Report of the inquest into the deaths arising from the Thredbo landslide

Derrick Hand
Coroner
29 June 2000

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Table of abbreviations

DMR	Department of Main Roads
KT1	Kosciusko Thredbo Pty Ltd (the holder of the Thredbo head lease from 1961 to 1987)
KT2	Kosciusko Thredbo Pty Ltd (the holder of the Thredbo head lease since February 1987)
KTL	Kosciusko Thredbo Ltd (the company that founded Thredbo)
LRO	Legal Representation Office
NPWS	National Parks and Wildlife Service
RTA	Roads and Traffic Authority
SMA	Snowy Mountains Authority
SMEC	Snowy Mountains Engineering Corporation
SMHEA	Snowy Mountains Hydro Electric Authority
SRSC	Snowy River Shire Council
TRIM	Technical Risk and Insurance Management Pty Ltd

Summary

1. The landslide which occurred at Thredbo Village at 11:30 pm on 30 July 1997 has been the subject of extensive investigation and inquiry through this Inquest.

2. The investigation has spanned a lengthy period of approximately 40 years during which the Village of Thredbo developed along side the Alpine Way.

3. A mass of evidence was led before me which established clearly that throughout that period the Alpine Way fill embankment which ran for approximately 1.3 kilometres above Thredbo Village was in a marginally stable state and extremely vulnerable to collapse if saturated by water.

4. I have found in this report that the landslide was triggered when water from a leaking watermain saturated the south-west corner of the landslide in the fill embankment of the Alpine Way setting off the first stage of the landslide. The first stage impacted upon the eastern wing of Carinya Lodge. Simultaneously the first stage removed the support of the land to its east causing that, too, to collapse onto the lodges below.

5. The causes of the tragic deaths which occurred as a result of that landslide are complex. I have found in this report that those causes are:

   - The failure of any government authority responsible for the care, control and management of the Kosciusko National Park and the maintenance of the Alpine Way to take any steps throughout that period to ensure that the Village was rendered safe from exposure to that marginally stable embankment.

   - The approval and construction of a watermain constructed of materials which could not withstand the movement which was taking place in the marginally stable Alpine Way embankment into which it was laid.

   - Leakage from the watermain leading to the saturation of the marginally stable Alpine Way fill embankment.

6. The Alpine Way fill embankment was in a marginally stable state because of the way in which it was originally constructed by the Snowy Mountain Hydro-Electric Authority for the limited purpose of use in connection with the Snowy Mountains Hydro-Electric Scheme.

7. Landslides occurred along the Alpine Way leading up to Thredbo and adjacent to the Village throughout the period from the construction of the Alpine Way until July 1997. The history was well known although not recorded in any systematic fashion. The possibility that landslide involving the road would cause death or injury was recognised albeit principally in connection with vehicular traffic.

8. I accept that much was done by the responsible government authorities over the intervening years to try to keep the Alpine Way and other poorly constructed roads in the Park operational. They had to struggle with the problems occasioned by

inheriting roads not designed for the purpose to which they were later put. They were subject to funding constraints.

9. My examination of the history of the road has left me with no choice but to come to the conclusion that the propensity of the Alpine Way to landsliding which could lead to destruction of lodges and serious injury to persons within them was known to those authorities throughout the relevant period. Despite this, no specific recommendation was ever made by those directly responsible for the road that would have led to the reconstruction of the road above the Village. I have been unable to resolve satisfactorily in my mind how this occurred.

10. Mr. Tim Sullivan said in his Interpretative Report the stability and geotechnical problems with the Carinya site were recognised and understood before any development of the Village in this area. At some later time, probably in the early to late 1960s, this knowledge was either lost, ignored or forgotten.

11. As development of the Village increased, the approach to geotechnical and/or stability issues in regard to individual lots was very haphazard and appeared to address a variety of geotechnical objectives. In some cases, stability was not even addressed and the stability of the Alpine Way was not included in the assessments. This approach continued at least into the mid 1980's.

12. This haphazard approach to stability occurred throughout this time despite the fact the Thredbo Village area continued to be referred to as a slip zone at the regulatory and planning level.

13. My findings have led to me making recommendations that the National Parks and Wildlife Service which has been the main Authority responsible for the care, control and management of the Park and the Alpine Way since 1967, should be the subject of an independent investigation to ensure that its ability to function both as an environmental, urban planning and road maintenance authority is assessed and assured. I would hope that in this way any concerns the public may have as a result of the Alpine Way remaining in its unsatisfactory condition adjacent to an essentially urban community for so long may be allayed.

14. Similarly, I have expressed grave concern that the principal road maintenance authority in this State, now the Roads and Traffic Authority but previously the Department of Main Roads, never expressly advised the National Parks and Wildlife Service of the need to reconstruct the road adjacent to the village to avoid the risk of death or injury due to landslide. It is a matter of grave concern to me that a representative of the RTA inspected the Alpine Way, including above the village for a period of some 6 or so years from 1991 until 1996 and never recommended that the road above the village should be reconstructed. I am aware that during that period the RTA developed a system of Slope Risk Assessment intended for use in assessing the stability of roads and slopes into which they were to be built. That system appears never to have been used to assess the Alpine Way during this period.

I would suggest that the RTA examines its system of assessment of slope stability in the light of the lessons I would hope it has learned from this landslide.

15. There were some criticisms expressed during the rescue operation which occurred after the landslide and by legal representatives on behalf of the families during the Inquest. I have found that the rescue was carried out expeditiously and diligently in the light of the extremely dangerous conditions which existed in the aftermath of the landslide. I commend the exceptional services of all those involved in the rescue.

16. It was submitted to me by Counsel on behalf of the families that those involved over the years with the Alpine Way demonstrated through their submissions to me that they were "throwing responsibility around like the proverbial hot potato - no-one wanting to catch it (and) no-one wanting to end up with it." As I made clear from the outset of this Inquest, it is not my function to decide issues of responsibility in the sense that such issues are determined in civil suits. It is, however, my function, if I see fit, to direct my recommendations to those responsible for the Alpine Way and any dangerous conditions which, in my view, have been identified throughout the Inquest and which can appropriately be the subject of recommendations intended to ensure public health and safety. I have made a number of recommendations directed to this end.

17. It also seems to me that the geotechnical community needs to evaluate the way it conducts its investigations to ensure that investigations whether of conditions of roads or the suitability of building sites, be undertaken having regard to the potential effect of instability on human life and the risk of loss of life or injury.

Introduction

The Landslide

1. At approximately 11.30 pm on 30 July 1997 a landslide occurred at Thredbo Village in Kosciusko National Park. It started in the fill embankment of the Alpine Way in the south-west corner of a block of land to the north-east of which lay Carinya Lodge. Carinya was a ski club lodge occupied, at the time, by one person. In a matter of seconds the first movement of the landslide impacted on the east wing of Carinya, tearing the lodge in two and projecting the east wing to the north-east.

2. The movement of the landslide from the south-west to the north-east removed the support from the fill embankment of the Alpine Way to its south-east. It then collapsed. This second movement of the landslide moved in a north-westerly direction and impacted directly on the west wing of Carinya, shearing it from its foundations. The combined mass of the soil and the superstructure of the west wing of Carinya was projected down the slope across Bobuck Lane. It then impacted on the western end of Bimbadeen causing it to collapse and slewing the building in a clockwise direction. Eighteen people were in that lodge at the time.

3. Eighteen of the nineteen people in the two lodges died in the landslide. It was the worst natural disaster in Australian history.

4. A rescue operation was mounted immediately. One fortunate survivor was located on 2 August 1997. All other occupants of the lodges were deceased when recovered.

5. When daylight dawned on 31 July 1997 a number of matters were apparent.

6. Despite the muddy nature of the landslide experienced by those who sought to venture onto the landslide mass soon after it occurred, the landslide scarp was substantially dry, except in the south-west corner where the slide had commenced.

The only other water apparent was emanating in a semi-circle from low down the scarp face.

7. In the middle of the wet area in the south-west corner lay a fractured watermain pipe.

8. On the opposite side of the Alpine Way running the full length of the landslide scarp and beyond in both an easterly and westerly direction, was a retaining wall which had been constructed by NPWS in February-March 1997 (see Appendix 10, Figure 2).

9. The investigation of the cause of the landslide has been extensive and comprehensive.

10. Thredbo is a young community. The time-line represented by the presence of the marginally stable Alpine Way corresponded closely with its development. It was natural, therefore, that issues concerning the development of the community in close proximity to a marginally stable road required investigation.

11. In seeking to identify the cause of death for the purposes of my reporting pursuant to s. 22 of the *Coroners Act 1980* as amended ("the Act"), the Inquest has focused on matters relating to the geological and urban environment in which the landslide occurred. These have included:

- the construction and maintenance of the Alpine Way;
- the development of Thredbo immediately adjacent to the Alpine Way;
- the construction of Carinya lodge;
- the design, approval and construction of the watermain; and
- the design, approval and construction of the retaining wall.

12. These topics have necessarily involved consideration of a number of background issues which have served to highlight the particular matters which were the focus of attention in the investigation of the cause of the landslide.

Scope of the Report

13. Section 22 of the *Coroners Act 1980* as amended requires the Coroner, at the conclusion or termination of the Inquest to record findings on a number of issues, including the manner and cause of the death of the persons the subject of the Inquest.

14. Section 22A of the Act permits the Coroner to make "such recommendations as the Coroner…considers necessary or desirable to make in relation to any matter connected with the death…with which [the] Inquest … is concerned."

15. Sub-section 22A(2) gives "public health and safety" as examples of matters that can be a subject of a recommendation. It also indicates that a recommendation may

include a proposal that a matter be investigated or reviewed by a specified person or body.

16. Sub-section 22A (3) directs that the record made under s. 22 is to include any s. 22A recommendations, but must not indicate or in anyway suggest that an offence has been committed by any person.

17. It should be born in mind by all who read this Report that an Inquest performs an important, but necessarily confined, function. An Inquest is essentially an inquisitorial process. There are no pleadings, parties or rules of evidence and procedure such as apply in civil or criminal courts.

18. The Inquest plays an important function as a fact-finding exercise, essential to investigate and answer the relatives' and public's need to know the cause of death free from the constraints which bind inter partes litigation. It does not apportion guilt.[1] The *Coroners Act* expressly injuncts the Coroner from indicating or "in any way" suggesting in the s. 22 Report that an offence has been committed by any person.

19. Although not expressly prohibited by the Act, it is not the function of a Coroner to determine, or appear to determine, any question of civil, let alone criminal, liability.[2] I have made this point more than clear, I hope from the outset of this Inquest. That said, however, it would be impossible in discharging my duties as Coroner not to analyse the evidence in the course of reaching my conclusions. A Coroner may make findings about any parts of the evidence in the course of the s. 22 Report. Findings are not limited to those required by s. 22.[3] As a former State Coroner Mr. Waller has said, summing up should be universal practice:

> *"…as it seems reasonable that the relatives, witnesses and public are entitled to know not only the verdict, but also what evidence was accepted and what weight was given to various factors from which the Coroner arrived at his conclusions. The summing up will give [the Coroner] the opportunity of making observations as to safety procedures, recommendations to public bodies, commendations for bravery, and for giving such warnings to the public as appear apt."* [4]

20. It is essential that a Coroner be able to make critical comment, as appropriate, in the course of the s. 22 Report. This is necessary to ensure the findings of the Inquest are of "social and statistical importance in a modern community"[5] and to found recommendations for the purpose of s. 22A. Such critical comment as may be made, however should not be regarded as formed with reference to principles of civil or criminal liability.

Submissions on Cause

21. After Counsel Assisting circulated to all parties the Outline of Adverse Inferences, I received a submission from Counsel on behalf of NPWS concerning matters suggested in the Outline as permissible areas of findings under s. 22. In essence,

NPWS submitted that I could make none of the possible adverse inferences outlined by Counsel Assisting. NPWS submitted that the power to make findings pursuant to s. 22 as to the cause of death was limited to making findings concerning what was described as "a definable event". NPWS argued that such a definable event might be a distinct act or omission of a person but, before it could be considered to be the cause of death under sub-s. 22(1)(c), there must not only be a clear causal connection to the act or omission, but the definable event must be closely and directly associated with the death.

22. It was further submitted that, as a general proposition, the greater the time lapse between the event inquired of and the allegedly causative factor, the less relevant as an initiating cause that factor will be.

23. NPWS's submissions acknowledged that the existence of a casual connection between a definable event and the death of a person was a question of fact to be determined after the event. Thus, it was said, issues of foreseeability were not relevant to determining the existence of a casual connection.

24. One consequence of what was said to be the limitation directing that only the real and direct cause of death be identified, was that the Coroner was not entitled to include in the s. 22 Report "whatever human failure might be thought to have contributed to the death."

25. Subsequent to the circulation of the NPWS submission to all parties granted leave to appear at the Inquest, the NPWS submission was, in substance, supported by Lend Lease, RTA, Mr. Warren-Gash, SRSC and Mr. Ubrihien. All the families opposed the submission.

26. KT2 submitted that "cause" in sub-s. 22(1)(c) meant the "real cause" of death. It referred to decisions of the High Court in which it has been held that questions of causation are determined essentially by common sense with policy and value judgments also having a role to play.

Consideration of Cause Submissions

27. Authorities which consider the question of what constitutes causation at law point out that it is a difficult question to resolve. Philosophical or scientific notions of causation are not relevant. The issue of what was the "cause of a particular occurrence" is determined, at common law, as a question of fact "by applying common sense to the facts of each particular case." Thus, at law, a person may be responsible for damage when his or her wrongful conduct is one of a number of conditions sufficient to produce that damage.[6]

28. The question of what constitutes causation may depend on the legal context in which the issue arises. Most cases which deal with the issue of causation arise in the context of determining the legal liability for a particular act for the purposes of

deciding who, if anyone, should pay damages for a particular injury. In the criminal context, the question arises in determining whether an individual is guilty of the crime charged. Application of the common sense approach can lead to a different conclusion in different forums.

29. This may mean that what the common law regards as constituting "cause" for the purposes of determining liability to pay damages, may not lead to the same outcome in the coronial context. The purpose of an inquest after all is "to seek out and record as many of the facts surrounding the death as public interest requires."[7] As already noted, an inquest does not determine issues of civil, let alone criminal, liability.

30. That said, however, it is appropriate to approach the question of what constitutes "cause" for the purposes of sub-s. 22(1)(c) on the common sense basis proposed by the High Court, albeit in the common law context. This means no more or less than "what or who has caused a certain event to occur is essentially a practical question of fact…".[8] It would not be appropriate to impose arbitrary limits or labels on determining that question such as requiring the identification of a "definable event" or a "close and direct association". These words are not found in the *Coroners Act*. They may be relevant in the course of taking the common sense approach, but they would not limit the ordinary course of that inquiry. Where there is no notion of liability to be resolved, it may be that the question of "cause" can be decided by determining "the factors which played a part in the happening of an event or occurrence."[9]

31. One reason for not giving the word "cause" in sub-s. 22(1)(c) of the Act a narrow or preconceived meaning can be found in the power to make recommendations. That power should not be read down. This can be illustrated in the following manner. NPWS submits that the only findings of fact and inferences that can be drawn from those facts that can properly be made in relation to sub-s. 22(1)(c) are limited to definable events to wit, the landslide, an increase in water pressure in the batter that caused the landslide and possibly either leakage from the watermain or the water seepage from the Winterhaus Retaining Wall that increased the water pressure in the batter. It submitted that the s. 22 report cannot extend to any events preceding those three matters.

32. If that submission was accepted, it would provide little or no opportunity to make any recommendation under s. 22A. It is clear that the power to make recommendations is included in the *Coroners Act* to ensure that any lessons learnt from the matters investigated in the course of the Inquest can be the subject of recommendations. Such recommendations are intended to ensure that, to the greatest extent possible, the chain of events which leads to the deaths the subject of the Inquest can be prevented. As the section itself says, "public health and safety" are matters which can properly be the subject of recommendations.

33. If, as NPWS submits, it is not permissible to refer in the s. 22 report to any event which preceded the infusion of water from one or other source into the Alpine Way batter, there would be no opportunity to assess whether any human or other failing was involved in the events leading to the landslide. There would be virtually no scope to make any recommendations under s. 22A designed to enhance "public health and safety". The families would be entitled to say their loved ones died in vain. Although, of course, an inquest is not an exercise in vindication, the limited report proposed by NPWS cannot have been the intention of the *Coroners Act*.

