**BEFORE COMMISSIONER ON BEHALF OF THE CENTRAL OTAGO DISTRICT COUNCIL**

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| **IN THE MATTER** | of an Proposed Private Plan Change 13 to the Central Otago District Plan |
| **BY** | **RIVER TERRACES DEVELOPMENTS LIMITED** |
| | **Proponent** |

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# STATEMENT OF EVIDENCE OF AARON STAPLES ON BEHALF OF HIGHLANDS MOTORSPORT PARK (SUBMITTER 144), CENTRAL SPEEDWAY CLUB CROMWELL INC (SUBMITTER 45), 45 SOUTH GROUP OF COMPANIES (SUBMITTER 123), SARITA ORCHARDS LIMITED (SUBMITTER 310), DJ JONES FAMILY TRUST AND SUNCREST ORCHARDS LIMITED (SUBMITTER 164), PETER JOHN MEAD & ALASTAIR DAVID STARK AS TRUSTEES OF THE MCKAY FAMILY TRUST (SUBMITTER 228)

**16 May 2019**

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## 1.0 INTRODUCTION

1.1 My full name is Aaron James Staples.

1.2 I am a Senior Consultant in the international acoustical consulting firm of Marshall Day Acoustics (MDA). I hold a Bachelor of Engineering degree with First Class Honours in Mechanical Engineering from the University of Canterbury. I have worked in the field of acoustics with MDA since 2010.

1.3 I have been involved in many environmental noise assessment projects around New Zealand, including projects with reverse sensitivity issues such as residential developments near large-scale industrial activities. Of relevance to this project are:

a) My previous involvement with Highlands Motorsport Park including reviewing noise assessment reports and reviewing and preparing detailed noise models of motorsport activities. MDA has been advising Highlands with respect to noise issues since 2015, including through the reconsenting process referred to in the evidence of Josie Spillane;

b) Detailed noise modelling and assessment including reverse sensitivity controls for a number of dairy factories around New Zealand including Edendale, Stirling, Studholme, Clandeboye, Darfield, Pahiatua, Kapuni and Whareroa; and

c) Noise assessment and sound insulation design for various residential developments and subdivisions close to noise generating activities such as major roads, airports and industrial zones.

1.4 I am also often involved in the sound insulation design of dwellings to achieve a suitable standard to specifically protect against wind machine noise intrusion.

1.5 I have been engaged by Highlands Motorsport Park Ltd (Highlands) and several of the owners of the surrounding horticultural activities (45 South Management Ltd, 45 South Orchard Ltd, Suncrest Orchard Ltd, Sarita Orchard Ltd and Alan McKay) to review and comment on reverse sensitivity effects that would arise for motorsport and horticultural activities as a result of proposed Plan Change (PC13).

1.6 In preparing this evidence I have reviewed:

a) The Assessment of Noise Effects report prepared by Styles Group, dated 20 June 2018;

b) The noise-related aspects of the Section 42A Planning Report prepared by Johnston Whitney Planning Consultants on behalf of the Central Otago District Council, dated 21 March 2019; and

c) The statement of evidence prepared by Mr Jon Styles, dated 23 April 2019.

1.7 I am familiar with the proposed River Terrace site and surroundings having visited the area on a number of occasions, the most recent being on 3 May 2019.

1.8 Whilst this is a Council Hearing, I acknowledge that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and agree to comply with it. I confirm that this evidence is within my area of expertise, except where I state that this evidence is given in reliance on another person's evidence. I have considered all material facts that are known to me that might alter or detract from the opinions I express in this evidence.

## 2.0 SUMMARY OF EVIDENCE

2.1 I consider the proposed River Terrace development to be incompatible with the existing noise environment due to the significant cumulative adverse noise effects that would be experienced by a large number of residents as a result of existing lawfully established and compliant motorsport and horticultural activities.

2.2 Allowing the proposed development to proceed would result in residents being subject to high noise levels from motorsport noise (both from Highlands Tier 2 events and the nearby Speedway) for approximately 28 days and/or evenings per annum, as well as elevated noise levels from bird scaring devices, wind machines and helicopters during critical parts of the growing and harvesting season. The outdoor amenity of dwellings and recreational areas would be severely compromised during these times.

2.3 In addition to the high motorsport noise levels generated on 28 days per year by Highlands and the Speedway, Highlands operates on every non-Tier 2 day of the year generating a lesser, but still significant noise level across much of the River Terrace site. This noise is not characteristic of a residential environment.

2.4 Whilst noise mitigation measures by way of minimum sound insulation standards are theoretically able to reduce noise effects experienced by residents indoors as a result of Highlands day-to-day activities (i.e. Tier 1 events) and horticultural activities, this would have significant implications on the construction cost of the buildings, based on my experience with sound insulation design of dwellings and buildings. This is contrary to the development's claim of "*providing affordable housing*" (item (d) on page 4 of the *Assessment of Effects on the Environment* report prepared by Brown & Company Planning Group, dated 1 March 2018).

2.5 The level of sound insulation proposed by the applicant would address general amenity standards <u>indoors</u> for Tier 1 days at Highlands but would not render noise from Tier 2 Highlands race days, Speedway activity or wind machine activity acceptable in my view. During these activities, an appropriate level of respite would not be available to residents, even indoors.

2.6 Providing enhanced sound insulation, even if effective against high noise activities as described above, does nothing to mitigate annoyance and loss of amenity outdoors which, based on my experience with other projects, is at risk in this situation.

2.7 In my opinion there is also a high risk of residents becoming sensitised to motorsport noise and wind machine noise, which would result in additional annoyance arising from day-to-day Highlands motorsport activities and horticultural activities such as bird scaring. This means that some residents become more sensitive to the sound of these noise sources after having to endure them at high noise levels for periods of time.

2.8 I consider it unlikely that the proposed no complaints covenant would prevent future complaints and activism aimed at curtailing the lawfully established Highlands and Speedway motorsport activities and horticultural activities surrounding the proposed River Terrace development. Based on experience at ports, airports, industrial facilities, intensive agriculture or horticulture, motorsport and music activities around New Zealand, encroachment of residential development into close proximity with such activities inevitably leads to dissatisfaction and efforts to curtail or shut down the "noisy neighbour".

## 3.0 SCOPE OF EVIDENCE

3.1 My evidence will address noise received at the proposed River Terrace site from:

a) Highlands motorsport activities;

b) Speedway motorsport activities; and

c) Horticultural activities;

3.2 I will address the cumulative noise effects of these activities on residents of the proposed development.

3.3 I will also provide commentary on the acoustic evidence prepared by Mr Jon Styles and relevant noise-related aspects of the Section 42A Planning Report.

## 4.0 HIGHLANDS MOTORSPORT NOISE

4.1 MDA has had significant involvement in managing and assessing noise from Highlands motorsport activities over a number of years. Whilst most of this work has been undertaken by colleagues in MDA, I have been involved in aspects of that work and have undertaken a thorough review of this previous work and summarise it as follows:

a) MDA has undertaken detailed noise measurements of Highlands motorsport activities during "Tier 2" events such as The Festival of Speed and "Tier 1" events such as members' evenings. Both attended and unattended noise monitoring has been undertaken at nearby dwellings and at Highlands on-site locations.

b) Based on these detailed noise measurements, MDA has developed a noise model to predict noise emissions for the two categories of events that occur at Highlands (i.e. Tier 1 – 'day-to-day events' – and Tier 2 – 'race events'). I am well familiar with this model having been involved in its original review and subsequent updates. Noise contour plots for these activities are provided in Appendix A.

4.2 Noise emissions from Highlands is addressed for each of the event categories below.

**Tier 2 Race Events**

4.3 In summary, our noise measurements and associated analysis indicates that almost the entire River Terrace site would be exposed to noise levels of 60-70 dB $L_{Aeq(15\ min)}$ before any adjustment for Special Audible Characteristics during Tier 2 race event days, which are consented to occur 16 days per year. For noise levels this high, there are no practical noise mitigation measures to reduce motorsport noise to suitable levels for outdoor residential amenity. More vocal effort would be required for speech to be understood in outdoor areas that are exposed to noise levels greater than 65 dB $L_{Aeq(15\ min)}$. With many affected residents, I expect this would cause serious annoyance amongst sufficient people that noise complaints will result regardless of the limited number of events or whether a no-complaint covenant applies to the development.

