OTAGO REGIONAL COUNCIL

Agenda for a meeting of the Technical Committee to be held in the Council Chamber, 70 Stafford Street, Dunedin on Wednesday, 8 February 2017, following the Regulatory Committee

Membership:

Cr Maggie Lawton (Chairperson)
Cr Stephen Woodhead (Deputy Chairperson)
Cr Graeme Bell
Cr Doug Brown
Cr Michael Deaker
Cr Carmen Hope
Cr Trevor Kempton
Cr Michael Laws
Cr Sam Neill
Cr Andrew Noone
Cr Gretchen Robertson
Cr Bryan Scott

Apologies: Cr Sam Neill

In attendance:

Please note that there is an embargo on agenda items until 8.30 am on Friday 3 February 2017

CONFIRMATION OF AGENDA

CONFLICT OF INTEREST

PUBLIC FORUM

MINUTES

Minutes of the meeting held on 23 November 2016, having been circulated for adoption.

Otago Regional Council

PART A ITEMS FOR NOTING

Item 2
2016/1145 **Updated hazard maps for Dunedin City Council Second Generation District Plan**, DEHS, 02/02/17 7 - 12

The report summarises changes ORC has recommended to the hazard maps, since the 2GP was notified in September 2015.

Item 2
2016/1145 **2016 Air Emissions Inventory for select Otago town**, DEHS, 20/01/17 13 - 21

The covering report provides information about the Air Emissions Inventory commissioned for the four Otago towns: Alexandra, Arrowtown, Milton and Mosgiel in 2016. Results of the inventory detail the sources and magnitude of emissions in these towns.

The full report entitled "Alexandra, Arrowtown, Mosgiel and Milton Air Emission Inventory – 2016" is circulated separately with the agenda.

Item 3
2017/0568 **Director's Report on Progress.** DEHS, 02/02/17 22 - 26

Topics covered in the report are: Lake Snow; Climate and Weather; Leith Flood Protection Scheme, and Geomorphic Change Detection

The full World Meterological Organization report entitled "Standardized Precipitation Index – User Guide" is circulated separately with the agenda

OTAGO REGIONAL COUNCIL

Minutes of a meeting of the Technical Committee held in the Council Chamber, 70 Stafford Street, Dunedin on Wednesday, 23 November 2016, commencing at 10:57am

Membership:

Cr Maggie Lawton (Chairperson)
Cr Stephen Woodhead (Deputy Chairperson)
Cr Graeme Bell
Cr Doug Brown
Cr Michael Deaker
Cr Carmen Hope
Cr Trevor Kempton
Cr Michael Laws
Cr Sam Neill
Cr Andrew Noone
Cr Bryan Scott
Cr Gretchen Robertson

Cr Lawton welcomed attendees to the meeting.

A correction to the membership list was noted for the Committee and Deputy Chair than that listed in the agenda.

Cr Lawton congratulated Dr Palmer on his appointment to the Climate Change Adaptation Technical Working Group. This panel of ten experts will advise central government on adaption for climate change.

Apologies: Nil.

Leave of Absence: Nil.

In attendance:

Peter Bodeker
Nick Donnelly
Gavin Palmer
Caroline Rowe
Fraser McRae
Scott MacLean
Adam Uytendaal
Dean Olsen
Lauren McDonald (minute taker)

CONFIRMATION OF AGENDA
The agenda was confirmed.

CONFLICT OF INTEREST
No conflicts of interest were advised.

PUBLIC FORUM
No public forum held.

Otago Regional Council

PART A RECOMMENDATIONS

Item 1
2016/1138 **Terms of Reference for the Technical Committee** DCS 8/11/16

The report provided the Terms of Reference for consideration and recommendation to Council.

Suggested amendments to the Terms of Reference were noted as:

- Purpose:
  addition of the word "identify" to the first bullet point.
  Addition of the words "by and for Council" to the second bullet point
- Explanatory Comment:
  a separation of Resource Science analysis and monitoring into two separate bullet points for resource science research and investigation and then SOE reporting.

Moved Cr Woodhead
Seconded Cr Kempton

That the Terms of Reference with the suggested amendments for the Technical Committee be considered and a final version presented to Council on 7 December 2016, for adoption.

The motion was not put to the meeting for vote.

PART B ITEMS FOR NOTING

Item 2
2016/1075 **2016 Air Quality Results**, DEHS, 15/11/16

The report presented Otago's ambient air quality monitoring results for 2016 and examined the long-term trends in PM_{10}.

Dr Olsen, Manager Resource Science spoke to the report in the absence of the author, Ms Mills.

Dr Olsen was asked to outline the trends in air quality observed in the report. He advised that the variability in ambient air quality in individual towns depended on the climate, which was the main driver of trends. He commented that for most sites the trends had not changed drastically, other than for Dunedin city, which had a significant improvement in air quality since 2012.

A question was raised in regard to the timing of the air quality monitoring undertaken. Dr Palmer noted that there is 24 hour monitoring

through the year at some locations, with monitoring over the winter months at other locations and that measurement were taken at the site with the poorest air quality.

Discussion was held on the challenges to meet the National Environmental Standards Air Quality (NESAQ), in particular for Central Otago with its extreme cold in winter and the current review by MfE on the health-related effects of $PM_{2.5.}$

Mr McRae confirmed that this Council had taken an even handed approach with the regime set in place with the air sheds for Otago. He commented that Central Otago is an environment that the NES did not expect to have to operate in.

Discussion was held in regard to public health and the debate over health problems being caused by air quality or the cold winter conditions. It was noted that good clean air quality, warm houses and good health all need to be considered, and it was not an either, or, situation.

Cr Robertson commented it was good to see the 10 year trend analysis – which would assist in refining Council policies and that it would be beneficial to see the full analysis of the statistics.

Staff were thanked for the comprehensive report.

It was requested that a report be provided to the committee once the NESAQ is released by MfE.

Moved Cr Lawton
Seconded Cr Deaker

1. *That the report be received.*
2. *That the state of air quality in Otago be noted.*

Motion carried

Item 3
2016/1108 **Director's Report on Progress.** DEHS, 18/11/16

Topics covered in the report included: Leith Flood Protection Scheme; Clutha bioenergetics and instream habitat modelling; lake monitoring and lake snow; Chard Road landslide (Kawarua Gorge) and the Dunedin City District Plan Natural Hazards submissions.

Dr Palmer confirmed that the technical review of the Dunedin City District Plan Natural Hazards Submissions was progressing well and that the finalised technical information would be ready for endorsement by ORC in the New Year.

Lake monitoring and lake snow - Dr Olsen confirmed that the technical experts workshop would be held in the third week in December 2016. He advised that the results of the workshop and recommendations would then come to the Technical Committee and through the Annual Plan process.

Dr Palmer explained that the technical workshop was an initiative outside the Annual Plan process and that the workshop would ensure the research is focussed around solutions and would lead to the next steps that need to be taken.

