IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	applications by Central Plains Water Trust to: Canterbury Regional Council for resource consents to take and use water from the Waimakariri and Rakaia Rivers and for all associated consents required for the construction and operation of the Central Plains Water Enhancement Scheme Selwyn District Council for resource consents to construct and operate the Central Plains Water Enhancement Scheme
AND	
IN THE MATTER OF	a notice of requirement by Central Plains Water Limited to: Selwyn District Council for the designation of land for works associated with the construction and operation of the Central Plains Water Enhancement Scheme

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BRIEF OF EVIDENCE OF ANDREW FERGUSON CURTIS
RESPONSE TO COMMISSIONERS REQUEST
APRIL 2008

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Qualifications and experience

1. My full name is Andrew Ferguson Curtis. I have a degree in Chemical Engineering (BE Chemical and Materials) from the University of Auckland, New Zealand, and a Postgraduate Diploma in Toxicology from RMIT University, Australia. I am a Principal with the firm of URS New Zealand Limited (URS) specialising in air pollution. I have over 20 years engineering experience and have specialised in air quality assessment for the last 11 years.

2. My experience in dealing with the effects of air discharges from processes that have the potential to generate particulate nuisance includes:

   (a) Carrying out the assessment of dust associated with the proposed Wairau Valley Hydro Electric scheme and presenting evidence on that matter to the Council Hearing.

   (b) Carrying out the assessment of air quality effects associated with Project Aqua.

   (c) Carrying out the assessment of air quality effects associated with the proposed Arnold River Hydro Electric Power Scheme.

   (d) Carrying out an assessment and presenting evidence to the Environment Court on the potential for dust emissions associated with Lake Mahinerangi, as part of the reconsenting of the Waipori Hydro Electric Power Scheme.

   (e) Carrying out an assessment and presenting evidence to the Environment Court on the potential for dust emissions associated with Lake Hawea, as part of the reconsenting of the Clutha Hydro Electric Power Scheme.

   (f) Carrying out an assessment of the effects associated with the establishment of cleanfills for overburden disposal adjacent to the both the Belmont and Hunua Quarries.

3. I have read the code of conduct for expert witnesses set out in Environment Court practice note, and confirm that I have complied with the code in the preparation of my evidence.

Scope of Evidence

4. I have been asked to present evidence as a result of the Commissioners requesting further information on how practicable dust control was during project construction in the Canterbury environment.

5. In my evidence I will discuss: the potential causes of dust, the potential for effects, the types of mitigation measures that can be utilised to control dust, and where and when mitigation measures should be implemented, as well as the practicality of the measures.

6. In making this assessment I have primarily relied on the reports prepared by URS New Zealand Limited (URS) to determine the extent and types of works that will be carried out, as well as meteorological data from the National Climate database, and a site visit which I undertook in early April 2008.

Potential Effects Associated with Dust

7. Before discussing the potential effects associated with dust, it is important to define exactly what I mean when I use the term dust. Broadly speaking the term dust refers to the particulate size fraction that is greater than about 50 microns in size, which because of its size rapidly deposits onto surfaces.

8. The term dust does not apply to the finer particulate size factions, for example PM_{10} (which is particulate matter less than 10 microns in size) which are associated with respiratory health effects.

9. The primary effect that is associated with dust is nuisance soiling. That is the material settles out of the air onto surfaces and makes them “dirty” or feel gritty. In some instances there is the potential that there can be effects on vegetation, particularly on horticultural crops at certain times of the year; and in locations that are continually affected by high concentrations of dust for example immediately adjacent to an unsealed road. The primary effect is potentially lower growth rates due to reduced photosynthesis.

10. It is important to emphasis that this dust will not result in health effects. This is for a number of reasons, the first of which is that the dust is primarily soil and consequently is essentially inert and will not result in health effects.

11. In addition there is little potential for dust to be inhaled as the human body is very effective at filtering out larger particulate and preventing it from entering the respiratory system. As can be seen in Figure 1, and Table 1, the human body is effective at removing large dust, with little particulate greater than 10

microns being able to enter the body, and that which does, depositing in the upper portions of the respiratory system.

Table 1 Dust Removal Efficiency of the Human Respiratory System

Particle Size (microns)	% Removal Efficiency
>10	nearly 100
5	50
2	20
<1	Negligible

12. Consequently, even if dust were inhaled it would be removed from the body and not reach the lungs.

13. Finally, there is a common misconception that all dust is the same, and therefore when people who have asthma hear the term they get concerned. There is no doubt that household dust is a trigger for asthma in some people, this is because the majority of household dust is organic detritus, including dust mite droppings, and not non-organically derived material such as dirt and clay. Consequently as asthma is primarily[1] an allergic reaction there is little potential for the inert dust associated with large earth moving projects to result in health effects.

