 Grigg Drive and Solomon Place to slope	Vegetation maintenance	MDC and farm management
R-7	20	31	RUI-2 Reservoir access road to Rifle Range carpark back to the slope	Vegetation maintenance	MDC and farm management
BG-5	21	32	Tip face and landfill area	Firebreak maintenance	Bluegums

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
BG-2	21	33	Bottom entry area and roads	Vegetation maintenance	Bluegums
MTB/RR-7	22	34	Rotary Lookout Track	Track maintenance	MDC
MTB/RR-8	22	35	Twin Tanks Walk ridgeline to Intersect track	Track maintenance and possible grazing	MDC
RR/QS-1	23	36	Western end of Forest Hills Track	Track maintenance	MDC
QS-1	24	37	4x4 track to Quail Junction	Track maintenance	MDC
QS-7	24	38	Twin Tanks and Taylor View track (main ridgeline)	Track maintenance	MDC
MTB/RR-3	22	39	Grassed flats and toe slopes	Vegetation maintenance	MDC
MTB/RR-6	22	40	Reservoir Road	Vegetation maintenance	MDC
HS-2	25	41	Land parcel true right of Harling Stream below Lower Farm Track	Vegetation maintenance and water supply	MDC and Farm management
HS-4	25	42	4x4 track to reservoir	Track maintenance	MDC
HS-5	25	43	4x4 track beside Wither Stream to past Reservoir Dam	Track maintenance	MDC
HS-8	25	44	Tracks from Sutherland Stream carpark & end of Redwood St.	Track maintenance	MDC
HWSR-2	26	45	Upper Harling and Reservoir Ridge tracks	Track maintenance	MDC

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
SS-1	27	46	Upper Reservoir and Mt Vernon Track ridges	Track maintenance	MDC
SS-3	27	47	Sutherland Stream track and the 4x4 farm track	Track maintenance	MDC
EV/R-7	29	48	Middle and Cob Cottage Tracks	Track maintenance	MDC

Table 32: High priority risk treatment order for implementation

The following table is the recommended order for implementing the HIGH priority risk treatments with H-1 being the first and H-22 last.

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
EV/R-2	29	1	Communication facilities (towers and structures) on Mt Vernon Ridge	Property maintenance and fire suppression equipment	MDC, facility owners and FENZ
R-2	20	2	All RUI and RI	Property maintenance	MDC and FENZ
R-3	20	3	All RUI and RI	Property maintenance	MDC and FENZ
R-11	20	4	RUI-6 Solway Drive to Redwood Street	Track, vegetation, and property maintenance	MDC
R-1	20	5	All RUI and RI within 500-metres of WHFP boundary	Property maintenance	MDC and FENZ
MTB/RR-1	22	6	MTB carpark	Surveillance	MDC

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
WH-7	19	7	All WHFP	Farm management plan for grazing	MDC and Farm Management
R-8	20	8	RUI-3 Forest Park Drive & Quail Stream carpark to the vehicle track (Forest Hills track)	Track and vegetation maintenance	MDC
R-9	20	9	RUI-4 Quail Place & Elmwood Ave.	Vegetation maintenance	MDC and Farm management
R-12	20	10	RUI-7 Sutherland Stream Reserve.	Vegetation maintenance	MDC
BG-6	21	11	Outer boundary of Bluegums property	Suggested new firebreaks	MDC and Bluegums
BG-7	21	12	Vegetated areas	Vegetation maintenance	Bluegums
MTB/RR-4	22	11	Gullies and tree cover area	Vegetation maintenance	MDC
MTB/RR-5	22	12	Ridge from Twin Tanks Walkway to the upper reservoir	Track upgrade	MDC
QS-3	24	13	Upper Quail, Twin Tanks, and Intersect Tracks	Track maintenance	MDC
QS-6	24	14	Quail Stream old true left track	Suggested reestablishment of track	MDC
QS-2	24	15	4x4 track from Quail Junction to Reservoir Ridge junction with Mt. Vernon Ridge	Track maintenance	MDC

Ref#	Table #	Order of Priority	Location	Action/activity	Groups concerned
HS-3	25	16	Toe slopes of Harling, Wither and Sutherland Streams	Vegetation maintenance	MDC and Farm management
RR/QS-7	23	17	Water tanks on Ridge between Quail & Harling Streams	Vegetation maintenance	MDC
HS-6	25	18	Tree area surrounding the reservoir and Reservoir Dam and in Wither Stream	Vegetation maintenance	MDC
HS-9	25	19	Bottom section of Sutherland Stream	Vegetation management and debris dams	MDC
SS-4	27	20	Sutherland Stream	Vegetation maintenance and debris dams	MDC
SS-5	27	21	Sutherland Stream Covenant	Vegetation maintenance	MDC
EV/R-4	29	22	Pine in the headwaters of Mapps Gully West	Vegetation maintenance	MDC

15. References

Adams, J.; Millen, P. (1984). Wither Run Landscape Development Concept Plan and Report (for Blenheim Borough Council now Marlborough District Council).

Anderson, S.A.J. (2005). Forest and rural fire danger rating in New Zealand. In: Colley, M. (ed.). Forestry Handbook. New Zealand Institute of Forestry, Christchurch. pp 214-244.

Australian Institute Disaster Resilience (AIDR); https://knowledge.aidr.org.au/glossary/ : definition.

Boffas Miskell. (2015). Marlborough Landscape Study Landscape Characterisation and Evaluation.

Campbell, I. B. (2011) Soil Survey of Part of the Wither Hills – Redwood Hills Area, Marlborough. Marlborough District Council Technical Report No: 11-004.

Clifford, V.R.; Pearce, H.G.; Anderson, S.A.J. (2013). Guide to New Zealand Fuels – A technical guide for selecting the most appropriate fuel type for fire behaviour predictions. Scion, Rural Fire Research Group, Christchurch. (October 2013). 110 p.

Cookson, C. (2021). Wild about the Withers. Retrieved November, 29, 2022, from https://www.marlboroughonline.co.nz/marlborough/information/commentary/wild-about-the-withers/

FENZ & NIWA (2018). Fire weather website. Fire and Emergency New Zealand and the National Institute for Water & Atmospheric Research, Wellington. https://fireweather.niwa.co.nz/

FENZ data. Creative Commons Attribution 4.0 International licence (CC BY 4.0).

Forestry Canada Fire Danger Group. (1992). Development and structure of the Canadian Forest Fire Behavior Prediction System. Forestry Canada, Science and Sustainable Development Directorate, Ottawa, Ontario. Information Report ST-X-3. 63 p.

Hutchinson, R. (n.d.) Wither Hills Farm Park (presentation of Boxing Day 2000 wildfire).

Langer, E.R. (Lisa).; Wegner S.; Pearce H.G.; Melia N.; Luff N.; Palmer D. July 2021. Adapting and mitigating wildfire risk due to climate change: extending knowledge and best practice.

Malcolm McKinnon, 'Marlborough region - Overview', Te Ara - the Encyclopedia of New Zealand, http://www.TeAra.govt.nz/en/marlborough-region/page-1 (accessed 29 November 2022)

Marlborough District Council (n.d.). South Marlborough Wither Hills Ecological District Report, p 43-48.

Marlborough District Council (n.d.). Soil Survey of Part of the Wither Hills – Redwood Hills Area, Marlborough. MDC Technical Report NO: 11-004, p 38-46

Marlborough District Council. (August 2022). Risk Management Policy.

Marlborough District Council. (2001). Vegetation species purchase lists

Marlborough District Council. Geo spatial data accessed 2022/2023 under Creative Commons Attribution 4.0 International Licence.

Marlborough District Council. (2003). Wither Hills Farm Park Management Plan.

Marlborough District Council. (2020). Brochure. Brilliant Wither Hills Farm Park.

NZMS. 1983. Meteorological Service Climatic Map Series Part 2 – Climatic Regions. NZMS Miscellaneous Publication 175, Wellington.

NIWA. (March 2021). Climate change projections and impacts for Marlborough.

Page W.G., Freeborn P.H. (2019) Entrapment. In: Manzello S. (eds) Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires. Springer, Cham. https://doi.org/10.1007/978-3-319-51727-8_183-1

Pearce, H.G.; Anderson, S.A.J.; Clifford, V.R. (2012). A Manual for Predicting Fire Behaviour in New Zealand Fuels. Second edition. Scion Rural Fire Research Group, Christchurch. September 2012. (version 2).

Pearce, H.G.; Langer, E.R.; Harrison, D.R. and Hart, M.; Describing Wildfire Prone Areas in the New Zealand Context: Final Report

Thompson, R. (2001). Wither Hills Farm Park Fire Management Review.

Scion. (2012). New Zealand Fire Behaviour Toolkit, v2.0. Software package. Available online at: https://www.scionresearch.com/rural-fire-research/tools/fire-behaviour-toolkit

Scion (2018.) Flammability of native plant species: a guide to reducing fire hazard around your home. Scion, Rural Fire Research Group, Christchurch. (Pamphlet)

Scott, J.H.; Burgan, R.E. (2005). Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado. General Technical Report RMRS-GTR-153. 72 p.

Tonkin and Taylor. (2019). Bluegums Regional Landfill. Landfill Management Plan.

Tymstra C.; Bryce R.W.; Wotton B.M.; Taylor S.W.; Armitage O.B. (2010). Development and Structure of Prometheus: the Canadian Wildland Fire Growth Simulation Model. Natural Resources Canada, Canadian Forest Service, Northern Forestry Center, Edmonton, Alberta. Information Report NOR-X-417. 88 p. (http://www.firegrowthmodel.ca).