Dr Uytendaal advised that lake snow was present in Lake Wanaka over the summer months and disappeared over autumn and winter, but that Lake Wakatipu has had lake snow present over the winter months also. Lake Hawea only had a small quantity of lake snow found to be present. He advised that currently ORC is taking the opportunity to add some additional parameters for sampling on the lakes to specifically understand the location, cycle and volume of lake snow in the lakes.

Dr Olsen advised that there was no standard method for quantifying lake snow.

It was questioned if there were any international lakes which had lake snow present and if there was any precedence known. Dr Olsen advised that lake snow had been recently detected in Youngs Lake in Washington D.C. but that the water was not taken for municipal supply so did not have the same impact as for Wanaka. It was commented that it is likely that the ORC would be the world leaders in analysing lake snow.

Cr Laws left the room at 12:10pm

Moved Cr Lawton
Seconded Cr Deaker

That the report be received.

Motion carried

The meeting was declared closed at 12:11pm

Chairperson

Otago Regional Council

REPORT

Document Id: A972391

Report Number: 2017/0591
Prepared For: Technical Committee
Prepared By: Dr Jean-Luc Payan, Manager Natural Hazards,
Dr Ben Mackey, Natural Hazards Analyst
Date: 2 February 2017

Subject: **Updated hazard maps for Dunedin City Council Second Generation District Plan**

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1. Précis

The Otago Regional Council (ORC) has been working with the Dunedin City Council (DCC) to provide hazard information to be incorporated into the Second Generation Dunedin City District Plan (2GP)[1]. This report summarises changes ORC has recommended to the hazard maps since the 2GP was notified in September 2015. Many changes have been in response to reviewing submissions received on the hazard aspects of the 2GP.

2. Hazard Overlays[2]

The ORC provided DCC with hazard information which was presented in a series of reports produced by ORC and GNS Science (references in Section 8). The reports identify the various flood, coastal and land instability hazards in the Dunedin district, with the intent they can be incorporated into planning maps (or hazard overlays). These reports were approved by the Council Committee[3] prior to being presented to DCC.

Hundreds of submissions were received by the DCC in relation to the natural hazards maps and provisions in the 2GP. ORC natural hazards staff have reviewed these submissions, and modified some of the hazards maps based on information provided in some of the submissions and on further technical work undertaken or commissioned by ORC. This report outlines the rationale and approach to the changes.

It is possible that further changes to the information are made during the remainder of the 2GP process. The technical reports and overlays will be finalised once that process is concluded.

3. Land Instability Overlays

As part of the review of the 2GP the ORC compiled a geodatabase of landslides across the Dunedin district. Compilation of the landslide database was done in collaboration with GNS Science, who produced a series of three reports for ORC bringing together

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[1] Report 2013/0777 presented to the Engineering and Hazards Committee in April 2013.

[2] Areas of land-based hazards such as instability or land potentially subject to flooding or coastal hazards. Properties in this overlay will have additional rules which control or limit new residential development or other sensitive activities, based on the level of risk faced. Each hazard overlay has a hazard category (one, two and three; one being classified by DCC as high, two as moderate and three as low) associated with planning rules in the proposed 2GP.

[3] Report 2014/0826 presented to the Technical Committee in June 2014.

information about landslides in Dunedin. In total the process collated over 2,000 previously mapped landslides into a geographic information system (GIS) geodatabase. The notified 2GP included 428 Landslide features that covered 59 km^2 as a Hazard Two overlay, and Hazard One overlay comprised 11 landslides across 2.4 km^2.

Approximately 300 submissions were received relating to the land instability hazard overlay aspect of the 2GP. In response to these submissions the ORC engaged GNS Science to verify and if necessary re-map the landslides in the wider Dunedin urban, industrial, and rural-residential areas from Saddle Hill north to Waikouaiti.

Existing landslides were mapped with greater accuracy resulting in changes to the landslide margins and extents. Some areas previously mapped as landslides were assessed as not being landslide terrain, and conversely the revised work identified previously un-mapped landslide features. The updated landslide map for the developed area of the Dunedin District included 1083 individual landslides, with a total landslide area of 52 km^2. ORC recommended a Hazard One land instability hazard overlay was applied to 9 landslides which have demonstrated ongoing movement. Hazard Two land instability hazard overlay was recommended to be applied to landslides which have documented historical movement. This incorporated 91 landslides with a total area of 3.1 km^2.

Based on the further work ORC recommended that buffers are no longer retained in the 2GP as a formal hazard overlay in the re-mapped section of the 2GP. The improved accuracy with which landslide margins have been mapped negates much of the prior rationale for the buffers and for the landslide awareness areas to be included as hazard overlays.

The 2016 GNS mapping revision included the more densely developed part of the Dunedin district, from Brighton to Waikouaiti. Some land instability hazard overlays in the 2GP are outside the area of revised mapping – these areas are primarily around the coastal hills north of Dunedin City. It is recommended this area is retained as originally presented with the buffer areas retained.

4. Coastal Hazard Overlays

Hazards facing Dunedin's coastal communities were detailed in 2014 ORC report 'Coastal Hazards of the Dunedin City District'. This report addressed a range of hazards facing coastal communities, including inundation, flooding, liquefaction, coastal ponding, and tsunami.

The 2GP included a coastal hazard overlay for areas vulnerable to inundation by the sea. In the ORC 2014 report, areas vulnerable to inundation by the sea were separated into two categories, 'Area A' and 'Area B'. These areas are elevation-based, and extracted from LiDAR-derived elevation data. The specific elevations used to define the extent of these areas vary slightly along the coast depending on local conditions, and are taken from a 2008 NIWA study relating to predicted storm surge heights.

Area A is land below the height of a 1:100 year predicted storm surge level. Area B is land at the height of a 1:100 year storm surge plus 1 m elevation. Area B will by definition also encompass Area A. The additional 1 m elevation is to account for

predicted sea level rise over the coming century and is consistent with the proposed Regional Policy Statement. The DCC has not distinguished between areas A and B in the 2GP, and Area B largely represents the extent of coastal hazard overlay.

A limited number of submissions were received relating to the coastal hazard overlay aspect of the 2GP. The only change made to ORC supplied inundation areas was at the margin of 'Area B' in Aramoana where evidence indicated land had been built up subsequent to the LiDAR data being acquired in 2004 and used during the mapping.

It is understood the DCC have made some additions to the coastal inundation areas provided by the ORC. This additional work and any enlargements to inundation areas provided by the ORC is beyond the scope of the review undertaken by the ORC and not addressed.