34. In recording the formal finding pursuant to s.22, it is clear that the Coroner is permitted to look at the circumstances which lead to the finding. In this case it was common ground that the most important factor relevant to the landslide was the fact that the Alpine Way had been constructed in such a way that the fill embankment above the landslide site was in a fragile condition and the slope had only marginal stability.[10]

35. The Alpine Way was built in the early 1950s and was upgraded in 1958-1959. This means there is great deal of history relating to the area in which the landslide occurred which could, upon examination, have been relevant to the cause of the landslide and hence the deaths. It is necessary, therefore, to look at the surrounding circumstances and to draw inferences from those surrounding circumstances to come to the decisions as to "cause" for the purposes of sub-s. 22(1)(c). It may be that a time lapse between an event inquired of and the ultimate event[11] will reduce the causal effect of the earlier event. That proposition loses force in this case, however, when it is recognised that the underlying condition which all the experts agreed led to the landslide was the defective Alpine Way fill embankment which had been in existence for at least 39 years before the tragedy.

36. Accordingly, I reject the NPWS submission that the s. 22 report must be limited to the three events it has outlined. Nevertheless, I am conscious of the necessity that findings as to "cause" must be seen, as matter of common sense, to have played a part in the deaths.

Hindsight

37. In determining the issue of the cause of the landslide, it is important that caution be exercised as to the use of hindsight. The events which have been considered in the course of the Inquest occupy some 39 or more years. Human experience and instincts make it easy and attractive to judge earlier events in the light of later knowledge. It is important to ensure that such "hindsight" judgment does not affect consideration of the issue of cause.

38. That said, it is appropriate to have regard to current developments in the course of considering appropriate recommendations pursuant to s. 22A. Use of later events in

that way should not be confused with the application of hindsight to determine issues of causation.

The Course of the Inquest

39. In several respects the Inquest into the Thredbo tragedy has no precedent.

40. First, it concerned more deaths than had previously being considered as a result of any natural catastrophe in Australian history. Secondly, it was a natural disaster which affected an essentially urban community located in a national park.

41. An investigation into the cause of the tragic deaths commenced at once. Detective Inspector Bob Cocksedge was appointed to coordinate the investigation on my behalf. Senior and Junior Counsel and a Solicitor were retained to prepare and present the evidence at the Inquest.

42. A firm of geotechnical engineers, Pells Sullivan Meynink Pty. Ltd. (PSM), was retained on the 3 August 1997 by the NSW Police Service to prepare an independent report on the cause of the Thredbo Landslide. The appointment of PSM arose as a result of consultation with Police Commanders, the State Coroner and engineers employed by other interested parties. Their view was that the services of an independent engineering consultant were necessary to assist in the preparation of the Police brief for the Coroner. Mr. Tim Sullivan, of PSM, was responsible for all expert reports prepared by PSM. He retained specialists to assist him in his investigations.

43. Those who sought and were granted leave to appear at the Inquest represented the Commonwealth, State and local government and commercial interests who had been involved in the construction and maintenance of the Alpine Way and the development of Thredbo Village as well, of course, as the families of the deceased. A list of the parties granted leave to appear and their legal representatives is set out in Appendix 4.

44. Counsel Assisting and the parties granted leave to appear agreed on a set of core issues which required investigation. That list is set out in Appendix 9. By and large, albeit with some different emphases, the Inquest investigated all those issues.

Presentation of Technical Evidence

45. Mr. Sullivan developed an expert protocol intended to ensure, essentially, that there was only one geotechnical investigation into which all experts could have input. Thus there was one set of common data, the collection of which was subject to scientific control. This avoided unnecessary duplication of work.[12] The intention was that the results of the shared scientific investigation would be assembled by PSM and presented as a report about the site factors potentially relevant to the cause of the landslide. This was done in the Site Factors Report[13] and the Supplementary Site

Factors Report[14] Those documents were made available to all parties granted leave to appear.

46. Mr. Sullivan prepared an Interpretative Report analysing the cause of the Thredbo landslide[15] which was circulated to all parties prior to the commencement of the Inquest.

47. There have been criticisms by some parties that the preparation of that report prior to the opening of the Inquest and, further, the fact the Counsel Assisting opened the Inquest on the basis that the most probable cause was that identified by Mr. Sullivan constituted bias or demonstrated a "partisan" attitude. This criticism was quite misconceived.

48. First, it was open to any party to use the Site Factors and Supplementary Site Factors Report to prepare their own expert's reports which could have been made available to Counsel Assisting prior to the commencement of the Inquest. This had been the course taken with a number of witness statements settled by the legal representatives of parties granted leave to appear and provided to the Solicitor assisting me.

49. Secondly, the preparation of the report was attacked on the basis that it was an opinion given before all the evidence was taken. However, again, as far as I understand it, Mr. Sullivan had access to all the statements which had been obtained whether by the Police team lead by Detective Inspector Cocksedge or by the Solicitor assisting me. It might have been reasonable to expect that substantially all the evidence relevant to the cause of the landslide had been obtained through that process.

50. Thirdly, as Mr. Sullivan made clear, he was, at all times, prepared to modify his opinion, if appropriate, on the basis of any further evidence given. As events have transpired, his opinion has not changed in substance, although in some respects the factual basis for it may have altered due, in particular, to further investigations undertaken during the course of the Inquest.[16]

51. Finally it should be noted that it is the practice in inquests for the Coroner's expert to circulate a report prior to the Inquest opening. This provides a framework within which the debate about technical issues can take place. That was the case in this Inquest.

The Convocation of Engineers

52. Even before Mr. Sullivan was retained, a number of the parties had retained technical advisers. As the hearing progressed it became apparent that an efficient method was needed to deal with the large number of technical issues and technical evidence concerning the geotechnical investigation into the landslide.

53. It was anticipated that the parties would wish to put each of their respective experts' theories to, at least, Mr. Sullivan, and, possibly, call evidence from their own experts.

It was apparent to me that unless the areas of expert evidence were as confined as possible, the Inquest would be substantially prolonged by the canvassing of the various experts opinions.

54. Counsel Assisting proposed that all parties expert advisers meet in a Convocation of Experts with the intention that they identify common areas of agreement and isolate any true areas of disagreement. It was intended to limit cross-examination of experts to the areas of true disagreement.

55. The Convocation took place in April 1999. It was chaired by the Honourable T.R.H. Cole R.F.D. Q.C. Twenty-five experts participated. The duration of the Convocation was limited by agreement. Mr. Cole prepared a report which was signed by all the experts who attended the Convocation recording the areas of agreement or disagreement of the participants.[17]

56. The Report recorded substantial areas of agreement as well as substantial areas of disagreement. It reduced the debate about the possible events which actually triggered the landslide to an increase in the groundwater pressure in the slope above Carinya in the material placed there during the Alpine Way construction or upgrading with that increase being due to an influx from, a source which could not be agreed. The potential sources, however, were agreed to be either additional flows resulting from the construction of the Winterhaus Retaining Wall permitting additional groundwater infiltration to that pre-existing, or a leaking joint in the water pipe laid in uncompacted fill adjacent to the Schuss Lodge near the top of the slope that failed.[18]

57. Following the Convocation, it was apparent that a number of parties wished to call the experts they had retained to explore the remaining contentious areas identified in the report of the Convocation of Engineers. Calling all the experts retained by all parties would have considerably prolonged the hearing. After debate between Counsel Assisting and the parties, it was agreed that the experts retained by NPWS and Lend Lease[19] be called as they represented the opposing opinions as to cause. It was agreed that the expert retained on behalf of the families represented by the Legal Representation Office also be called.

58. Accordingly, the expert evidence given at the Inquest concerning the trigger of the landslide was given by:

- Mr. Shirley, the expert retained by the Legal Representation Office on behalf of the families it represented.
- Dr. de Ambrosis, Mr. Kotze and Mr. M Polin on behalf of NPWS.
- Dr. McMahon, Mr. P Dundon, Mr. J Price, Dr. H Stark, Associate Professor A Crosky, Dr. M Hoffman and Mr. J McCaffrey on behalf of Lend Lease.
- Mr. T Sullivan, Mr. K Macoun, Mr. C Jewell and Mr. Winter being the experts retained to advise the Coroner.

59. Geological and geohydrological investigations and engineering depend upon, information, interpretation, extrapolation, inference and intuition based upon experience. This point was made in the Convocation Report which also pointed out that in considering a problem different engineers may place different emphasis or weighting upon the various factors. Thus while a fertile ground for disagreement might be the consequence, another consequence was said to be that "difference in emphasis on aspects of this reducing spectrum of empirical knowledge permits engineers to maintain differing positions with apparent reason."[20]

60. It was contended by some parties granted leave to appear that the Inquest should accept the outcome of the Convocation Report to the effect that the experts could not agree whether the increase in groundwater pressure which led to the landslide resulted from either the construction of the Winterhaus Retaining Wall or a leak from the watermain.[21] That submission was also made before the expert testimony commenced.[22] I rejected the submission for the following reasons.

61. As Coroner, I am charged with the duty of seeking to identify the cause of the landslide. The question left unanswered by the Convocation was: what was the "trigger" of the landslide, as the geotechnical community would describe it,?

62. Further, courts must administer justice in public. That principle applies as much to an inquest as to any other court.[23]

63. The course proposed would have meant that there would have been no public airing of the controversy between the experts proposing competing theories. The expert evidence would have been confined to Mr. Sullivan's Interpretative Report which expressed the conclusion that there was a high likelihood that a leak from the watermain caused the landslide. Moreover, the fact that experts could not agree between themselves as to which of their respective theses was more probable, did not mean that I could not form an opinion about that issue following cross-examination of the respective experts. I considered it was necessary, in order to discharge my coronial duty, that I attempt to see whether any choice between the competing theories was possible.

64. Accordingly agreement was reached that experts be called, although, as already said, the number of experts to be called was limited in a way intended to permit some economy and the avoidance of repetitious evidence.[24]

Section 33

65. Section 33 of the *Coroners Act* provides for a witness to refuse to answer questions under certain conditions. This provision was availed of by one witness in the course of the Inquest, Mr. David Warren-Gash. I do not, of course, draw any adverse conclusion from that fact. A short statement provided by Mr. Warren-Gash in November 1997 was tendered.[25] Mr. Warren-Gash had also prepared a number of

reports in the course of work he undertook on behalf of NPWS. These were all tendered and will be the subject of consideration in this Report.

Indictable Offence

66. It should be apparent from the course of the Inquest, that the evidence I have considered has not lead to me forming the opinion that there is a prima facie case against any known person for any indictable offence in respect of the deaths in the landslide.[26]

Legislative Framework

67. The Kosciusko State Park (the "Park") was created pursuant to the *Kosciusko State Park Act 1944*. The same Act created the Kosciusko State Park Trust (the "Trust"). The Trust had the care control and management of the Park. The Trust was given the power (inter alia) to carry out any work in connection with the improvement, development and maintenance of the Park including the opening of roads, the erection of hostels and other buildings and structures.[27]

68. Land within the Park was expressly made available to the public for recreational purposes. The public was to have free access to and over all roads in the Park.

69. In 1952 the *Kosciusko State Park Act* was amended to permit the Minister administering the Act to grant leases of land within the Park on which accommodation, hotels or houses and facilities and amenities for tourists and visitors could be erected and provided.[28]

70. The *National Parks and Wildlife Act* was passed in 1967. Pursuant to that Act the Park was permanently reserved as a national Park named "Kosciusko National Park".[29] The care, control and maintenance of the Park was vested in the Director of National Parks and Wildlife pursuant to a Proclamation made under the *National Parks and Wildlife Act* on 24 November 1967.

A Cautionary Note

71. Kosciusko National Park (the "Park") was managed by the Kosciusko State Park Trust (the "Trust") until late 1967 when the National Parks and Wildlife Service ("NPWS") was created.

72. Several companies have managed Thredbo Village since it was founded. Those companies have very similar names. It is important, therefore that care be taken not to confuse their different management.

73. Thredbo was established by a Syndicate which floated as a public company, Kosciusko Thredbo Limited. It controlled the Village from 1956 until about December 1961. It is referred to in this report as "KTL".

74. In about December 1961 Lend Lease Corporation acquired all the shares in KTL which, in due course, it converted to a private company, Kosciusko Thredbo Pty. Limited. It is referred to throughout this report as "KT1". It acquired a Head Lease over the land on which the Village was erected in about 1962.

75. KT1 managed the Village until early 1987 when it assigned the Head Lease to Greenfields Pty Limited. Greenfields Pty Limited later changed its name to Kosciusko Thredbo Pty Limited. It is referred to throughout this report as "KT2". It still holds the Head Lease.

76. The Alpine Way was constructed by the Snowy Mountains Hydro-Electric Authority ("SMHEA") in about 1955 and upgraded in about 1958. SMHEA retained responsibility for it until 1968 when it and all SMHEA roads in the Park were transferred to the State of New South Wales. NPWS assumed responsibility for the care control and management of the Alpine Way and all Park roads from that time.

77. The Department of Main Roads ("DMR") acted as NPWS's agent to maintain and conduct snow clearance on the Alpine Way and all Park roads from 1968 until 1988. Its name was changed to the Roads and Traffic Authority ("RTA") in January 1989.

78. The Snowy Mountains Shire Council acted as contractor to the NPWS from 1988 until 1996 in relation to maintenance of the Alpine Way and Guthega Roads in the Park.

79. From 1991 until 1996 the RTA provided technical advice to NPWS about the stability of the Alpine Way.

80. From late 1990 Mr. Tony Sullivan was the NPWS District Engineer responsible for the Alpine Way and many other roads. He should not be confused with Mr. Tim Sullivan who was the independent geotechnical expert assisting the Coroner.

81. In the evidence before the Inquest and in this Report, the Alpine Way is treated as running east-west, with Jindabyne being the eastern end and Dead Horse Gap the western end. On this basis, Thredbo and the landslide site is to the north of the Alpine Way and the Winterhaus Corner is to the south.

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1 *R v. South London Coroner, ex. parte Thompson* (1982) 126 Sol J 625-628 [PAGE].
2 cf. s. 43 (1) (j) *Coroners Act 1920* (WA)*; R v. H.M. North Humberside & Scunthorpe Coroner; ex. parte Jamieson* [1995] QB 1 at 24; *Commissioner of Police v. Hallenstein* [1996] 2 VR 1 at 15-16.
3 *Keown v. Kahn and Another* (Supreme Court of Victoria, Court of Appeal, unreported at p. 8).
4 K. Waller, *Coronial Law and Practice in New South Wales*, Butterworths, 2nd ed., pp. 63-64.
5 *ex. parte Minister of Justice; Re Malcolm; Re Inglis* [1965] NSWR 1589 at 1602.
6 *March v. E & M H Stramare Pty Ltd* (1991) 171 CLR 506 at 515; see also *Royall v. Queen* (1990) 172 CLR 378 per Mason CJ at par. 13, McHugh J at par. 24.
7 *R v. South London Coroner; ex. parte Thompson* (1982) 126 Sol J 625-628.
8 *R v. Poplar Coroner; ex. parte Thomas* [1993] 2 WLR 547at 552.
9 *Royall v. Queen* per McHugh J, supra, at par. 24.
10 Report of the Convocation of Engineers, ex. 99.01, par. 26.1.
11 *Harmsworth v. State Coroner* [1989] VR 989 at 999.10.
12 Ex. 92.0001, Thredbo Site Factors Report, par. 2.2.