Van Wagner, C.E., 1987. Structure of the Canadian Forest Fire Weather Index System. Environment Canada, Canadian Forest Service, Ottawa, Ontario. *Publication No. 1333.*

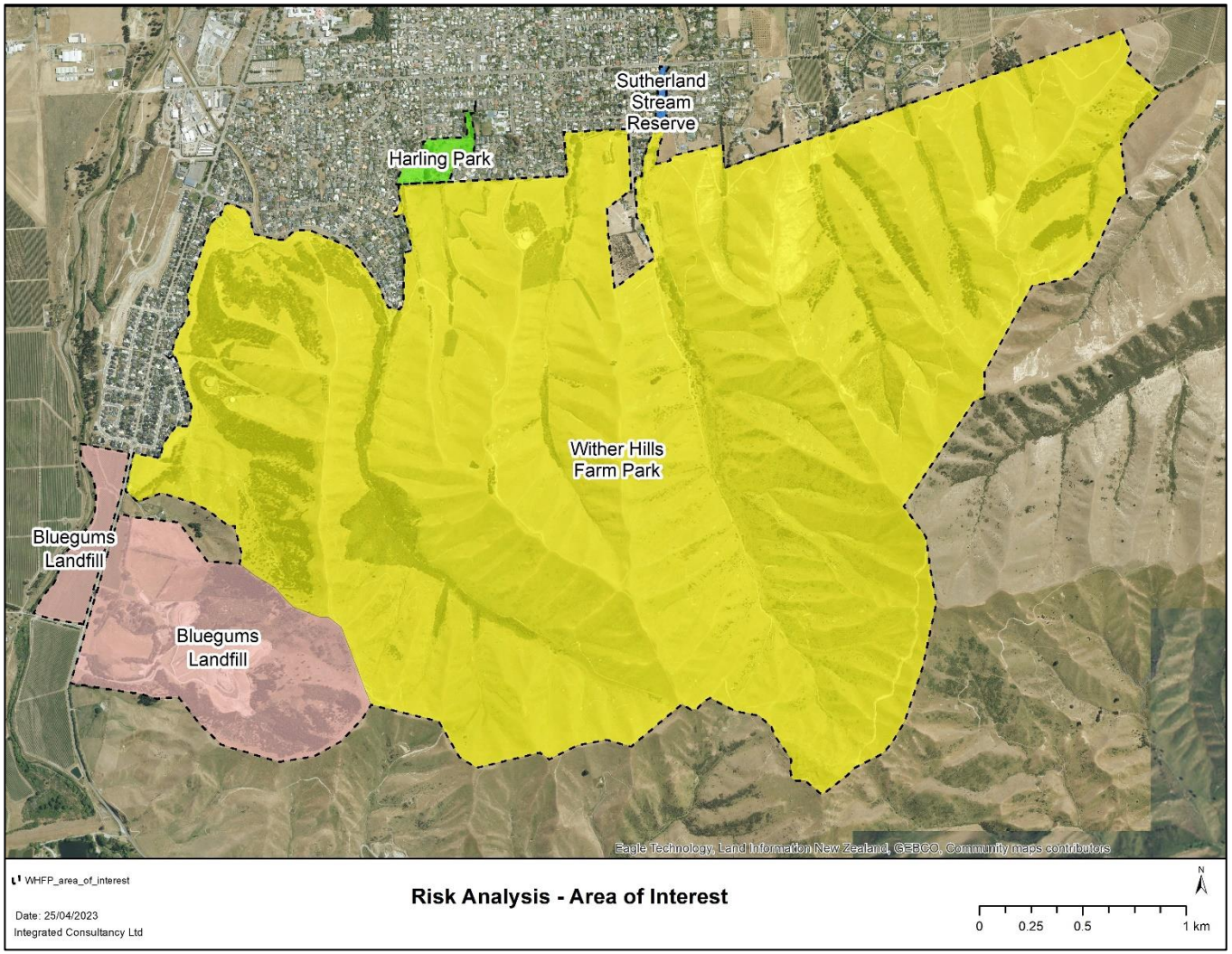
WRFA (2016). Guidelines for Forestry Operations, v1.5 (operative from 1 October 2016). Waimea Rural Fire Authority. 12 p.

Wotton, B.M.; Alexander, M.E.; Taylor, S.W. (2008). Updates and revisions to the 1992 Canadian Forest Fire Behavior Prediction System. Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, Sault Ste. Marie, Ontario, Canada. Information Report GLC-X-10. 45p.

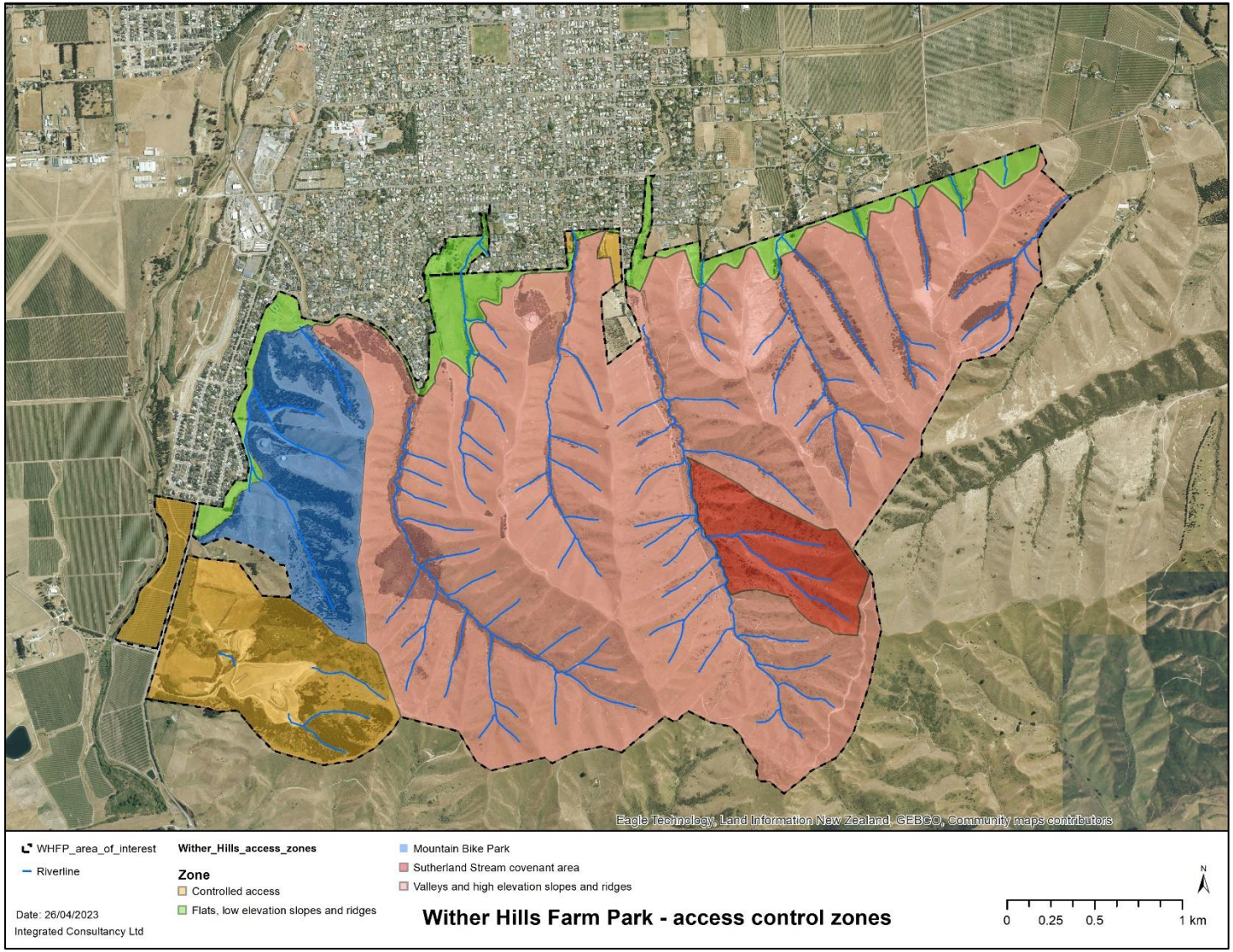
Wyse, S.; Perry, G.; O'Connell, D.; Holland, P.; Wright, M.; Hosted, C.; et al. (2016). A quantitative assessment of shoot flammability for 60 tree and shrub species supports rankings based on expert opinion. International Journal of Wildland Fire 25: 466-477. doi:10.1071/WF15047

16. Appendices

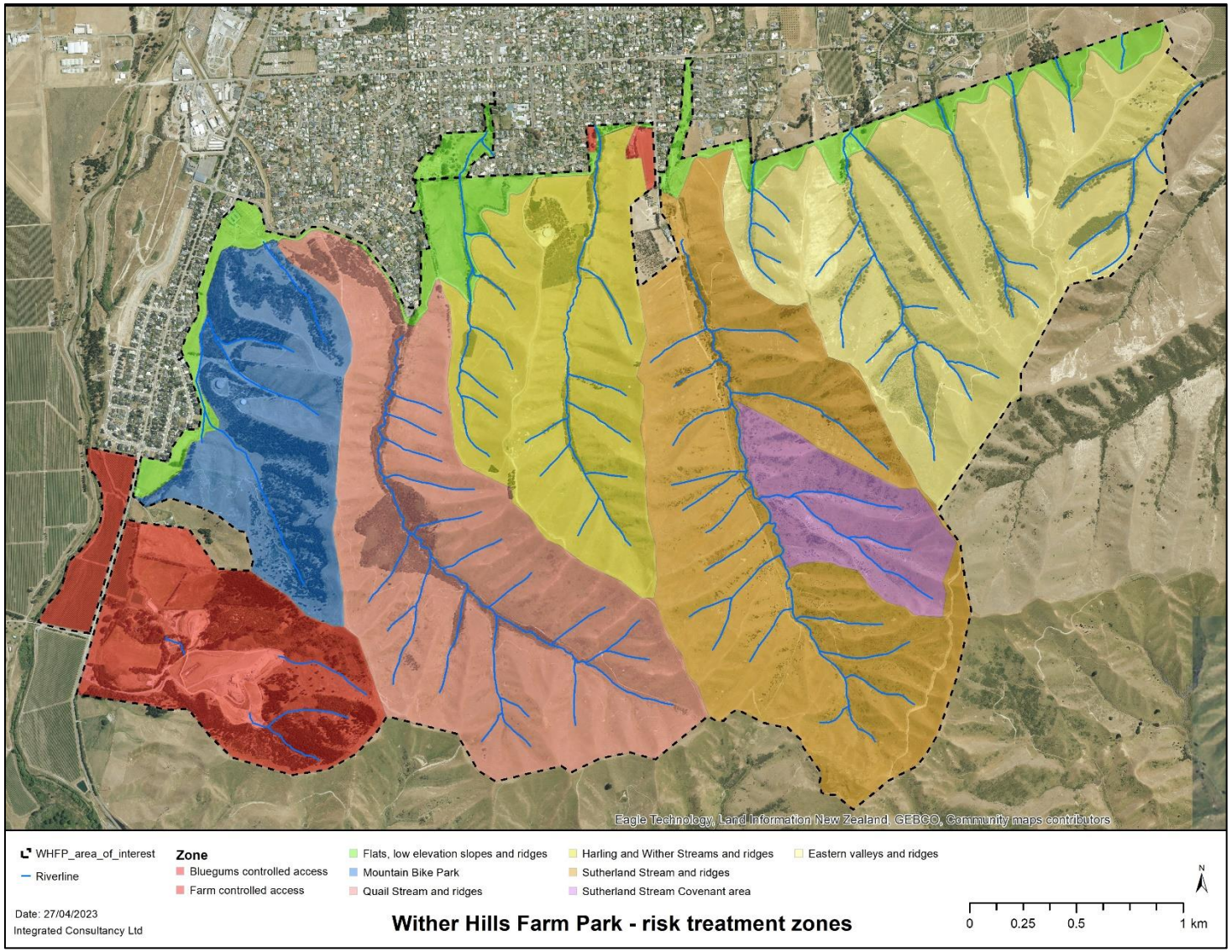
16.1. Appendix 1: Risk analysis area of interest map