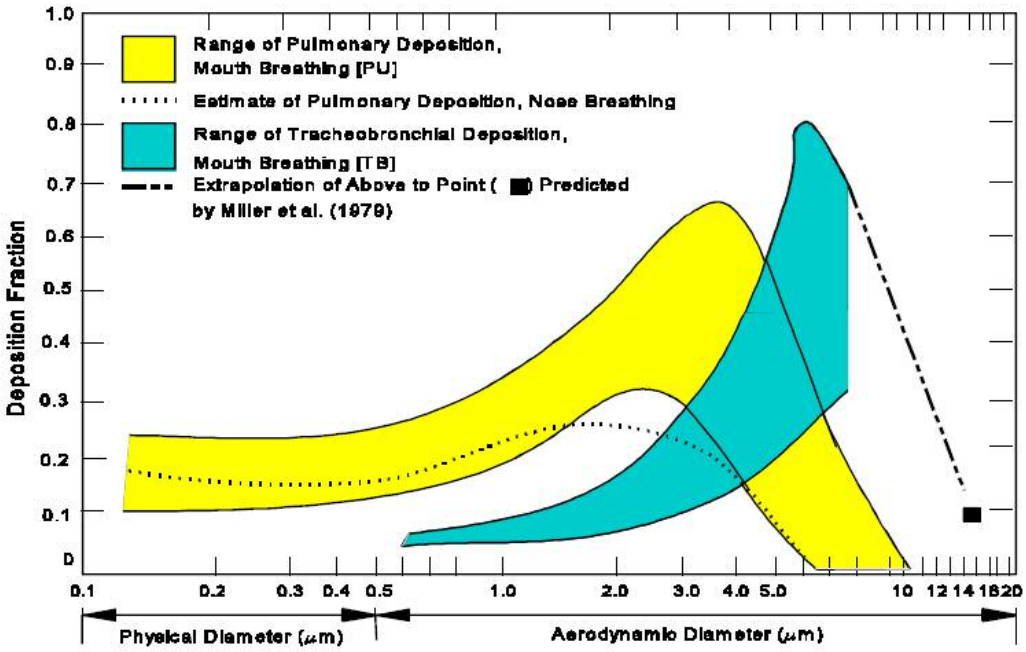

Figure 1 Deposition of particles for mouth and nose breathing

[1] I note that there is a proportion of the population whose asthma can be triggered psychosomatically. That is it can be triggered by anxiety or a perception that they may be affected by some source or activity. Thus any environmental stressor can potentially trigger an attack.

Potential for Dust Generation

14. There is the potential for dust to be generated from most construction related activities involving earthmoving. With respect to the proposed Scheme I have identified the following activities as having the potential to generate particulate:

    - River works;
    - Topsoil removal and storage;
    - River intake and settling basin construction;
    - Race construction including cut and fill operations;
    - Dam construction; and
    - Construction traffic.

15. The reason for dust generation from these activities will roughly fall into one of three categories regardless of exactly what is being done. The first category is that mechanical agitation or movement of material is occurring. That is some operation, for example excavation, is moving soil. If there is silt in the soil then there is the potential for dust to be generated.

16. The second category is activities such as construction traffic that mechanically agitate a surface, resulting in the liberation of dust from the surface in some circumstances.

17. Finally there is dust generated by the wind, as it passes over an unsealed surface. For this to occur, the wind speeds at ground level need to be greater than what is called the “threshold velocity”. While the exact value of the threshold velocity is dependent on the material, it is generally in the region of 5 m/s for soil sourced particulate.

18. Therefore whether dust generation occurs will depend on what strategies are put in place to minimise or mitigate the potential emissions, as it is impractical to completely avoid emissions from these types of activities.

19. The types of mitigation measures are discussed in the following section of my evidence, but before doing so it is important to discuss the one aspect of dust generation that is outside the control of the applicant and that is the wind.

20. I have presented as Figure 2 a copy of the wind rose for Darfield for the period 2003 to 2007. This is the closest location that I have been able to identify that has data in the National Climate database, and given the location

it is likely to be representative of the wind conditions experienced throughout a significant portion of the area within which the major construction works will occur.