5. Flood Hazard Overlays

For the 2GP process, flood hazards have been divided into five geographic categories which have been addressed separately:

- Urban Streams (Water of Leith, Lindsay Creek, Kaikorai Stream)
- Coastal Rivers (including Waikouaiti, Waitati rivers)
- Strath Taieri (Middlemarch area)
- Lower Taieri (Taieri Plains)
- Alluvial fans (district-wide)

5.1 Urban Streams

The Dunedin Urban Stream mapping involved mapping potential flood hazard areas associated with the Water of Leith, Lindsay Creek, and Kaikorai Stream catchments.

The basis for the maps presented in 2GP was the 2014 ORC report 'Flood Hazard of Dunedin's Urban Streams.

The approach taken to identifying flood hazard areas was to identify the relevant geomorphic floodplain[4] associated with each waterway (refer to ORC 2014 for details on the mapping approach).

5.1.1 Review of Urban Stream Flood Hazard areas

Approximately 50 submissions were received on the proposed 2GP urban stream flood hazard overlays. In response to these submissions the urban stream flood hazard areas were reviewed by staff. The review focussed on ensuring the margins of the flood hazard areas were consistent with the mapping approach to identifying the geomorphic floodplain.

[4] The natural landform created by the creeks when they are in flood, or the area occupied by the creek before the creek was confined or incised to its present course. Typically the geomorphic floodplain comprises low-gradient planar landforms adjacent to the river extending to the break in slope at the base of the adjacent hillslope.

Limited adjustments (reduction) to the flood hazard overlay were made for the Water of Leith and Lindsay Creek. More extensive adjustments were made to the flood hazard overlay for the Kaikorai Stream due to the heavily altered valley floor (rec-contouring of industrial sites, construction of motorway embankment, etc.) making the identification of the floodplain less straightforward.

5.2 Strath Taieri

The proposed flood hazard overlay for the Strath Taieri was based on the flood hazard area described in 'Floodplain Management Report Dunedin District – Rural Areas' produced by the Otago Regional Council in 1993.

Less than ten submissions were received on the proposed 2GP Strath Taieri flood hazard overlays. Mostly the submissions commented on the accuracy of the mapping in general.

Localised modifications to the flood hazard extent were made generally using the topographical information available and aerial photography and confirmed by a site visit.

The total area of the Strath Taieri flood hazard overlay has reduced from 20.17 km^2 to 19.85 km^2.

5.3 Coastal Rivers

The coastal rivers describe the non-urban coastal rivers, notably Otokia Creek (Brighton), Waitati, Careys Creek (Evansdale), and the Waikouaiti River. The source report for coastal floodplains is 'Coastal Hazards of the Dunedin City District', produced by the ORC in 2014.

Approximately 20 submissions were received on the proposed 2GP coastal river flood hazard overlay.

Newly acquired data and information provided in the submissions resulted in some changes (usually minor) to the mapped floodplain. The changes generally led to a reduction of the flood hazard overlay extent. Changes involved following the break in slope between floodplain and hillslope in more detail, and ensuring consistency between the mapped floodplain and topography and between neighbouring areas.

5.4 Taieri Plain

The basis of the flood hazard overlays associated with the Taieri Plain is described in 'Flood hazard on the Taieri Plain and Strath Taieri' prepared by the ORC in 2015.

Approximately 15 submissions were received on the proposed 2GP Taieri Plain flood hazard overlay.

No major changes were made to the flood hazard areas presented in the report. The changes included modifications of the East Taieri Lower Pond extent, refinements to extent of some swales and Taieri berm area near Allanton.

Revision of the extent of the alluvial fans and flood hazard associated with the Maungatuas is in progress (refer to section below on Alluvial Fans for the justification).

5.5 Alluvial Fans

Alluvial fan mapping was collated from studies spanning from 1998 to 2014.

Alluvial Fans were presented in the draft 2GP as a 'Flood Hazard' overlay, with either a 'Hazard 2' or 'Hazard 3' risk classification. Approximately 35 submissions related to alluvial fans.

It was difficult to distinguish between flood hazards and alluvial fan hazards in the 2GP maps that were part of the Plan that was notified, which generated some confusion for some users. Many of the mapped alluvial fan hazard areas can extend some distance up tributary valleys and hillslopes which would not be susceptible to conventional flooding.

In the updated 2GP maps it is being recommended that alluvial fans be distinguished from other flood hazards into a separate overlay. This improves the understanding of the respective hazards. It is also being recommended that alluvial fans be given a 'Hazard 3' risk classification, reflecting the low recurrence intervals of activity across most of the Dunedin district.

6. Discussion

The proposed map changes have largely been driven by new information that has become available during the submission and notification process. Many submissions highlighted areas which were in need of refinement and the majority of changes have reduced the extent or hazard classification of the hazard overlays. The quality of the dataset has improved as a consequence of this process. It is probable there will be additional changes to maps during the remainder of the 2GP process. It is envisioned the technical reports which the maps are based upon will be updated and re-issued by ORC at the completion of the process.

As previously advised to Committee, the coastal hazard overlay was used by DCC for South Dunedin as a holding pattern pending specific work on the implications of climate change for that area. The technical report on natural hazards for South Dunedin that has been prepared by ORC is now available to inform a review of planning considerations for South Dunedin.

7. Recommendation

That this report is noted.

Gavin Palmer

Director Engineering, Hazards and Science

8. References

Barrell, D.J.A.; Smith Lyttle, B. 2015. Identification of areas possibly susceptible to landsliding in the coastal sector of the Dunedin City district, GNS Science Consultancy Report 2015/34. 38 p.

Barrell, D.J.A. 2015. Extent and characteristics of alluvial fans in the northeastern sector of the Taieri Plain, Otago, GNS Science Consultancy Report 2014/45. 23 p.

Barrell, D.J.A.; Smith Lyttle, B.; Glassey, P.J. (in preparation). Revised landslide database for the coastal sector of the Dunedin City district, GNS Science Consultancy Report 2016.

Barrell, D. J. A.; Glassey, P. J.; Cox, S.C.; Smith Lyttle, B. 2014. Assessment of liquefaction hazards in the Dunedin City district, GNS Science Consultancy Report 2014/068. 66 p.

Glassey, P.J.; Smith Lyttle, B. 2012. Attributing and reconciling source of landslide data within the Dunedin City Council area. GNS Science Consultancy Report 2012/279. 17 p. plus appendices

Glassey, P. J.; Barrell, D. J. A.; Smith Lyttle, B. 2014. The hazard significance of landslides in and around Dunedin City, GNS Science Consultancy Report 2013/339. 32 p.

NIWA, 2008. Client Report CHC 2008-047. Otago Regional Council Storm Surge Modelling Study. 156 p.

Otago Regional Council. 2014. Review of Dunedin City District Plan: Natural hazards - Project overview. 32 p.

Otago Regional Council, 2014. Coastal Hazards of the Dunedin City District. 122 p.

Otago Regional Council, 2014. Flood hazard of Dunedin’s urban streams. 44 p.