[13] Site Factors Report PSM R2, ex. 92.0001.
[14] Supplementary Site Factors Report PSM R3, ex. 93.001.
[15] Analysis of Thredbo Landslide, PSM R4, ex. 94.001-94.323.
[16] I note, in particular, that prior to the Inquest the retaining wall was not deconstructed. This was because NPWS had indicated that it intended not to disturb the retaining wall. The perceived cost of dismantling the wall it was thought to outway any possible benefit. This position altered in late 1998 when NPWS indicated it no longer intended to keep the wall. At that stage it was deemed appropriate for the investigation to be extended to include observations made during deconstruction of selected portions of the wall.
[17] Report of the Convocation of Engineers, ex. 99.01.
[18] Report of the Convocation of Engineers, ex. 99.01, par. 26.2.
[19] Being respectively the approvers and builder of the watermain and the builder of the retaining wall.
[20] Report of the Convocation of Engineers, ex. 99.01, par. 5.1.
[21] Submissions on Experts Issues from Lend Lease Group of Companies, May 2000, par 1.19
[22] Submission by Malcolm Craig QC, T5986.47ff.
[23] *Mirror Newspapers Limited v. Waller* [1985] 1 NSWLR 1 at 11-12; see also s. 30 *Coroners Act 1980* (NSW) as amended.
[24] See *Maksimovich v. Walsh & Anor* (1985) 4 NSWLR 318.
[25] Statement of David Warren-Gash, 14 November 1997, ex. 86.01.
[26] Section 19(1) *Coroners Act* NSW.
[27] *Kosciusko State Park Act 1944*: ss. 3,4 & 5.
[28] *Kosciusko State Park Act 1944*: as amended sub-s. 11(3).
[29] *National Parks and Wildlife Act 1967*: s. 15 (1).

The Alpine Way

82. The Alpine Way was built by SMHEA during the construction of the Snowy Mountains Scheme in order to connect Cooma with Khancoban (see Appendix 10, Figure 1). It was considered essential for the Scheme's development in the Khancoban area. The SMHEA recognised that "the terrain was extremely difficult for road building and that the road would only ever by used for light vehicle traffic."[1]

83. According to SMHEA the Alpine Way was constructed to a "class A" standard, which was SMHEA's highest standard at the time. However, SMHEA also points out, a class A standard road was never intended to be a main public highway.[2] It was intended to be used as a construction road, a fact which was readily apparent.[3] The SMHEA roads were designed with the intention that they last twenty years.[4]

84. The fact that the Alpine Way was constructed with a view to being used primarily for a relatively short term purpose in connection with the Snowy Mountains Scheme had long term consequences when the road was later acquired by New South Wales for permanent use as a vehicular thoroughfare.

85. The problems with the Alpine Way were well known and described by commentators throughout its history. Thus, in February 1974, Mr. Shaw, a former Commissioner of Main Roads, wrote of the roads:

> *"The SMHEA construction access requirements necessitated road location on high plateaux and along very steeply sloping mountains and gully sides involving costly side cutting liable to slipping unless placed wholly in the solid. Very little of the latter was done…In many places their (roads) edge is supported against slip down the side slope of the ridge by logs of felled timber which were rolled or dragged into a roughly horizontal position. These logs are now rotting and slips will occur with increasing frequency."* [5]

86. The problems were well described, and apparently understood, by Mr. Isberg, the NPWS Operations Engineer in the 1970's, in the following terms:

> *"As a result of those early 'construction road' requirements we are now faced with carriage ways too narrow to cater for the annually increasing traffic, rock cuttings with too steep batters causing constant rock falls, embankments filled on steep mountain*

> *slopes without proper benching causing serious land slides, inadequate road-base construction and finally inadequate and incorrectly designed drainage causing not only constant blockage of drain pipes with consequence high cost for never ending cleaning but also damaging existing road pavement."* [6]

87. In 1991 on behalf of NPWS, a firm of consulting engineers, Sinclair Knight, undertook an evaluation of the benefits of providing funds for the upgrading of the Alpine Way within the Park. That firm observed slippages along the road which were reported as appearing to result from the nature of original construction with "one side cut in wet Alpine Way conditions with no sub-grade and the other side on embankment." The report recorded land slippage as evident on the Alpine Way, especially adjacent to Thredbo Village. The point was made that:

> *"A landslip would not only cause severe damage to the road but may also damage property and subsequently endanger human life. Remedial action is recommended to reduce the possibility."* [7]

88. The Alpine Way extends for approximately 1.3 kilometres above Thredbo Village. Throughout the history of the Village prior to the 1997 landslide, and despite comments like Mr. Isberg's and Sinclair Knight that part of the Alpine Way was never reconstructed to improve the original construction road standards. The Sinclair Knight report was used by NPWS to obtain funds for road improvements along the Alpine Way but those funds were not spent on reconstructing the road above the Village.

89. Hence the description Mr. Isberg gave to the Park roads in 1971 was still applicable to that part of the Alpine Way which ran above the Village in 1997.

Responsibility for the Alpine Way

90. From the 1950's it was apparent to those concerned with the Park, that roads being constructed by SMHEA within it, in particular the Alpine Way, could have long term tourist implications. In 1955 the Trust expressed the view to a representative of the Department of National Development that the Trust would appreciate any action by that Department which would ensure that the roads being constructed through the Park were constructed for permanent use.[8]

91. By 1964 the amount of SMHEA traffic using the Alpine Way was less than 10% of the total traffic using the road. In that year SMHEA made a statement to the effect that it could not continue to meet fully the costs of maintenance and snow clearing of the road but should only meet that portion of costs which represented its own use.[9]

92. By 1966 SMHEA had advised the Minister for Lands that the Alpine Way was no longer required for the Snowy Mountains Scheme and asked whether the Trust was going to assume responsibility for the road.[10]

93. On 1 April 1968 the Alpine Way and other roads within the Park constructed by SMHEA became the responsibility of the New South Wales State Government. New South Wales accepted responsibility for maintenance and snow clearing of those roads on the basis that SMHEA was to pay the State an amount of $200,000 per annum for 10 years, $150,000 per annum for the next 5 years and $100,000 per annum for the final 5 years in respect of the roads constructed by SMHEA and required by the State for public use as well as being required for operation and maintenance of the Snowy Mountains Scheme.[11]

94. NPWS was responsible for the care and management of roads within the Park. In addition, the DMR agreed to act as agent for NPWS in undertaking snow clearing and maintenance of the roads on a priority basis. The question of providing protection within the Park and general management responsibilities connected with roads remained with NPWS.[12]

95. The RTA has been responsible for the New South Wales main road system including the Snowy River Shire, throughout the period of the existence of the Alpine Way. It has done this in its various manifestations, first as the Department of Main Roads and then its successor, the Roads and Traffic Authority.

96. At various stages throughout this period it was open to the State Government to proclaim or declare the Alpine Way to be a main road or one or other of a variety of other described roads. The effect of such a proclamation or declaration would have been to bring the Alpine Way under the control of the RTA and to make it directly responsible for maintenance or construction works. Although this step was not taken prior to the landslide, numerous attempts were made throughout the history of the road to make the RTA directly responsible for it. These steps were unsuccessful. It is ironic to note that shortly before the Landslide it appears that that part of the Alpine Way up to the Park entrance was to be reclassified as a main road.[13]

97. The significance of declaring the Alpine Way a main road was that if it was so proclaimed, then State funds could have been made available for its reconstruction. The effect of it not being so proclaimed, apparently, was that the only funds which the RTA could have spent on improving the road was from annual funds for Rural Local Roads provided by the Commonwealth Government. Applying any part of those funds to the Alpine Way would have led to a corresponding reduction in the amount of funds available for distribution to Local Government.[14]

Historical Understanding of Landslide Risk

98. I start from the proposition that what collapsed on the evening of 30 July 1997 was the Alpine Way fill embankment - an area which was marginally stable due to the method of construction of the Alpine Way by SMHEA in the 1950's. That method of construction was agreed at the Convocation of Engineers to be a factor material to the mechanism of the failure.

99. The question which must be asked is how it came about that despite that history, the Alpine Way above the Village was allowed to remain in a condition of recognised susceptibility to that risk.

100. Mr. Tim Sullivan provided a useful history of the development of geotechnical engineering knowledge and practice in relation to landslides over the period of development of Thredbo Village. Coincidently, starting in 1958, the Highways Research Board of the United States, published a number of reports into landslides. The first, in 1958 studied Landslides and Engineering Practice. The second, published in 1978, studied Landslides - Analysis and Control while the third, published in 1996, studied Landslide - Investigation and Mitigation. I say "coincidently" because it will be noticed that the first of these reports was written at the time KTL was contemplating developing the Eastern Subdivision and at about the time the Alpine Way above the Village was upgraded.

101. Mr. Tim Sullivan describes the 1958 Report as dealing with topics which provided a sound fundamental basis for assessment of most aspects of the landslide problem. He pointed out that the type of material associated with the landslide comprised an aggregate of soil particles primarily of sand size or less. He said the type of movement which comprised the landslide would have been classified by the 1958 report as "flows" and having regard to the velocity of the movement, as "rapid earthflow". In regard to these materials and type of movement, the 1958 Report noted:

> *"An earthflow is a flow of slow to very rapid velocity involving mostly plastic or fine-grained non-plastic material… the failure follows saturation or building up of pore water pressure so that part of the weight of the material is supported by interstitial water…"*

102. He points out that it is clear from that description in the 1958 Report that both the mechanics and the potential problem with landsliding in the materials which comprised the fills along the Alpine Way were quite well understood.[15]

103. I accept what Mr. Tim Sullivan says about the contents of the 1958 Report. It appears the Report was being cited in Australian engineering works in the 1950's and 1960's. Mr. Tim Sullivan points out that there is no comparable comprehensive document dealing with the theory and practice of landslides in Eastern Australia.

104. He does, however, point to the history of landslide problems in association with human development in hilly areas.

105. He points out that landslides have been a concern along the Illawarra Railway since as early as 1890. The NSW Geological Survey began detailed studies of that area in 1951 and in 1958 a general assessment of the landslides was published in the journal of the Royal Society of NSW.[16]

106. As the first paragraph of that paper pointed out:

> *"The influence of geological formations, structures and processes on the lay-out of our lines of communication is well-know. Trunk roads and railways often follow broad, open valleys because of the ease of access and construction. In many cases these valleys owe their origin to the presence of softer and more easily weathered formations or of weaker zones caused by faulting…. whether the foundations for our roads and railways are safe or unstable depends on the nature of the underlaying rock formations."*

107. He also points out that in Tasmania while landslide problems were recognised in the Tamar Valley as long ago as the mid-19th century, the problem was not really recognised as widespread until houses were destroyed in 1970 and 1971. That incident, apparently, led to the production of an instability zoning map of the Tamar Valley prepared by the Geological Survey of Tasmania.

108. A similar approach was taken in urban areas around Sydney and, again, Illawarra, when landslide movements were experienced as development spread into the steeper areas of hills and valleys. This apparently lead to stability zoning maps for the Warringah Shire in the mid-1970's. It also led to the development and publication in geomechanics publications of guidelines for preferred Practice in Hillside Construction in 1976.

109. It is apparent from the short history of reactions to landslides in Eastern Australia that despite the availability of technical understanding as to their cause, investigation and prevention, preventative steps have often not been taken until after major incidents. This, apparently, is a common experience throughout the world. Thus, the 1996 Report of the Transportation Research Board points out:

> *"In many regions large landslides are infrequent events. In comparison with the length of human lifetimes, their occurrence is so low as to lull many into a false sense of security concerning landslide hazards, especially in areas of lower topographic relief. An appreciation of historical experiences with landslide is a frequently neglected but important component of landslide investigation and mitigation studies."*[17]

110. It has been very apparent throughout the Inquest that there has been no systematic recording of the landslides which have occurred along the Alpine Way.

111. Nevertheless an examination of the records associated with the Alpine Way, not only in association with the occurrence of landslides does show an appreciation of the risk of injury they posed.

History of Landslides along the Alpine Way

112. Landslides occurred along the Alpine Way leading up to Thredbo from the Ranger's Station and adjacent to Thredbo throughout the period from the construction of the Alpine Way until July 1997. This history was well known. The possibility that landslide involving the road would cause death or injury was recognised, albeit principally in connection with vehicular traffic.[18]

113. The best recorded landslides were:

- Landslide on the Alpine Way in 1955;[19]
- The cut batter collapse of the Alpine Way in Winterhaus Corner in 1958-9;[20]
- The 1964 Winterhaus Slide;[21]
- The slide shown on a 19/11/65 map prepared by KT1;[22]
- The slipping of the Alpine Way towards the Village observed by the DMR in or about May 1968;[23]
- The instability observed by R. Oldfield in July 1968;[24]
- The 1973 landslides;[25]
- The 1974 landslide;[26]
- The 1978 landslide;[27]
- The 1989 landslide.[28]

114. Despite this history of landslides and a general recognition of the risk such as the reference to "serious landslide" in Mr. Isberg's document, both the NPWS and DMR records show little or no appreciation of the risk those landslides might pose to Thredbo. The Lend Lease, and later KT2 documents, similarly show virtually no recognition of any risk posed to the Village by such an event. I say "virtually", because in the early nineties, KT2 undertook several exercises which recognised the risk of the Village being cut off by a landslide along the Alpine Way to the east of the Village and also a Risk Assessment Study. In the course of that latter study, the potential for landslide in Thredbo Village "through inadequate construction and/or geologically unsound location or water seepage" was recognised but the likelihood considered to be low. The potential for loss of life from a landslide within the Village was recognised although, again, it was thought it likely that slippage areas could be identified before the incident occurred.[29] That risk assessment process evolved over a period of months and the final version of the Survey no longer listed landslide.

The Winterhaus Landslide

115. Few records remain of the early landslides associated with the Alpine Way. The first well recorded landslide occurred in 1964 adjacent to Winterhaus Lodge in the Thredbo Village. The 1964 Winterhaus landslide is remarkable for the fact that even though it occurred within the Village in circumstances where it narrowly avoided impacting upon a Lodge, there is no record of it in the documents discovered either by the Trust nor any direct reference to it in the documents discovered by Lend Lease. This is so, notwithstanding the fact that it is apparent from the few

documents which do exist that it caused considerable consternation to the occupants of Winterhaus Lodge and that it was still a subject of concern in 1968.

116. The Winterhaus landslide occurred on 2 October 1964. It involved the sudden slump of an outer segment of the fill on the Alpine Way above the Winterhaus Lodge through a vertical distance of about 6 feet. That slump was followed by a further vertical displacement to about 9 feet below the road pavement which occurred slowly over the following three days accompanied by a mudflow down-slope extension at the toe of the landslide. Prior to the landslide occurring, cracks and differential settlement of the pavement of the Alpine Way had developed. They were accompanied by several small isolated water outflows from the fill down-slope of the road (see Appendix 10, Figures 4 and 5).

117. Mr. Svenson, who was an Engineering Geologist in charge of SMHEA's Construction Material Field Investigation Section, investigated the landslide. He found that a length of 94 feet of the Alpine Way road pavement had been affected by settlement of the fill with slumping of a 50 foot length of pavement to a maximum width of 2 feet. The effects of the slide extended for a slope distance of about 100 feet below the road. He concluded that the landslide occurred as a result of complete saturation of an essentially uncompacted and differentially settling fill of completely weathered granite. He concluded that there would be no danger to life and property provided that adequate treatment of the landslide area was carried out.[30] Mr. Svenson mentioned in his report that the possibility that the Alpine Way still might fail was mentioned to the Project Manager of KT1. No document was produced to the Inquest by KT1 recording that warning or ever acknowledging that the event had occurred.

118. There are records, however, which were produced by SMHEA which give an insight into the concerns of the Winterhaus Lodge owners. In early 1964, Mrs. Clifford, who had built Winterhaus Lodge with her husband, wrote to SMHEA. It appeared that by that stage no remedial work of any significance had been undertaken. Furthermore, a Geologist who turned out to have been Mr. Svenson, had advised her that a further slip was imminent. She was concerned not only about the possibility that the Lodge would be damaged but also that human life would be endangered in both Winterhaus and other Lodges. She asked SMHEA to take action as soon as possible.[31] Mr. and Mrs. Clifford delivered their letter to SMHEA and reiterated their concern that if the culvert above their property (C138) should collapse "their Lodge would be seriously damaged with the resultant possibility of injury to persons."[32]

119. That visit led to a further investigation of the cause of the Winterhaus landslide which was undertaken by Mr. Lewis, the Field Construction Engineer. It is interesting to note that he observed that even though there had been forewarning of the Winterhaus landslide because of the cracking of the pavement of the Alpine Way, "the steep sideslope below the road and the proximity of the guest houses to

the road made it impractical to provide for any additional support to the fill." He also made a general assessment of the slope in the vicinity of the Winterhaus landslide which might be thought to have been equally apposite to the sideslope in any other parts of the Alpine Way above the village, including above Carinya. He said:

> *"The general sideslope below the road in the vicinity of the slip is between 1 1/4 to 1 and 1 1/2 to 1 and for the decomposed granites this slope is too steep for stability when saturation occurs. It is considered that the slip occurred through saturation of sidecast fill where the gully fill was widened during the improvement of the old investigation track. The water would have entered from the high side of the road and also from the snow overlying the fill batter during the winter period."*[33]

120. It appears that Mr. Lewis drafted a letter to be sent to Mrs. Clifford which the Business Manager declined to send. He did not doubt that what was set out in the draft letter was factual or correct, however he thought SMHEA "should say as little as possible".