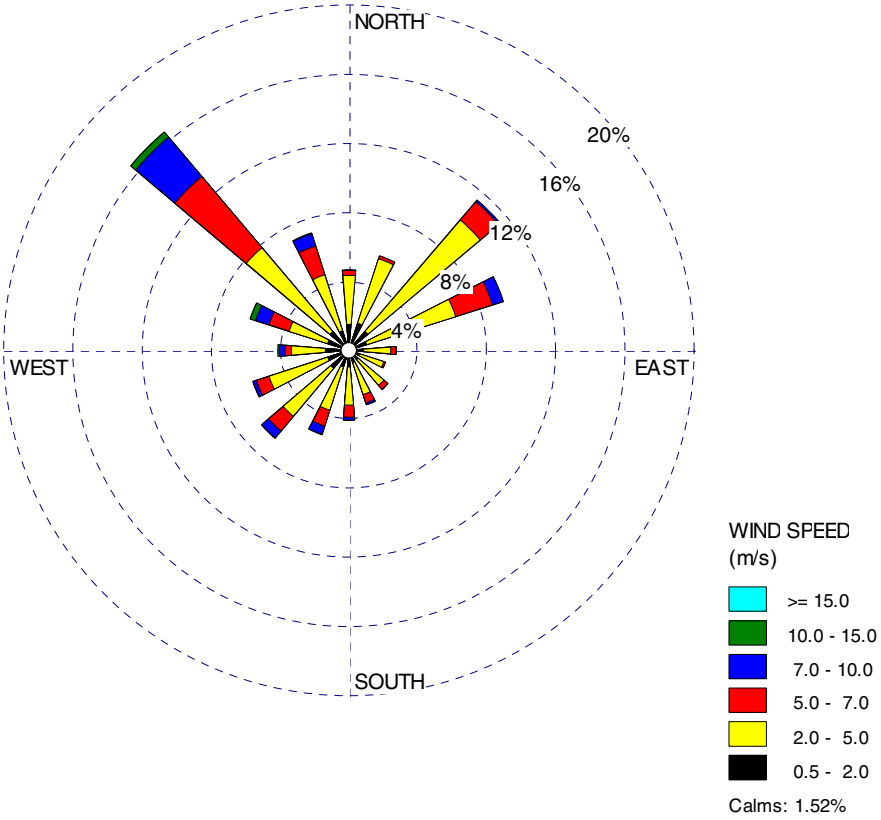

Figure 2 Darfield Windrose January 2003 – December 2007

21. As can be seen in Figure 2 the winds at Darfield are dominated by the north-westerly winds, which is not unexpected given the topography; with those from the north-east representing the next highest percentage.

22. In terms of wind generated dust from static surfaces the most important percentage is that greater than about[2] 10 m/s, which represent in total about 1.1% of all winds during the five year period, with 0.9% occurring from the west to north-west quarter. Therefore it is at locations downwind of this direction i.e. to the south-east, that wind driven dust effects are most likely to be experienced. In addition because of the dominance of this wind direction it is probable that it will be at locations to the south east of works that other dust effects are most likely to be experienced.

[2] Due to the effects of friction wind speeds reduce the closer you get to the ground. Consequently a wind speed of 5 m/s at ground level is equivalent to 10 m/s at the standard anemometer height of 10 m.

23. Having said that I would note from my site visit on 4 April 2008 that the wind conditions that are experienced at Coalgate appear to be quite different to those experienced close to either of the rivers. For example there were strong north-westerly winds noticeable in the area near both the Rakaia and Waimakariri intakes (measured at Darfield to be between 6 and 9 m/s during the period of the site visit), but the conditions at Coalgate were essentially calm.

24. Consequently it appears that the hills behind Coalgate are sheltering the township when winds are from that direction. This has also been confirmed by anecdotal comments made to Mr Lewthwaite by farmers in the area.

25. Notwithstanding this, I have undertaken my assessment as if all areas were equally affected by the strong winds that are measured at Darfield.

26. As works get closer to State Highway 1 the wind conditions will change and I have included as Figure 3 a copy of the wind rose for Lincoln for 2003 to 2006 (also from the National Climate database) the closest location that has appropriate data.

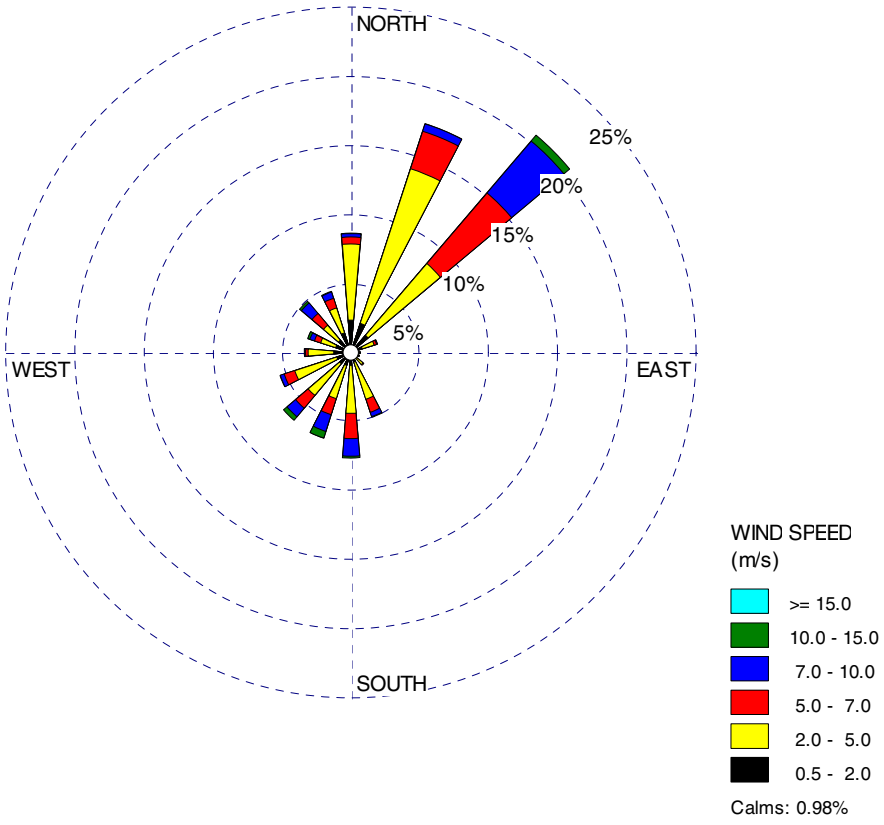

Figure 3 Lincoln Windrose 2003 - 2006

27. As can be seen in Figure 3, nearer the coast the influences of the north-westerly winds reduce and it is likely to be in the area to the south-west of works that any effects will be experienced.