Otago Regional Council, 2014. Flood hazard on the Taieri Plain and Strath Taieri. 51 p.

Otago Regional Council. 2015. Active landslides in the Dunedin area. 45 p.

Otago Regional Council, 2015. Flood hazard on the Taieri Plain and Strath Taieri. 87 p.

Otago Regional Council

REPORT

Document Id: A954060

Report Number: 2016/1145
Prepared For: Technical Committee
Prepared By: Deborah Mills, Environmental Scientist
Date: 25 January 2017

Subject: **Air Emissions Inventory for select Otago towns**

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1. Précis

Air emissions inventories are a fundamental component of ambient air quality analyses. In 2016, an emissions inventory and report were commissioned for four Otago towns: Alexandra, Arrowtown, Milton and Mosgiel. Results of the inventory detail the sources and magnitude of emissions in these towns; additionally, current emissions are compared to previous emission estimates in order to quantify any changes. Data from the report will be used to assist with informing policy decisions related to the air quality strategy and Air Plan review.

These towns were chosen for their particular settings in terms of their: air quality records, geography, and socio-economics. Alexandra is the primary site for compliance reporting to the Ministry for the Environment (MfE) and has one of the longest records of continuous air quality monitoring in the region; results show that Alexandra has some of the worst winter air quality in the country. Arrowtown also exhibits very poor winter air quality, has a long period of record and has strong community interest in air quality issues. Both of these towns participated heavily in Council's Clean Heat Clean Air incentive programme. Milton was chosen due to its extremely poor winter air quality coupled with its coastal location. Along the economic spectrum, it stands in sharp contrast to Arrowtown. Mosgiel was chosen because of its recent growth and trend of degradation in air quality.

In Otago, the main pollutant is PM_{10}, particles suspended in the air that have an aerodynamic diameter of less than 10 micrometres. The inventory found that the main source of PM_{10} in urban areas is domestic heating which accounts for nearly all (99%) of PM_{10} in Alexandra, Arrowtown and Mosgiel. In Milton, domestic heating accounts for 83% of all PM_{10} emissions; industrial discharges account for most of the remainder.

Compared to estimates from the previous (2005) inventory[1], there appears to be a reduction of approximately 50% in the amount of mass emissions of PM_{10} in all study areas. Reasons for this include the reduction in coal use as a heating fuel, the replacement of older, inefficient wood burners with newer burners that meet the National Environmental Standard for Air Quality (NESAQ) design criteria as well as stricter Otago Regional Council rules, the closure of some industries, and fuel switching within the industrial and commercial sectors.

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[1] Environet Limited, *Warm Homes Technical Report: Home Heating Methods and fuels in New Zealand*, Prepared for the Ministry for the Environment, Wellington, 2005

In 2014, Council received a report discussing the context and challenge of managing air quality in Otago, titled *Air quality in Otago – Issues and Considerations*.[2] The report focused on the reliance on solid fuel burners to provide adequate levels of warmth in homes and the challenges in meeting the requirements of the NESAQ. Eight principles were offered in the report as an interim approach to air quality management (Appendix 1). Key to these principles was the acceptance of a balanced approach to solid-fuel burner use and household warmth. Exploration of new burner technologies and other ideas related to emission-reduction was recognised as an important component of achieving that balance and studies were commissioned to supply relevant information.

In 2016, Council received a report on issues related to technology, titled *Technology-based solutions for air quality management: A Discussion Document*[3] which provided a synthesis of these studies which included:

- *Investigating Meteorological Interventions for Improving Air Quality in Airshed 1 Towns* (Prepared by Bodeker Scientific)
- *Domestic home heating technologies – review of existing and emerging technologies promoting low emissions* (Prepared by Environet, Limited)

The current Emissions Inventory study will complement the previous technical work and supply robust baseline data for future work.

2. Introduction

This inventory was conducted by Environet Limited for the Otago Regional Council and serves two purposes. The primary objective was to quantify the amount of pollutants that are discharged to the atmosphere over daily, monthly and annual timeframes. The contribution of various pollution sources to the total was assessed as part of that evaluation.

A secondary function was to collect various demographic and housing data. These data can be summarised and cross-tabulated to gain a better understanding of relationships such as housing stock and warmth, among others.

Industrial and commercial activities, motor vehicle and domestic heating emissions were all evaluated for this inventory; outdoor burning activities were not included as they are extremely difficult to quantify.

A domestic home heating phone survey was conducted during June and July 2016 to ascertain the proportion of various categories of heating appliances in use during the year and to gauge the amount of fuel used in each. Sample sizes were calculated for each town to achieve a 5% sample error on the question of wood burner use.[4] Emission rates for home heating appliances were based on the latest information from Environet

[2] Otago Regional Council, Report # 2014/0983, Presented to the Technical Committee 24 July 2014
[3] Otago Regional Council, Report # 2016/0698, Presented to the Technical Committee 8 June 2016
[4] Samples sizes used in the study: Alexandra (324), Arrowtown (270), Milton (255), Mosgiel (333)

and Golder Associates[5]. Details of the inventory's methodology are given in the accompanying report, *Alexandra, Arrowtown, Mosgiel and Milton Air Emission Inventory - 2016*.

Table 1 indicates that electricity and solid-fuel burners[6] (SFBs) are the main forms of domestic heating used in the main living area. For electricity users, heat pumps are the preferred appliance.

Table 1. Home heating methods and fuels used given as a percentage of the total number of households in each town. NB: Some households report using more than one form of heat; therefore, the totals add up to more than 100% for each town.

Town	Electricity	Solid-fuel burners	Gas	Oil
Alexandra	66%	62%	12%	8%
Arrowtown	67%	66%	19%	10%
Milton	51%	73%	9%	3%
Mosgiel	83%	55%	9%	0%

On a typical winter day, use of these SFBs results in the following amounts of PM_{10} being emitted:

- Alexandra - 171 kgs
- Arrowtown - 94 kgs
- Milton - 119 kgs
- Mosgiel - 271 kgs

In a worst-case scenario where every available burner is assumed to be used every day, these total daily amounts may increase by anywhere from approximately 9% (Alexandra) to 28% (Milton).

3. Rules for domestic heating appliances

3.1. National environmental standard for air quality

The NESAQ introduced a suite of regulatory items designed to improve air quality in New Zealand. In addition to setting limits on common ambient pollutants and banning certain activities (such as burning tyres in the open), woodburner design standards were introduced[7].

From 1 September 2005, any domestic wood burner installed on properties smaller than 2 hectares are required to achieve the following design standards:

a) Discharge of less than 1.5 grams of particles for each kilogram of dry wood burnt (g/kg).
b) Thermal efficiency not less than 65%.

[5] Wilton E, Bluett J and Chilton R, *Home heating emission inventory and other sources evaluation*, Prepared for the Ministry for the Environment and Statistics New Zealand, Wellington, NZ 2015
[6] This figure includes open fires, pellet fires, multi-fuel appliances, and cookers.
[7] Regulations 23 and 24 of the NESAQ.