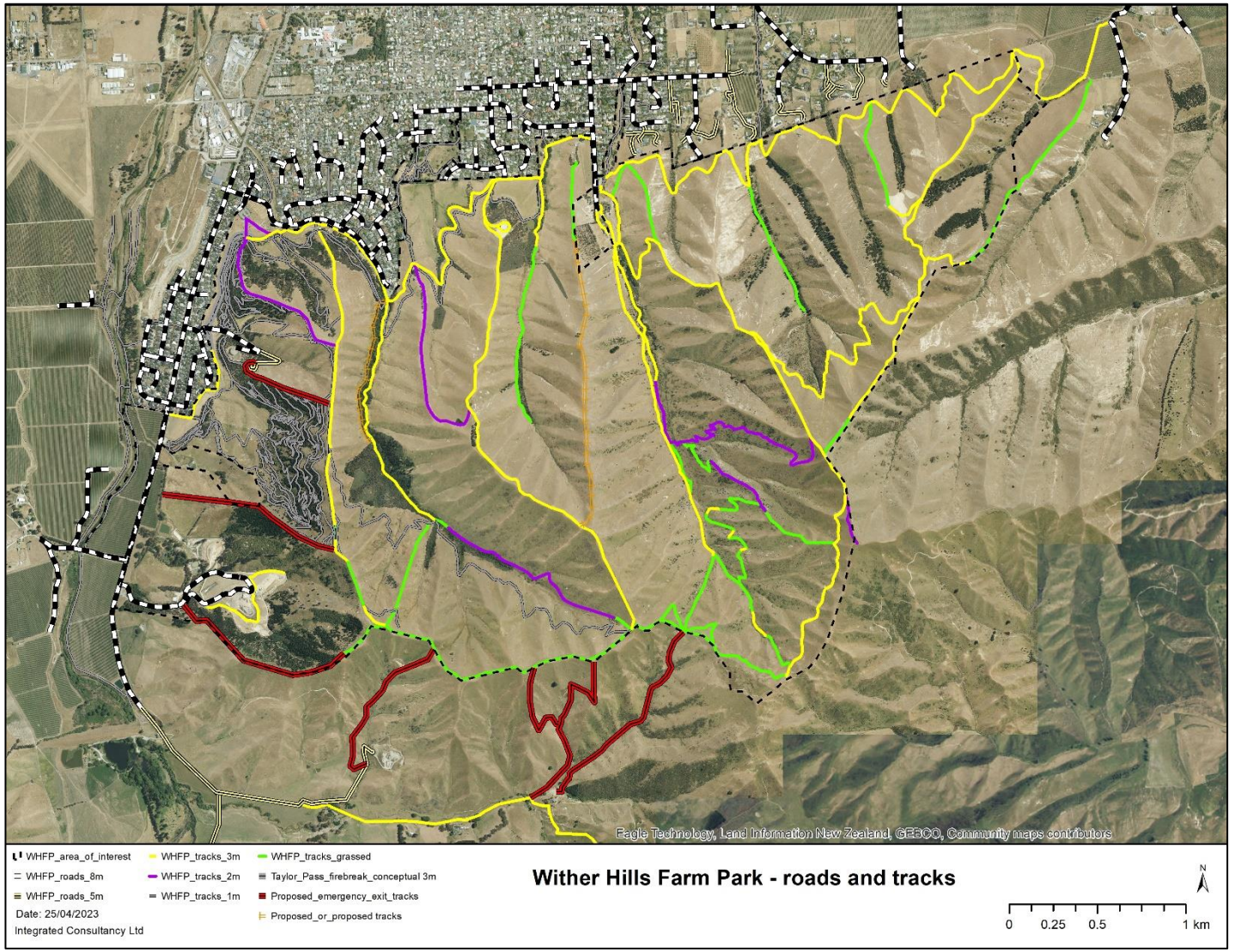
16.2. Appendix 2: Park access control zone map



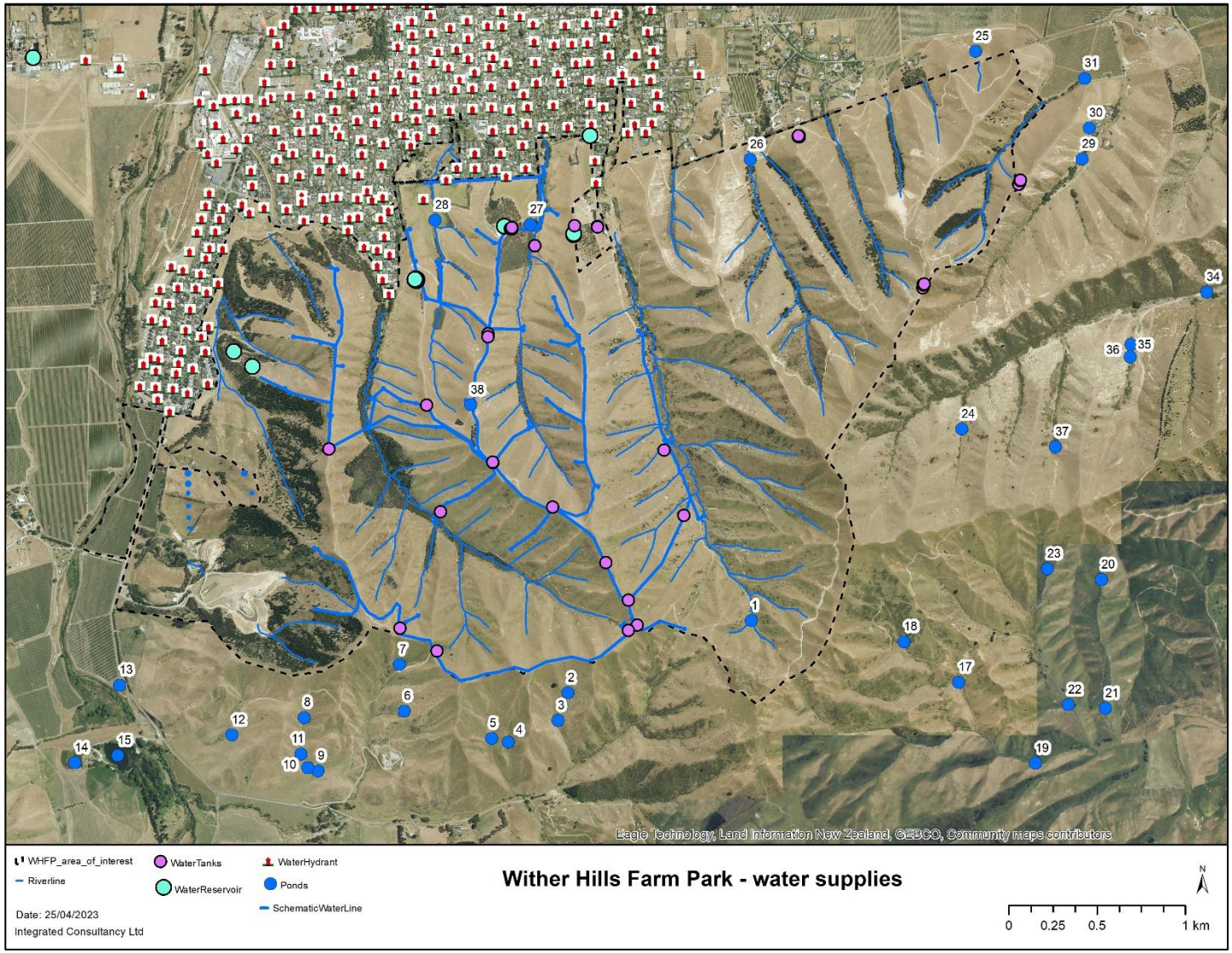
16.3. Appendix 3: Risk treatment zone map