28. Consequently it is my view that one of the key parameters that needs to be monitored throughout the project is wind speed and direction.

DISTANCES WITHIN WHICH DUST EFFECTS CAN OCCUR

29. It is generally accepted that dust effects are confined to a relatively limited distance, with the greatest potential for effects, within 100 m of the source. Effects will lessen with distance such that by about 300 m it is unusual to experience any effects.

30. The reason for this is simple physics, gravity acts on the particles so that they fall to the ground. Thus the potential distance within which effects may be experienced will be a combination of release height and wind speed. Figure 4 presents this relationship for a number of particle sizes and wind speeds.

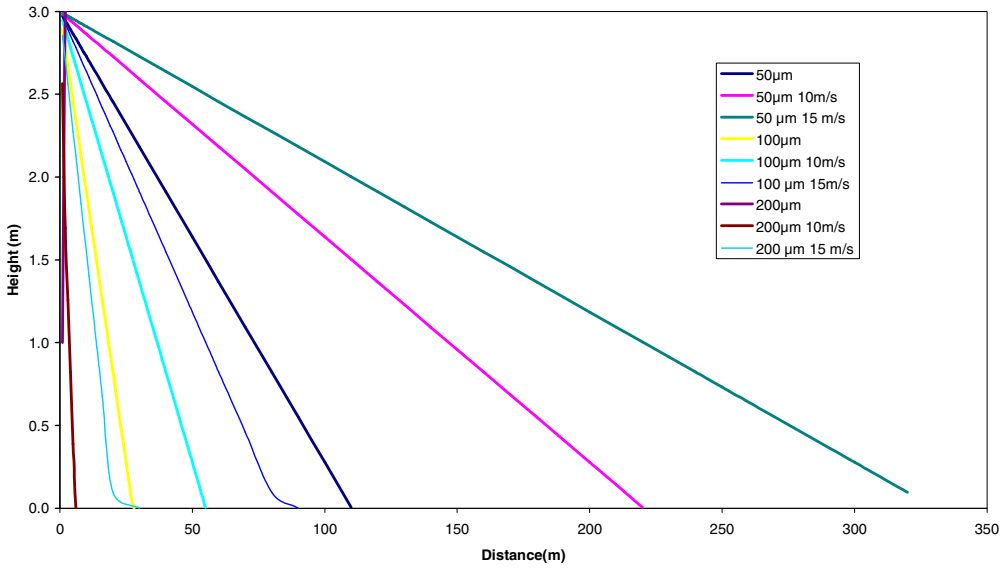

Figure 4 Examples of Distances within which Dust Effects could occur

31. As can be seen in Figure 4 the heavier particles will generally not travel more than 100 m even in very strong wind conditions, but as particle size decreases the distance that particles can travel will increase out to approximately 300 m. As I have already indicated, it is unlikely that particles smaller than 50 µm will result in nuisance, although they can potentially generate a visible dust plume if they are present in sufficient quantities.

EXISTING DUST SOURCES

32. Finally before moving on to discuss mitigation measures, I consider that it is important to put the potential for dust effects in context. The area that is encompassed by the scheme is a rural area and therefore there is the potential for dust generation to occur from a range of normal agricultural activities. In addition, the braided nature of both the Waimakariri and Rakiaia Rivers mean that these also can be dust sources.

33. The levels of dust that can occur from these existing activities can be significant, and equal to the levels of dust that might occur from construction activities, if they were not mitigated. To illustrate this potential, I have a series of photos that I took on my site visit on 4 April 2008.

34. Figure 5 shows dust being generated by vehicles moving in an area adjacent to State Highway 73 near Kirwee, which had been cleared of vegetation. While the dust was relatively isolated in this case, this activity could equally occur adjacent to a residential property.

Figure 5 Dust Generation adjacent to State Highway 73

35. There was also a significant stretch of State Highway 73 being rebuilt, and dust was being generated as vehicles moved through that section of road (see Figure 6). The dust can be seen moving into the adjacent paddock to the left of the vehicle in the photo. This level of dust is similar to that which might occur during race construction.