4.4 Based on the minimum sound insulation standards proposed (30 dB Outdoor Indoor Transmission Class for the dwellings closest to Highlands) and the results of our detailed noise modelling, I expect that motorsport noise would from Tier 2 race events would be clearly audible indoors (up to 40 dB $L_{Aeq}$ with all windows and doors closed) at the dwellings closest to Highlands. This is above the World Health Organisation recommendations for daytime noise levels inside dwellings (which is 35 dB $L_{Aeq}$) and I therefore expect that some residents would experience annoyance indoors, particularly given the character of the noise.

**Tier 1 Day-to-Day Events**

4.5 Whilst the proposed sound insulation standards would sufficiently mitigate motorsport noise received indoors from Tier 1 (day-to-day) Highlands events, noise from Tier 1 events would often still be clearly audible outdoors. In addition, noise from helicopter movements (up to six movements per day are permitted during Tier 1 events under the existing consent) would be clearly audible to residents, particularly as the Queenstown-Highlands flight path crosses directly over the River Terrace site.

4.6 This will result in high levels of annoyance, particularly given the ongoing nature of the activity at Highlands and the addition of many high-noise events from Highlands and other sources throughout the year. Similar levels of noise at other motorsport sites has resulted in significant community pressure and activism aimed at curtailing or closing these venues (e.g. Western Springs Speedway in Auckland and Mike Pero Motorsport Park at Ruapuna, Christchurch).

## 5.0 SPEEDWAY MOTORSPORT NOISE

5.1 Whilst MDA has not been engaged to undertake specific noise measurements of Central Motor Speedway (Speedway) activities, our access to the data collected by the permanent noise logger at Highlands nearby in conjunction with our noise measurements at several other speedway venues around New Zealand gives us sufficient information to predict noise Speedway noise levels received at the River Terrace site . A noise contour plot for speedway activity is provided in Figure 3 of Appendix A.

5.2 Based on this analysis, noise levels from Speedway activities are similar to Highlands Tier 2 events at the nearest dwellings: 60-70 dB $L_{Aeq(15\ min)}$ before any adjustment for Special Audible Characteristics over more than half (approximately 55%) of the River Terrace site. I understand that the Speedway consent does not place any limit on operational hours or the number of events that may be held each year. Approximately 10-12 speedway events are understood to currently take place each year, but there could be more than this. Based on my review of the noise data captured by the noise logger at Highlands during Speedway events, Speedway events tend to run until around 10 pm which impinges not only on adult bedtimes, but especially those for children. I expect this to result in significant adverse noise effects on residents.

5.3 As Highlands is not permitted to hold a Tier 2 event on the same day as a Speedway event, any increase in the number of Speedway events would result in an increase in the number of days that the River Terrace development is exposed to elevated noise levels.

## 6.0 HORTICULTURAL ACTIVITIES

6.1 MDA has been engaged by several owners[1] of the surrounding horticultural activities to assess noise from various horticultural activities on land around the proposed River Terrace development. My colleague Alex West visited the orchards adjacent to the proposed River Terrace development on 12 and 14 February 2019 to undertake comprehensive noise measurements of several horticultural activities. I have used this noise data to build a detailed noise model of these activities to predict the noise levels that would be received across the River Terrace development under various scenarios.

[1] 45 South Management Ltd, 45 South Orchard Ltd, Suncrest Orchard Ltd, Sarita Orchard Ltd and Alan McKay.

6.2 A report on my findings is attached in Appendix B. In summary, my analysis shows that the proposed development would be exposed to high noise levels (up to 75 dB $L_{Aeq(15\ min)}$) at times during various horticultural activities. Frost-fighting in particular, which typically occurs for 15 nights per year, but can occur up to 27 nights per year[2], is expected to result in significant adverse noise effects on residents, should the development proceed. Based on my experience in the sound insulation design of other dwellings close to wind machines, mitigating the noise effects would be challenging due to the magnitude of the noise reductions required to achieve an appropriate internal noise level within bedrooms. I calculate that a 40 dB reduction would be required to achieve the District Plan 45 dB $L_{AFmax}$ noise limit inside bedrooms. Wind machines and helicopters produce high levels of low-frequency (bass) sound which is more challenging to mitigate than mid and high frequency sound. This restricts the types of constructions available for the proposed dwellings to high mass (e.g. masonry) and/or large cavity walls. Windows would need to be restricted in size and use heavy glass panes which adds cost. Lightweight roofing would likely require sarking and the ceilings would require multi-layer high-density plasterboard linings. An alternative form of ventilation would also be essential so that windows can remain closed.

6.3 During the day, fruit drying using helicopters, and impulsive noise from bird scarers and shotguns is likely to cause significant annoyance to residents in outdoors areas. These noisy activities occur between mid-December to early February which coincides with the warmer months of the year when residents are more likely to use outdoor living areas. Maximum noise levels in excess of 100 dB $L_{AFmax}$ are predicted at the nearest dwellings during bird control, and average noise levels of up to around 70 dB $L_{Aeq(15\ min)}$ are predicted at the closest dwellings during fruit drying. In addition, the use of chainsaws near the site boundary of the proposed River Terrace site would need to be carefully managed. This would lead to restrictions on the operation of horticultural sites and result in adverse reverse sensitivity effects.

6.4 The proposed development would also restrict the ability of surrounding orchard owners to install new wind machines near the River Terrace site. Under the current Central Otago District Plan, wind machines must not be located closer than 300 metres to any Residential Resource Area or within 100 metres of a dwelling not located on the same property. These restrictions would result in further reverse sensitivity effects for surrounding orchard owners.

## 7.0 CUMULATIVE NOISE EFFECTS

7.1 Whilst noise effects from each of the activities above are individually significant, cumulative noise effects that arise from all these activities combined are most concerning. In my view this does not appear to have been adequately assessed by the applicant.

7.2 In my experience, motorsport noise has distinctive characteristics that can result in annoyance at lower noise levels than an equivalent broad-band noise source (e.g. distant road traffic).

[2] Based on the data provided in Mr Tim Jones' evidence.

7.3 For a combined 28 days and/or evenings per year (16 Tier 2 Highlands events plus 10-12 Speedway events), the proposed development would be exposed to very high levels of motorsport noise for which there would be serious annoyance outdoors and no adequate respite indoors. In addition, the proposed development would be exposed to high levels of noise from wind machines and helicopters during frost-fighting for up to 27 nights per year.

7.4 During the remaining days of the year, motorsport noise levels would be much lower but still clearly audible outdoors over much of the development at levels likely to cause serious annoyance for many residents.

7.5 The cumulative effect of residents being exposed to high levels of motorsport noise throughout the year without adequate respite would in my view result in significant adverse noise effects, particularly as there is a risk that residents become sensitised to motorsport noise (i.e. more sensitive to the sound of motorsport noise).

7.6 In addition, the high levels of noise received from wind machines, helicopters and bird scaring devices during the growing and harvesting season would exacerbate the issue causing greater cumulate adverse noise effects. Noise contour maps showing the noise levels that the River Terraces site would be exposed to in a 24-hours period under the following two scenarios are provided in Figure 4 and Figure 5 of in 0:

a) Speedway activity, Highlands day-to-day activity, wind machine and helicopter use; and

b) Highlands Tier 2 activity and wind machine and helicopter use.

7.7 Under these circumstances the figures show that the entire River Terraces site would receive noise levels greater than 60 dB $L_{Aeq(15\ min)}$ at times, depending on what activities are taking place around the site (e.g. Speedway, Highlands and/or horticultural activities).

7.8 Noise from traffic on the nearby State Highway will also be clearly audible at dwellings at the northern end of the proposed development. Whilst an appropriate internal noise level from State Highway traffic can be achieved by requiring dwellings to achieve a suitable sound insulation standard, the outdoor noise environment of the dwellings closest to the State Highway would be degraded which would further contribute to cumulative adverse noise effects.

## 8.0 COMMENTS ON MR STYLES' EVIDENCE

8.1 I have read the Acoustics Evidence submitted by Mr Jon Styles, dated 23 April 2019 and provide the following comments relating to what I consider to be the critical noise-related aspects.

8.2 There appears to be significant differences in the noise levels quoted in Mr Styles' evidence and the predicted noise levels provided in the Styles Group Assessment of Noise Effects Report dated 20 June 2018. For example, at paragraph 9 (b) of his evidence, Mr Styles states that "*Up to approximately 16 days and 20 evenings per annum where noise levels are high (approximately 70 dB $L_{Aeq}$)*". However, the noise contours provided in the Styles Group Assessment of Noise Effects report show that the River Terrace site would be exposed to noise levels up to 75 dB $L_{Aeq}$ during Highlands Tier 2 events and up to 80 dB $L_{Aeq}$ during Speedway events. These noise levels are significantly greater than those referenced in Mr Styles' evidence.