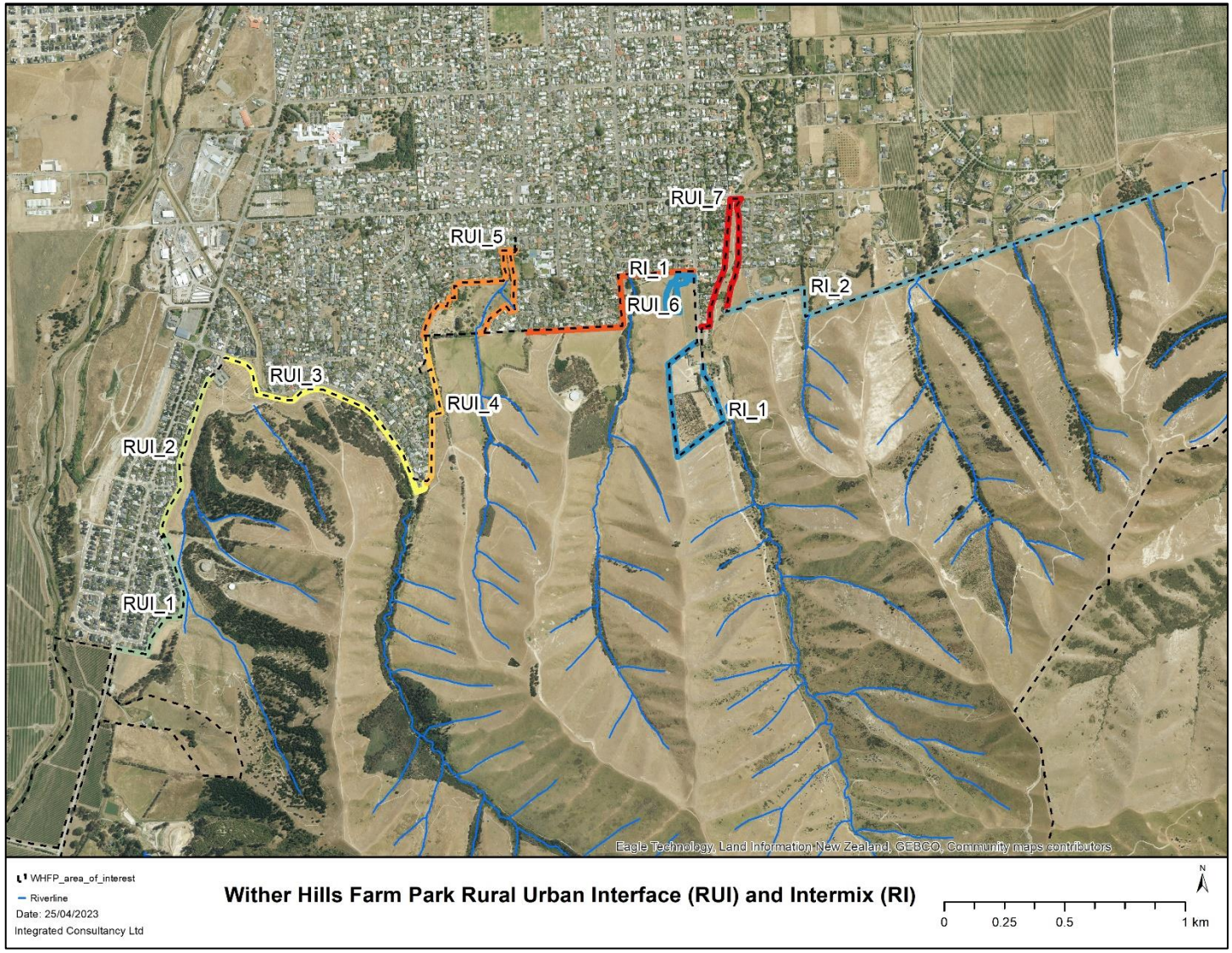
16.4. Appendix 4: Roads and tracks



16.5. Appendix 5: Water supplies

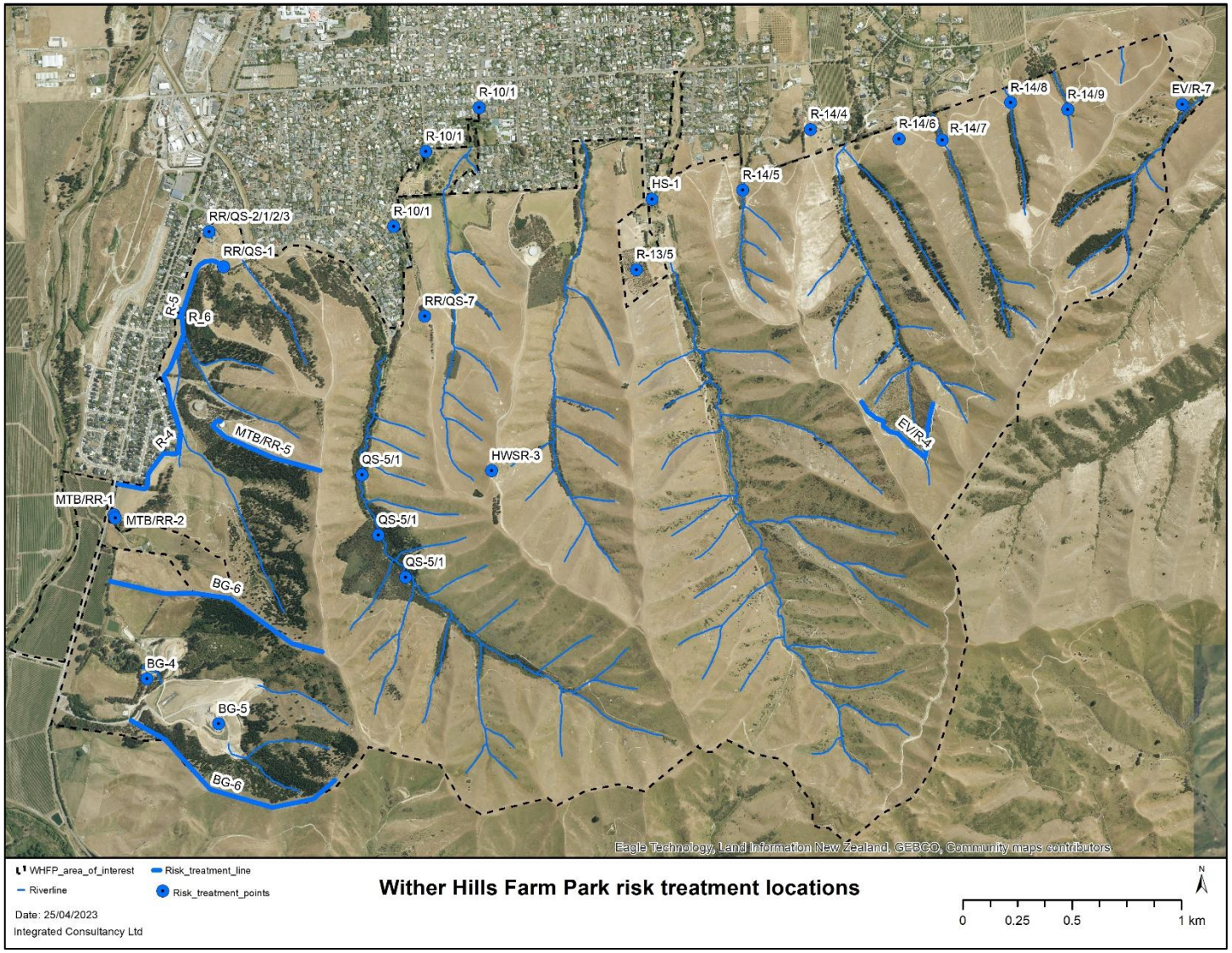


16.6. Appendix 6: Rural urban interface (RUI) and Rural intermix (RI)



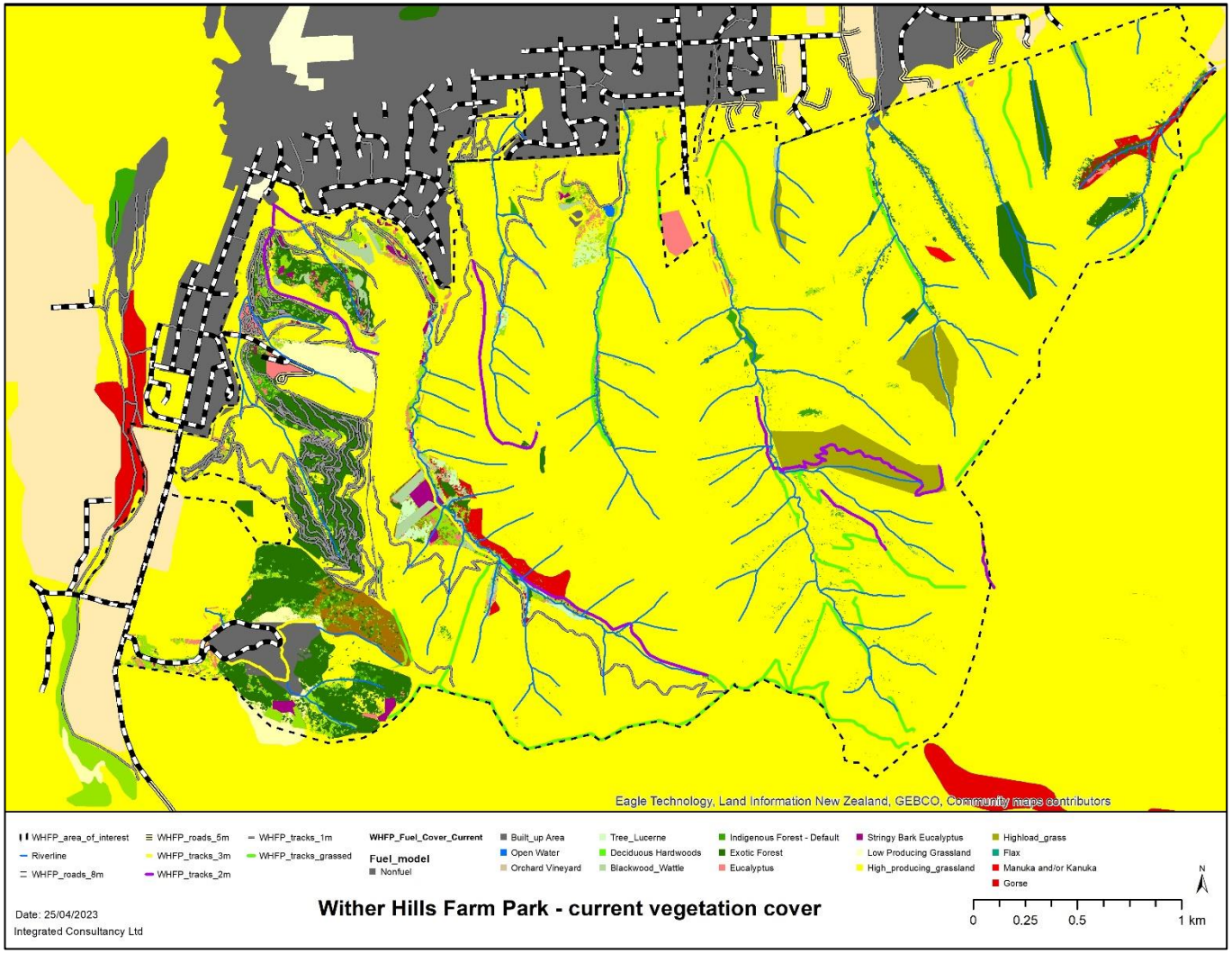
16.7. Appendix 7: Built, utility and historic values