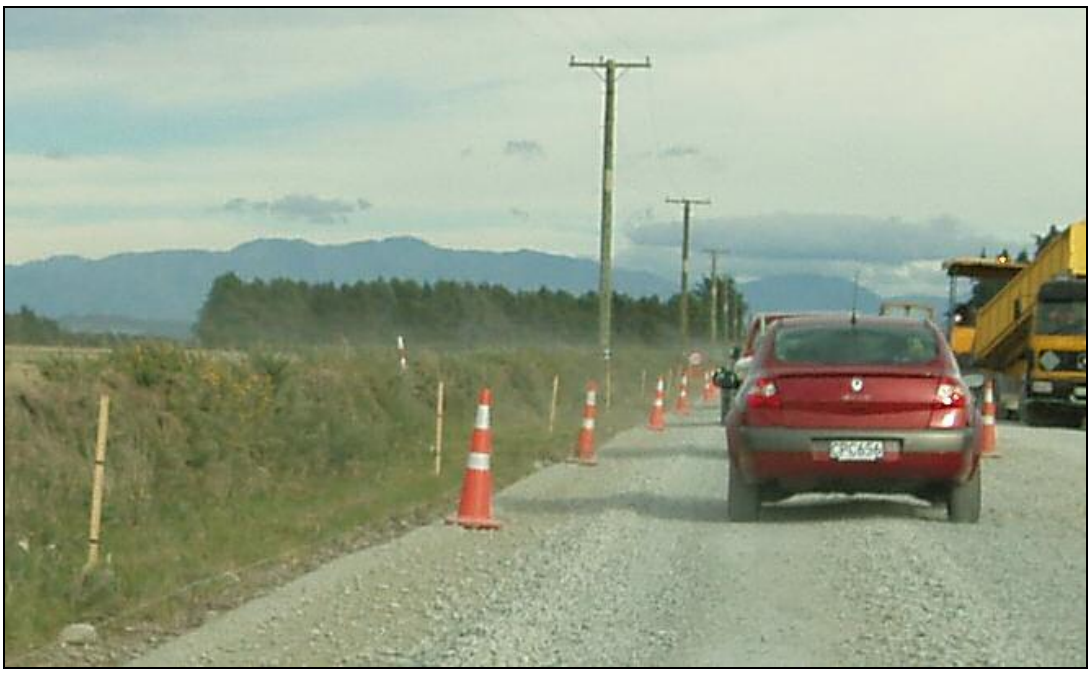

Figure 6 Dust from Roadworks on State Highway 73

36. Figure 7 shows a farmer resowing pasture after preparing a paddock. While this was not particularly dusty in this instance, the field preparation would have had a high potential to generate dust, and could occur in paddocks adjacent to residences.

Figure 7 Dust from Pasture Renewal

37. There are also significant lengths of unsealed road in the area which will generate dust, and potentially affect residences that are located close to them.

38. Finally there is the potential for dust to be generated from the exposed gravels associated with the two main rivers. Figure 8 shows dust being generated in the Rakaia riverbed in the order of 7 km downstream of the Rakaia Gorge Bridge. Figures 9 and 10 show dust being generated in the Waimakariri riverbed, with Figure 9 looking up stream from the Waimakariri Gorge Bridge and Figure 10 looking downstream from that same location.

39. What is interesting about the dust generation shown in Figure 10, is that I drove through that same dust cloud on Old West Coast Road, as shown in Figure 11. The levels of dust that are occurring in this case are significantly greater than I would expect are likely to occur from the proposed works due to the use of dust mitigation techniques.

Figure 8 Dust from exposed gravels on the Rakaia

Figure 9 Dust from exposed gravels on the Waimakariri

Figure 10 Dust from exposed gravels on the Waimakariri

Figure 11 Dust from the Waimakariri on Old West Coast Road

MITIGATION MEASURES

40. An important aspect of the question raised by the Commissioners, was not whether appropriate mitigation measures could be implemented, but whether measures could be implemented in this case, which could deal with local conditions.

41. The simple answer to this question is yes, I consider that appropriate mitigation measures can be implemented. I also consider that all of the measures that I outline in the following sections of evidence are practical, and have been implemented or proposed to be implemented at other locations in New Zealand. However what those measures will be will depend on the location, the types of activities that are occurring, the likely duration of those works and the preferred methods of operation of the contractors.

42. Therefore in the following sections I will discuss what I see as the main works and the mitigation measures that I consider could be implemented and are most appropriate.

43. Before doing so I note that I see these measures as being a "tool basket" of control measures, with the actual measures that are implemented at one location being determined by a range of factors including the proximity of potentially affected parties and the scale of the works. In addition it is likely

that the mitigation measures that are used close to residential properties will be arrived at in consultation between landowners and the company. I also note that I have not carried out assessments of all the properties that could potentially be affected, and therefore I have made no recommendations on suitable mitigation measures for specific properties.

44. Finally Mr Lewthwaite indicated in paragraphs 262 to 270 of his evidence in chief, the intention to have an overall construction management plans (CMPs) developed for the various sections of the project. Included in each of these CMPs will be a specific plan that deals with dust control. This is reflected in the conditions proposed by Mr Tipler, in particular, for CRC061765, which requires the applicant to submit a dust management plan to the Regional Council prior to commencing works. The plan is directed to meeting the conditions of this consent which include minimising the effects of dust beyond the boundary of the construction site, and taking all practicable measures to limit the duration and frequency that dust associated with construction, operation and maintenance activities is discharged to air..