These national design standards apply to new wood burner installations; they do not apply to existing burners. They also do not apply to pellet burners, open fires, or multi-fuel burners. The Ministry for the Environment holds a list of approved wood burners.

3.2. Otago Air Plan rules

The Otago Regional Council Regional Plan: Air (Air Plan) gives consideration to the NESAQ but also provides for stricter regulation in areas where winter air quality is most degraded due to emissions from domestic heating.

According to the Air Plan, the following rules apply in Air Zone 1 towns (Alexandra, Arrowtown, Clyde and Cromwell):

- Any domestic heating appliance (DHA)[8] installed after 1 January 2009 must have a particle emission rate of no more than 0.7 g/kg, with thermal efficiencies of no less than 65%.[9]

- As of 1 September 2012, any DHA in use must emit no more than 1.5 g/kg and have no less than 65% thermal efficiency. This regulation includes open fires, pellet burners and multi-fuel burners. In effect, this is an operational phase-out of older, non-compliant appliances.

4. Use of solid-fuel burners and their emissions contribution

4.1. Stocktake of burners

For the purpose of the inventory, wood burners were broken down by age; the category of "Pre-2006 wood burner" identifies wood burners that are presumed to be non-compliant with the Air Plan in Alexandra and Arrowtown due to their relatively high emissions and low thermal efficiencies. Open fires and multi-fuel burners are also considered non-compliant for the same reasons.

Table 2 provides a profile of the solid-fuel wood burners in use as of 2016. As a point of reference, census figures of total number of 2006 households are listed at the bottom of the table.

[8] By definition in the Otago Air Plan, DHAs are combustion appliances with a heat generation capacity of up to 50 kW in which solid fuel is burnt for heating or cooking. They include open fires, woodburners, multifuel, pellet or coal burning heaters or cookers.

[9] Otago Air Plan, Section 16.3: There are minor variations to the rules depending on installation dates.

Table 2. Breakdown of type/age of solid-fuel burner in use; appliance figures are percentages of the total number of SFBs reported in use in each town.

	Alexandra	Arrowtown	Milton	Mosgiel
Total # of 2016 Households	2169	1049	792	3063
% SFB used	62%	66%	73%	55%
# SFB used	1344	692	578	1684
Open fire	0%	8%	1%	1%
Pre-2006 wood burner	10%	13%	18%	21%
Post-2006 wood burner	48%	41%	35%	18%
Multi-fuel burners	0.6%	3%	16%	11%
Pellet burners	3%	2%	2%	3%
Cookers	0.6%	1%	1%	1%
Total # of 2006 Households	2001	888	753	2907

Some of the key findings from these figures are that:

- Mosgiel has the lowest percentage of solid-fuel users (55%) and Milton has the highest percentage (73%).

- Arrowtown reports the highest percentage of open fires (8%), the most inefficient and polluting appliance.

- Pellet fires make up no more than 3% of households' main heating appliance. Pellet fires have the lowest emission rates of all solid-fuel heating appliances.

- In terms of non-compliant fires (open fires, pre-2006 burners, and multi-fuel burners) in Air Zone 1, there are approximately:

    - Alexandra = 230 (11%)
    - Arrowtown = 250 (24%)

In Milton and Mosgiel, as long as any wood burner installed since 1 September 2005 is MfE-approved, all ages and types of solid-fuel burners are compliant given their designation as Air Zone 2.

4.2. PM_{10} contributions from solid-fuel burners

Each category of burner has its own emission factor depending on its type and age. Contributions to total PM_{10} emissions are calculated based on the number of burners in each category, their designated emission rate, and the amount of fuel used in each as reported by the householder.

Although only 11% of burners are considered non-compliant in Alexandra, due to their relatively large contribution of emissions, they contribute approximately 35% of total daily PM_{10} emissions. Likewise, Arrowtown's approximately 24% non-compliant burners contribute to approximately 50% of total daily emissions.

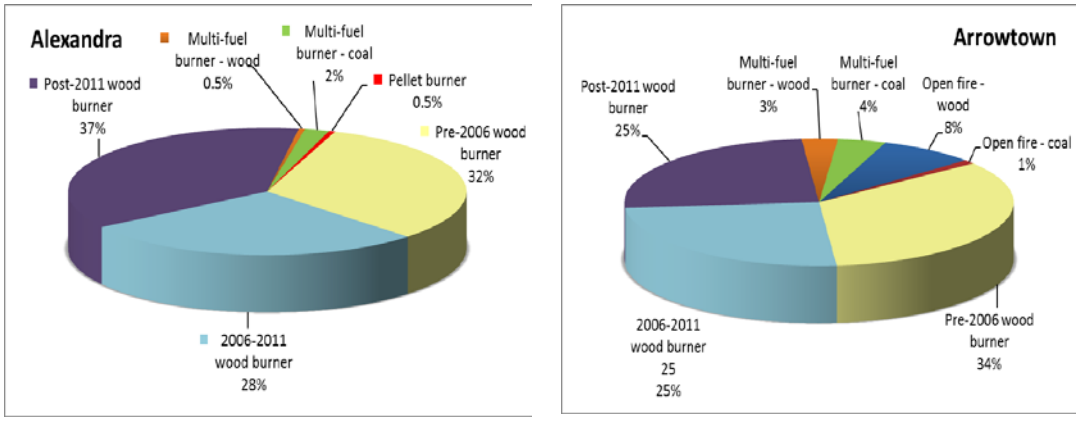

Figure 1. Relative contribution of various heating methods to the total average daily winter PM_{10} emissions in Alexanda and Arrowtown.

The original emission-reduction scenario work done for Alexandra[10] estimated that a 70% reduction in daily PM_{10} emissions was needed in order to meet the NESAQ; that equates to allowing a total of 115kgs of daily PM_{10}. Further emission-reduction analysis[11] indicated that if all SFBs in Alexandra were compliant with Air Plan rules, every burner would need to be correctly operated[12] with an appropriately dry fuel supply in order to meet those reduction targets. This relies heavily on human behaviour.

In Mosgiel, 271kg of PM_{10} is emitted on a typical day during winter; more than half of that comes from pre-2006 wood burners despite them making up only 21% of the total wood burner fleet. This is due to the older burners' relatively high emission rate of 10 g/kg. In Milton, relatively high contributions to the total PM_{10} load (18%) are made by multi-fuel burners.

[10] Environet Ltd., *Air Emission Inventory – Dunedin, Mosgiel and Alexandra 2005*, Christchurch 2006
[11] Otago Regional Council Report #2014/0983, *Air quality in Otago – Issues and Considerations*, 2014
[12] Proper lighting, firebox loading, fuel supply procedures followed.