121. The draft letter proposed to inform Mrs. Clifford about the cause of the Winterhaus landslide to which I have already referred. It also proposed to explain what was to happen concerning the repair work. The draft letter contained the following paragraph:

> *"It should be noted that the siting of the lodges and works carried out below the road have been done through the Kosciusko State Park Trust without reference to the needs for maintenance of the road along the steep terrain where slips have not been infrequent.*
>
> *Our intention is to stabilise the present slip area, carry out further drainage and to deviate the road by cutting further into the hillside so that the edge of the slip area will not be subjected to traffic loading."*

122. Instead of that letter being sent, SMHEA sent Mrs. Clifford a short note which explained that the repairs to the Winterhaus landslide have had to await favourable weather conditions and that the work would be commenced shortly.[34]

123. Mr. Svenson gave a further insight into the reaction in the Village to the Winterhaus slide during his evidence to the Inquest. He pointed out that in his opinion the Alpine Way along the top side of the Village traversed an area where there were large sections with a safety factor of 1, in other words where the road could collapse at any moment because the load on the slope exceeded the shear strength of the slope soil. He was concerned, he said, that the fills would become saturated and lose cohesion. It was essential, in his opinion, that in order for the embankment to retain its stability that its exposure to water be kept to a minimum.[35]

124. Mr. Svenson provided a statement to the Inquest in which he expressed the opinion that "the Alpine Way poses a potential safety hazard to the people occupying the lodges located below the road."[36] When he gave evidence before me, he said that that was an opinion he had always held about the slope below the Alpine Way.[37] He

qualified that answer by saying that he was not certain whether he held that opinion in relation to the whole area of the fill batter above Thredbo east of Winterhaus Lodge. It depended upon the nature of the fill and the quality of its compaction, if it was compacted. What he did say, however, was that there was always a potential hazard and the fill had to be very carefully looked at. In effect, he said, any of the slopes which were at 30 degrees or more were in the zone where their factor of safety approached unity, and therefore failure.[38] He could recall the failed fill extending 100 feet from the edge of the road cutting down to the toe.[39]

125. If, however, he said a lodge was to be constructed, below the batter of the Alpine Way, it would be necessary to have a proper geotechnical investigation on the site, taking into consideration the site itself and what conditions were between the road and the site or upslope of the site.[40]

126. Mr. Turner, was the site engineer for Civil and Civic Pty Limited in Thredbo from around October 1961 until early to mid 1963. He was not working in Thredbo at the time of the Winterhaus slide. He agreed, however, that based on his experience, that it would have been clear after that landslide that there was a problem in relation to the fill batters of the Alpine Way and construction below the road as long as those fill batters remained unremediated.[41]

127. Mr. Hagley acted as Village Manager in Thredbo during the period of about October 1964 through to March 1965 while Mr. Van der Lee was away. While he could not recall the landslide, he agreed that both he, and the company managing Thredbo would have become aware of it.[42] Despite the fact that half of the Alpine Way was closed off for a substantial period before the Winterhaus slide was remediated, and the fact that the major remediation did not take place until about March 1965, Mr. Hagley could not recall any consideration given by KT1 to any issues arising from that landslide. Mr. Van der Lee could, in fact, remember seeing the 1964 slide.[43] He acknowledged that the reference in Mr. Svenson's first report concerning the landslide, to the Project Manager of KT1 having been warned of the possible failure of the fill, could have been a reference to himself although he could not remember receiving that warning. Had he received it, however, he said he would not have informed other personnel within KT1 but would have discussed it on site with the representative of SMHEA.[44]

128. Mr. Van der Lee could not remember ever consciously turning his mind to whether the Winterhaus landslide had any significance in relation to other areas of the Alpine Way batter to its east.[45] Certainly, no records of either KT1 or any other company involved in the Lend Lease Group indicated any consciousness of such a matter. Indeed, the only reference in these documents is a letter Mr. James, an Architect, wrote to Civil and Civic Pty Limited in August 1965 in which he expressed his concerns about seepage and drainage coming from underneath the Alpine Way above the village. One of the concerns he expressed was that the new drainage section installed by SMHEA adjacent to Winterhaus had been badly damaged by a

recent storm, with overflow from the storm scarring the face of the hill. He also pointed out that there was too much seepage along the water course on the south side of the road.[46] His recommendations appear to have been to little avail because approximately a year later, he wrote to KT1 pointing out that the seepage and the surface drainage to which he had referred in his August 1965 letter was still damaging part of the Alpine Way above the village.[47]

129. Mr. Van der Lee said he would probably have reported the Winterhaus landslide, as a matter of normal writing of management reports for management meetings held in Sydney.[48] To the extent he did report it, however, it did not appear to have been because of any concern about the significance of the Winterhaus landslide in relation to development elsewhere along the Alpine Way but, rather, because it was, "an event". Certainly he could not recall any engineer on behalf of KT1 examining the land above the lease boundary, adjacent to the Alpine Way, to determine whether or not it posed a risk to development of buildings in the area of the Eastern Subdivision.[49]

130. Nobody else who was engaged in work in and around Thredbo in the mid-60s on behalf of KT1 could recall the Winterhaus landslide.[50].

131. It is unlikely that Mr. James' letter would ever have provoked any action on the part of KT1 or any company doing work on its behalf in Thredbo at the time. Mr. Dusseldorp and those working for him took the view that even though the Alpine Way was adjacent to Thredbo, it was outside KT1's lease area and not its responsibility.[51] I can understand that attitude, although I would note that Mr. Dusseldorp and KT1 campaigned vigorously to ensure that the condition of the Alpine Way as it led up to the Village was improved in order to facilitate visitor access to the site.[52]

132. There was no document which was produced by NPWS to the Inquest which shows any contemporary record of the Winterhaus landslide. The only apparent reference to it is in a memorandum written by Mr. Oldfield soon after NPWS took over responsibility for the road from SMHEA. At the time Mr. Oldfield was working in the Park as an engineer. He received complaints from lodge owners in Thredbo that the area of the Winterhaus slide had deteriorated sufficiently to pose a further danger of the embankment slipping. He formed the opinion that the drainage in the area of the Winterhaus slide was inadequate and arranged for the table drain on the south side of the road to be deepened and lined with bitumen by the DMR. That work led to the situation he observed above the Winterhaus having been arrested.[53]

133. Although no other record of the Winterhaus slide was produced from either the Trust or NPWS records, there appears to be little controversy that it should have come to the Trust's attention.[54]

134. There is a reflection of Trust concern about the proximity of the Village to the road. In July 1965, just a few months after the repairs to the area of the Winterhaus

landslide, Superintendent Gare expressed caution about the development of the lot where Carinya was ultimately to be developed and lots further to its east, proposed as part of the Eastern Subdivision, because of his concern that the sideslope in the vicinity of those lots was critical to further road improvement.[55]

135. NPWS submitted that the Trust did not know about the Winterhaus landslide. I find this an extraordinary submission. As should be apparent from my description of the incident, the landslide should have been apparent to anybody who travelled along the Alpine Way for a period of approximately five months from October 1964 through to March 1965. Mr. Dwyer acknowledged that he was sure the landslide would have come to the attention of the Superintendent. As at November 1964, for example, the cracks in the Alpine Way pavement had widened and it was clear that whatever movement had been associated with the landslide was continuing. At that stage SMHEA was recommending that heavy transport be diverted around the landslide through Thredbo Village.[56] I infer that the reason there is no mention of the landslide in Trust documents is similar to that Mr. Van der Lee gave, namely, that it was seen as an SMHEA problem which had been dealt with by that Authority.

136. Superintendent Gare's Memorandum of July 1965 indicates that he was conscious of the view expressed in SMHEA draft letter which was never sent to the effect that the siting of the lodges in the Village had been carried out without reference to the needs for maintenance of the road. I cannot speculate as to whether or not he formed that view as a result of discussions with representatives of SMHEA. No doubt it was abundantly apparent from mere observation that the lodges were so close to the road that future repairs would be rendered difficult. I note, for example, that one of the explanations given for the fact that the landslide was not prevented from occurring despite the forewarning given by the cracks in the road was that the steep sideslope and the proximity of the guest houses to it made it impractical to provide any additional support to the fill.[57] Much the same sentiment was to be echoed many years down the track when in 1984 the DMR was considering reconstructing the road and did not include that section above Thredbo because of the difficulties occasioned by the proximity of development.[58] The Winterhaus landslide was but one illustration of the general problem of the instability of the Alpine Way. Whether or not the specific incident was known to the Trust or the DMR, the vulnerability of the road to landslide was well known to both.

137. Shortly after the State of New South Wales assumed responsibility for the Park roads, the DMR undertook an inspection of them. The inspection revealed a location overlooking Thredbo Village where, according to those undertaking the inspection "the road is tending to slip down onto the village." The record of the inspection noted that the DMR was to "ask the SMA for details of their investigations and the treatment of the slip areas past Thredbo Village." It seems highly probable that this was a reference to the Winterhaus slide which area was the subject of similar observations made by Mr. Oldfield in July of the same year.[59]

Status of the Alpine Way before 1968

138. The Trust was aware from the 1950's that the Park roads were not being constructed for permanent use.[60] Although, again, its discovered records make no note of this event, it would be expected that it would have been aware of the slip which occurred above the Winterhaus corner in 1958 when the Alpine Way was upgraded. The scar left by this slip was readily apparent even in 1997. It was viewed with concern by people wishing to develop lodges within the village. SMHEA bulldozed the fallen spoil from the slide onto the northern side of the Alpine Way causing what was described as an "unnatural batter" and as constituting a "serious menace … to the whole of the Alpine Village lying below this land."[61]

139. The DMR resisted taking responsibility for the Alpine Way. It was of the view that it was not a suitable road for a State Highway and that it would need a great deal of money to put the road in suitable condition for tourists.[62] The debate which took place prior to the State taking over responsibility for the road in April 1968 indicates the tensions which existed arising from the fact that it was SMHEA which had determined the location and mode of construction of the Alpine Way, yet there were many other groups interested in taking advantage of the road. One of the principal difficulties with their respective use of the road was that considerable sums of money needed to be spent on it to make it suitable for long term use. The problems were well illustrated by early complaints made by KT1 complaining about the condition of the Alpine Way. The DMR took the view that it had been presented with a "fait accompli" by SMHEA which had provided a road across the mountains which could not be denied to the public in the future and would progressively require considerable sums of DMR money for improvement over the years.[63]

140. The problems which confronted the DMR, the Trust and later NPWS were simple. The standard of road construction in the Park were notably below those generally accepted for roads carrying similar traffic volumes. The deficiencies consisted of sub-standard foundations, poor construction, poor alignment, ineffective drainage and excessively steep and winding sections. These problems arose from the fact that, as already outlined, the Park roads were designed for short term requirements and were not built to standards suitable for the large volumes of public traffic which they attracted. In a 1973 report which investigated the Park roads, the authors pointed out that although the roads had been designed for construction purposes, during the 1950's and the 1960's SMHEA had actively encouraged tourists to view the Snowy Mountain's Scheme and thus stimulated a change in the pattern of road usage.[64]

141. Notwithstanding that encouragement, the Commonwealth refused to take any fiscal responsibility for the road apart from contributing to the use of the road said to be attributable to SMHEA.[65] Finally, in 1966 SMHEA announced that it would have no further use for the Alpine Way as a construction road, would cease to carry out maintenance and considered the road to the State Government's responsibility. The

Alpine Way was regarded as a prime example of the low standards attached to the Park roads.[66]

142. No doubt the Winterhaus slide served only to highlight the manifest problems of the road. From soon after SMHEA announcement that it had no further use of the Alpine Way, the Trust sought clarification of who was to be responsible for the maintenance of the lengthy road.

143. When it took over the responsibility for the roads, NPWS wanted maintenance priorities directed to the Alpine Way. This was no doubt in part, at least, because KT1 continuously pressed first the Trust and later NPWS to improve the Alpine Way at least up to the Park entrance. NPWS, however, had limited funds available to maintain the Park roads.[67]

144. Mr. Oldfield reported many incidents of batter slips along the Alpine Way and other Park roads in the period soon after NPWS assumed responsibility for them.[68] Indeed, Mr. Oldfield gave evidence that in his view there were two potential slip areas above the Village, one located between the Alpine Way and Banjo Drive and the other the site of the 1997 landslide. He identified the latter as a potential slip area, he said, because the trees were leaning over and it was wet on the uphill cutting. He said he made sure the drains were not blocked in that location and advised the DMR of it and told them to keep the drains clear. He said he also informed the Superintendent of the Park at the time.[69]

145. He said that he foresaw that if the drains were not kept clear in that area there might be a medium sized slip, meaning that the land might slip onto Bobuck Lane.[70] Like all other engineers who were involved in the road, he regarded drainage as essential as, if it was not maintained, the road would become unstable and liable to slip.[71]

146. NPWS submitted, in relation to Mr. Oldfield, that his recollection of two potential slip areas was poor and unreliable. The submissions made a point I regard as compelling to the effect that it was Mr. Oldfield's practice to record matters requiring attention by NPWS. On the assumption that all memoranda Mr. Oldfield has written concerning the matters in issue have been produced by the NPWS, it is certainly the case that there is no mention of a concern about a potential slip area to the east of Schuss Lodge, the position in which he placed it when he gave evidence before me.

Tyrola Lodge

147. There is, however, a series of memoranda in which Mr. Oldfield deals with some concerns which arose in relation to Tyrola Lodge, which is immediately to the west of Schuss Lodge.

148. In March 1969 a Park Ranger wrote to Mr. Oldfield reporting to him concerns expressed by the owners of Tyrola Lodge about the position of a number of granite

boulders embedded in the fill batter of the Alpine Way to the south east of the Lodge. The note pointed out that inspection revealed that upwards of 20 boulders were partially embedded or resting upon a detritis of granite sand and shattered tree trunks, stumps and the like. The Ranger commented that excavations for the foundation of the Lodge appeared to have over-steepened the fill batter above the critical angle of repose for the materials and pointed out that the possibility of slip circle failures or individual rock falls could not be overlooked. He viewed the whole area as being in danger of slip.[72] Mr. Oldfield inspected the area in June 1969 by which time he was able to observe several small slip circle failures on the roadside batter. In a memorandum addressed to the Superintendent, he pointed out:

> *"The conditions that are prevailing at the moment, I feel, have been brought to bear by the fact that the SMHEA constructed the Alpine Way very cheaply and did not dispose of dead timber from out of the fill. This dead timber trapped various rocks and now the timber is rotting some danger exists to the buildings below the Alpine Way. I feel the SMHEA should be asked to remove these rocks at their expense. Additionally, the building of lodges below the road has created the problem as without any buildings in this area, no danger to human life would exist."*

149. The memorandum carried a note, apparently written by the Superintendent, asking Mr. Oldfield to discuss with Mr. Neary what liability the Service had and institute appropriate action. The author of the note thought it would be difficult to hold SMHEA to any responsibility.[73]

150. It is not clear whether anything was done in the short term in relation to the problem adjacent to Tyrola however, in March 1971 Ranger Robson sent a note to Mr. Oldfield advising that the Manger of Tyrola had asked that rocks and tree stumps be removed from the road batter above the Lodge. Echoing Mr. Oldfield's words of 1969, Ranger Robson pointed out that "This material … could cause damage to the building should there be any slip in a batter surface." He advised that Mr. Isberg, the NPWS Engineer and others had inspected the area and that Mr. Isberg was to confirm the Service's responsibility in relation to the work.[74] The Acting Superintendent of the time wrote to the Director of the Service advising that his opinion was that "Once we have taken over a road such as the Alpine Way, we are responsible for remedying any hazard that road poses to buildings." Furthermore, he noted:

> *"… the question is important on a matter of principle, in view of the poor standard of original construction of this road and the likelihood of other defects of this nature."*[75]

151. Mr. Isberg provided his views in early April 1971. He regarded the Manager's request as a "test case for similar future requests from other lodge owners along the road." In a memorandum, which, in my view, demonstrates very clearly the NPWS' full appreciation of the dangers to the lodges from the Alpine Way batter he wrote:

> *"The general impression of the area is that development close to the road batter should never have been allowed. Any removal at this stage of existing rocks and timber may*

> *or may not trigger off a disturbance in the rock batter. If a slip later should occur the removal of a few stones would not prevent serious damage or destruction of the lodge but the Service could be held responsible for disturbance of the stability of the batter. Leaving the area as it is will create a 'non-feasance' condition freeing the Service from all responsibility."*

152. In the light of his view, he recommended that the owner of Tyrola be told the Service was not prepared to undertake any work on the road batter but could, at his own expense and responsibility erect a retaining wall at the bottom of the batter to prevent any loose material rolling onto the walls of the lodge. The Director of the NPWS endorsed Mr. Isberg's recommendation and asked the Superintendent of the Park to deal with the matter on the recommended basis and report on the outcome. It is notable that a person, who appears to have been Mr. Gare, wrote at the bottom of the memorandum "How can we adopt this attitude now?".[76]

153. It appears that Mr. Isberg's recommendation had been overtaken by events as in mid-March some rock from the Alpine Way batter fell onto the lodge's barbecue pit and Ranger Robson was asked to arrange necessary protective measures using KT1 equipment.[77]

154. I have little doubt that Mr. Isberg fully appreciated the significance of what he wrote. Only a few weeks before he had written a memorandum for the Service's Chief Operations Officer and Assistant Director (Management) dealing with maintenance organisation for roads in the Park. I have already set out the detail of that memorandum however, in the present context it is significant to note his reference to the minimum standards of the early construction of the roads by SMHEA had led to "embankments filled on steep mountain slopes without proper benching causing serious landslides."[78]

155. I cannot believe that by 2 April 1971 when he wrote his memorandum concerning the particular problem near Tyrola that he did not have in mind the possibility a serious landslide above the Village from those fill embankments. He referred to the possibility of the destruction of a lodge. He could not have entertained that possibility without also entertaining the likelihood of death, or at least injury to occupants.