45. I consider that this is an appropriate way to address dust control issues, as it will not be until detailed construction methodology and timing is available, that the extent and nature of any dust control or mitigation will be able to be determined with any specificity. As I have discussed, there are a number of practicable methods for controlling or mitigating dust nuisance, and as long as the plans have appropriate objectives then measures such as those I have discussed can be adopted, as appropriate, to manage dust discharges and their effects.

INTAKE CONSTRUCTION

46. Generally all three intakes are located a reasonable distance from potentially affected residences, and therefore there are unlikely to be any significant issues associated with construction dust.

47. However, given the topography and measured wind data, there is the potential for residences located in the area below the Upper Waimakariri intake to be affected by dust in what I classify as strong wind conditions (greater than 10 m/s). Because of the distances involved (more than 600 m to the closest residence) it would require wind speeds greater than 15 m/s to carry dust to these properties.

48. Therefore I consider that it is appropriate that during work in this area wind speed is monitored, probably by a portable anemometer. If the wind speed

exceeds a trigger value (the value of which will depend on the height of the anemometer) the contractor will be required to implement measures to minimise dust.

49. The following are a list of the types of measures that could be implemented during high wind speed conditions:

- Reducing vehicle speeds to less than 15 kph
- Operating water trucks to wet potential dust discharging surfaces
- Minimising earth moving activities, particularly those that place fill, or excavated material into stockpiles
- Restricting construction activities to areas that are either downwind from residences, or an adequate distance upwind.
- Ceasing work during extended periods of high winds in dry conditions

50. In addition there are a number of standard construction measures that I would expect to be implemented where necessary regardless of any wind speed triggers. These measures are as follows:

- Minimising as far as practicable the level of ground disturbance
- Revegetating or mulching disturbed surfaces as soon as practicable following completion of works
- Keeping vehicles speeds to less than 20 kph on unconsolidated surfaces
- Using water trucks to dampen haul roads or other areas that have the potential to generate dust

51. I do not consider that it is necessary to monitor ambient levels of dust in these areas due to the distances to residences, but it will be necessary for the contractor to have a person responsible for ensuring that mitigation measures are implemented in the event that the wind trigger is reached.

HEADRACE CONSTRUCTION

52. Like the Intakes, much of the Headrace will be located well away (more than 500 m) from potentially affected residences and consequently dust nuisance is unlikely to occur. However, the Headrace will pass close to a number of residences, and potential effects on these residences will need to be assessed.

53. The potential effects on these residences will depend to a large extent on the orientation of the residence to the prevailing wind and the Headrace alignment and exactly how close the residence is to the Headrace.

54. Thus in general terms I would expect a residence that was located 100 m to the south-east of the headrace to be potentially affected to a greater degree than a property located 100 m to the north-west of the headrace due to the strength and frequency of the winds from that direction.

55. The potential differences in dust effects will increase with distance such that I would expect almost no effect on properties more than 200 m to the north-west of the alignment, but some potential impacts on properties to the south-east out to about 300 m (but only in very strong wind conditions).

56. For properties less than 100 m from the headrace (which are outside the designation), the potential for effects is less dependant on wind conditions and it is necessary to ensure that mitigation measures are used all of the time.

57. The following are the types of general mitigation measures that I consider can be implemented to minimise the potential for effects on those properties that are located more than 100 m from the headrace:

    - Monitoring wind speeds to act as a trigger for further mitigation
    - Reducing vehicle speeds to 15 kph within 200 m of residences
    - Operating water trucks
    - Restricting construction activities to areas that are either downwind from residences, or an adequate distance upwind
    - Minimising earth moving activities particularly those that place fill or create stockpiles when winds speeds are greater than 10 m/s

58. These measures are additional to the use of good construction practice that I outlined in paragraph 48.

59. In addition to the above there may be the need to implement some additional mitigation measures for residences that are located less than 100 m from the headrace. The use of some of these measures would need to be negotiated with the affected people:

    - Provision of alternate clothes drying options
    - Installation of wind fences

- Periodic provision of internal or external house cleaning

60. It is also important to note that effects associated with construction will only occur, on average for a period of six months near to any one residence due to the proposed construction methodology.

BORROW AREAS

61. As indicated in the evidence of Mr Lewthwaite there may be the need to establish some borrow areas for headrace canal lining material. These are essentially quarries for dirt, and therefore can be managed using the same mitigation measures that are successfully applied to other types of quarries.

62. Therefore for example, I would expect that there would be progressive overburden removal, and if necessary the use of water trucks to control dust. I would also expect that any site would be located well away from residential properties and hence unlikely to result in nuisance in any event.

RESERVOIR CONSTRUCTION

63. There are two aspects of the reservoir construction that could give rise to dust nuisance. The first of these is obviously the construction of the dam and the second, if it occurs, is the construction of the tunnel from the Upper Waimakariri intake.

64. The tunnel intake will potentially generate spoil which may or may not be utilised in the dam. If it is used there will need to be a temporary stockpile for the material near the tunnel exit. Regardless of whether it is used or not the spoil will need to be placed in a stockpile, and that will need to be located to minimise the potential for off-site effects.