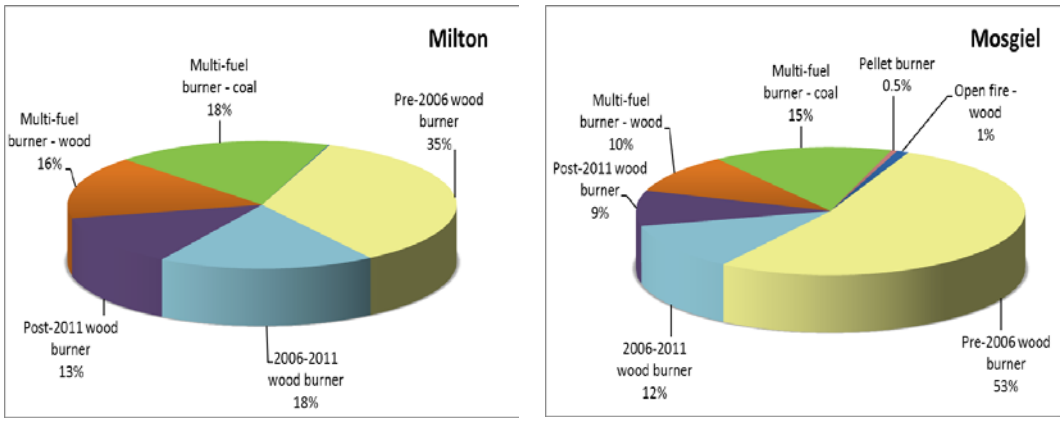

Figure 2. Relative contribution of various heating methods to average daily winter PM_{10} from domestic heating in Milton and Mosgiel.

5. Demographic information

Alongside information regarding burners, their ages and amounts of fuel burnt, several demographic questions were asked during the emissions inventory survey. These included questions concerning:

- Age of housing, age of occupant
- Insulation
- Home ownership versus rental, and length of tenancy
- Household incomes
- Indoor warmth perception
- Whether, and how, people check their wood supply for moisture content

Summary data will assist in accurately characterising towns, the housing stock, levels of insulation, perception of housing warmth, etc. For example, Table 3 indicates that, of the four towns surveyed, Milton has the highest percentage of houses over 40 years old (57%) and the lowest percentage of houses less than 10 years old (13%).

Conversely, of the four towns Arrowtown has the *highest* percentage houses that are less than 10 years old (25%) and the *lowest* percentage of those over 40 years old (16%).

Table 3. Breakdown depicting age of houses as percentage of total number of houses.

Age of house	Alexandra	Arrowtown	Milton	Mosgiel
10 years or less	18%	25%	13%	17%
11-20 years	12%	27%	8%	15%
21-40 years	34%	31%	22%	23%
>40 years	35%	16%	57%	45%
Total	100%	100%	100%	100%

Cross-tabulating the data, various relationships can be evaluated by town, by age of house, or any other variable of interest. Householders were asked to rank their home's level of warmth during winter. The available categories were: "warm", "adequate", or "too cold". Patterns and trends are apparent despite these being subjective labels.

Warmth and age of house do appear to be inversely related. As an example, Figure 3 shows that in Arrowtown, householders whose houses are older than 40 years had the fewest "warm" responses and the most "too cold" responses. Conversely, houses that are newer than 10 years old are most frequently rated as "warm" and had the fewest ratings of "too cold". This relationship holds up across the four towns.

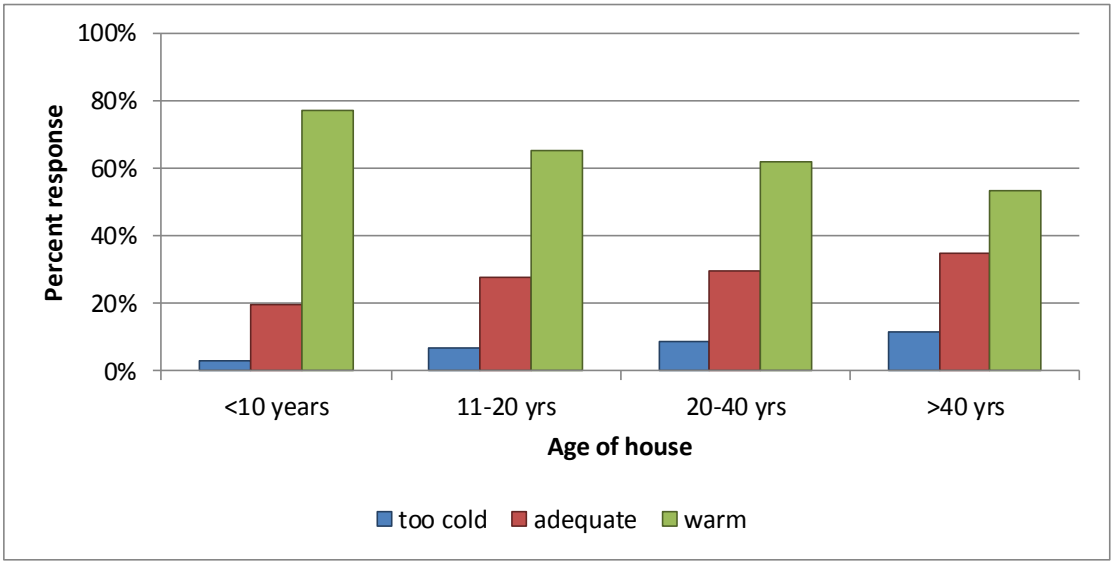

Figure 3. Percentage of responses rating the level of warmth in Arrowtown houses.

Work is underway delineating questions pertinent to the air strategy development. Analysis of the types of relationships identified above will assist with answering policy and strategy implementation questions.

Part of that work includes reviewing and revising emission-reduction requirements and scenarios in light of this new information and with consideration to any revisions by the Ministry for the Environment to the NESAQ.

6. Recommendations

That this report be noted.

Gavin Palmer
Director of Engineering, Hazards and Science

Otago Regional Council

Appendix 1. Guiding principles as an approach to future air quality management.

1. Re-affirming our commitment to work with the community to improve air quality.
- ORC should continue to identify appropriate avenues for improving air quality and advocate to relevant stakeholders for collaboration and action. This may result in a national 'call to action' in order to address significant external issues.

2. Collaborating with other authorities to develop/deliver a common message
- In order to get public buy-in on any future initiatives, a clear and effective message on air quality is required; this work should be developed in collaboration with health officials, territorial authorities, and other key stakeholders.

3. Retaining the commitment to SFB in existing houses, <u>for the time being</u>
- Until a truly affordable, sustainable, and acceptable alternative to the SFB is found we must ensure that households can maintain their current level of heating.

4. Considering higher levels of enforcement/education to ensure that current rules are followed
- A programme of enforcement would be required to ensure the maximum benefit from the current rules. This could take the form of identifying non-compliant burners that are still in use and also of curtailing gross emissions.