8.3 At paragraph 9 (e), Mr Styles states that "*Noise effects would be restricted to annoyance only*". I disagree with this assertion. With Speedway activities operating until 10 pm, I expect there would be sleep disturbance noise effects for some residents, particularly children, even with the proposed minimum sound insulation standards.

8.4 At paragraph 21 (b) (ii) and (iii) Mr Styles states that "*anyone affected by the noise would have the opportunity to plan around it*" regarding Highlands Tier 2 events and Speedway events. I consider it unrealistic to expect 2,000-3,000 residents to have to plan around 28 motorsport events and up to 27 nights of frost-fighting each year.

8.5 At paragraph 73 Mr Styles draws comparison with this project to residential activities near major infrastructure such as State Highways, shipping ports, airports and railways. I do not consider this comparison valid. Major infrastructure such as roads, rail and airports are generally accepted as being an integral part of modern living. However, noise from motorsport activity is not afforded this concession. In my view there is a greater risk that adversely affected residents would seek to reduce or limit motorsport activities to reduce the adverse noise effects they experience. This in turn would have adverse reverse sensitivity effects on the surrounding motorsport operators.

8.6 I note that even major infrastructure can be constrained by nearby residential activities due to noise. A local example is Queenstown Airport which has put expansion plans on hold following community concerns about noise.

8.7 Given the character of the noise from motorsport and horticultural activities is likely to be more, rather than less, annoying in comparison to the above sources; this strengthens my view that the environment is not suited to the proposed residential development.

8.8 Throughout Mr Styles' evidence, the proposed sound insulation rules are referred to as "*providing respite*" from external noise. However, his evidence does not state that noise effects will be acceptable or will meet generally agreed guideline values. I agree that respite will be provided in the sense that noise levels indoors will be substantially lower than outdoors. However, internal noise levels during Highlands Tier 2 events and Speedway events would still be above criteria considered acceptable for residential living which in my view would result in adverse noise effects such as annoyance and sleep disturbance in the case of Speedway activities. In this regard, respite from adverse noise effects will not be provided during these events.

8.9 In isolation, I agree that noise effects from Highlands' Tier 1 or "day-to-day" events could be mitigated with appropriate design of outdoor living areas and a minimum sound insulation standard for the development. However, these events do not occur in isolation. As previously mentioned, my concern is that many of the residents would become sensitised to motorsport noise as a result of having to endure 16 days and approximately 10-12 evenings of very high levels of motorsport noise each year. For the remaining days of the year, where motorsport noise levels would still be clearly audible, I anticipate that residents that become sensitised to motorsport noise would also experience serious annoyance from Highlands day-to-day motorsport activities. In addition to this, the high levels of noise received from helicopters during fruit drying and bird scaring devices during the growing and harvesting season would exacerbate the issue.

8.10 In my view the proposed no-complaints covenant for the development would be ineffective. No-complaints covenants do not avoid adverse effects, they are only intended to avoid the consequences of the adverse effects (i.e. complaints). The Ports of Auckland is one example that I am aware of where the Auckland Council receives noise complaints from time to time despite a no-complaints covenant being in place. They are also difficult to administer because they generally only apply to 'lawful' activities and it can be difficult for a resident to determine what is lawful and what is not. This can lead to residents complaining, claiming unlawfulness.

## 9.0 COMMENTS ON THE SECTION 42A PLANNING REPORT

9.1 I have reviewed the noise-related aspects of the Section 42A Planning Report prepared by Johnston Whitney Planning Consultants on behalf of the Central Otago District Council, dated 21 March 2019 and offer the following comments.

9.2 I agree that the "*noise effects of motorsport activities ... will significantly affect residential amenity within the* [development]" (last paragraph of Section 7.10.2.5, page 46).

9.3 I share the significant reservations expressed in the Section 42A Planning Report with respect to the appropriateness and effectiveness of a no-complaint covenant for such a large number of residential units (up to 900 including retirement living units) (last paragraph of Section 7.10.2.6, page 48), as previously mentioned in my evidence.

9.4 I agree that "*adverse* [noise] *effects will not be adequately avoided, remedied or mitigated by Plan Change 13*" (last paragraph of Section 7.10.5, page 55) for the reasons previously set out in my evidence.