65. The location of the inlet is quite remote and consequently I do not consider that there will be any effects on residential properties. I note that prior to beginning this work the company will have purchased all of the required land to form the reservoir, and therefore it is unlikely that there would be people living close to the tunnel in any event.

66. However, if necessary, mitigation such as dampening material using water could be used to minimise dust.

67. The main activity that will have the potential to generate dust will be the construction of the dam.

68. There are a number of properties in Coalgate that could potentially be affected by dust from the construction process, as approximately nine of

them will be within 200 m of the toe of the dam and a significant proportion of the township within 500 m. In addition, construction will occur continuously at this location for longer than at any other site.

69. Therefore I consider that additional measures over and above those I have discussed previously are necessary to ensure that effects are minimised as far as practical.

70. The primary additional measure I consider necessary is the installation of a dust monitor that measures the concentrations of Total Suspended Particulate (TSP). This monitor could be located in the vicinity of Homebush Road. If the concentrations of TSP are maintained at levels which are less than the Ministry for the Environment trigger for Moderately sensitive areas (100 $\mu g/m^3$ as a 24 hour average), then it is an indication that the mitigation used during dam construction is effective.

71. If a continuous TSP monitor was installed, it could be fitted with monitoring software that alerted construction staff if concentrations began to increase, and allow additional mitigation measures to be implemented.

72. The second measure that I consider could reduce the potential for dust is staged construction, which would see the outer bund face of the dam being constructed first, which would then "shield" Coalgate from dust generated by works on the inner face. I have discussed this possibility with Mr Lewthwaite, and it appears that it is practicable, to a degree. However to maintain the integrity of the dam, it would not be possible to construct the entire outer (i.e. downstream) face in one go, and construction would have to proceed in an stepwise fashion with a section of the outer face being constructed, and then the inner sections being brought up to the same level.

73. Construction in this fashion would also allow the outer face to be vegetated slightly more quickly than might otherwise be the case and hence reduce wind erosion effects

74. Another mitigation measure could be to work on a part of the dam that is remote from houses during unfavourable meteorological conditions that are likely to give rise to a risk of dust nuisance. This will be a practicable measure at times, given the length of dam crest will be up to 2 km.

75. In the event that the constructor is not able to ensure that dust concentrations remain less than the MfE trigger value, it may be necessary to implement

mitigation measures for the closest of the residences (those within 200 m of the toe of the dam) such as:

(a) Provision of alternate clothes drying options.

(b) Installation of wind fences

(c) Provision of internal or external house cleaning

(d) Provision of a filtered air supply, particularly during summer.

76. I consider that the other residences are unlikely to experience any significant nuisance if dust concentrations are maintained at levels less than the MfE trigger value.

77. However I consider that it is prudent to also use wind based triggers in this area, and consequently I recommend that an anemometer is installed in Coalgate at an appropriate location to be used, in conjunction with the dust monitor, to trigger mitigation measures such as those set out in paragraph 48.

DISTRIBUTION RACE CONSTRUCTION

78. There is an extensive network of races that extend from the headrace to deliver water to the individual farms. Depending on the location and the number of farms that are serviced the width of the race will vary in size from less than 14 m to 25 m. Consequently this is another variable that needs to be considered when determining whether there is potential for dust effects from the construction process.

79. As I have previously stated, I consider that there is little potential for nuisance for residences that are more than 200 m upwind or more than 300 m downwind of any race construction.

80. In this instance the potential for effects is also reduced by the fact that construction will occur at quite a rapid pace, with a kilometre of race taking about 3 months to complete.

81. Having said that, there will be a number of residences which will be extremely close to the races (within 100 m) and consequently are likely to experience some nuisance dust effects.

82. Therefore there will be a need to implement appropriate mitigation measures. As I have previously indicated I do not consider that it is necessary to be proscriptive at this stage as to which mitigation measures are implemented,

as particular landowners may have a preference. However the following are the minimum measures that I expect will be used where necessary:

(a) Monitoring wind speeds to act as a trigger for further mitigation

(b) Reducing vehicle speeds to 15 kph when within 200 m of residences

(c) Operating water trucks where practical to minimise dust

(d) Minimising earth moving activities particularly those that involve placing fill during strong winds when within 200 m upwind of residences

(e) Ceasing work during extended periods of high wind in dry conditions

(f) Not locating stockpiles within 200 m of residences

83. For some very close residences (less than 50 m) it may be necessary to use the following additional measures:

(a) Provision of alternate clothes drying options.

(b) Provision of internal or external house cleaning

(c) Schedule works when the wind is blowing away from the residences

(d) Offering alternate accommodation while works are immediately adjacent to the residence

84. It will also be important to ensure that the canal berms are vegetated as soon as practicable, and if that is not possible then consideration shall be given to the use of mulch or chemical binding agents.

WIND MONITORING LOCATIONS

85. I have recommended in a number of places in my evidence that wind speed and direction should be used to determine whether mitigation is required in some instances. Therefore I consider it is important to establish where that monitoring will occur and what should be monitored.