16.8. Appendix 8: Risk treatment location map

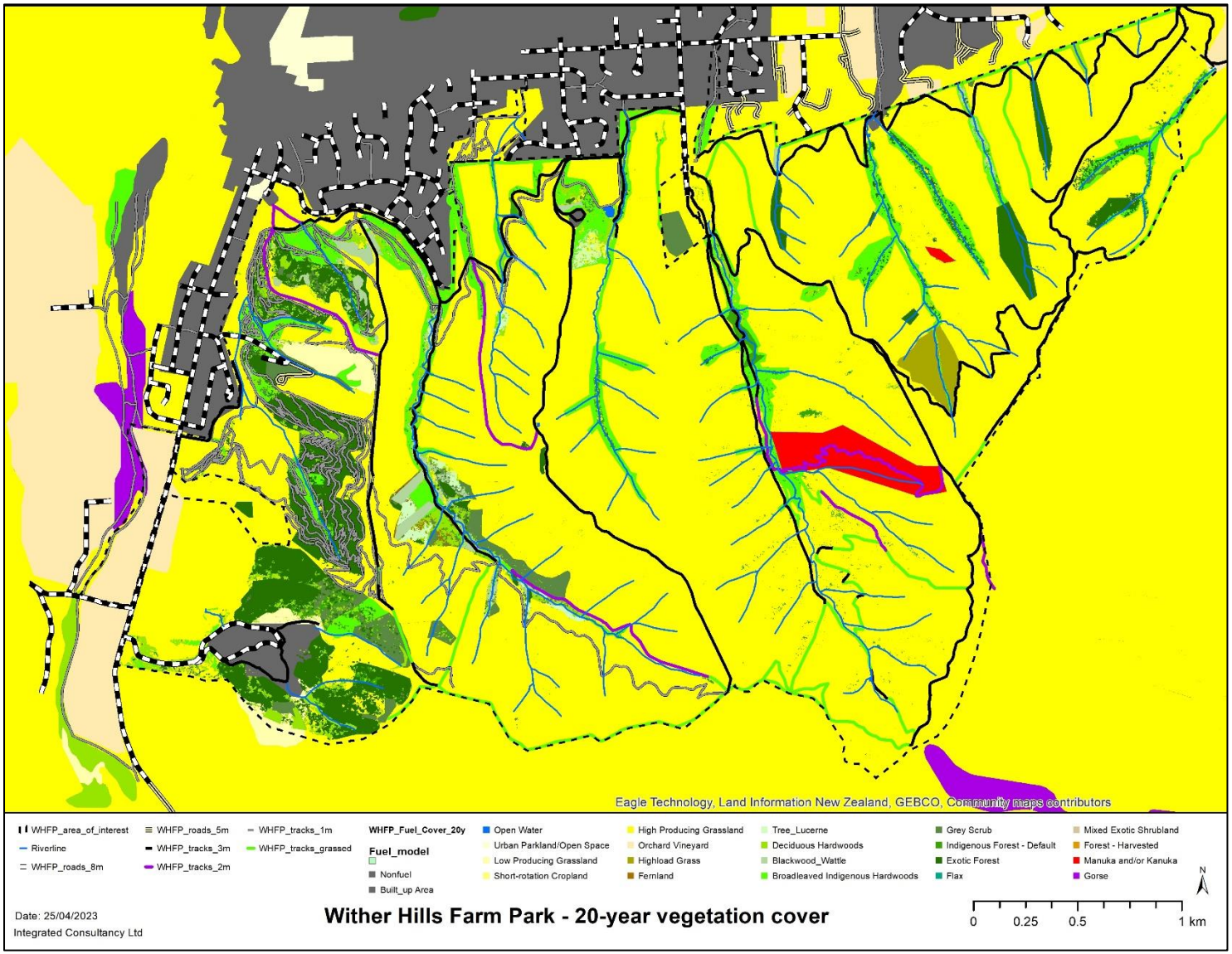


16.9. Appendix 9: Current and proposed vegetation cover maps

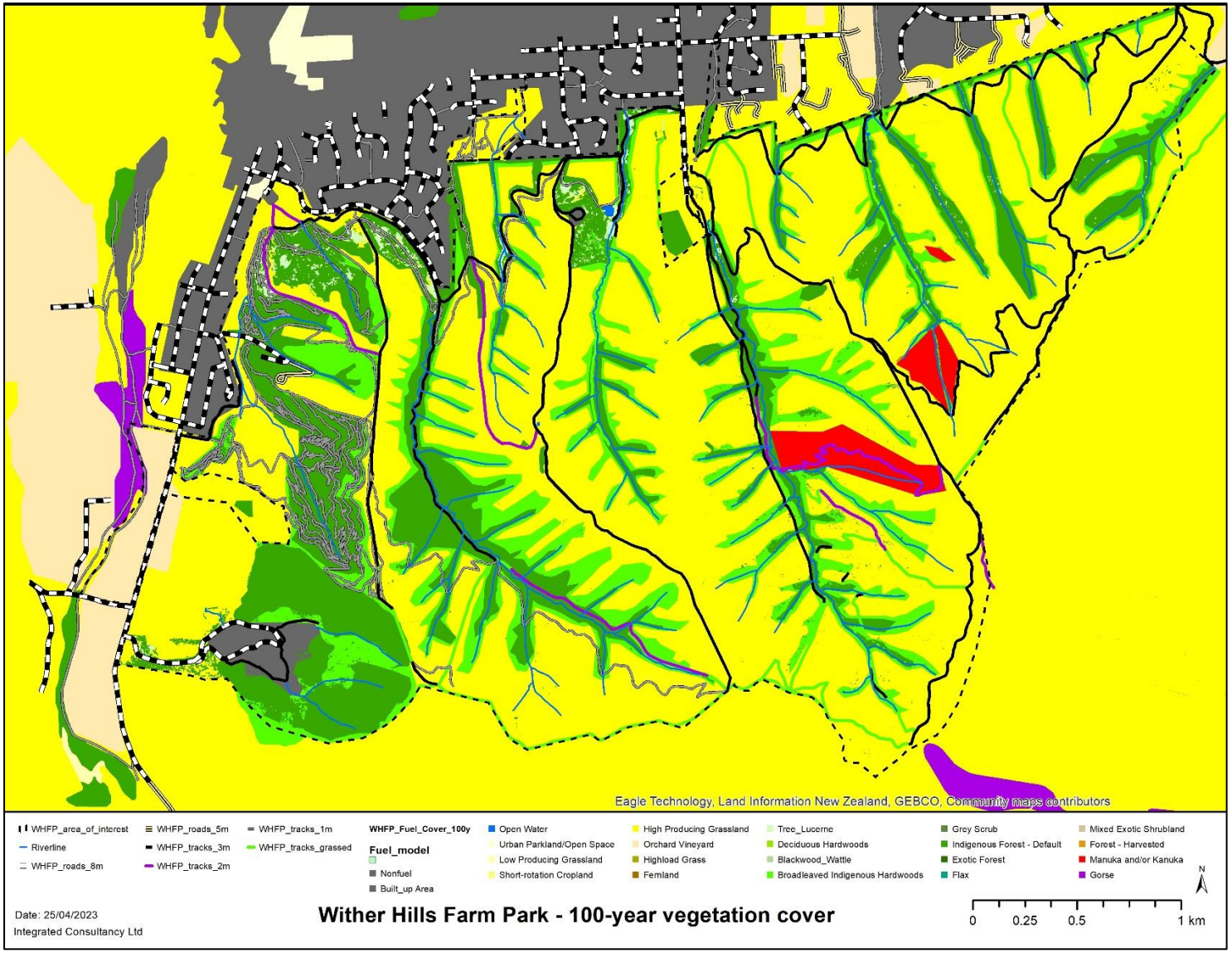
Current vegetation cover



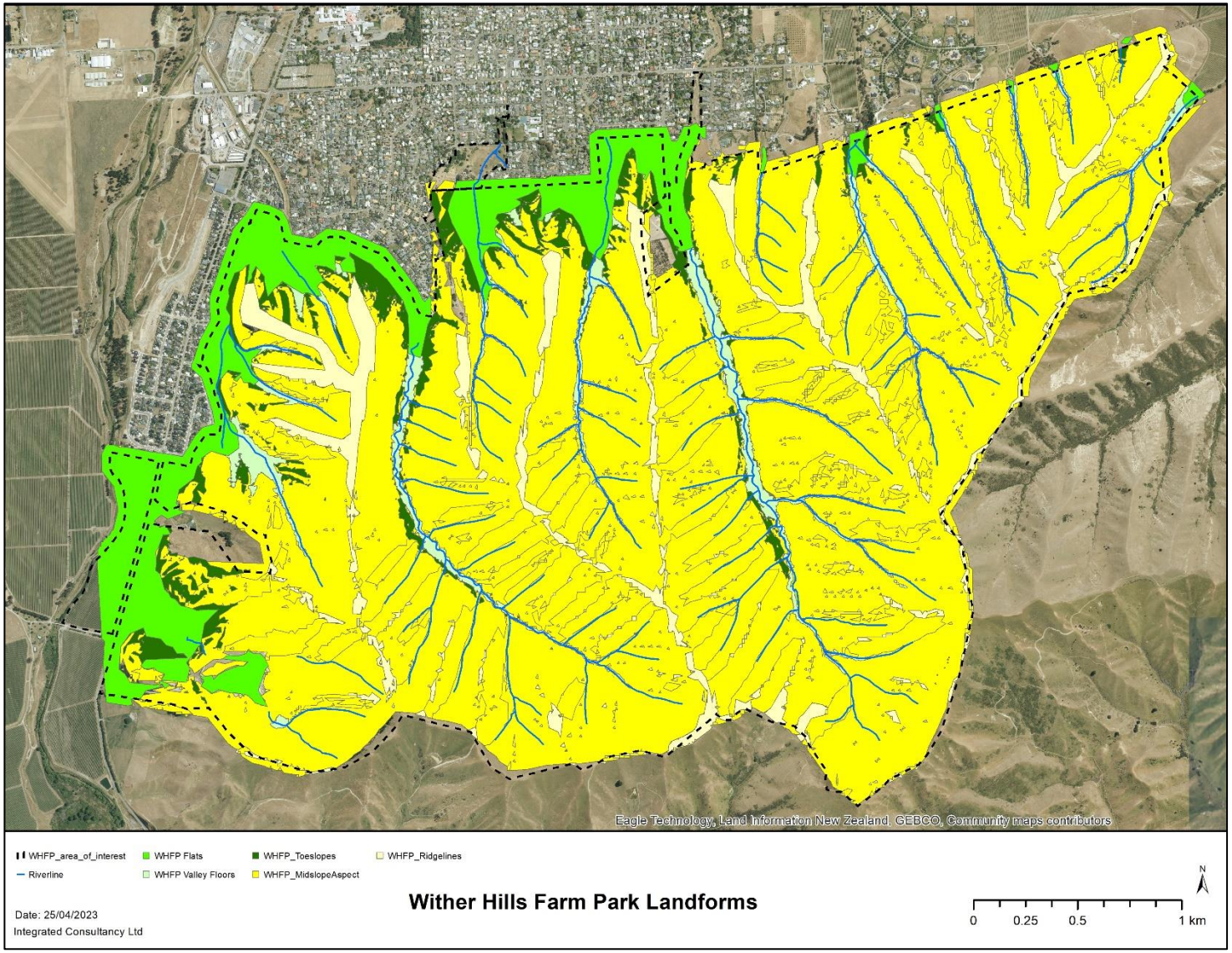
20-year vegetation concept



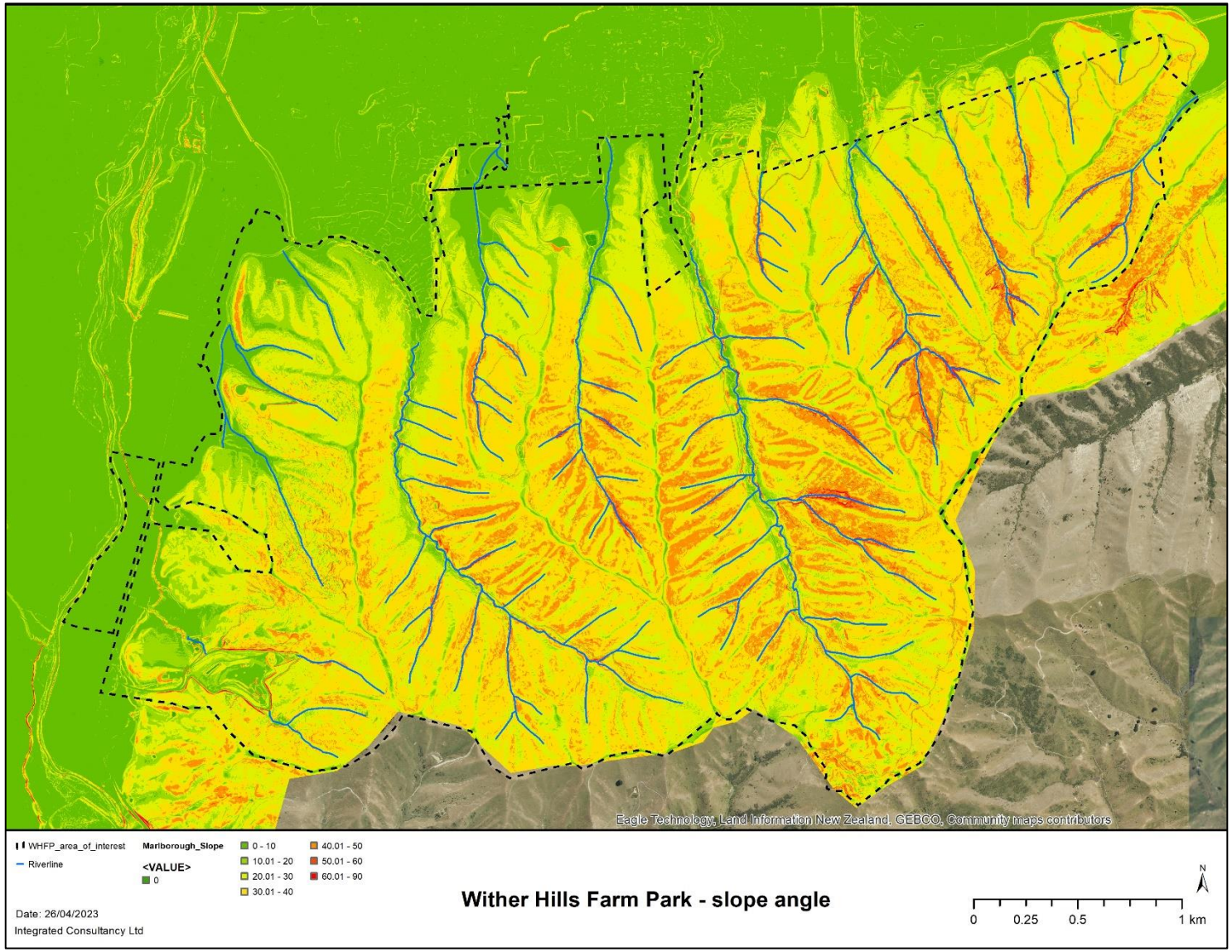
100-year vegetation concept



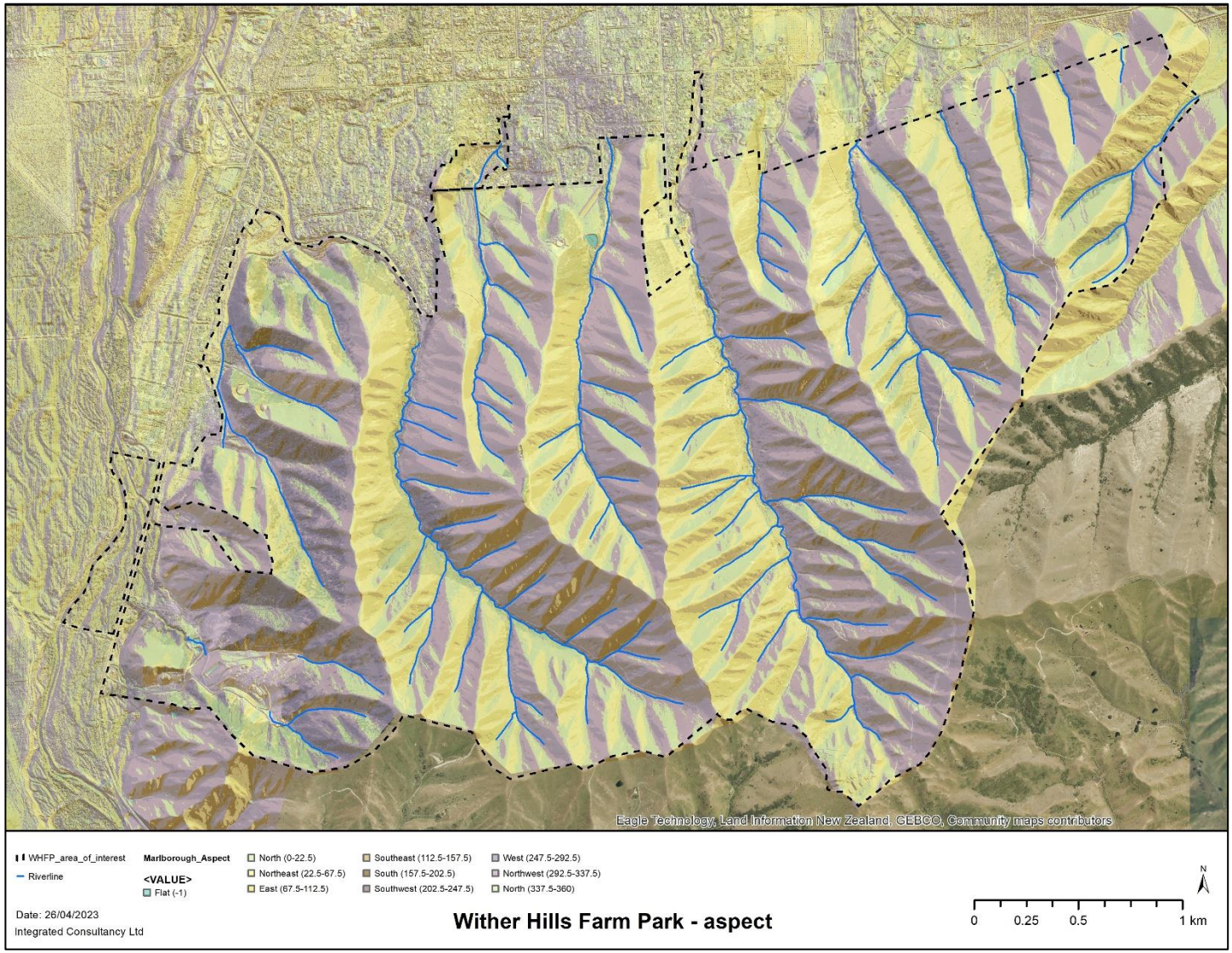
16.10. Appendix 10: Landforms



16.11. Appendix 11: Slope steepness map



16.12. Appendix 12: Terrain aspect map



16.13. Appendix 13: Fire Danger Class Criteria Definitions

Table of Suppression Interpretations for the New Zealand Fire Danger Classes (after Alexander, 2008).

Fire Danger Class	Fire Intensity (kW/m)	Description of Probable Fire Potential and Implications for Fire Suppression[†]	Nominal Max. Flame Height (m)
LOW	< 10	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 dry fuel to support smouldering combustion*. Colour code is GREEN.	no visible flame (< 0.2 m)
MODERATE	10 - 500	From the standpoint of moisture content, fuels are considered to be sufficiently receptive to sustain ignition and combustion from both flaming and most non-flaming (e.g., glowing) firebrands. Creeping or gentle surface fire 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 firefighters with only hand tools and back-pack pumps is possible. Colour code is BLUE.	0.2 to 1.3 metres
HIGH	500 - 2000	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. Colour code is YELLOW.	1.4 to 2.5 metres
VERY HIGH	2000 - 4000	Burning conditions have become critical as the likelihood of intense surface fires is a distinct possibility; torching and intermittent crowning in forests can take place. Direct attack on the head of a fire by ground forces is feasible for only the first few minutes after ignition has occurred. Otherwise, any attempt to attack the fire's head should be limited to helicopters with buckets or fixed-wing aircraft, preferably dropping long-term chemical fire retardants. Until the fire weather severity abates, resulting in a subsidence of the fire run, the uncertainty of successful control exists. Colour code is ORANGE.	2.6 to 3.5 metres
EXTREME	4000 - 10,000	The situation should be considered "explosive" or super critical. The characteristics associated with the violent physical behaviour of conflagrations or firestorms is a certainty (e.g., rapid spread rates, crowning in forests, medium- to long-range mass spotting, firewhirls, towering convection columns, great walls of flame). As a result, fires pose an especially grave threat to persons and their property. Breaching of roads and firebreaks occurs with regularity as fires sweep across the landscape. Direct attack is rarely possible given the fire's probable ferocity except immediately after ignition and should only be attempted with the utmost caution. The only effective and safe control action that can be taken until the fire run expires is at the back and along the flanks. Colour code is RED (or PURPLE for VERY EXTREME).	3.6 to 5.4 metres
VERY EXTREME	> 10,000		> 5.4 m