## APPENDIX A NOISE CONTOUR MAPS

**Figure 1: Highlands Motorsport Park – Tier 1 Events (Day-to-Day Activities)**

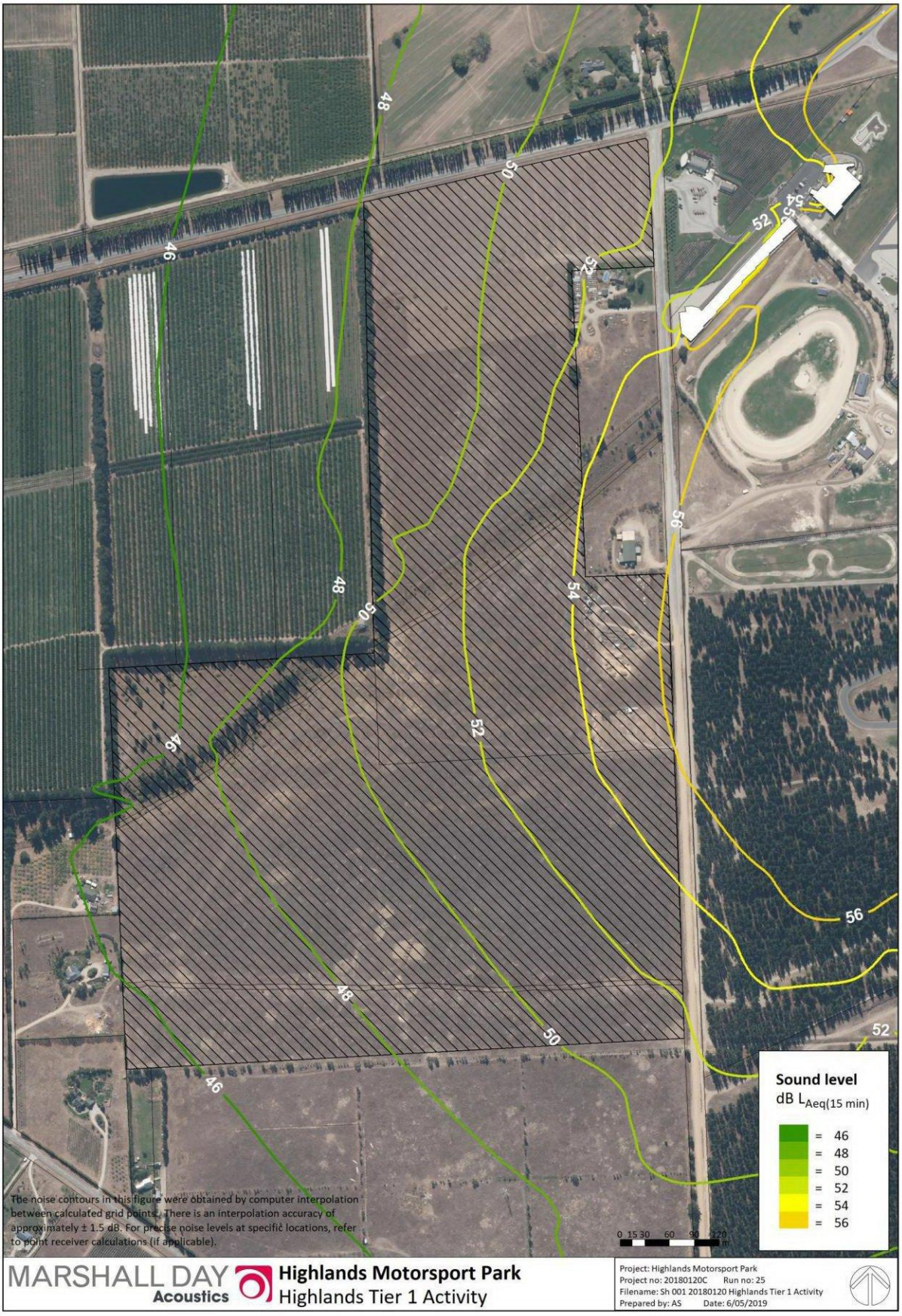


**Figure 2: Highlands Motorsport Park – Tier 2 Events (Race Days)**

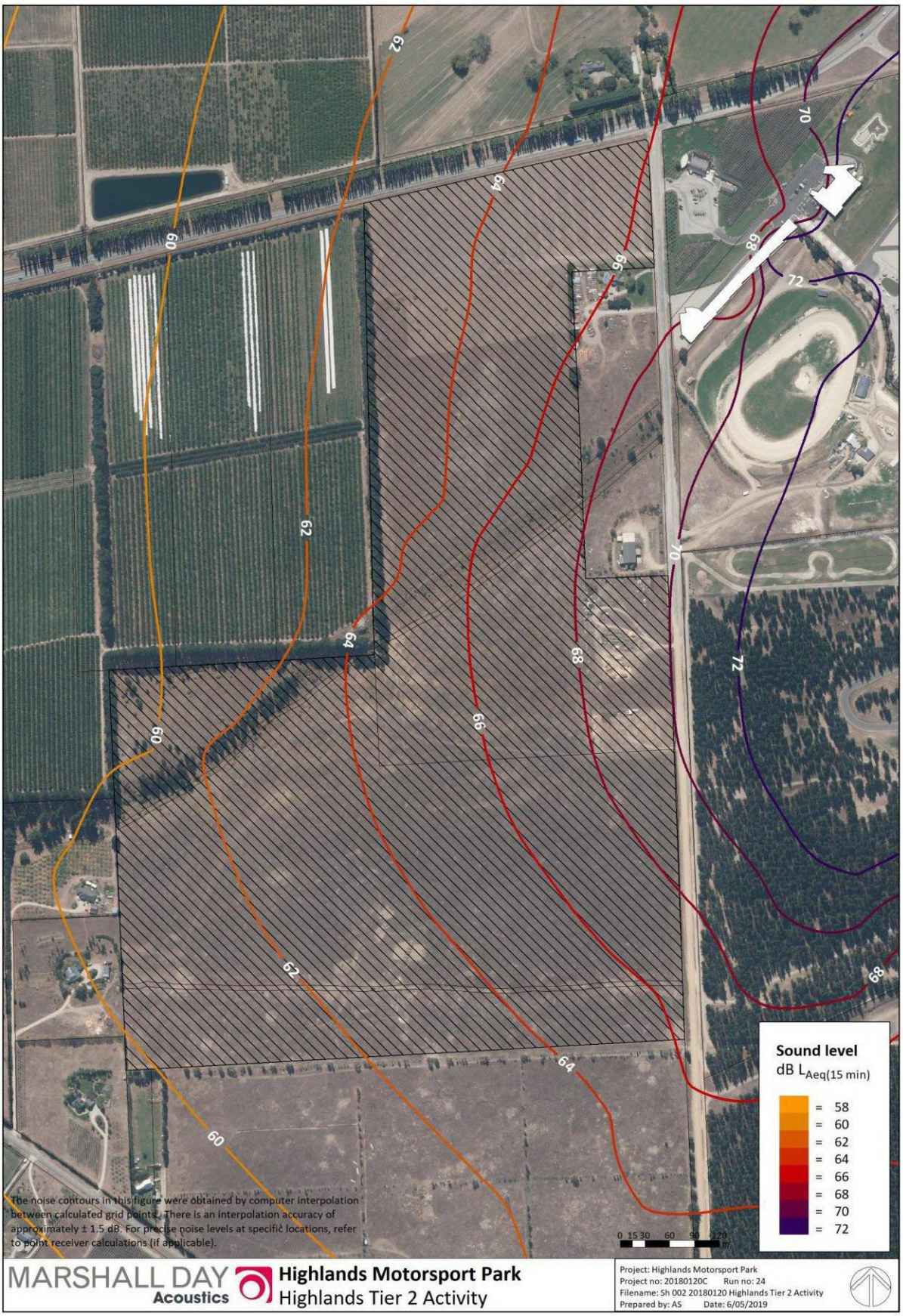


**Figure 3: Speedway Events**

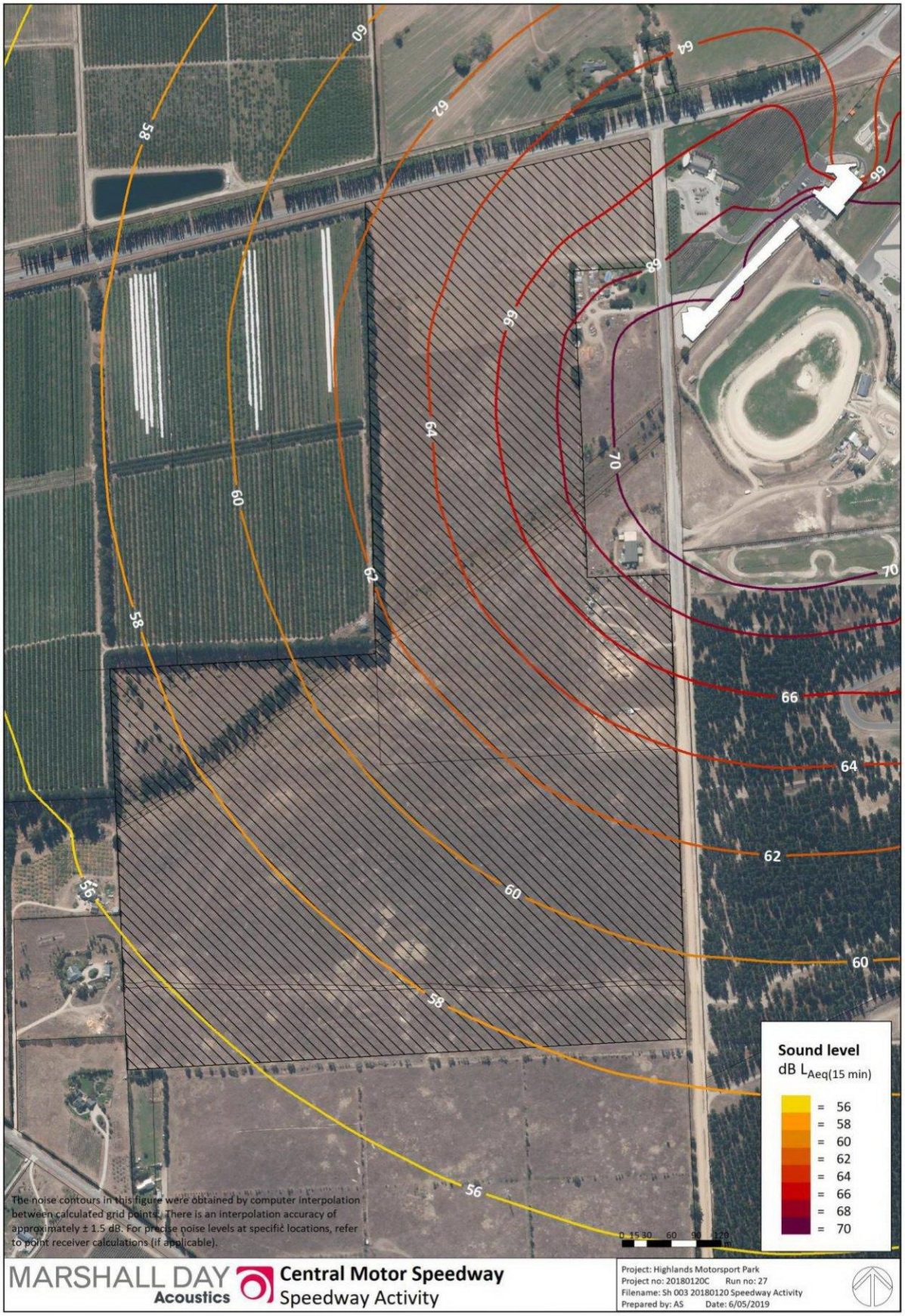


**Figure 4: Total noise from a Speedway event, Highlands day-to-day activity, wind machine and helicopter use**

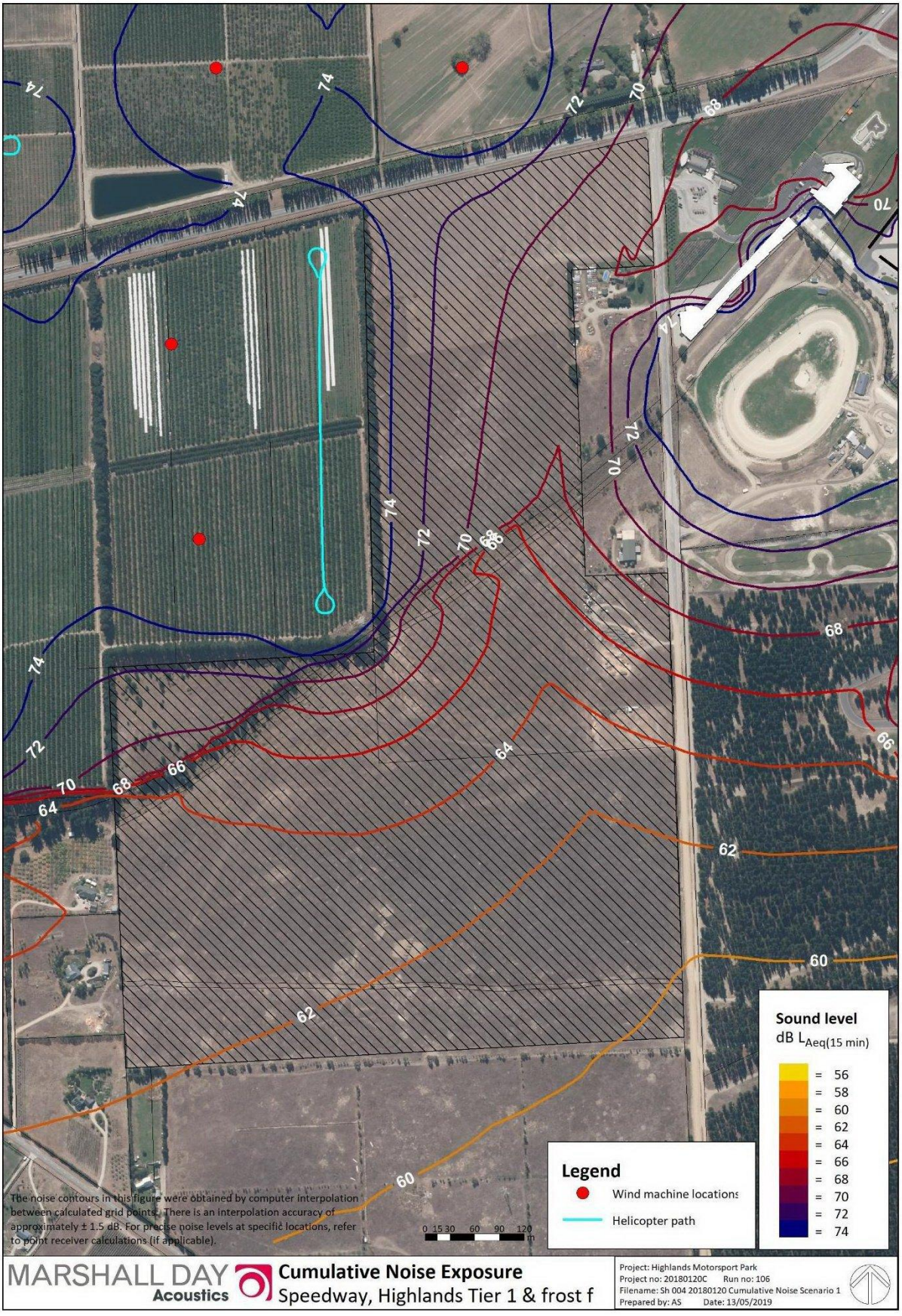
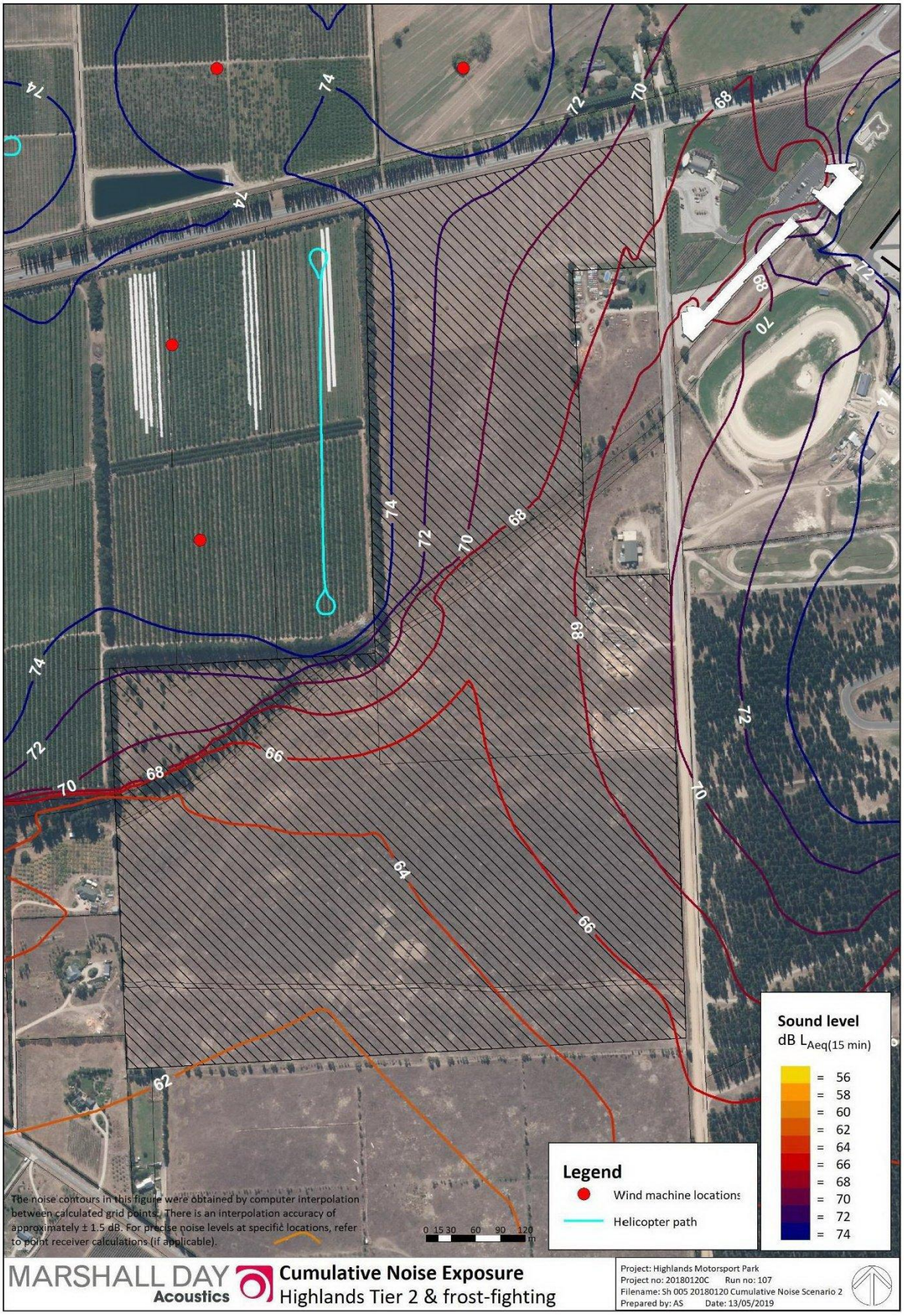


**Figure 5: Total noise from a Highlands Tier 2 event and wind machine and helicopter use**



## APPENDIX B HORTICULTURAL ACTIVITIES NOISE ASSESSMENT

(Following pages)

MARSHALL DAY Acoustics

# CENTRAL OTAGO DISTRICT PC13 SUBMISSION

## Horticultural Activities Noise Assessment

Rp 001 20181442 | 24 April 2019

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Report No.: **Rp 001 20181442**



## Document Control

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| Approved | - | - | 24 Apr 2019 | Aaron Staples | Gary Walton |

# EXECUTIVE SUMMARY

This report provides an assessment of the effects of noise emissions from adjacent horticultural activities on the proposed River Terrace development in Cromwell, Central Otago.

Noise measurements of various equipment associated with horticultural activities such as frost fans, helicopters, bird scarers, sprayers, chainsaws, mulchers and mowers were undertaken. Based on these noise measurements, a detailed noise model was prepared to predict noise levels received on the River Terrace site.

Our analysis shows that the proposed development would be exposed to relatively high noise levels at times during various horticultural activities. Frost-fighting in particular, which usually occurs at night, is expected to result in significant adverse noise effects on residents, should the development proceed. In our view, mitigating such noise effects would be challenging due to the magnitude of the noise reductions required to achieve an appropriate internal noise level within bedrooms.

During the day, impulsive noise from bird scarers and shotguns is likely to cause significant annoyance to residents in outdoor areas.

Noise from other horticultural activities such as mulching, mowing, spraying and the use of chainsaws would generally be acceptable in our view, given that these activities only occur during daytime hours for limited duration and produce noise levels that are in line with typical daytime noise limits. However, use of chainsaws near the River Terrace site boundary would need to be carefully managed.

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## 1.0 INTRODUCTION

Marshall Day Acoustics has been engaged by 45 South Management Limited to assess noise from existing and permitted future horticultural activities on land around the proposed River Terrace development (Central Otago District Plan Change 13) in Cromwell, Central Otago.