156. NPWS submits that I should not find that Mr. Isberg's memorandum demonstrates the making of a deliberate decision not to take steps to stabilise the road above Thredbo. It points out that that would be a serious conclusion which should only be made in the event that strong evidence existed in its support. I do not think I need go beyond the terms of Mr. Isberg's memorandum to find that evidence for it was endorsed, as I have said, by the Director of the Service. It is true, as NPWS submits, that notes on the memorandum indicate dissent. All of those notes, however, appear to have been prepared by NPWS officers serving within the Park. There is no indication that the Director ever altered the view expressed by endorsing Mr. Isberg's memorandum.

157. NPWS also submits that the incident recorded in relation to Tyrola "merely reports on a local condition which required a local solution." However, as Mr. Isberg said, the problem raised by the Manager presented a test case. It is clear that he foresaw that similar problems would arise in relation to other lodges along the Alpine Way. That is hardly surprising having regard to the views he expressed in his March 1971 memorandum.

158. NPWS also submits that nothing in Mr. Isberg's memorandum supported the proposition as a matter of logic that the event in question warranted the reconstruction of the Alpine Way at a cost of millions of dollars. I cannot agree with that submission. Once it was recognised, as Mr. Isberg must, that there was a risk of a serious landslide from the Alpine Way fill embankment which might lead to the destruction of a lodge in Thredbo Village it was incumbent upon NPWS in my opinion to take all available steps to have the Alpine Way reconstructed in such a way as would eliminate the risk posed to the Village by the unsatisfactory road.

159. Against that I should weigh the fact that in the March 1971 memorandum, Mr. Isberg proposed that maintenance of the Park roads be attached to the Park Superintendent's office so that, among other things major improvements or reconstruction works could be designed by Parks engineering staff. The idea that there should be major improvement works along the road was not novel. Soon after NPWS assumed responsibility for the Park roads, the Public Service Board undertook a review of road servicing within the Park at the request of the Minister for Lands, Mr. T. L. Lewis MLA. The report made it clear that the Board thought that technical services in depth were beyond the capacity or potential of the NPWS and that it should continue to rely on the DMR for technical services except where specific problems could be referred to outside consultants. It highlighted the tension which existed between the DMR and NPWS, with DMR officers seeing their role as advisory only with the NPWS officers making the decisions whereas NPWS officers regarded the program advised by the DMR as something which could hardly be questioned. The consequence was, according to the authors, that it was "doubtful if officers of the DMR look on the annual programs submitted as forming part of a long range plan whilst executive officers of the NPWS are inclined to regard the DMR as accepting the responsibility for a degree of long term planning." In the area of long term planning the report pointed out that a detailed survey of road bases and services should be made because it was widely reported that the roads were construction roads. Thus, it was said, road bases were allegedly so poor that in some locations maintenance at a high cost was possible only up to the point in time when the road must be reconstructed completely."[79]

160. There is no doubt that considerable attention was paid in the 1970's to the reconstruction of the Alpine Way. I have no doubt that those who determine the priority of the areas which should be reconstructed were well intentioned. I note, for example, that in late 1970 Superintendent Gare advised the Director of NPWS, after discussions with Engineer Oldfield, that serious slips and other road failures during

winter had led to the expenditure of a large proportion of the eighty-one thousand dollar estimate proposed for road improvements on the Alpine Way. He urged that as much money as possible be spent on road improvements that summer to prevent further deterioration of the roads such as had occurred during the previous winter. In the absence of what was described as "the detailed Survey which has been suggested previously" he considered that top priority should be accorded to the progressive improvement of the Alpine Way from Dead Horse Gap towards Tom Groggin. This area, it might be noted, is some distance to the west of Thredbo. He reiterated what, in his view, was the need for a systematic survey of the whole Park road system by a competent engineer reporting to the Service.[80]

161. The matters reported upon in relation to Tyrola in March and April 1971, did not lead to any re-allocation of priorities.

162. It is hardly surprising, however, that officers of NPWS remained concerned about the safety of the village. Soon after the 1997 landslide, Mr. Gallard, who had worked as a Ranger in the Park from 1967 until 1990 gave a statement to the Police. He said he noted that the area between the Thredbo Ranger Station, the Village and Dead Horse Gap was particularly prone to road slip. Above Thredbo Village he observed that the cut and fill batters were potentially subject to landslips. He said that the Rangers of the day used to watch the area carefully for any signs of a slip developing. Indeed, he said, the Rangers had:

> *"… discussed this problem amongst ourselves and were of the opinion that the whole village, under the right conditions could slip into the Thredbo River."*

163. He said the Rangers discussed their views with a number of people including the DMR Engineer of the time, the NPWS Engineer, Mr. Blakers and representatives of KT1. He was told he was raising unnecessary fears in residents and there was nothing to worry about.[81] None of those to whom he referred recalled such conversations.

164. There is no doubt Mr. Gallard was concerned about landslides sufficiently to make extensive photographic records of several which occurred during his term of duties. In early 1973 the road was closed due to road slips which were said to be a function of the original low standard of construction. The Minister for Lands advised KT1, which complained about the problem of the road being regularly closed by washcuts that such problems would only be overcome when the Alpine Way was "reconstructed to an adequate standard with proper drainage, formation, width and sealing."[82] In August 1974 the road was closed again due to a landslip approximately one kilometre inside the Park.

165. The most significant landslide of the 1970's occurred in October 1978. On that occasion a length of approximately 50 metres of the Alpine Way slipped some 200 or so metres into the Thredbo River completely closing the road. Warnings of the landslide's imminence had appeared for approximately a week before with increasing

cracking in the surface of the road. The landslide occurred approximately three kilometres to the east of Thredbo. The Village was isolated from traffic from the east for a number of weeks while the road was repaired. Although there is no contemporary document specifically claiming to identify the cause of the landslide, the DMR Works Engineer reported that the slip uncovered a large number of springs flowing in all parts of the failed road and that heavy rains had fallen in the week preceding the slip. Most of the material was saturated, according to the Engineer, and "required little effort to make it flow."[83]

166. The 1978 landslide was the first which appears directly to have provoked concern in the senior ranks of NPWS concerning its implications for Thredbo Village. As I have mentioned elsewhere in this Report, it was only a short time after that landslide that a request was received from KT1 that approval be given to the development of the Western Subdivision. NPWS's first response was to advise that the submission had to be viewed in the light of concerns about the stability of the Alpine Way "particularly highlighted by the recent slope subsidence." (emphasis added)

167. An interesting insight into the attitude of the DMR to the significance of the 1978 landslide comes from correspondence which took place between Mrs. Koeman, the Secretary of the Thredbo Chamber of Commerce, her Local Member and the DMR. She conveyed her anxiety as to whether a survey of the Alpine Way within the Park had taken place to indicate whether any further landslides were anticipated.[84] It is worth quoting substantial portions of the DMR's response about the long term stability of parts of the Alpine Way:

> *"As you are aware, there are numerous locations where it is known that slips could occur, and these are monitored by the Department's officers during normal maintenance inspection. Due to the nature of the road and the original methods of construction, there would also be locations where slips could occur, although the sites presently show no sign that they might become unstable.*
>
> *Works to prevent slips happening initially or to stabilise areas where some movement has already occurred are usually very expensive and frequently the desired results are not obtained.*
>
> *It is not considered economically feasible to undertake expensive works of doubtful effect at all locations where a slip may possibly occur at some time in the future."*[85]

168. NPWS accepts that by at least 1978 information was available to all bodies and persons with an interest in the Alpine Way that it was prone to landslips and required its length to be reconstructed although the primary focus was to provide a safe surface for the passage of vehicles. It submits, however, that I should not consider its role in failing to take steps to rectify the defective construction of the road adjacent to Thredbo prior to July 1997 without having regard to the roles played by others in respect to the road which was of significance not only, it submits, to the region but to the State and Federal Government.

169. NPWS submits that prior to 1978 there is insufficient evidence to suggest that it was sufficiently aware of the instability of the Alpine Way. It accepts, however, that by 1978, presumably when the 1978 landslide occurred, information was available to all bodies and persons with an interest in the Alpine Way that it was prone to landslips and required its length to be reconstructed. It suggests that the primary focus was to provide a safe surface for the passage of vehicles.[86]

170. It submits, however, that in considering the issue of the Alpine Way attention must be paid not only to the role of NPWS, but also to the role which was played by others in respect to the road. In particular it submits that there is consistent and uncontradicted evidence that the RTA was in control of determining priorities for the reconstruction of the Alpine Way.[87] Needless to say that RTA submission is to the opposite effect.

Relationship between NPWS and the DMR

171. NPWS submits that the DMR/RTA was in control of determining priorities for the reconstruction of the Alpine Way. On this basis any decision not to reconstruct the road above the Village was, it was submitted, a decision of the DMR/RTA and not one in which NPWS participated or to which it contributed.

172. The DMR, on the other hand, submits that the legal arrangement between NPWS and it of principal and agent is an accurate factual representation of the relationship. In other words, the DMR submits that it did what it was instructed to do by NPWS. It refers to a number of documents which came into existence in the early period of the NPWS' responsibility for the Alpine Way which, it is true, indicate the DMR's belief that it was up to NPWS to decide what should be done on the roads.

173. The submissions of NPWS and the DMR concerning the substantive nature of their relationship during the period 1968 to 1988 ironically reflects the tensions commented upon by the Public Service Board in its 1970 Review of Road Servicing.[88] I have referred previously to that tension.

174. As I have emphasised throughout this Report, it is not my function to decide, as a matter of law, the relationship between NPWS and the RTA.

175. I think the common sense view, which most members of the community would hold is that at the end of the day it was the DMR which held the upper hand in the relationship with NPWS in the sense that its specialty lay in the construction and maintenance of roads. The point was well put by the Minister of Transport in 1975 in response to a submission that serious consideration should be given to terminating the DMR's role in relation to the Park roads. It is apparent that the Commissioner for Main Roads had formed the view that the Department's commitment to undertake works in the Park had become inconvenient and uneconomical. Moreover, the Department was concerned with "the question of liability for any claims arising from road deficiencies inherent in the original construction undertaken

by the Snowy Mountains Hydro-Electric Authority." The liability with which the Commissioner was concerned appears to have arisen from two fatal accidents in 1973 involving tourist coaches on the Alpine Way and another Park road. He was concerned that the DMR would be seen by the general public to be the maintaining Authority and be criticised for any deficiencies in the roads "even though the standard of maintenance is specified by the Service."[89]

176. The Minister for Transport and Highways did not agree with the Commissioner's submission. In response he reminded the Commissioner of the "Government's intention that your Department be the principal road constructing Authority in the State. In this role, I envisage that your Department would not only build roads, but have the broad oversight of as many of the State's road programs as practicable. By this, I do not mean that your Department actually carry out the road work in every case but, where appropriate, exercise a supervisory and coordinating role."[90]

177. The role the Minister envisaged the DMR playing both generally and in relation to the Park roads reflects, I have no doubt, the common perception of the DMR's role. Indeed, it was that perception that the Commissioner warned might be to the DMR's disadvantage in relation to its work in the Park. It would also reflect a common sense view of their relationship. Although it is the case that some 1970's NPWS documents indicate an understanding on the part of at least one engineer employed by NPWS of some difficulties presented by the mode of construction of the Park roads,[91] I accept the evidence of Mr. Blakers, the NPWS Engineer responsible for the roads from 1971 until 1994 that the DMR was considered to be the expert body and that he was not able to advise that body on how to allocate resources for maintenance of a roadway.[92]

178. Mr. Allen was the DMR Divisional Engineer at Bega and responsible for works conducted by the DMR on behalf of NPWS in the Park from 1979 until 1982. He said he understood that "the relationship between the DMR and NPWS was such that the ultimate decision on what work would be done and with what priority was a matter for NPWS, but it was the DMR's task to provide advice to assist the NPWS to make such decisions as it could make having regard to the funding it had available."[93]

179. Mr. Allen's understanding of the relationship appears to accord with the Minister of Transport and Highway's expectation that the DMR would in acting as the principal road constructing authority in the State advise NPWS on what work should be done. By the same token, the DMR submits and I accept, that it would be expected that NPWS would have a better understanding than the DMR and would bring to the DMR's attention any particular instances of concern relating to the Park roads upon which it sought advice from the DMR.

180. Throughout the years, the DMR acted as NPWS's agent in relation to the Park roads, no advice was given that the Alpine Way above Thredbo should be reconstructed or remediated in any way. Similarly, throughout the same period, NPWS did not seek

any specific advice from the DMR concerning that section of the road. Having regard to the agreement at the Convocation of Engineers that Alpine Way fill above the Village was in fragile condition and the slope had only marginal stability, the question must be asked why those conditions were not observed prior to the landslide and steps taken to reconstruct the road to eliminate any risk the condition of the embankment posed.

181. A number of submissions were made by NPWS and the DMR respectively concerning the fact that the Alpine Way was not reconstructed above Thredbo.

182. NPWS submitted that:

- The DMR decided not to rebuild the Alpine Way above Thredbo and did not advise NPWS of that decision.
- NPWS did everything it could to make sure the Alpine Way was rebuilt including seeking funding, but it had to defer to DMR advice as to funding.
- It did everything it could to seek to have the Alpine Way reclassified.

183. The DMR, on the other hand, submitted:

- That it carried out NPWS's instructions in relation to works done on the road.
- That in any event it was of the opinion that the Alpine Way was stable under normal conditions and it acted in accordance with this opinion.
- That at least one officer during the 1970's had a full understanding of the history and functioning of the Alpine Way so that the NPWS was not a mere nominal principal in respect of the maintenance work on the road being undertaken by the DMR.
- That the Government and NPWS directed that priority be given to upgrading dangerous sections of the Alpine Way to enable the road to be used as a tourist route to Thredbo.

184. I have already dealt with the apparent appreciation by NPWS early in 1971 of the risk that landslides above the Village from the Alpine Way fill embankment could lead to destruction of the lodges below the road. There is no evidence before me that the opinion expressed by Mr. Isberg in his memoranda of March 1971 and April 1971 which reflect NPWS views in this regard were expressly communicated to the DMR. Nevertheless, it does not appear to accord with practical reality that the DMR would not have had the same appreciation as Mr. Isberg.