5. Promoting best practice burning using tested education/behaviour change programmes
- If, in fact, SFBs are to be retained in the medium-term, one emerging national initiative is 'social marketing', a programme of behaviour/culture change. This is a relatively new area of work in New Zealand is being spearheaded by Environment Canterbury and we support their efforts.

6. Actively investigating the use of new technologies/techniques for future development
- We need to remain aware of advancements overseas, advocate for nationally-based research as needed, and participate in trials where relevant to our region.

7. Consider requiring the use of low- to no-emission heating in new houses
- New, better-built houses may well meet WHO indoor temperature guidelines with properly sized low- or no-emission heating.

8. Consideration be given to other PM_{10} issues
- Banning the use of coal in urban areas to lower PM_{10} and harmful emissions
- Regulating outdoor burning around polluted airsheds

Otago Regional Council

REPORT

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Report Number: 2017/0568
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Date: 2 February 2017

Subject: **Director's Report on Progress**

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1. Lake snow

The Trophic Lake Sampling program is continuing with five successful monthly rounds of sampling completed on lakes Wanaka, Hawea, Wakatipu and Hayes from September 2016. The next sampling run is scheduled for the latter half of February 2017.

The genetics work being undertaken for ORC by Dr Phil Novis (Landcare Research) to determine whether *Lindavia intermedia*, the lakes snow producing diatom is non-native is progressing according to plan. Stage 1 of the project, involving method development for chloroplast genome sequencing, was completed on time. The next stage of the project involves the collection of samples of *L. intermedia* from the United States and Europe (France) for genetic comparisons to the New Zealand population. As previously advised to Committee, the project is scheduled to be completed by the end of June, 2017.

The experts' workshop on lake snow was held on 20 December, facilitated by Dr Greg Ryder (Ryder Consulting Ltd). The participants represented Landcare Research, Cawthron Institute, NIWA, University of Waikato, University of Otago (Catchments Otago), Ministry of Primary Industries, Queenstown-Lakes District Council, Environment Canterbury and Environment Southland. Participants discussed the further, applied research that will be needed to identify potentially feasible methods of managing the effects of lake snow. The workshop proceedings are being prepared and will be reported to Committee in March, along with recommendations, a programme and cost estimates for the further work that ORC should commission or undertake. In the meantime Dr Ryder will provide an update to a councillor workshop on 9 February.

One of the priority activities identified by participants was the field trialling of equipment to test whether the distribution of lake snow within lakes Wanaka and Wakatipu can be measured. The timing of the trial is governed by the period in which the diatoms and lake snow are most abundant, being February to April. Arrangements have been made with Professor David Hamilton of the University of Waikato to trial an advanced water quality testing instrument known as a BioFish (Figure 1).

The BioFish is a towed instrument designed to collect real-time, high frequency water quality data using a suite of fast-response sensors. The BioFish is towed behind a boat and travels up and down in the water column collecting data on water depth, temperature, conductivity, dissolved oxygen, chlorophyll fluorescence, light transmittance and photosynthetic active radiation. The trial aims to see if the BioFish can be used to measure the presence of lake snow. The data collected by the BioFish will also provide extremely valuable information on lake water quality and stratification dynamics across a wide area of the lakes.

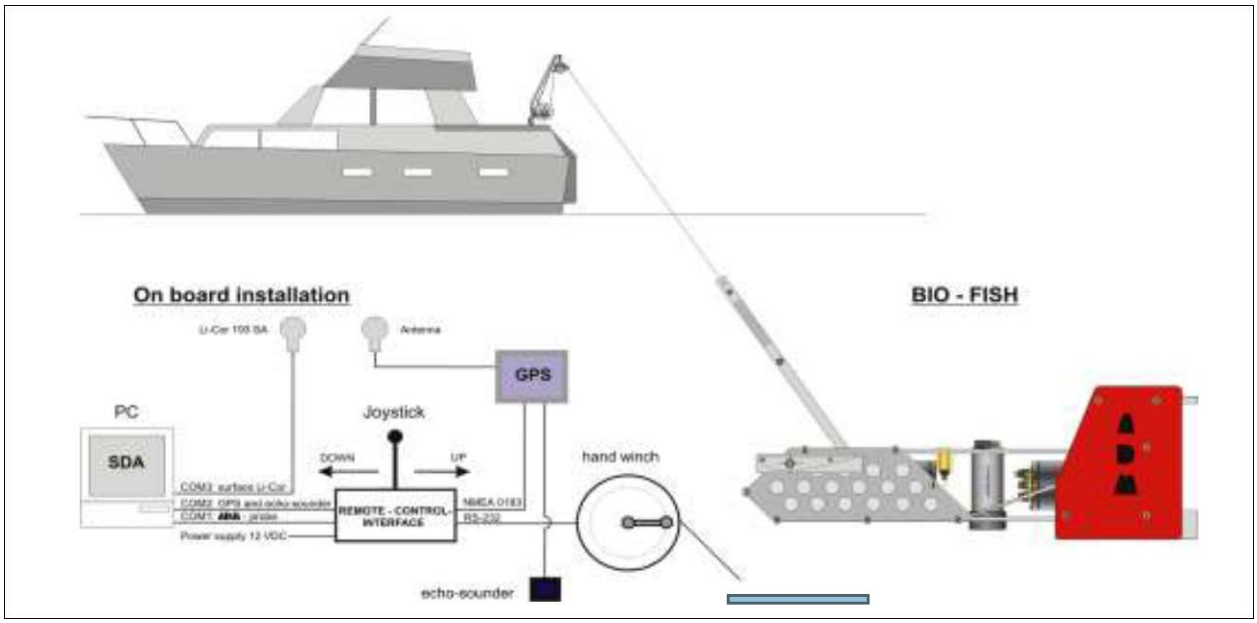

Figure 1: Boat, on-board and underwater setup of the BioFish. (Photo courtesy of the University of Waikato)
(http://researchcommons.waikato.ac.nz/bitstream/handle/10289/3792/CBER_68.pdf?sequence=1&isAllowed=y)

2. Regional Climate and Weather

Heavy rainfall on 21 and 22 January caused high flows in most Otago rivers and streams. Staff monitored and operated Scheme pumping stations, developed forecasts of expected flows and levels for rivers and lakes across the region and groundwater levels for South Dunedin and issued flood advisories as required. All flood and drainage schemes functioned as intended. The level of Lake Wakatipu remains high and is being closely monitored.

Figure 2: Paretai pump station and floodbank (left) and Kaitangata locks (right) on 23 January 2017. The station, locks and floodbank are part of the Lower Clutha Flood Protection and Drainage Scheme

Rainfall across most of the region during Summer has been above-normal (Figure 3). The lowest river flows observed in January were below normal for this time of the year at most monitoring sites in the Taieri, North Otago and Central Otago catchments, with flows dropping below the mean annual low flow (MALF) at several sites on the Taieri and in the Manuherikia River at Ophir. However, the recent rainfall has raised flows in these catchments to well above minimum flows.