[1] THE ABOVE SHOULD NOT BE USED AS A GUIDE TO FIREFIGHTER SAFETY, AS FIRES CAN BE POTENTIALLY DANGEROUS OR LIFE-THREATENING AT ANY LEVEL OF FIRE DANGER!

16.14. Appendix 14: Fire Danger Class summary and projection to 2080/90

Table 33: Forest FDC current climate

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	28.1	26.4	19.5	16.2	8.2	6.9	4.3	3.9	5.4	10.3	19.1	24.8	**172.9**	**55.1**
Moderate	2.7	4.4	9.0	11.0	11.7	10.0	9.3	7.9	10.9	13.2	9.3	4.7	**104.1**	**73.9**
High	0.0	0.1	1.0	2.6	5.0	5.7	7.5	7.7	6.9	3.9	1.4	0.3	**42.0**	**39.2**
Very High	0.0	0.0	0.4	0.6	2.2	2.7	3.8	3.2	2.9	0.9	0.6	0.1	**17.3**	**16.2**
Extreme	0.0	0.0	0.0	0.5	2.9	5.5	7.0	6.1	4.9	1.6	0.4	0.0	**28.9**	**28.5**
Extreme	0.0	0.0	0.0	0.5	1.6	2.9	4.2	3.7	3.5	1.3	0.4	0.0	**18.2**	**17.8**
Very Extreme	0.0	0.0	0.0	0.0	1.3	2.6	2.8	2.4	1.4	0.3	0.0	0.0	**10.7**	**10.7**

Table 34:Forest FDC Projected climate 2080/90

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	27.3	25.0	16.0	11.3	1.0	0.0	0.0	0.0	0.0	3.9	15.2	23.2	**122.9**	**16.2**
Moderate	3.6	5.9	12.1	14.7	15.7	12.5	6.7	5.5	11.6	17.7	12.5	6.3	**124.7**	**84.3**
High	0.0	0.1	1.3	3.5	6.7	7.6	10.1	10.3	9.2	5.2	1.9	0.4	**56.3**	**52.5**
Very High	0.0	0.0	0.5	0.8	2.9	3.6	5.1	4.2	3.8	1.2	0.8	0.1	**23.2**	**21.7**
Extreme	0.0	0.0	0.0	0.7	3.8	7.2	9.2	8.0	6.4	2.1	0.5	0.0	**37.9**	**37.3**

Table 35:Scrub (standard) FDC current climate

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	8.2	7.8	5.2	4.7	3.1	3.2	2.3	2.1	2.6	4.2	6.3	8.5	**58.2**	**22.3**
Moderate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	**0.1**
High	4.4	3.9	2.7	2.2	1.2	1.2	0.6	0.6	1.3	2.0	3.6	4.1	**27.7**	**9.0**
Very High	4.6	4.5	3.3	2.9	2.3	2.0	1.6	1.5	1.7	2.5	3.7	4.5	**35.1**	**14.4**
Extreme	13.6	14.7	18.6	21.0	23.3	24.5	27.5	24.4	25.2	21.2	17.3	12.7	**244.2**	**167.2**
Extreme	9.1	9.1	8.4	6.3	4.7	3.9	3.8	3.9	6.4	10.0	10.6	8.7	**84.9**	**39.1**
Very Extreme	4.6	5.6	10.3	14.7	18.6	20.5	23.7	20.5	18.8	11.2	6.8	3.9	**159.3**	**128.1**

Table 36:Scrub (standard) FDC projected climate 2080/90

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	**3.3**	**0.0**
Moderate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.1**	**0.1**
High	5.9	5.2	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	5.5	**21.1**	**0.0**
Very High	6.2	6.0	4.4	3.4	0.0	0.0	0.0	0.0	0.0	2.3	5.0	6.1	**33.5**	**5.7**
Extreme	17.9	19.3	24.4	27.6	30.0	31.0	31.0	28.0	31.0	27.7	22.7	16.6	**307.2**	**206.3**

Table 37:Scrub (hardwoods) FDC current climate

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	4.7	5.5	4.9	3.8	6.0	5.5	6.0	5.6	4.2	4.3	3.7	4.0	**58.3**	**35.4**
Moderate	1.8	1.8	1.7	1.4	2.4	1.9	1.6	2.1	1.8	1.8	1.1	2.2	**21.5**	**13.0**
High	7.4	6.4	6.7	6.1	8.4	6.8	7.7	6.5	7.0	7.9	6.8	6.9	**84.8**	**50.6**
Very High	5.9	5.9	6.0	6.1	5.2	6.2	7.0	5.1	5.6	5.5	6.6	5.2	**70.5**	**40.8**
Extreme	11.0	11.3	10.6	13.5	7.8	10.4	9.6	9.3	12.3	10.3	12.7	11.5	**130.2**	**73.2**
Extreme	7.9	8.8	8.2	9.1	6.6	9.5	7.9	6.8	8.4	7.6	9.2	8.6	**98.5**	**55.8**
Very Extreme	3.1	2.5	2.4	4.4	1.2	0.9	1.7	2.5	3.9	2.7	3.5	2.9	**31.7**	**17.4**