86. I consider that three meteorological monitoring stations would be sufficient, in conjunction with the existing Darfield site, to provide sufficient information for the project and I recommend that the final location of these sites is determined in conjunction with the regulatory authorities. However my suggestion is that one is located near to Coalgate, one is located somewhere between Hororata and Te Pirita, with the third one located near Dunsandel.

87. These meteorological sites should at a minimum measure wind speed and direction together with parameters such as temperature and rainfall. The sites will need to be able to be accessed remotely, with data available to the various contractors. In addition the monitoring system will need to include the ability to alert people if set points for wind speed or direction are reached.

88. While I am not aware of a system of this type being used currently for a construction project in New Zealand, a system that does almost the exact same thing has been operated in the horticultural sector for a number of years, and therefore I am confident that it can be implemented for a project of this type.

OPERATIONAL DUST EFFECTS

89. The only opportunity for operational dust effects, results from the draw down of the reservoir, and the exposure of its bed for extended periods of time.

90. Given the information in Mr Lewthwaite's evidence in chief (paragraphs 171 to 175) the potential for the reservoir to be reduced to its minimum level will occur only once every 34 years, with reasonably significant draw downs predicted to occur in typical seasons.

91. However what is probably most significant, with respect to the potential for dust generation, is the period of time over which the draw down could occur. To illustrate this I have reproduced Figure 30 from Mr Lewthwaite's evidence in chief as Figure 12.

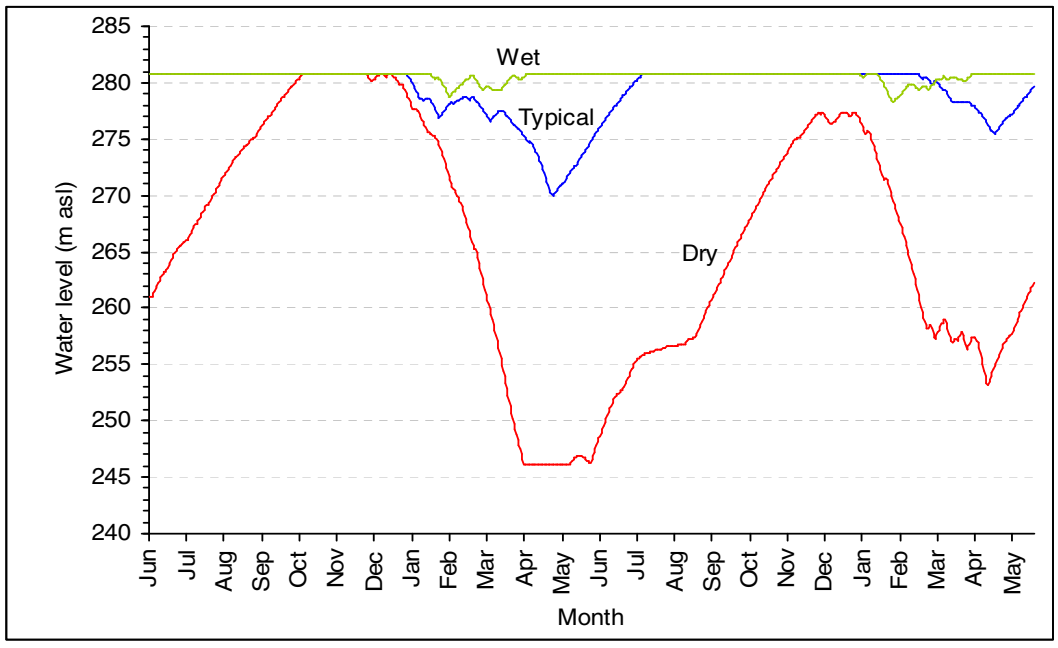

Figure 12 Projected Changes in Reservoir water level

92. As can be seen the draw down is most likely to occur in the period February to May, and therefore will not coincide with the period of time when the strongest winds that might generate dust could occur.

93. Based on work that I have done elsewhere the greatest potential for effects from this type of surface occurs if the naturally formed crust is broken up. In this area, that is likely to occur either from stock or people driving over the surface. This crust significantly reduces the potential for wind generated dust as it effectively increases the threshold velocity, meaning that stronger winds are required to lift dust from the surface. Therefore the primary mitigation measure is keeping vehicles, people and stock off the surface to ensure that the crust is kept intact.

94. In addition, the exposed surfaces will be in remote areas with few close houses, and those that are present are to the north-west. Consequently as the prevailing winds are from the north-west, and the winds from the south-east are generally not strong there is little potential for dust nuisance for these properties.

CONCLUSIONS

95. My conclusions are as follows:

    (a) Activities associated with the construction of the scheme have the potential to generate dust.

    (b) These effects will be short-term and to a large extent are dependent on weather conditions.

    (c) Appropriate and practical mitigation measures exist that can be utilised to minimise the potential for effects.

    (d) These mitigation measures can be selected case by case as appropriate and according to need, and developed in a Dust Management Plan rather than being stipulated as universal conditions of consent.

    (e) There is the potential for dust to be generated by exposed surfaces in the reservoir, when it is drawn down for extended periods of time.

    (f) The most effective measure to control dust from this source is to ensure that the surface remains undisturbed.

A. F. Curtis