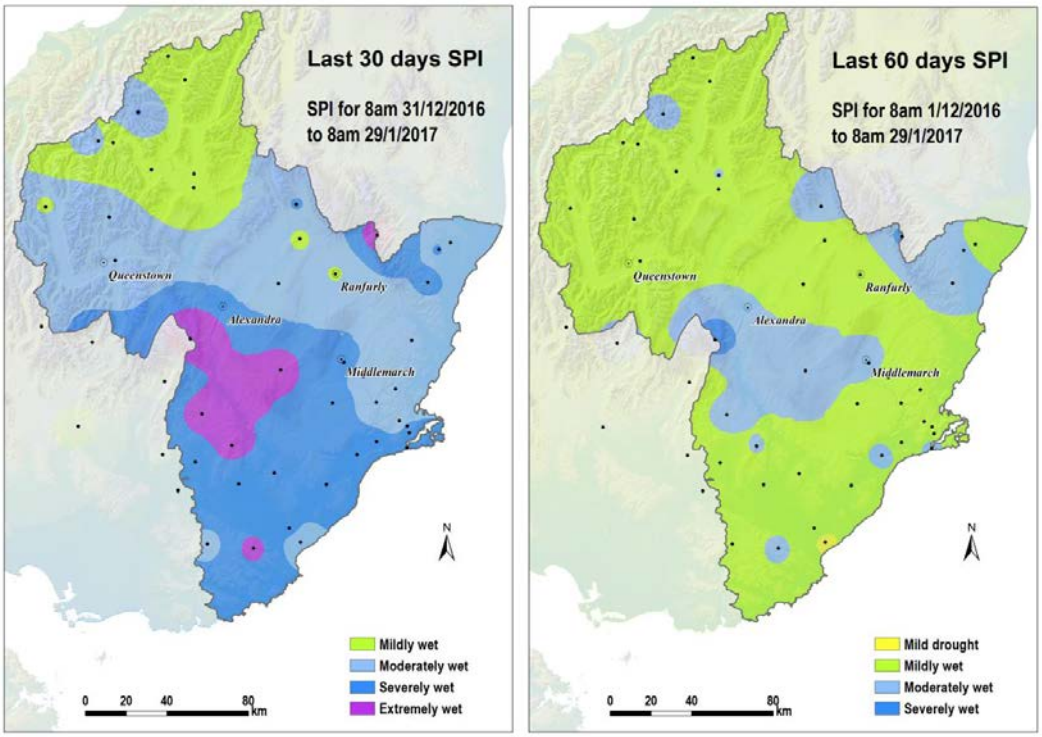

Figure 3: Maps of the Standardised Precipitation Index (SPI)[1] for Otago for the last 30 days and the last 60 days.

[1] For details of the SPI refer to "Standardized Precipitation Index User Guide", WMO-1090, World Meteorological Organization, 2012.

The NIWA climate outlook for January-March 2017 predicts that rainfall totals in eastern Otago are most likely to be near normal, while soil moisture and river flows are about equally likely to be below to near- normal. They also predict that rainfall totals, soil moisture and river flows in Inland Otago (alps and foothills) are likely to be in the normal range.

4. Leith Flood Protection Scheme

Negotiations are continuing with the preferred contractor for construction of the Union to Leith Street footbridge stage of the Leith Flood Protection Scheme. The proposed works include channel widening, bed regarding and armouring and construction and raising of concrete walls. The University of Otago have agreed to the arrangements for access to enable the construction works to proceed and are working with ORC to prepare and implement a communications plan for the period of the works.

5. Geomorphic Change Detection

The ORC is a supporting partner in a successfully funded proposal to develop GeoTERM – a geospatial toolkit for enhancing river management. The project is being led by Professor James Brasington from Queen Mary, University of London, and includes collaborators from institutes in the UK and the USA, and NIWA, and is primarily funded by the UK's Natural Environment Research Council. ORC is one of three regional councils participating in the project, along with ECAN and Hawkes Bay Regional Council. The project involves developing software to quantify geomorphic change and sediment flux ("geomorphic change detection") in gravel bedded rivers and streams with multi-temporal elevation data (such as LiDAR).

Otago's Shotover River (or possibly Dart River) will be used to trial the technique, along with other gravel bedded rivers in Canterbury, Hawkes Bay, and Scotland. The method has the potential to improve the way river morphology is managed, with practical implications for the management of gravel resources, erosion and flood hazard, and river habitat.

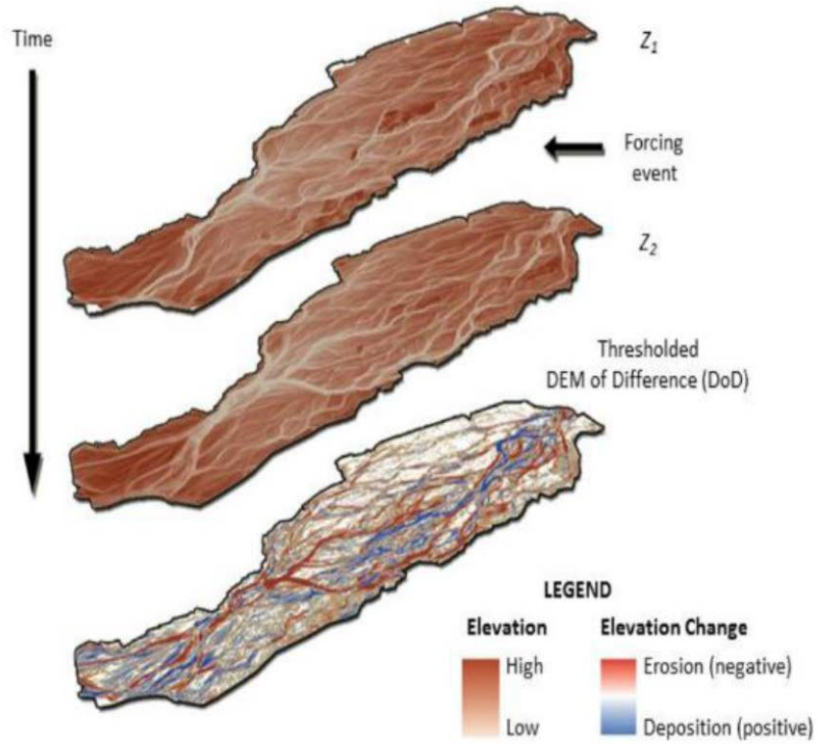

Figure 4 An example of differencing elevation models to assess river change (Rees River, Otago)

6. Recommendation

That this report is noted.

Gavin Palmer
Director Engineering, Hazards and Science