This report provides:

- An overview of the proposed Plan Change;
- A summary of our noise measurements of existing horticultural activities;
- Predicted noise levels from existing and permitted future horticultural activities received at the proposed River Terrace development; and
- An assessment of the potential noise effects on the proposed River Terrace development arising from horticultural activities.

This report does not consider noise emissions and the associated effects from the nearby Highlands Motorsport Park and Speedway activities.

A glossary of the acoustical terminology used in this report is provided in Appendix A.

## 2.0 OVERVIEW OF PROPOSED PLAN CHANGE 13

River Terrace Developments Ltd has requested a change to the Central Otago District Plan (Plan Change 13) to allow a large urban development on the land known as "River Terrace". River Terrace is a 49 hectare area of land located to the south-west of the Cromwell town centre, bordering Kawarau Gorge Road (State Highway 6) and Sandflat Road, directly west of Highlands Motorsport Park, as shown in Figure 1.

The locations of the nearest frost fans (both existing and consented) on the surrounding properties are also shown in Figure 1, based on information provided to us by 45 South Management Ltd.

**Figure 1: River Terrace site and locality**

In summary, Plan Change 13 proposes to change the zoning of the River Terrace site from Rural Residential and Rural Resource Areas to a new zone called "River Terrace Resource Area". The proposal is to permit urban activities including medium and high density residential, retirement living and possibly a school, along with associated infrastructure. A copy of the indicative masterplan provided in the Plan Change 13 application documentation is provided in Figure 2 to illustrate the scale of the development.

This development would introduce a large number of noise-sensitive receivers (i.e. residents, retirement home occupants and school users) within close proximity to the surrounding orchards.

**Figure 2: Indicative masterplan (from Jasmax Design Report, dated 7 December 2017)**

## 3.0 NOISE MEASUREMENTS OF HORTICULTURAL ACTIVITIES

On 12 and 14 February 2019, we undertook comprehensive noise measurements of a number of horticultural activities on the orchards adjacent to the proposed River Terrace development. Conditions were fine with light winds during our noise measurements. Noise survey details such as equipment and calibration information are provided in Appendix B.

The results of our noise measurements are summarised in Table 1. This data has been used to prepare a noise model to assess noise received at the proposed River Terrace development under various scenarios. Although not shown in Table 1, items of equipment were measured at multiple distances to assist with calibrating our noise model.

**Table 1: Summary of noise measurements of horticultural equipment**

| Equipment | Description | Measured noise levels |
|---|---|---|
| Frost fan | Orchard-Rite, measured over full cycle | 70 dB $L_{Aeq}$ at 110 m<br>77 dB $L_{AFmax}$ at 110 m |
| Helicopter | Hughes 500 | 100 dB $L_{AE}$ for pass-by at 20 m<br>95 dB $L_{AFmax}$ at 20 m<br>92 dB $L_{Aeq}$ at 20 m (hovering) |
| Bird scarer | Gas powered Vinetech mobile bird scarer | 108 dB $L_{AE}$ at 20 m (on axis)<br>120 dB $L_{AFmax}$ at 20 m (on axis) |
| Shotgun | Used for bird scaring | 105 dB $L_{AE}$ at 5 m (90° off axis)<br>117 dB $L_{AFmax}$ at 5 m (90° off axis) |
| Sprayer | Croplands Cropliner trailer mounted sprayer | 98 dB $L_{AE}$ for pass-by at 4 m<br>89 dB $L_{Aeq}$ at 5 m (stationary)<br>90 dB $L_{AFmax}$ at 5 m |
| Mulcher | | 92 dB $L_{AE}$ for pass-by at 6 m<br>88 dB $L_{AFmax}$ at 6 m |
| Tractor with mower | | 90 dB $L_{AE}$ for pass-by at 5 m<br>83 dB $L_{AFmax}$ at 5 m |
| Tractor | | 85 dB $L_{AE}$ for pass-by at 5 m<br>78 dB $L_{AFmax}$ at 5 m |
| 3x diesel engines | Used for irrigation and spraying. Measured 10 m from the acoustic centre of all three engines. | 81 dB $L_{Aeq}$ at 10 m |
| Chainsaw | Cutting wood | 89 dB $L_{Aeq}$ at 4 m<br>91 dB $L_{AFmax}$ at 4 m |

## 4.0 PREDICTED NOISE LEVELS

### 4.1 Prediction Methodology

To accurately predict noise levels, the noise modelling package SoundPLAN has been used. Calculations in SoundPLAN are based on ISO 9613-2:1996 "*Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*". This method has the scope to take into account a range of factors affecting the sound propagation including:

- The magnitude of the noise source in terms of sound power;
- The distance between source and receiver;
- The presence of obstacles such as screens or barriers in the propagation path;
- The presence of reflecting surfaces;
- The hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity.

In ISO 9613, the effect of meteorological conditions is significantly simplified by calculating the average downwind sound pressure level. The Standard adopts the conservative approach of assuming that wind is always blowing from the noise sources to the receiver locations. The equations and calculations also hold for average propagation under a well-developed, moderate, ground based temperature inversion, such as commonly occurs on clear, calm nights.

### 4.2 Modelling Scenarios & Predicted Noise Levels

To assess the noise impacts of horticultural activities on the proposed River Terrace development, we have predicted noise levels for a range of scenarios involving the horticultural activities that generate the greatest noise levels:

1) Frost-fighting (frost fans only) – all frost fans operating (understood to occur approximately 10 - 30 times per year, usually at night. The duration varies depending on the frost). Frost fan locations are shown in Figure 1.
2) Frost-fighting (frost fans plus helicopters) – as per above scenario plus two helicopters operating.
3) Post-rain drying – two helicopters (any time after rain throughout the harvesting season).
4) Bird control – six mobile bird scarers and two shotgun shooters (typically 0500 – 2200 hours daily throughout harvesting season with four blasts per 15 min per bird scarer/shotgun).
5) Other horticultural activities – 1x mulcher, 1x tractor with mower, 2x chainsaws and 1x sprayer and diesel engines associated with irrigation (typically 0800 – 1700 hours three times per week).

As the River Terrace development covers a significant area, we have presented our predicted noise levels using noise contour maps to illustrate the changes in noise levels across the River Terrace site for the various activities. These noise contour maps are provided in Appendix C. A summary of the results is provided in Table 2 overleaf. Please note that these results do not include any adjustment for Special Audible Characteristics as defined in New Zealand Standard NZS 6802:2008 *"Acoustics - Environmental Noise"*.

The greatest $L_{AFmax}$ noise levels that can be expected within the River Terrace site for each scenario are also provided in Table 2. Note that for scenarios 2-5, the magnitude of the $L_{AFmax}$ values strongly depend on how close the particular noise sources operate to the River Terrace site boundary.

**Table 2: Summary of predicted noise levels at River Terrace site**

| Scenario | Predicted range of noise levels on River Terrace site | |
|---|---|---|
| | dB $L_{Aeq(15\ min)}$ | dB $L_{AFmax}$ |
| 1) Frost-fighting (frost fans* only) | 59 - 72 | Up to 80 |
| 2) Frost-fighting (frost fans* plus helicopters) | 60 - 75 | Up to 85 |
| 3) Post-rain drying | 53 - 69 | Up to 87 |
| 4) Bird control | 47 - 63 | Up to 106 |
| 5) Other horticultural activities | < 45 - 58 | Up to 87 |

* Note that the Central Otago District Plan permits frost fans to produce up to 65 dB $L_{A10}$ at 300 metres. The frost fan noise measurements upon which our predictions are based are effectively 2 dB lower than this. Therefore, frost fan noise levels received at the River Terrace site could be up to 2 dB higher than our predicted levels whilst still achieving the District Plan frost fan noise requirements.

## 5.0 POTENTIAL NOISE EFFECTS ON RIVER TERRACE DEVELOPMENT

Our predicted noise levels for the frost-fighting, post-rain drying and bird control scenarios all expose the River Terrace site to relatively high noise levels which would be likely to result in significant adverse noise effects on River Terrace residents in our view. Whilst specific horticultural activities only occur for limited durations, frost-fighting in particular, which largely occurs at night, would cause sleep disturbance and significant annoyance to residents.