Table 38:Scrub (hardwoods) FDC projected climate 2080/90

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	**0.0**
Moderate	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.3	0.0	0.0	0.0	0.0	**1.8**	**1.8**
High	8.7	8.3	8.1	5.1	11.3	9.0	9.0	8.8	7.4	9.0	5.5	8.0	**98.2**	**59.6**
Very High	7.9	8.0	8.1	8.2	7.0	8.4	9.4	6.8	7.5	7.4	8.8	7.0	**94.4**	**54.7**
Extreme	14.4	14.8	13.8	17.7	10.2	13.6	12.6	12.2	16.1	13.5	16.7	15.0	**170.6**	**95.9**

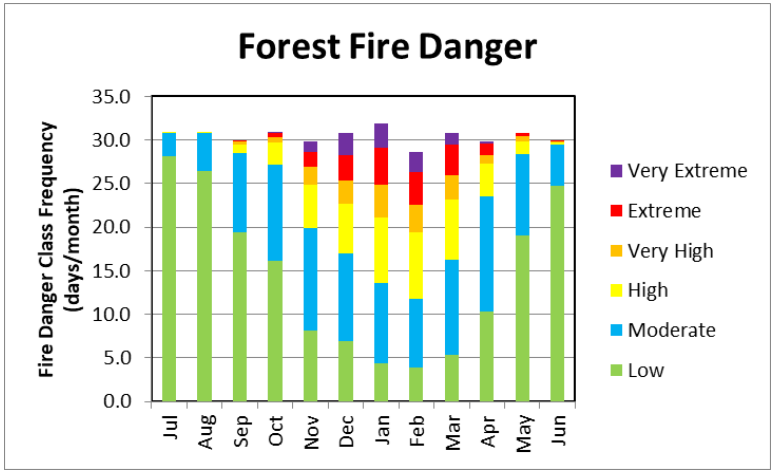
Table 39:Grassland FDC current climate

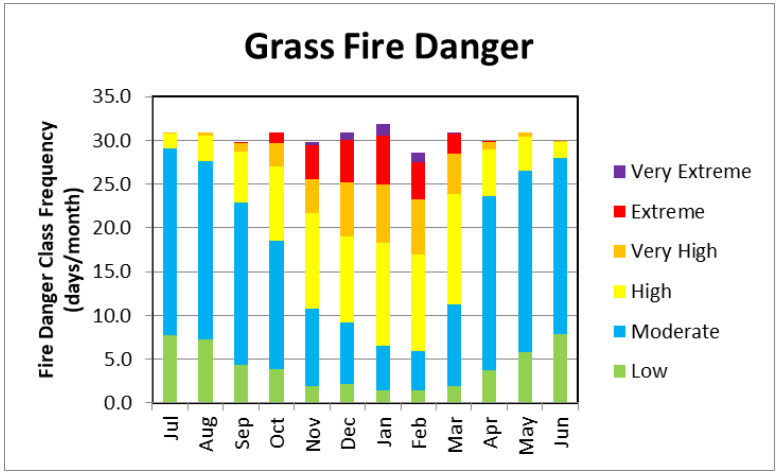
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	7.8	7.2	4.3	3.8	1.9	2.2	1.4	1.4	1.9	3.8	5.8	7.9	**49.5**	**16.4**
Moderate	21.3	20.4	18.6	14.7	8.9	7.1	5.1	4.6	9.4	19.9	20.7	20.1	**170.8**	**69.7**
High	1.7	2.9	5.8	8.6	10.9	9.8	11.8	11.0	12.6	5.3	3.9	1.8	**86.1**	**70.0**
Very High	0.1	0.3	1.0	2.7	3.9	6.1	6.6	6.3	4.6	0.8	0.4	0.1	**32.8**	**30.9**
Extreme	0.0	0.0	0.2	1.1	4.3	5.7	6.9	5.4	2.4	0.1	0.0	0.0	**26.1**	**25.9**
Extreme	0.0	0.0	0.2	1.1	3.9	4.9	5.5	4.3	2.3	0.1	0.0	0.0	**22.2**	**22.0**
Very Extreme	0.0	0.0	0.0	0.0	0.5	0.8	1.4	1.1	0.1	0.0	0.0	0.0	**3.9**	**3.9**

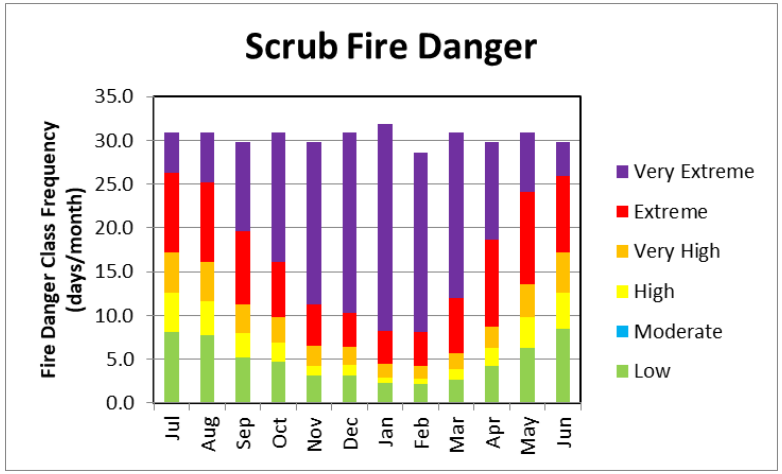
Table 40:Grassland FDC projected climate 2080/90

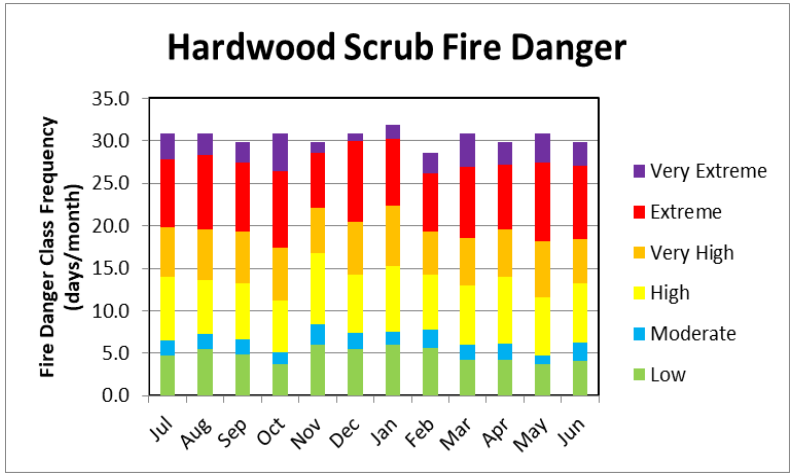
Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Year	Fire Season
Low	0.0	6.3	2.1	0.0	0.0	0.0	0.0	0.0	0.0	1.8	4.5	7.4	**22.1**	**1.8**
Moderate	28.6	20.4	18.6	14.5	4.6	2.2	0.0	0.0	4.8	19.9	20.7	20.1	**154.4**	**46.0**
High	2.3	3.9	7.8	11.5	14.5	13.1	13.1	12.5	16.9	7.2	5.2	2.4	**110.4**	**88.8**
Very High	0.1	0.4	1.3	3.6	5.2	8.2	8.9	8.4	6.1	1.1	0.5	0.1	**43.9**	**41.5**
Extreme	0.0	0.0	0.2	1.5	5.7	7.4	9.0	7.1	3.1	0.1	0.0	0.0	**34.2**	**34.0**

Figure 1: Fire danger class graphs – current climate









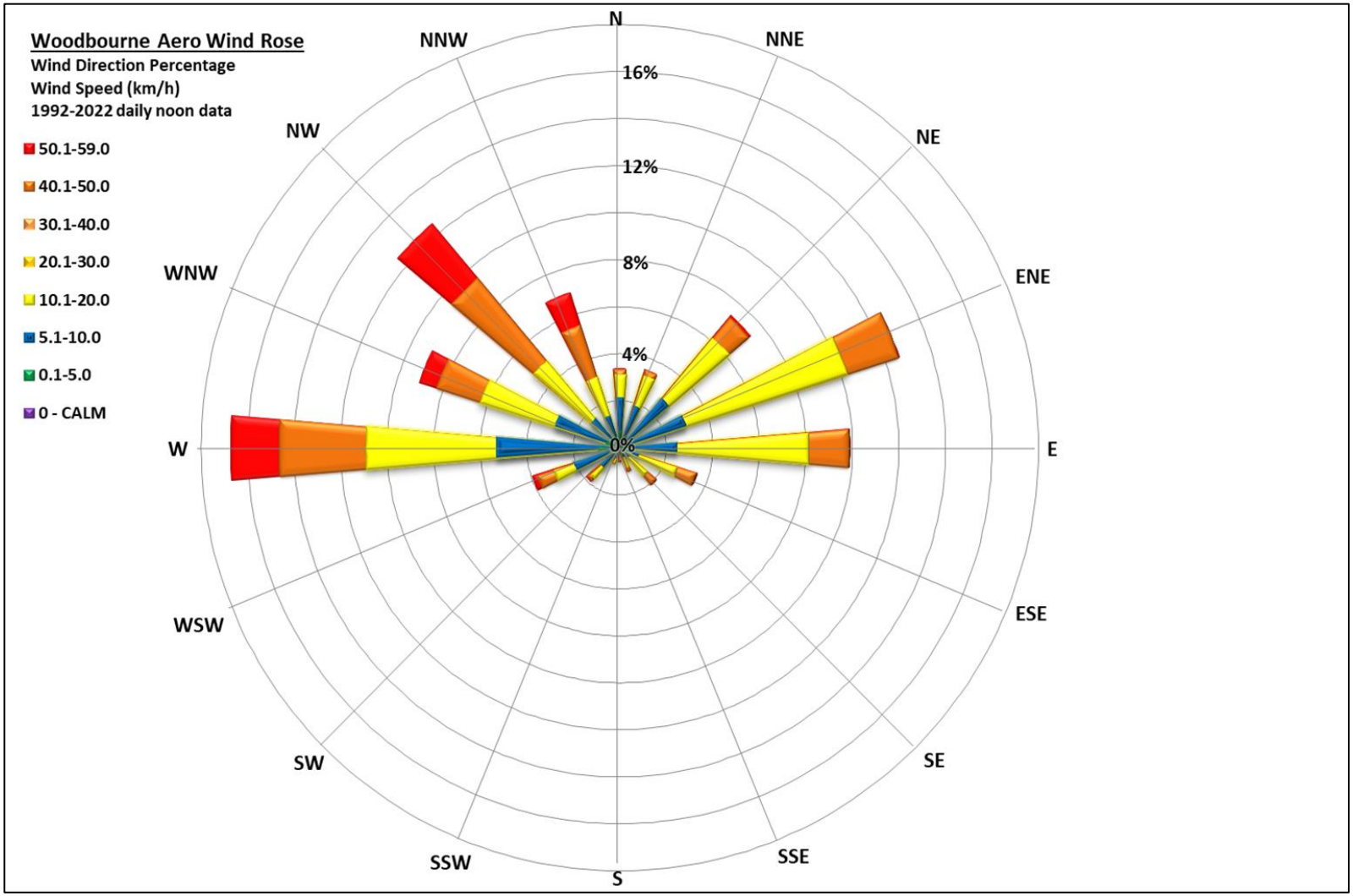
16.15. Appendix 15: Weather and FWI summary