185. The only direct evidence of the DMR's opinion about the Alpine Way above Thredbo is that given by Mr. Allen in his statement to the Inquest which was settled by the RTA's legal advisers. It was provided at a time when the Inquest had reached the stage of expert evidence concerning the trigger of the landslide and a decision had been made, in the interests of case management, that no further witnesses be called. Thus, Mr. Allen was not cross-examined on his opinions. Nevertheless,

those opinions afford considerable insight into the DMR's approach to the Alpine Way.

186. Mr. Allen knew that the Alpine Way had originally been a track which was developed by cut and fill techniques without the usual levels of compaction and without benching. He knew the road had underlying problems caused by SMHEA's original construction techniques. He saw the principal underlying problem as being minor slipping of batter faces particularly after difficult winters. He believed the Alpine Way "to be stable under normal conditions." The only major failure of the Alpine Way of which he was aware was the 1978 landslide. He instructed his staff to monitor the road for cracks and movements and to inspect drainage. Areas of subsidence and slip were repaired promptly.

187. He believed that once a road such as the Alpine Way had stabilised after its original construction, a change in the normal conditions would be required to affect its stability. The sort of change he contemplated was a damaged or blocked culvert or other change which might cause water to enter the road fill and thus saturate and weaken it with the weight of the embankment above the fill then leading to slippage of the fill material. It was his experience that there is invariably some warning such as cracking before a major slip occurs.

188. He thought that the only way in which the difficulties of the Alpine Way could have been completely resolved was to rebuild the road in accordance with proper engineering principles. This would have included removing the old fill and replacing it with properly layered and compacted fill. However, with the limited funds available to NPWS, he said that leaving the fill in place was unavoidable. However, to minimise the difficulties presented by the fill, he said it was important to reduce the risk of water entering it.

189. He explained that while he was Divisional Engineer, no proposal was developed to reconstruct the road above Thredbo because:

- There was no sign or indication during the period of his involvement that anything other than a minor shoulder slip would occur.
- The road above Thredbo, while inadequately constructed in the first place, appeared to be stable. There was a concern that minor improvements to the road may reduce rather than improve its stability.
- The presence of inhabited buildings increased the undesirability of interfering with the slopes.
- There was no practical way at the time of satisfactorily overcoming the problems of the road without undertaking a full removal and reconstruction of the road above the village. The cost of such a project would have been beyond the nineteen million dollars of funding which had been suggested as being required to complete the seal of the Alpine Way between Dead Horse Gap and Khancoban.

- It would not have been possible in his view to install a retaining wall to replace the fill batters because the solid foundation required for such a wall would have been too deep.

- An alternative route through Thredbo Village catered for the majority of through traffic.

- It was not possible to widen the road southwards into the hill to any significant degree because to do so would have created a problem of an unstable cut batter on the south side of the road. Such a task, cutting back huge amounts of material on the hillside above the road would have left a very substantial scar which would have been unacceptable to NPWS. The cost of such roadworks would have been well beyond the funding available to NPWS.

190. In the light of Mr. Allen's recollections of his opinion at the time, it is interesting to note the contemporary views he expressed both in DMR and public documents. In 1981 he was quoted in an article published in a newspaper in relation to reconstruction works being undertaken by the DMR on the Alpine Way on that section of the road to the east of Thredbo. Mr. Allen accepts that he was accurately quoted in that article. The article attributes the following to him:

> *"The Alpine Way between Penderlea, 17 kilometres west of Jindabyne, and Khancoban was constructed some 25 years ago as an access road for the Snowy Mountains Scheme with an expected life span of about 20 years.*
>
> *The major problem in keeping the road beyond its originally intended life is in maintaining its stability against landslides in the steep Alpine country.*
>
> *It has been shown in recent years that the original road formation is now only marginally stable under saturated conditions and continuing slips are to be expected … in view of the much higher traffic volumes between Jindabyne and Thredbo compared with volumes between Thredbo and Khancoban and the need to maintain access to Thredbo Village, the limited road funds available for construction have been committed to improvements on the former section. … to increase stability, a subsoil drainage system is being installed which, together with sealed shoulders and the particular care and the control of surface run-off, will allow the water table to be lowered; thereby providing more stable conditions. …"* [94] (emphasis added)

191. It is clear from Mr. Allen's remarks that reconstructing the Alpine Way above Thredbo was not under consideration. In fact, Mr. Allen had given consideration to the question of widening of the road above Thredbo in March 1980 as part of a submission to provide a plan of operations for upgrading the road between Jindabyne and Khancoban. The submission set out a plan for reconstructing various sections of the Alpine Way and a summary of the costs for each section. It also allocated priority to the works recommended.[95] A Plan — SC291 — was attached to the submission which showed the length of the Alpine Way against a cross-section indicating the nature of the works to be undertaken in relation to each section of the road. The Alpine Way above Thredbo Village was marked out with an annotation "widening above Thredbo Village is undesirable through existing development."[96]

192. The NPWS submits that that note indicates a deliberate decision taken by the DMR not to reconstruct the road above the village, a decision which, it further submits, was not communicated to it. The DMR has submitted that this note was placed on the Plan because it related to the difficulty of cutting into the hillside embankment.

193. In the light of that submission, it is interesting to note that Mr. Allen further developed the point he made on that map when he was considering the issue of the Western Subdivision. In May 1980 Mr. Leaver, who was the Director of the South-East Region of NPWS, wrote to the DMR referring to KT1's application for approval to construct roadworks in the Western Subdivision. He enclosed the Coffey Partners Report on the Investigation of Stability of the Alpine Way and asked for the DMR's views about that Report.[97] Mr. Allen submitted a memorandum to the Engineer-in-Chief at the DMR Head Office advising that the conclusions drawn by Coffey and Partners that slips were likely along the existing Alpine Way above the proposed development, were in line with his Report of 12 March 1980. He expressed concern at the identification in the Coffey Report of decaying wood, trees and roots in the fills in regard to their effect on stability even after pavement widening and strengthening of the road. He concluded that reconstruction of the Alpine Way should be carried out before development of the Western Subdivision took place to ensure that development did not lead to subsequent failure of the road which he expressed to be "only marginally stable at present".[98]

194. In his statement, Mr. Allen said that he understood that the essence of the Coffey Report concerning the instability of the Alpine Way above the area of the Western Subdivision was that water had to be kept out of the embankment. This was consistent with the view he and his officers already held about the Alpine Way fill. He says, however, that he was aware "that the area of road above the Western Subdivision was more marginal than most of the rest of the Alpine Way…(because) it passed through a slightly flatter swampier area than other sections of the road, was slumping and was poorly drained."[99]

195. Mr. Allen's concerns about the difficulty of widening the Alpine Way above Thredbo Village was not the only occasion when the DMR expressed reservations about work in that location. In 1984 the DMR undertook an estimate of the cost of reconstructing the Alpine Way. It appears that those involved, who, coincidentally, included Mr. Ubrihien, used Mr. Allen's 1980 Plan (SC291) to undertake that exercise. Insofar as the section of the road above Thredbo Village was concerned, it was reported:

> *"The 1.3 km section above the Village of Thredbo has not been included because the proximity of development and the risk of landslips will require an intensive geological and cadastral survey to achieve a realistic estimate."*[100]

196. Mr. Ubrihien said that the "geological survey" which was referred to in that memorandum was intended to determine the risk of landslips. He accepted that he was conscious that there was a risk of landslips from that area of the Alpine Way

above Thredbo and was concerned that an intensive study was necessary to determine the extent of the work involved to negate that risk. He said he did not consider that the risks of landslips from the Alpine Way was any greater than the risks anywhere else along the road, but that, because of the closeness of the development, the consequences of them would be more of a problem.[101] He was aware that the distance landslides along the Alpine Way had travelled had been sufficient that if one occurred above Thredbo Village, it would encounter buildings within that range close to the road. Thus the danger consequent upon a landslide upon the Alpine Way above Thredbo would be much greater.[102]

197. Mr. Tim Sullivan commented upon the August 1984 Memorandum that that statement was one of the "most explicit acknowledgments of the risks associated with the Alpine Way above the village."[103]

198. The RTA has submitted that the true nature of the August 1984 Memorandum was, not to acknowledge the risks associated with the Alpine Way above the Village but, merely to state that to achieve a realistic estimate of the cost of reconstructing the road in that area, it would be necessary to undertake an intensive survey "to take into account the possibility of landslips arising out of the reconstruction work, in the context of the Village below the work, and also to take into account the cadastral (real property boundary) considerations arising out of reconstruction which could infringe on leasehold land. I cannot accept that submission. Not only is it inconsistent with the plain words of the document, it is also consistent with the evidence given by one of its authors, Mr. Ubrihien to which I have already referred.

199. Mr. Blakers gave evidence that he had never seen the August 1984 memorandum and that there was no discussion between himself and the DMR about reconstructing the road above the village.[104]

200. By the same token, it should be noted that Mr. Blakers held views about the Alpine Way above the Village which, it might be thought would have led to an express request by him to the DMR for advice about what, if any work should be undertaken in that area.

201. In October 1980 KT1's Village Manager contacted a Senior Ranger in the Park and expressed concern about potential landslip areas along the Alpine Way. The Senior Ranger inspected the sites with the Village Manager and some workmen from the DMR and found no immediate problems but asked the Acting Superintendent of the Park to obtain an authorised engineer from the DMR to appraise the stability of the Alpine Way between an area around Thredbo Diggings and the Village.[105] The Acting Superintendent submitted Mr. Moore's Report to Mr. Blakers, the Regional Engineer. It appears he and a Mr. Lehane, a geotechnical officer with NPWS, inspected the areas to which the Village Manager had drawn attention and an area "above Thredbo Village." A handwritten note of the inspection records Mr. Blaker's opinion:

> *"Mr. Blakers advises that the road could slip tomorrow or could last for a considerable period. However, at this stage it is a matter for the DMR as upgrading of the Alpine Way proceeds."*[106]

202. Mr. Blakers could not recall making that statement, but did not doubt that he may well have. He could not remember the inspection or what part of the Village was inspected. Although he could not recall either the inspection or the area, Mr. Blakers thought that if he or Mr. Lehane had considered the possibility of imminent road slippage they would have carried the matter further. He saw his remark as having been written in the context that the matter was being looked at by the DMR who were NPWS's technical advisers as well as contractors.[107]

203. NPWS submits that the statement Mr. Blakers made concerning the assessment of the slipped areas inspected in October 1980 was consistent with the proposition it advances to the effect that it was the DMR which had the dominant role in determining spending priorities on the Alpine Way and other Park roads.

204. It appears to me that there is some weight to be accorded to both the NPWS and RTA submissions concerning their respective roles. Certainly during the 1970's it was apparent that NPWS had formed the view to which I have already referred that there was a risk of serious landslides along the Alpine Way including above Thredbo Village and that such a landslide could cause the destruction of a lodge. It seems extraordinary, in the light of that opinion, that nothing was done about the road above the Village then and there.

205. Two reasons occur to me as to why nothing was done. Neither, I should say, is set out in the documents which were produced nor was the subject of direct evidence. Nevertheless, I am left with the overwhelming impression from the documents and the evidence which was given that the problem of the cost of maintenance, let alone reconstruction, of the Park roads burdened the officers of both NPWS and the DMR from the time NPWS assumed responsibility for them. I cannot ignore the fact that the Alpine Way was not the only road in the Park to be maintained, although, as far as I am aware, it was the only one next to which was positioned an essentially urban community. Furthermore, the documents indicate that the overwhelming pressure on both NPWS and the DMR was that attention be directed to the Alpine Way as a vehicular route. It appears to have been for that reason that over a ten year period ending in 1989[108] the Alpine Way leading up to the Village was reconstructed and that a section of the road far beyond the Village and to the west of Dead Horse Gap was also the subject of DMR works in the 1970's.

206. It is not for me to second guess decisions which were made concerning the allocation of funds for the maintenance and reconstruction of the Alpine Way.

207. Nevertheless, it is a matter of great concern to me that the opinions the DMR formed concerning the Alpine Way appear never to have been directly communicated to NPWS. Even accepting the DMR's Submission that its role in

relation to NPWS throughout the period 1968-1988 was that of agent only, it did not lose its capacity as the principal road constructing authority in the State in which position I would have expected it to have explained clearly to NPWS the vulnerability of the Alpine Way above the Village to landslide. Even an opinion that the Alpine Way above the Village was "stable under normal conditions" called out for clear communication to NPWS and advice concerning the potentially catastrophic consequences which could follow if the fill embankment was sufficiently saturated with water to cause landslides of the nature of those which had occurred along the Alpine Way in at least 1973, 1974 and 1978.

208. Mr. Allen said that the reason he did not relate the Coffey Reports concerning the Alpine Way embankment above the Western Subdivision area to the Alpine Way embankment above the rest of the Village and recommend that action be taken in respect of that part of the road was, in part, his expectation that the sorts of investigations NPWS required in relation to the Western Subdivision would have been expected in relation to the development of the rest of the village.[109]

209. I appreciate that Mr. Allen was in a difficult position in being asked to consider some 19 years after the event, a matter to which he appears never expressly to have turned his mind. Nevertheless, that opinion appears to me to be inconsistent with acknowledgement of the inadequate construction of the road above the existing Village and that the road was one which was only stable under normal conditions but required extensive rebuilding works to minimise the problems it posed.

210. At the very least, it appears to me, that the DMR should have expressly warned NPWS of the opinions it held concerning the Alpine Way as it ran past Thredbo. I am sure a clear warning from the State's principal road constructing authority would have clearly brought home to NPWS the necessity that reconstruction works be taken above the village.

211. By the same token, I am satisfied that even without the warning one might have hoped the DMR would have given NPWS concerning the road, NPWS itself had a great deal of information which it could have used to warn those responsible for Thredbo at various stages throughout its history that it was unsafe to build in proximity to the road and, indeed, that building construction should not be permitted in proximity to the Alpine Way unless it was rendered safe. There is no doubt that once NPWS became responsible for the roads in 1968 its knowledge of their condition and vulnerability to slip increased. As its knowledge increased so, too, did its responsibility to deal expressly with the problem. NPWS's response is that it did everything it could to make sure the road was rebuilt including seeking funding for the work. I accept that that is so. What those applications for funding lacked, however, was any express warning of the dangers the road posed to the buildings below in Thredbo Village.

212. It does seem to me that if express attention had been drawn to the risks the road posed to the Village below, that better consideration could have been given to

allocating resources to the reconstruction of the road adjacent to the Village so as to render it safe. I note, in this respect, that when the Sinclair Knight Report warned that land slippage was evident adjacent to Thredbo and that a landslip would not only cause severe damage to the road but that it may damage property and endanger human life, funds were allocated to undertake works along the road.[110] Regretfully, the funds which were allocated were not applied to remediation works above the village. Mr. Tony Sullivan did, however, spend part of them on securing the "peace of mind" provided by Mr. Warren-Gash's inspections and inclinometers.

The Bright Period

213. The arrangement between NPWS and the DMR in relation to the Park roads continued until 1988 when the funding agreement made in 1968 concerning maintenance of the road ended. At that time, NPWS reached an arrangement with the SRSC for the Council to be its agent to carry out maintenance works on the Alpine Way. The agreement lasted for five years during which time the SRSC undertook various programs of work as directed by NPWS. The arrangement altered slightly over that period as the Council undertook more specific construction and heavy maintenance works whilst NPWS increased its share of routine maintenance. The agreement was extended in June 1993 until June 1996.[111] For substantially all of the period the SRSC undertook maintenance works of the Alpine Way on behalf of NPWS Mr. Robert Bright was the Shire Engineer responsible for managing that arrangement.