Mitigating noise effects by requiring a minimum sound insulation standard for the proposed development's dwellings would be challenging, particularly with regard to frost-fighting noise. To achieve an appropriate noise level inside bedrooms (30 dB $L_{Aeq(8h)}$ and 45 dB $L_{AFmax}$ based on the World Health Organisation guidelines[1]), a noise reduction in the order of 30 - 45 dB would be required, based on our predicted noise levels of 60-75 dB $L_{Aeq(15\ min)}$ and up to 85 dB $L_{AFmax}$ during frost-fighting with helicopters. To achieve a noise reduction of this magnitude for frost fan and helicopter noise (which have significant low-frequency components) would require masonry constructions and closed windows with an associated alternative means of ventilation to provide fresh air to bedrooms.

During the day, impulsive noise from bird scarers and shotguns is likely to cause significant annoyance to residents in outdoor areas based on the $L_{AFmax}$ noise levels predicted (up to 106 dB $L_{AFmax}$). Noise effects in outdoor areas are difficult to mitigate. Solid boundary fences would be of limited use.

Noise effects arising from other general horticultural activities in scenario 5 (mulching, mowing, spraying and the use of chainsaws) would generally be acceptable in our view, given that they only occur during daytime hours for limited duration and produce noise levels that are in line with typical daytime noise limits (50 – 55 dB $L_{Aeq(15\ min)}$). However, use of chainsaws near the River Terrace site boundary would need to be carefully managed, as the predicted maximum noise levels ($L_{AFmax}$) could result in adverse noise effects (annoyance) on nearby residents.

[1] The World Health Organisation Guideline Values for Community Noise (Berglund and Lindvall, 1999)

## 6.0 CONCLUSIONS

We have assessed noise emissions from a number of horticultural activities on land around the proposed River Terrace development in Cromwell and draw the following conclusions:

- Based on our noise measurements of various horticultural activities and subsequent detailed noise model we prepared, we predict that the proposed development would be exposed to relatively high noise levels at times during various horticultural activities;
- Frost-fighting in particular, which usually occurs at night, is expected to result in significant adverse noise effects on residents, should the development proceed. In our view, mitigating such noise effects would be challenging due to the magnitude of the noise reductions required to achieve an appropriate internal noise level within bedrooms;
- During the day, impulsive noise from bird scarers and shotguns is likely to cause significant annoyance to residents in outdoor areas; and
- Noise from other horticultural activities such as mulching, mowing, spraying and the use of chainsaws would generally be acceptable in our view, given that these activities only occur during daytime hours for limited duration and produce noise levels that are in line with typical daytime noise limits. However, use of chainsaws near the River Terrace site boundary would need to be carefully managed.

## APPENDIX A GLOSSARY OF TERMINOLOGY

| | |
|---|---|
| **Noise** | A sound that is unwanted by, or distracting to, the receiver. |
| **Frequency** | The number of pressure fluctuation cycles per second of a sound wave. Measured in units of Hertz (Hz). |
| **Special Audible Characteristics** | Distinctive characteristics of a sound which are likely to subjectively cause adverse community response at lower levels than a sound without such characteristics. Examples are tonality (e.g. a hum or a whine) and impulsiveness (e.g. bangs or thumps). |
| **SPL or $L_P$** | Sound Pressure Level<br>A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 µPa RMS) and expressed in decibels. |
| **SWL or $L_W$** | Sound Power Level<br>A logarithmic ratio of the acoustic power output of a source relative to $10^{-12}$ watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source. |
| **dB** | Decibel<br>The unit of sound level.<br><br>Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 µPa i.e. dB = 20 x log(P/Pr) |
| **A-weighting** | The process by which noise levels are corrected to account for the non-linear frequency response of the human ear. |
| **$L_{Aeq\ (t)}$** | The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.<br><br>The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am. |
| **$L_{AFmax}$** | The A-weighted maximum noise level measured using fast time response (hence 'F'). The highest noise level which occurs during the measurement period. |
| **SEL or $L_{AE}$** | Sound Exposure Level<br>The sound level of one second duration which has the same amount of energy as the actual noise event measured.<br><br>Usually used to measure the sound energy of a particular event, such as a train pass-by or an aircraft flyover |
| **Sound Insulation** | When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it. |
| **NZS 6802:2008** | New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"* |

## APPENDIX B NOISE SURVEY DETAILS

The key details of our noise surveys are as follows.

### B1 Noise Survey, 12 February 2019

**Date**: 12 February 2019, 0915 – 1430 hours

**Personnel**: Alex West, Marshall Day Acoustics

**Weather**: 18-24°C, 25-50% cloud cover, 1-3 m/s wind from the north

**Instrumentation**: Brüel & Kjær Type 2250 analyser, serial 2488377, calibration due 02/08/2020
Brüel & Kjær Type 4231 calibrator, serial 1882775, calibration due 12/02/2020

**Calibration**: Field calibration of the equipment was carried out before measurements, and the calibration checked after measurements. Observed change within 0.1 dB.

### B2 Noise Survey, 14 February 2019

**Date**: 14 February 2019, 1100 – 1130 hours

**Personnel**: Alex West, Marshall Day Acoustics

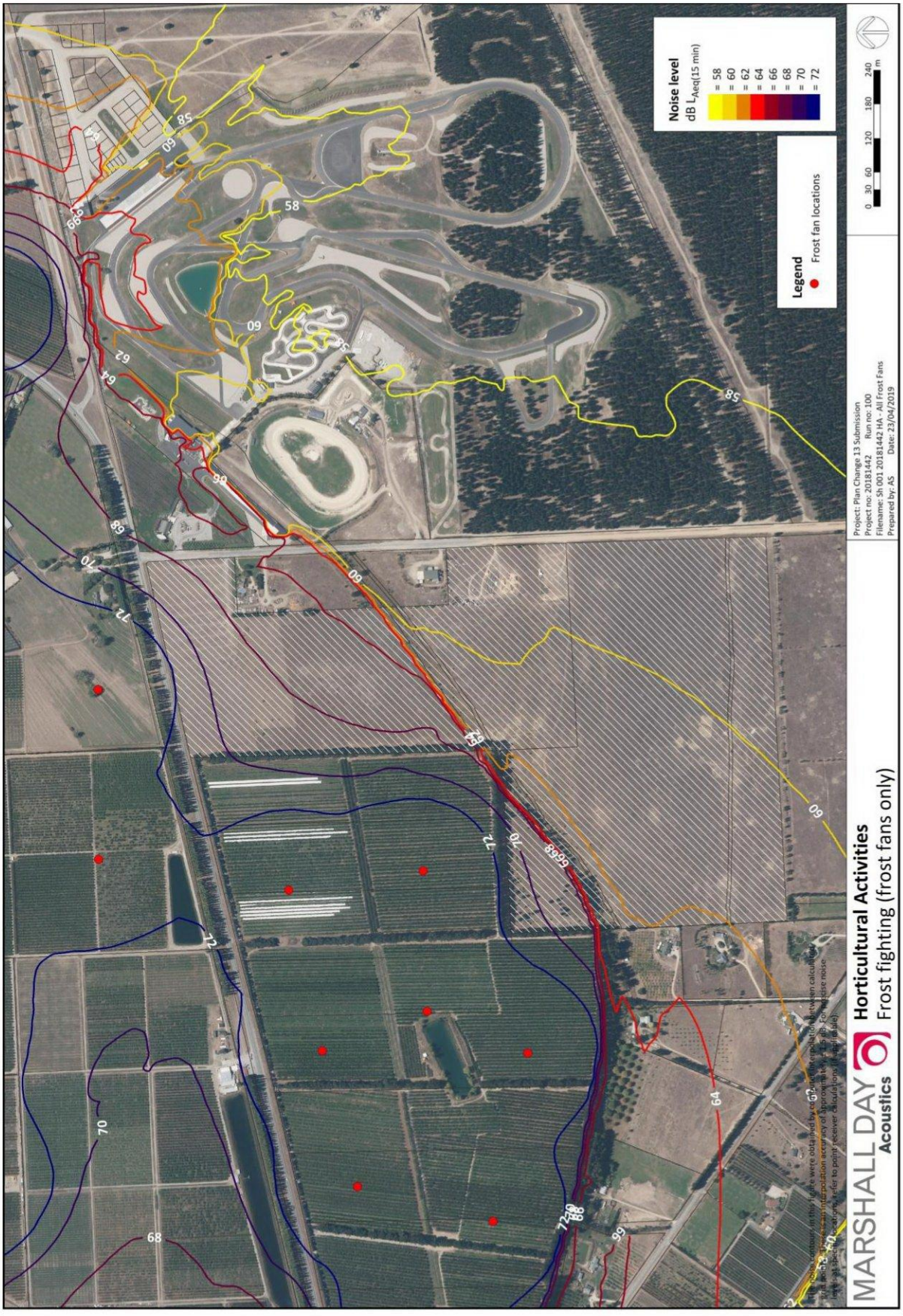
**Weather**: 24°C, 50% cloud cover, 1-2 m/s wind from the north