Table 41: Weather and FWI summary – current climate

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	FIRE SEASON
Temperature, degrees Celsius														
mean	22	21.9	20.2	17.3	14.3	11.4	10.6	12.2	14.3	16.4	18.2	20.6	16.6	19.5
median	22	22	20	17	14	11	10.6	12	14	16	18	20.3	16	19.1
max	32.3	32	28	25	23	19	17	20.5	23	27	33	32	33	33
min	12	11.6	10	9	6	2	3	4.4	5.2	8	9	8	2	8
Relative Humidity, %														
mean	53.8	54.8	55	59.1	63.9	68.1	66.8	62.6	60	59.2	55.6	55.3	59.5	56.1
median	53	53	54	57	62.7	67	66	61	59	58	56	55	59	55
max	100	100	100	99	99	99	99	100	100	100	99	100	100	100
min	11	12	17	18	30.5	26	32	27.1	23	17	9.1	14	9.1	9.1
Wind Speed, km/h														
mean	20.6	18.7	16.7	13.4	12.5	12.1	12.5	13	16.9	19.8	21.7	21.2	16.6	18.9
median	19	17.3	15	11	9	9.4	10.4	10.6	15	18.4	20	20	15	18
max	59	59	57	59	48	46	51.8	59	59	53.6	52	50	59	59
min	1.8	0	0	0	0	0	0	0	0	1.8	1.8	2	0	0
24-hr Rainfall, millimeters														
mean	1.5	1.7	1.4	2	2.2	2.7	2.6	2.5	2	2.2	1.7	1.9	2	1.8
median	0	0	0	0	0	0	0	0	0	0	0	0	0	0
max	107	95.2	55.6	80.2	69	79.9	101.6	83.8	63.6	59.2	43.2	58.2	107	107
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monthly Rainfall, millimetres														
mean	47.5	45.5	43.9	59.7	68.9	80.6	79.7	76.8	60.6	68.4	52.4	59.1	61.9	53.8
max	143.8	200.6	81.2	156	190.4	195.8	217.4	307	141.6	159.6	163.2	172.5	307	200.6
min	3.4	3.4	7.6	2	19.2	12.6	12.2	22.4	10.8	7.7	4.8	4.2	2	2
Seasonal Rainfall, millimetres														
mean													743.1	376.2
max													1235.9	556.6
min													479.8	126

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	FIRE SEASON
Fine Fuel Moisture Code, FFMC														
mean	83	82.5	81.6	77	72.6	67.4	68.8	70.2	74.2	75.6	79.6	80.3	76.1	80
median	87.2	87.1	86.8	85	82.3	77.7	79	78.5	82.2	83.1	85.4	86.2	83.9	85.9
max	97.1	95.8	94.1	93.4	92	89.3	88.5	89.9	92.1	95	97.2	96.1	97.2	97.2
min	19.8	11.2	10.4	1.7	5	1.6	5.4	8.1	10.7	2	12.9	12.8	1.6	1.7
Duff Moisture Code, DMC														
mean	40.3	47.9	40	24.8	14.2	6.1	4.1	5.8	10.4	14.1	26.2	33	22.2	32.3
median	36.1	40.6	32.9	20.2	9.5	3.9	3.3	4.7	9	11.9	21	26.4	13.7	25.3
max	122.5	203.8	207.1	122.9	74.1	33	18.1	20.4	36.7	62	126.7	127.6	207.1	207.1
min	1.8	1.2	2	0	0	0	0	0	0	0	1.3	0.3	0	0
Drought Code, DC														
mean	329.5	416.7	440.1	384.5	302.8	189.7	110.3	79.6	78.6	83.5	149	239.3	233.2	290.9
median	313.6	409.6	434.1	375.2	310.6	181.7	90.7	45.4	46.7	69.3	130.7	222.1	194.4	276.2
max	724.2	927.4	1049.4	1057.8	876	758.6	430.2	442.4	385	413.4	364.1	502.6	1057.8	1057.8
min	48.2	26.2	32.5	12.1	1.7	0.6	0.6	0.5	1	2.4	5.1	6.4	0.5	2.4
Initial Spread Index, ISI														
mean	9.8	8.4	7.2	4.5	3.3	2.3	2.4	2.8	4.6	6.2	8.6	9.2	5.8	7.7
median	7.1	6.6	5.4	3.4	2.4	1.7	1.8	1.9	3	3.8	6	6.6	3.5	5.5
max	127.8	69	53.6	35.6	29.1	21.2	35.7	26.6	42.4	86.6	55.8	85	127.8	127.8
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildup Index, BUI														
mean	59.9	71.6	63.5	41.3	24.4	10.7	6.7	8.5	14.1	18.3	34.7	47.3	33.4	48
median	55.4	64.9	54.4	35.6	16.9	7.1	5.6	6.7	11.9	15.2	29.2	39.9	21.2	39.5
max	172.2	263.1	266.5	190.5	122.3	59.5	30.9	34.6	55.6	72.1	132.9	134.6	266.5	266.5
min	3.3	2.3	3.6	0	0	0	0	0	0	0	2	0.5	0	0
Fire Weather Index, FWI														
mean	21.9	21.5	18	10.4	5.9	2.7	2.2	2.9	5.7	8.5	15.3	18.9	11.2	16.4
median	18.5	18.6	15.2	8	3.5	0.8	0.8	1	3.5	5.4	11.6	14.7	6	12.8
max	97.8	121.7	84.1	74	45.3	34.9	25.8	30.3	52.9	81.9	85.9	123	123	123
min	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 2: Woodbourne wind rose



16.16. Appendix 16: Risk level matrices

Table 42: Likelihood of ignition and spread

Likelihood of ignition and fire spread matrix						
Descriptor	**Description**	**Number of days in a month that fire danger is Moderate to Very Extreme**				
		30/31	**24 - 29**	**16 - 23**	**7 - 15**	**1 - 6**
Almost certain (5)	Expected to occur one or more times every year.	**100.0**	**92.9**	**74.0**	**51.0**	**30.0**
Likely (4)	Expected to occur once every two years.	**89.9**	**83.5**	**66.5**	**45.8**	**27.0**
Some chance (3)	Expected to occur once every three to five years.	**49.9**	**46.4**	**36.9**	**25.4**	**15.0**
Unlikely (2)	Expected to occur once every six to ten years.	**19.9**	**18.5**	**14.7**	**10.1**	**6.0**
Rare (1)	Expected to occur once every eleven to forty years.	**9.0**	**8.4**	**6.7**	**4.6**	**2.7**

Table 43: Consequence level

Consequence level					
Consequence level	**Wildfire ignition and spread**	**Evacuation opportunity and safety zones**	**Level of harm to people**	**Level of property damage (losses)**	**Level of environmental, cultural and historic damage (losses)**
Catastrophic (6)	Location of ignition and the subsequent fire spread will impact values in a very short time.	No time to evacuate, and no adequate vegetation clear areas that could be used as safety zones. Burn-over of people will most likely occur.	Multiple fatalities. Search and rescue involvement. Incident investigated by coroner.	Greater than $10 million.	Permanent loss of nationally significant values
Major (5)	Location of ignition and the subsequent fire spread will impact values in a short time.	There is little time to evacuate and no adequate vegetation clear areas that could be used as safety zones. There is no place for people to shelter from an advancing fire, or little time to move sufficiently away from it to a safe location. Access/egress may only be one way in and one way out as well as narrow roads and traffic congestion.	Multiple fatalities. Search and rescue involvement. Incident investigated by coroner.	Between $5 and $10 million.	Permanent loss of nationally significant values
Serious (4)	Location of ignition and the subsequent fire spread will impact values in a relatively short time .	There are vegetation clear areas of sufficient area, and time to re-locate to them, or to evacuate to somewhere clear of a spreading fire. People who are not particularly mobile may not move fast enough to a clear area or are unable to evacuate quickly. Access/egress may only be one way in and one way out as well as narrow roads and traffic congestion.	Single person fatality or major injury to multiple (more than 3) subjects. Search and rescue involvement. Incident investigated, possibly by coroner.	Between $500,000 to $5 million	Permanent loss of regionally significant values
Important (3)	Location of ignition is somewhat away from values and may develop sufficiently to cause damage. Subsequent fire spread may eventually cut off evacuation routes.	Generally there is time to evacuate or move sufficiently away to a safe location. People may be impacted if travel away from a fire is difficult, including very narrow roads and/or traffic congestion, steep up and down tracks or zig zagging tracks, poor track surface, no track. A fire may cut off their evacuation route or some peoples mobility may result in slow evacuation.	Serious injuries to an individual requiring rescue party, or moderate injuries to multiple subjects. Incident investigated. Medical treatment required, including immediate off site assistance, e.g., follow-up emergency medical treatment. Incident reported.	Between $50,000 and $500,000 million.	Significant damage with long term recovery time required (>20y) or district level losses.
Noticable(2)	Direction of fire spread is not aligned for a direct impact on values, or a fire is unlikely to develop sufficiently to cause too much damage to nearby values, however dense smoke and ash maybe dispersed over or near them, or a flanking fire may spread slowly towards them over a number of hours.	People would either evacuate or move sufficiently away to avoid smoke and ash fallout or a flank fire impact.	Minor injuries requiring first aid treatment - managed by those on site, e.g., minor cuts and bruises. No incident follow-up.	up to $50,000.	Moderate damage with medium term recovery time required (up to 20y) or local level losses.
Insignificant (1)	Direction of fire spread disperses low density smoke over values, or values are well away from a spreading fire and are not directly effected. Visual only	People do not need to take evasive action to protect themselves. Evacuation may be precautionary in situations where people have existing health issues. People may continue to go about their activities.	No injuries, "fright factor". No incident follow-up.	Minor or no cost	Minor damage only - short recovery time.

Table 44:Risk level

Risk levels							
Likelihood level	Almost certain (5)	High	High	High	**Extreme**	**Extreme**	**Extreme**
	Likely (4)	Medium	Medium	High	High	**Extreme**	**Extreme**
	Some chance (3)	**Low**	Medium	Medium	High	High	**Extreme**
	Unlikely (2)	**Low**	**Low**	Medium	Medium	High	High
	Rare (1)	**Low**	**Low**	**Low**	Medium	High	High
		Insignificant (1)	**Noticeable (2)**	**Important (3)**	**Serious (4)**	**Major (5)**	**Catastrophic (6)**
	Consequence level						