214. Mr. Bright's reaction to the condition of the Alpine Way and his advice to NPWS stand in stark contrast to the DMR's. At the time he undertook the work on behalf of NPWS he had worked in the Park area for close to fourteen years. He had considerable experience with restoring slips along the Alpine Way all of which, whether major or minor, had involved the fill along that road.[112]

215. This was reflected in an Inspection Report prepared in April 1988 about the Alpine Way. Mr. Bright believed the Alpine Way was a road which was very vulnerable to major and minor slips.[113] At the end of it he noted "this road has a history of periodical major slips. …urgent funds would need to be sought at the time if a major slip should occur."[114]

216. Although he identified the vulnerability of the Alpine Way to major slips in his Inspection Report, he said he would not have been able to forecast specific areas along the road which were vulnerable to such slips unless there had been a detailed geotechnical study done of the road.[115]

217. In his Inspection Report, Mr. Bright singled out the 1.3 kilometres of the Alpine Way above Thredbo Village as being generally "in poor condition and requiring remedial works." He did this on the basis that it was his observation that that part of

the road did not ever appear to have had any substantial reconstruction works done upon it.[116]

218. In March 1989 another landslide occurred on the Alpine Way about two kilometres east of Thredbo Village. The landslide was approximately 20 metres wide and extended from the Alpine Way road shoulder approximately 200 metres downhill to the Thredbo River. About 2,000 cubic metres of material slipped in the landslide. When the landslide was being repaired, it was discovered that water from an under road culvert had been discharged into the fill batter, saturating it so that it was a potential slip zone waiting for some action to trigger the landslide. That trigger came with heavy rains and some excavation works at the bottom of the slope. The landslide closed one lane of traffic of the Alpine Way between Jindabyne and Thredbo.[117]

219. Approximately a year before the 1989 landslide, on 30 April 1988, a landslide occurred at Coledale near Wollongong when a section of rail embankment collapsed during a heavy rainstorm causing severe damage to a dwelling at the foot of the embankment and the death of two of the occupants. An Inquest took place after that landslide. The Inquest was terminated after the Coroner decided that criminal charges should be brought against officers of the State Rail Authority who had been responsible for inspection and maintenance of the rail embankment.

220. The Coledale disaster struck a chord with Mr. Bright because of the similarity between the nature of the collapse of that rail embankment and his knowledge of the propensity of the embankment along the Alpine Way to collapse.[118] He thought it appropriate to draw his concerns to the attention of NPWS. On 26 May 1989 he wrote a letter to the Superintendent of the Park. It is such an important letter that I set it out in full below:

> *"*Re: *Alpine Way - Potential for Ongoing Embankment Slips*
>
> *I wish to bring to your attention a matter of concern in regard to possible legal action against supervisory road maintenance staff should a slip occur on the Alpine Way co-incidental with a motor vehicle accident.*
>
> *A recent press report detailed an incident on the State Rail Authority's Illawarra Line in which a rail embankment slipped causing the loss of human life. Following a Coronial Inquest criminal charges were brought against S.R.A. Engineers and supervisory foreman. The case is yet to be heard in the Court and the long term effect on the industry is not known.*
>
> *The Alpine Way with its history of road embankment slippage together with ordinary road traffic and coach traffic appears to be a parallel situation to the S.R.A. case. The Alpine Way had many potential slip sites and consequently I feel that it is appropriate that the issue be addressed as a policy matter by the National Parks and Wildlife Service.*"

221. A handwritten note on the letter, which the evidence discloses was written by the District Engineer with NPWS at the Park and was apparently addressed to the Acting Superintendent of the Park, reads:

> *"I do not accept any liability for this as long as:*
>
> *1. Limited funding is available.*
>
> *2. Advice given by myself is not attended to by NPWS.*
>
> *It is a very serious problem."*

222. The author of that note could not recall the "advice" to which he referred in that note nor the letter. He did, however, recall that nothing further happened during his employment with NPWS (which ceased in December 1989) about the issue raised by Mr. Bright.[119]

223. It is true that Mr. Bright's letter was directed to the possibility of the loss of life associated with a road embankment slippage affecting road traffic. His apparent lack of concern about the possibility that an embankment failure could involve an encounter with a lodge along the Alpine Way above Thredbo Village arose because he assumed that that section would have been the subject of an investigation before the village would have been allowed to have been built in that location.[120]

224. Mr. Blakers, who was Regional Engineer for the South Eastern Region at the time this letter was written, had no recollection of seeing it.[121] Nevertheless, it does appear to have been a matter of concern, at least to Mr. Huggett to whom it was directed. In June 1989 he attended a meeting between the Director of NPWS, Mr. Whitehouse and others who included Mr. Huggett and representatives of KT2. During that meeting the Alpine Way was discussed with the Director noting that he expected less money to be allocated to the upgrading of the road from Victoria. The minutes of the meeting, which appear to have been prepared by KT2, note:

> *"NPWS is concerned about further slips and the legal liabilities for those slips."*[122]

225. In 1990 Mr. Bright forwarded to NPWS proposals for the 1990/1991 road maintenance program for the Alpine Way. Coincidentally, at the time the court case which had resulted from the Coledale embankment failure was proceeding. He included the following in that letter:

> *"I would also refer to my previous correspondence in regard to the 'slip' potential of the Alpine Way. This road has a history of both small and large road formation losses due to slips. Although remote, it has the potential for a slip to occur concurrent with a vehicle (including passenger coaches) crossing that section of roadway. The current court case involving State Rail Authority accident involving the Coledale slip on the NSW South Coast has very similar parallels to vehicle traffic on the Alpine Way. I recommend that you monitor this case closely and consider any specific action you may wish to take in this regard."*

226. At about the same time that Mr. Bright was reminding NPWS of his concerns about slips along the road, a consulting engineering firm, Sinclair Knight and Partners prepared a report on behalf of NPWS as part of an endeavour to obtain further funding for road maintenance in the Park. Once again, it was brought home to NPWS in this report, how unstable the Park roads were. Thus, the report wrote:

> *"The roads were designed and built to a construction road standard inferior to current construction practices for similar design speed rural roadway. Roads were literally carved through the landscape with much of the vegetation en route being compacted underneath the sand and gravel road surfaces.*
>
> *Over time the vegetation has decomposed causing the road surface to subside and be in need of increasing maintenance including heavy patching.*
>
> *This is just propping up the roadway to keep it operational until a major and costly rebuild is required."*[123]

227. On this occasion, Mr. Bright's letter and, apparently, a complaint from the KT2 Engineer, concerning potential slip areas on the Alpine Way, got some response. The Minister responsible for NPWS was advised of possible problems with the Alpine Way particularly with the section from the Little Thredbo River to Thredbo Village. The Director of NPWS asked that a full investigation of potential problems be undertaken and, where appropriate, an independent expert engineering report be obtained. A copy of the NPWS internal memorandum from Mr. Huggett to the Roads Foreman, initiating that investigation was forwarded, as a matter of courtesy, to Mr. Bright. He concluded from the contents of that memorandum, that the issue of slips on the Alpine Way was being dealt with both as a policy issue and at the highest political levels. As a result, he felt that his responsibilities and those of the SRSC as contractor to NPWS had been fully undertaken.[124]

228. In late 1990 Mr. Tony Sullivan was employed by NPWS as the Kosciusko District Engineer. He was shown around the Alpine Way by Mr. Bright. Although Mr. Bright could not recall the detail of the conversation, he was sure he drew Mr. Tony Sullivan's attention to his concerns about the stability of the Alpine Way fill embankment.[125] One of the first tasks he undertook on behalf of NPWS after that first inspection with Mr. Tony Sullivan was a culvert survey intended to lead to a program of cleaning rehabilitation and reconstruction of culverts necessary for the long term maintenance of the road particularly in slip prone areas.[126] It is apparent from early reports prepared by Mr. Tony Sullivan that he was extremely conscious of the risk of slips along the Alpine Way and their potential to affect the Alpine Way so severely as to close the road. No doubt that intelligence was, at least in part, imparted to him by Mr. Bright.

229. In March 1991 the amount of work the SRSC was carrying out on behalf of NPWS contracted as NPWS increased its day labour organisation. The effect of that appeared to be that the SRSC was less involved on routine maintenance matters and undertook such works as heavy patching and resealing of roads.

230. This brief period during which Mr. Bright was giving advice to NPWS concerning the Alpine Way, must clearly have brought home to that organisation the potential consequences of a landslide along the road. It is true that Mr. Bright directed his remarks to an accident involving vehicular traffic because of his belief about the investigations which should have been undertaken in relation to the road before the village was constructed. Nevertheless, NPWS itself would have been under no doubt that the state of the road adjacent to the village was no better than anywhere else along its length. Although the Director sought a full investigation of potential problems with the road in April 1990, little appears to have happened before Mr. Tony Sullivan was employed at the end of that year. It does not even appear that Mr. Tony Sullivan saw Mr. Huggett's memorandum.

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1 Statement of Dr. Clive Perrett, 19 November 1997, ex. 132.1043, p. 9.
2 Statement of C. Perrett, ex. 132.1043 and 132.0052 par. 6.
3 Leaver T2829.51.
4 Report on Maintenance of Unclassified Roads Kosciusko National Park, 25 January 1988, ex. 78.08.
5 Report into Circumstances of Accident on 26 September 1973 in the Kosciusko National Park written by Mr. Shaw, February 1974, ex. 136.363.
6 Memorandum from R. Isberg to Chief Operations Officer and Assistant Director (Management), Kosciusko National Park Maintenance Organisation for Roads, 4 March 1971, ex. 78.16.
7 Sinclair Knight, Alpine Way Report, 1 May 1991, ex. 78.12.
8 Minutes of meeting of the Trust, 4 November 1955, ex. 132.0876.
9 Statement by the SMHEA on the Alpine Way, 14 July 1964, ex. 136.002.
10 Memorandum from the Secretary, KSPT to the Minister, 4 March 1966, ex. 136.114.
11 Letter from S Weems, Director, NPWS, to the Secretary, Public Service Board Sydney, dated 17 May 1968, ex. 132.0945.
12 ibid.
13 Letter from RTA to Snowy River Shire Council, 22 July 1997 (RT006060).
14 New South Wales - Cabinet Minutes No. 1372, 5 August 1980, ex. 54.72, par. 4.1.
15 Report on Historical and Planning Issues, PSM R1, par. 2.2.3.
16 Hanlon, F.N., Presidential Address, 27 October 1958, Geology and Transport with Special Reference to Landslides on the near South Coast of NSW. ex. 62.27
17 Landslides - Investigation and Mitigation, special report 247, Transportation Research Board, par.3.1.
18 Letter from J. Kelly, Divisional Engineer (DMR) to J Akister, 13 February 1979, ex. 132.0954, R. Bright, Inspection Report, 15 April 1988, Letter from R. Bright to Superintendent, Kosciusko National Park, 26 May 1989, part ex. 69.02, ex. 78.09, Letter from R. Bright to Director NPWS, dated 15 March 1990 part ex. 69.02, Alpine Way Report, Sinclair Knight, May 1991, ex. 78.12, Bright T3389.26-.48.
19 Statement of W. Cameron ex. 132.0147/ex. 132.0148; Photograph ex. 94.104.
20 Statement of T. Lewis, 14 August 1997, ex. 132.0049; Letter from C.J. Berry to KTL, 24 February 1960, ex. 50.18; Letter from KTL to C.J. Berry, March 1960, ex. 132.0563.
21 Statement of D. Svenson, 20 August 1997, ex. 72.01; Statement of C. Perrett, 8 August 1997, ex. 132.0052; Statement of C. Perrett, 19 November 1997, ex. 132.1043; Statement of B. Clifford, 12 August 1997, ex. 132.0114; Report prepared by D. Svenson titled "Construction Materials Report - Report on Landslide failure of Gully fill on the Alpine Way at Thredbo Village Winterhaus Slip, October 64", ex. 56.19; Photographs of the Alpine Way in the Vicinity of the Winterhaus Guest Lodge slip, exs. 54.36, 57.41, 57.42, 132.0170, 94.105-107; Plan of Alpine Way Landslide on Gully Fill at Thredbo Village, 5 October 1964, ex. 62.03; Memorandum from T. Leech to Field Construction Engineer, 26 November 1964, ex. 72.04; Letter from B. Clifford to SMHEA, 23 January 1965, ex. 132.0054; Memorandum from W. Crombie to Field Construction Engineer, 25 January 1965, ex. 132.0053; Memorandum from T.E. Lewis, Field Construction Engineer, to Business Manager, 5 February 1965, Draft letter from P.G. Collins to Mrs. V Clifford, 4 February 1965; letter from P.G. Collins to Mrs. V. Clifford, 10 February 1965, all ex. 56.26; Memorandum from T.E. Lewis to Associate Commissioner Merrigan, 2 March 1965, ex. 42.21; Memorandum from R. Oldfield to Superintendent, 19 July 1968, ex. 66.05; K. Dwyer T1464.12, T1466.13; D. Svenson T3716.36, T3717.18, T3719.24-3731.40, T3729.21, T3737.14-3740.07, T3753.44-.58; J. Turner T1708.51; J. Hagley T1843.09-.35, T1878.37, T2434.15; A. Van der Lee T 2418.15 -2424.50, T2576.26.
22 Statement of A. Van der Lee, 4 November 1998, ex. 62.02; A. Van der Lee T2426.

[23] DMR Memorandum, Inspection of the Park Roads, 18 July 1988, ex. 66.15.

[24] Memorandum by R. Oldfield to Superintendent, 19 July 1968, ex. 66.05; R. Oldfield, T2975.29, T2997.17.

[25] Statement of A.J. Gallard, 14 August 1997, ex. 78.04; Statement of A.E. Carter, 19 September 1997, ex. 132.0089; Letter by H. Droga to Minister of Land, 20 February 1973, ex. 133.032; Letter by D. Johnstone to H Droga (GM - KT), 20 July 1973, ex. 78.18; Letter by T. Lewis to H. Droga (GM - KT), 11 August 1973, ex. 78.19.

[26] Statement of A.J. Gallard, 14 August 1997, ex. 78.04; Photographs: exs. 132.0187, 132.0209, 132.0211, 132.0207, 132.0188, 132.0194, 132.0208, 132.0203, 132.0210, 132.0214, 132.0193, 132.0204, 132.0189, 132.0198, 132.0199, 132.0195, 132.0190, 132.0206, 94.108-109; Memorandum from G.F. Martin (Superintendent) to the Director, 6 February 1974, ex. 132.0654; Letter from G.F. Martin to Divisional Engineer, 29 October 1974, ex. 132.0649; Letter from C.A. Gittoes to NPWS, 3 October 1975, ex. 136.149; Memorandum from J. A. Erskine to the Director, 13 May 1976, with letter, 29 October 1974, from G. F. Martin to Divisional Engineer DMR and letter, 28 October 1974, from Soil Conservation Service to Divisional Engineer DMR, ex. 132.0923.

[27] Statement L. Blakers (NPWS), 17 September 1998, ex. 78.01 par. 37; Statement of W. Dagger, 7 October 1998, ex. 80.02 esp. at par. 34; DMR photographs of 1978 landslide and repair work, 5 October 1978, ex. 132.1005, Gallard photographs of 1978 landslide exs. 78.21, 94.111-2, 75.14, 78.21, 132.0215-6, 132.0175, 132.0184, 132.0176-9, 132.0181-3, 132.0213 some included in PSM R4 as 94.110-112; Photographs in ex. 62.23, 65.07 (PW084026 and PW084027) - see W. Dagger statement ex. 80.02, par. 45; Minutes of meeting of KNP Advisory Committee re Alpine Way reconstruction and maintenance, 5 October 1978, ex. 132.0675; Telex. from L. Blakers to J. Burrell (NPWS), 6 October 1978, ex. 78.22; Letter from J. Cook (Civil and Civic) to Chief Engineer, DMR, 16 October 1978, ex. 132.0983; Letter by Clout (Town Clerk), 16 October 1978, ex. 132.0984; Memorandum from R.W. Smith to the Superintendent, Kosciusko National Park, 26 October 1978, ex. 132.0679; Newspaper report, 1 November 1978, ex. 132.0483; Memorandum from J. Kelly (DMR) to the Engineer-in-Chief, 9 November 1978, ex. 132.1006; Letter from The Hon. D.P. Landa to A. Koeman, 10 November 1978, ex. 133.074; Letter from H. Jensen to A. Koeman, 14 November 1978, ex. 133.075; Letter from H Jensen Cooma Shire Council, 14 November 1978, ex. 136.038; Memorandum from M. Matthews to S. Hornery, 15 November 1978, ex. 132.0484; Letter from J. Robson to J. Chappell, 20 November 1978 attaching report from J. Strikis (DMR), ex. 62.43; Letter from J. Robson to KTPL, 14 December 1978, ex. 59.05; Letter from J. Akister to J. Kelly, Divisional Engineer, DMR, 5 February 1979, ex. 132.0955; Letter from J. Kelly, Divisional Engineer (DMR) to J Akister, 13 February 1979, ex. 132.0954; Letter from M .R. Matthews to The Hon. D.P. Landa, 13 February 1979, ex. 59.07; Memorandum from W. Dagger to Superintendent, Regional Director, 13 August 1979, ex. 65.07; Memorandum written by L. Blakers, 17 August 1979, ex. 65.06; Memorandum from J. Robson to B. Leaver, 23 August 1979, ex. 57.55; Letter B. Leaver to KT1, 24 August 1979, ex. 59.10; Letter from M. Matthews (KT1) to B. Leaver, 4 September 1979 ex. 59.11; Report prepared by R. Knutson titled "Reconstruction of the Alpine Way - KNP" undated ex. 65.13; W. Dagger T4743.26-T4746.41, T4904.18-T4905.43; L. Blakers T4536.02-T4538.05, T4551.01, T4553.58, T4580.53-T4581.03; B. Leaver T2844.12-T2845.02, T2847.55-T2848.51, T2881.06-.14, T2961.21-T2962.40; A. Van der Lee T2509.50-T2510.61, T2512.04-T2513.57.