**Instrumentation**: Brüel & Kjær Type 2250 analyser, serial 2488377, calibration due 02/08/2020
Brüel & Kjær Type 4231 calibrator, serial 1882775, calibration due 12/02/2020

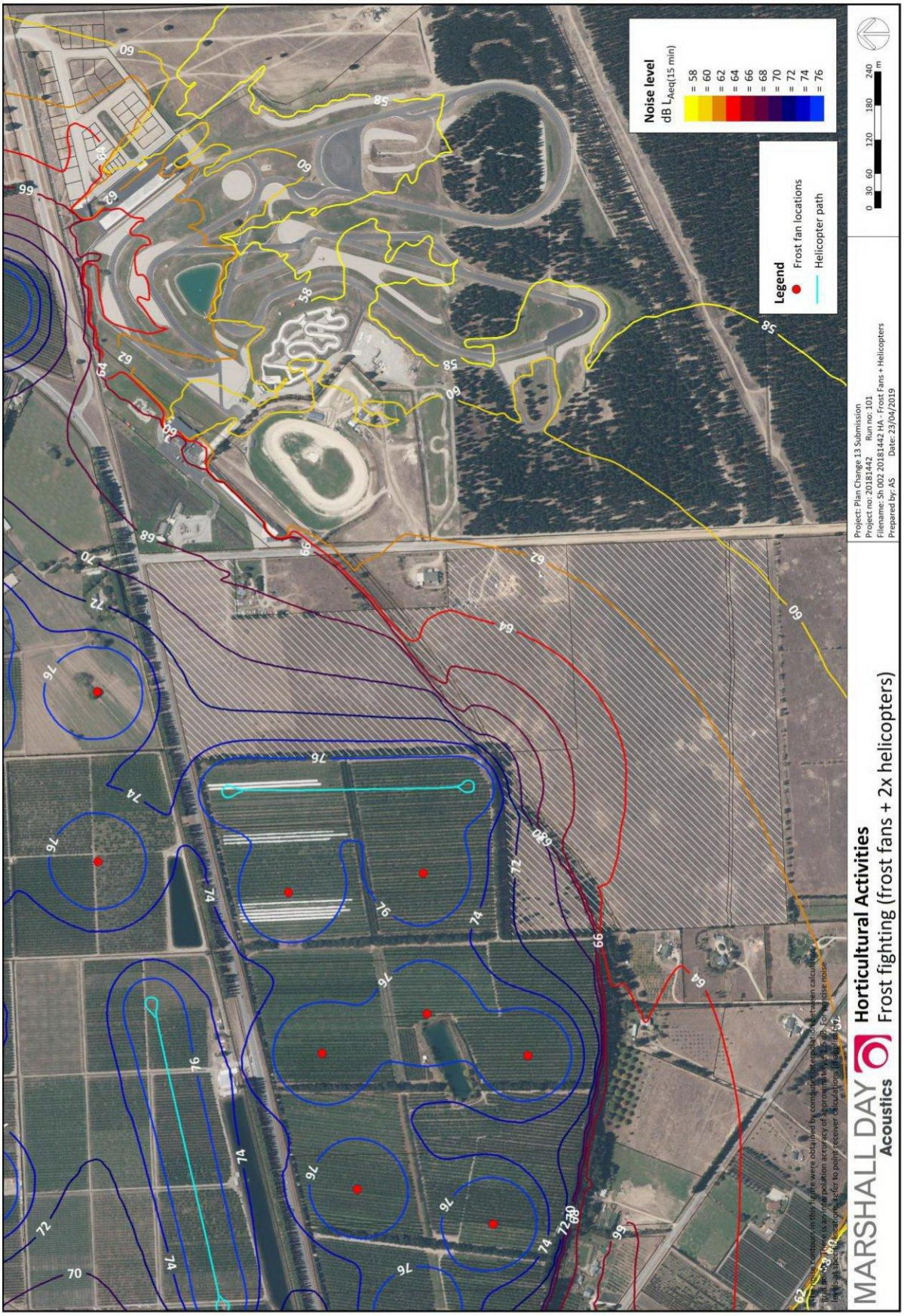
**Calibration**: Field calibration of the equipment was carried out before measurements, and the calibration checked after measurements. Observed change less than 0.1 dB.

## APPENDIX C NOISE CONTOUR MAPS

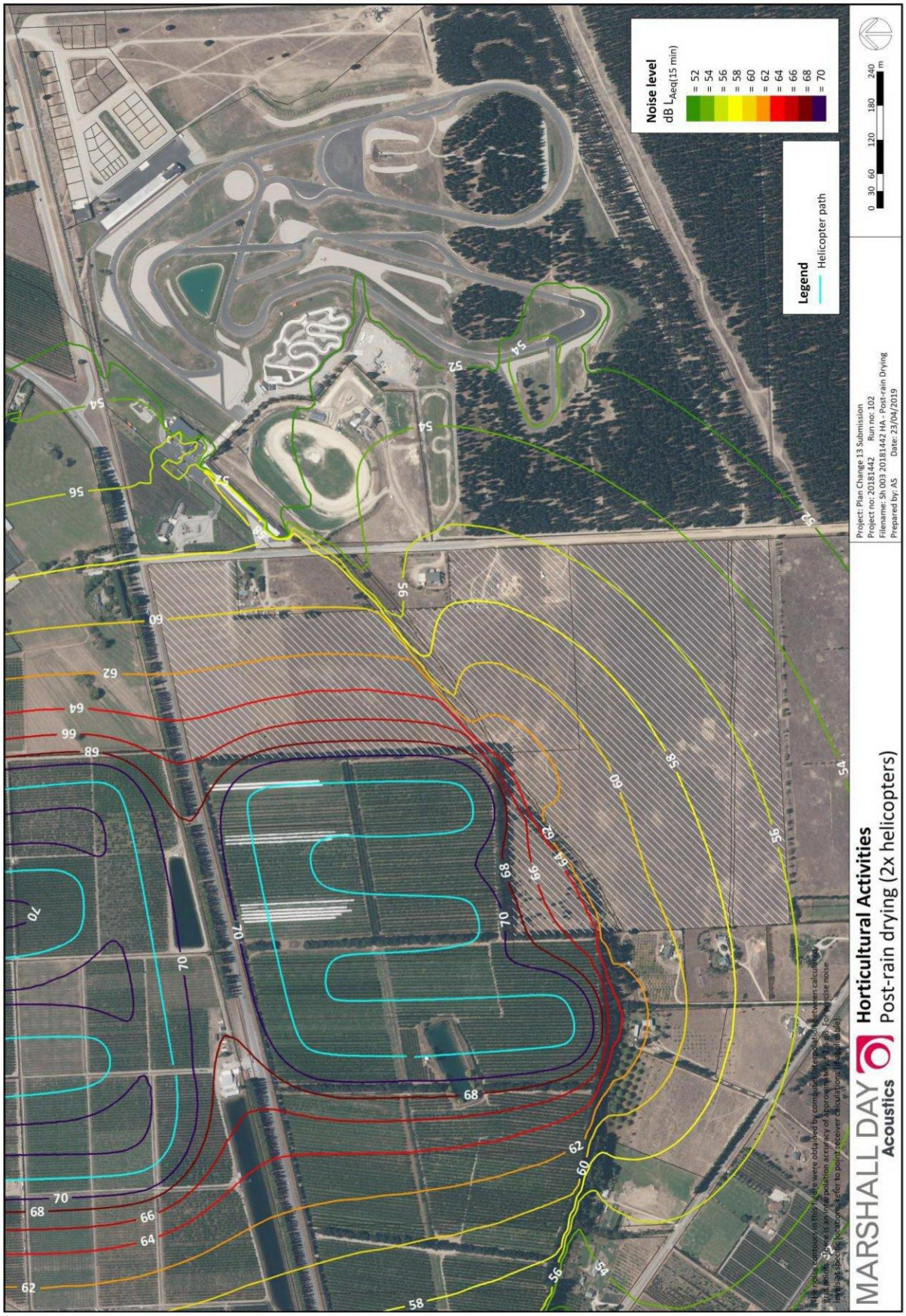
### C1 Scenario 1: Frost-Fighting (Frost Fans Only)



## C2 Scenario 2: Frost-Fighting (Frost Fans plus 2 Helicopters)



## C3 Scenario 3: Post-Rain Drying



## C4 Scenario 4: Bird Control

## C5 Scenario 5: Other Horticultural Activities