[28] Photographs, PSM R4, ex. 94.113-94.114; Memorandum by R. Knutson to the Director, 29 March 1989, ex. 132.0698; Report prepared by T. Lewis, 1 April 1989, ex. 84.18; Memorandum prepared by, 11 May 1989, ex. 84.17; Memorandum by G. Worboys to the Director, 6 April 1989, ex. 132.0404; Memorandum by R. Siebert, 7 April 1989, ex. 69.09; Memorandum from S. White to R. Siebert ex. 132.0804; Minutes of meeting between NPWS and KT1, 23 June 1989, ex. 132.0467.

[29] Risk Management Survey, 1 September 1991, ex. 87.09.

[30] Constructions Materials Report on a Landslide Failure of a Gully Fill on the Alpine Way at Thredbo Village, 1 October 1964, ex. 56.19.

[31] Letter, Mrs. Smith to SMHEA, 23 January 1965, Exhibit 132.0054.

[32] SMHEA Minute, 25 January 1965, ex. 132.0053.

[33] SMHEA Minute, 5 February 1965, part of ex. 56.26.

[34] Draft letter from P. Collins to Mrs. Clifford, 4 December 1965, and letter from P. Collins to Mrs. Clifford, 10 February 1965, both part of ex. 56.26.

[35] Svenson, T3717.18-.49.

[36] Statement of David Svenson, 20 August 1997, ex. 72.01.

[37] Svenson, T3729.21-.33.

[38] Svenson, T3740.37-T3741.13.

[39] Svenson, T3753.47

[40] Svenson, T3756.50, 3757.54

[41] Turner, T1708.43

[42] Hagley, T1843.09
[43] Van der Lee, T2418.21
[44] Van der Lee, T2419.3-.46
[45] Van der Lee, T2426.07
[46] J. James letter to Civil and Civic Pty Limited, 26 August 1965, ex. 57.32.
[47] J. James letter to KT1, 20 September 1966, ex. 62.41.
[48] Van der Lee, T2434.15-.39.
[49] Van der Lee, T2435.10-.57.
[50] Statement of Mr. Powter, ex. 133.009, par.53; Dusseldorp, T1979.17-24, 51-56.
[51] See, for example, Mr. Van der Lee, T2439.51,Hagley, T1822.15-.36, Van der Lee, T2584.34, McConnell, T4322.37, Dusseldorp, T2045.29-.37.
[52] Dusseldorp, T1957.06, Letter from Hudson to Dusseldorp, 28 May 1963, ex. 58.04, Letter from Dusseldorp to Hudson, 1 July 1963, ex. 58.05, Letter from Dusseldorp to Trust, 1 July 1963, ex. 58.06, Letter from Dusseldorp to Shire, 1 July 1963, ex. 58.07, Letter from Dusseldorp to Hon. Mr. Hills, 1 July 1963, ex. 58.08.
[53] R. Oldfield, Memorandum to the Superintendent, 19 July 1968, ex. 66.05 and Memorandum of 9 October 1968 to the Superintendent, ex.66.07.
[54] Dwyer, T1464.12, 1466.13.
[55] Memorandum from Superintendent Gare to the Secretary of the Trust, 26 July 1965, ex. 54.55
[56] SMHEA Minute, 26 November 1964, ex. 72.04
[57] SMHEA Minute, 5 February 1965, pt. ex. 56.26.
[58] DMR Memorandum, 23 August 1984, ex. 70.07.
[59] Memorandum of Inspection of Alpine Way undertaken in late May 1968, ex. 66.15.
[60] Minutes of Trust, 4 November 1955, ex. 132.0876.
[61] Letter from C.J. Berry to E. Pysden, 24 February 1960, ex. 5.18.
[62] DMR Memorandum, 20 March 1964, ex. 136.231.
[63] DMR Memorandum, 20 March 1964, ex. 136.231, p.2.
[64] Report and Findings of the KMP Road Investigation Committee, 6 July 1973, ex. 78.23.
[65] DMR Minute, 20 March 1964, ex. 136.231, p.3.
[66] 1973 Report, ex. 78.23, p.18.
[67] NPWS letter to KT1, 9 May 1969, ex. 136.045.
[68] R. Oldfield Memorandum to the Superintendent, 19 July 1968, ex. 66.05, 9 October 1968, ex. 66.07, 24 October 1968, ex. 66.16, 12 November 1968, ex. 66.11, 19 November 1968, ex. 66.17, 4 December 1968, ex. 66.13.
[69] Statement of R. Oldfield, 17 September 1998, ex. 66.02.
[70] Oldfield, T3042.3-.8.
[71] Oldfield, T2995.12-.26
[72] Memorandum from Ranger Wilson to R.Oldfield, 3 March 1969, ex. 66.02.
[73] Memorandum from R. Oldfield to the Superintendent, 16 July 1969, pt. ex. 66.02.
[74] Memorandum from J. Robson to Mr. Oldfield re Tyrola Lodge, 3 March 1971, ex. 66.08.
[75] Memorandum from M. Jarrett to the Director, 9 March 1971, ex. 66.09.
[76] NPWS Memorandum re Kosciusko National Park Alpine Road near Tyrola Lodge Thredbo, 2 April 1971, ex. 66.10.
[77] NPWS Memorandum, 9 March 1971, ex. 66.09.
[78] NPWS Memorandum, 4 March 1971, ex. 78.16.
[79] Kosciusko National Park-Review of Road Servicing, carried out by the C and R Division of the NSW Public Service Board, 2 April 1970, ex. 134.107.
[80] NPWS Memorandum from Superintendent Gare, to the Director, NPWS, 11 December 1970, ex. 132.0651.
[81] Statement of A. Gallard, 14 August 1997, ex. 78.04.
[82] Minister for Lands, Mr. T. Lewis, letter to KT1, 11 August 1973, ex. 78.19, KT1 letter to the Minister for Lands, 20 February 1973, ex. 133.032.
[83] DMR Memorandum, Road Slip on Alpine Way, ex. 132.1007, NPWS Telex, 6 October 1978, ex. 78.22.
[84] Letter from J. Akister to the DMR, 5 February 1979, ex. 132.0955.
[85] DMR Letter to Mr Akister, 13 February 1979, ex. 132.0954.
[86] NPWS Submissions, par. 756.
[87] NPWS Submissions, par. 757.
[88] Kosciusko National Park - Review of Road Servicing, April 1970, ex. 134.107.
[89] Commissioner of Main Roads, Submission to the Minister for Transport and Highways, 4 June 1965, ex. 136.281.

[90] Ministerial Memorandum, 24 June 1975, ex. 134.143.
[91] NPWS Memorandum, 4 March 1971, ex. 78.16, NPWS Report, 23 March 1973, ex. 78.17.
[92] Blakers, T4647.54.
[93] Statement of R.B.Allen, 31 August 1999, ex. 116.01, par.24.
[94] Newspaper Article, 3 March 1981, ex. 132.0986.
[95] DMR Plan of Operations for Upgrading the Alpine Way over a 10 Year Period, 12 March 1980, ex. 132.0993.
[96] Appendix "B" to Report by R. B. Allen of 12 March 1980 setting out plan of operations for upgrading the Alpine Way, ex. 70.06.
[97] NPWS Letter to DMR, 13 May 1980, ex. 65.16.
[98] R. B.Allen, DMR Memorandum to Head Office, 23 June 1980, ex. 132.0990.
[99] Statement of R. B.Allen, ex. 116.01, par.75.
[100] DMR Memorandum, Reconstruction of Alpine Way - K.N.P.1. Estimate of Cost, 23 August 1984, ex. 70.07.
[101] Ubrihien, T3591.01-.36.
[102] Ubrihien, T3591.01-.58.
[103] Report on Historical and Planning Issues, PSM R1, Section C5, p.7 at p.10.
[104] Statement of L.Blakers, ex. 78.01, par.25.
[105] G. Moore Memorandum to the Acting Superintendent, 8 October 1980, ex. 78.07.
[106] Memorandum from Acting Superintendent, Kosciusko District to Regional Director, Attention Mr. Blakers, 15 October 1980, ex. 78.06.
[107] Blakers, T4596.21.
[108] Statement of Tony Sullivan 30 September 1998, ex. 84.02 par.15.
[109] Statement of R.B.Allen, ex. 116.01 par.80.
[110] Sinclair Knight, Alpine Way Report, ex. 78.12.
[111] NPWS letter to SRSC, 19 July 1988, pt. ex. 69.02; Statement of R.C.Bright, 11 December 1997, ex. 69.01.
[112] Bright, T3380.57 - 3381.25.
[113] Bright, T3389.5 -.15.
[114] SRSC, Inspection Report, 15 April 1988, ex. 69.07.
[115] Bright, T3390.05.
[116] Bright, T3391.56.
[117] Report on repair of slip on Alpine Way April 1989, ex. 84.18, Memorandum, Alpine Way Landslip, Soil Conservation Works, 11 May 1989, ex. 84.17.
[118] Bright, T3407.56 - 3408.06.
[119] Statement of R.I.Siebert, 11 February 1999, ex. 132.0286.
[120] Bright, T3393.44, 3409.06.
[121] Statement of Blakers, 17 September 1998, ex. 78.01.
[122] Notes of meeting, NPWS and Kosciusko Thredbo Pty Ltd., 23 June 1989, ex. 122.0467.
[123] NPWS Roads Maintenance - Economic Evaluation, March 1990, ex. 132.0115.
[124] Statement of R.C.Bright, 11 December 1997, ex. 69.01.
[125] Bright, T3417.47.
[126] Tony Sullivan Report on Alpine Way, 2 January 1991, ex. 84.03.

RTA as Technical Advisor, 1991-1996

Arrival of Mr. Tony Sullivan

231. Mr. Tony Sullivan was an experienced and qualified civil engineer with a background in road engineering in local government in Victoria and the Northern Territory. He reported to the NPWS Regional Operations Manager.[1] He appears to have been the first engineer with substantial road experience employed by NPWS to manage Park roads.

232. He was employed by NPWS as Kosciusko District Engineer from October 1990. In this position, he was responsible for water, sewerage and roads in the park. His only responsibility in connection with Thredbo was the Alpine Way.

233. Mr. Tony Sullivan gathered around himself other persons with relevant road engineering experience. They included former RTA officers with experience of the Alpine Way and from November 1993, a design engineer, Mr. Ken Reedy.

234. From the outset of his employment by NPWS, he was the principal engineering officer dealing with funding, reconstruction and maintenance of the Alpine Way. Although he was responsible for 250km of unclassified roads and about 1500km of fire trails in the Park as well as other duties, Mr Sullivan spent 25% of his time on the Alpine Way alone. About 30-40% of his time was spent at Perisher Valley. [2]

235. Mr. Tony Sullivan said that he inspected the Alpine Way and found it a cause for concern[3]. He set about making a substantial funding application.[4] Various documents which were brought into existence in the course of making the funding application give an insight into Mr Sullivan's grave concerns about the Alpine Way.

236. The inspection he refers to may have been a reference to the inspection of the Alpine Way and Guthega roads which he carried out on 15 November 1990 in company with Mr. R C Bright, Shire Engineer for Snowy River Shire Council.

237. A week after the joint inspection Mr. Bright wrote a letter to Mr. Tony Sullivan that reflected arrangements between them about maintenance work. In particular, the letter says:

> *"A detailed culvert inspection register has been commenced on the Alpine Way.…a program will be formulated for cleaning, rehabilitation and reconstruction of the culvert.*
>
> *This program is considered as essential to the long-term maintenance of the road and in particular to reduce the risk of landslips caused by poor cross drainage."* [5]

238. Mr. Bright's letter was written in the year following the 1989 landslide on the Alpine Way at C102, a few kilometres to the east of Thredbo. His letter is consistent with his earlier correspondence to NPWS of May 1989 and March 1990. It seems reasonable to assume that the concerns of Mr. Bright were probably communicated to Mr. Tony Sullivan and assisted him to form his view that the Alpine Way was a cause for concern.

239. Mr. Tony Sullivan also became aware that the whole of the Alpine Way from the eastern entry of the Park to a point west of Thredbo, except for the section above Thredbo, had been reconstructed by the RTA a decade earlier. He also became aware during reconstruction work that the fill beneath the road was uncompacted and contained organic material.[6]

240. Mr. Tony Sullivan commenced the task of preparing an application for additional funding to meet the demands of the Alpine Way. Mr. Tony Sullivan also received a positive response from NPWS Sydney Head Office who arranged discussions with New South Wales Treasury. An inspection was carried out with Treasury officials who travelled the Alpine Way and stopped in Thredbo.[7] Mr. Tony Sullivan does not recall any discussion about the road having been cut off by a prior landslide.[8]

241. On 27 May 1991 which was the same month as the Treasury Inspection, Mr. R Fisher of Capital Works Unit prepared a memorandum called "A Rehabilitation of the Alpine Way" which noted the Minister's request for funding, set out the background of the road, noted urgency and supported the application for funding. There is no specific reference to the road above the village. There is nevertheless an awareness of:

> *"catastrophic failures… as whole sections of the road slip off and break away from the mountain… the potential for serious and fatal injury is considered high subject to severe aggravation by the large numbers of tourists coaches using the road".*[9]

242. Mr. Tony Sullivan recalls Mr. Blakers forwarding a copy of Mr. Fisher's memorandum to him but does not recall exactly when.[10] It seems likely however, that Mr. Tony Sullivan saw the document at about the time when the application was being made. Mr. Tony Sullivan accepted the proposition that it may have been sent to him to provide him with information about the outcome of the funding submission.[11]

243. Sydney Head office commissioned a detailed report on the Alpine Way from road engineering consultants, Sinclair Knight. Mr. Tony Sullivan was involved in briefing Sinclair Knight. He understood Sinclair Knight to have been appointed to collate the case for funding.[12] Mr. Tony Sullivan also had the opportunity to read a draft of the Sinclair Knight report at some stage during its preparation. It had been faxed to him and Mr. Costello on 29 May 1992.[13] Mr. Tony Sullivan said that when he read the draft, it confirmed his own views and that had he disagreed with anything in the document, he would have informed Sinclair Knight in a facsimile which he sent back to them on 30 May 1991.[14]

244. In the meantime, Mr. Tony Sullivan prepared a report in May 1991. It was annexed to the Sinclair Knight report that issued in the same month outlining the condition of, and work needed on, the roads.[15] The Sinclair Knight report made the following statement:

> *"…Some land slippage is evident especially adjacent to the Village. A landslip would not only cause severe damage to the road but may also damage property and subsequently endanger human life. Remedial action is recommended to reduce this possibility."*

245. The application was successful in that it produced a substantial increase in funds. By the end of May 1991, Mr. Tony Sullivan had a detailed appreciation of the problems with the Alpine Way. He had been instrumental in organising a substantial increase in funding. Much of the funding was spent over the 5-year period on reconstructing and sealing the Alpine Way from a point west of the Village further westward to Khancoban. A question of the prioritisation of the expenditure arose.

246. Mr. Tony Sullivan was confronted with problems on the whole of the Alpine Way. He balanced the first 19kms including Thredbo with the unsealed western sector of the road by retaining geotechnical advice from the RTA and attending to works recommended in those reports but otherwise proceeding with the upgrading and sealing of the western end of the road.

247. The approach taken by Mr. Tony Sullivan does not seem unreasonable. Priority was given to works recommended by the RTA geotechnical expert, Mr. Warren-Gash, in that what he recommended was done. Otherwise the funds were allocated to resealing the Alpine Way. The defects in the road west of Thredbo were patent and demanding of recurrent expenditure particularly because it was unsealed.

Mr. Warren-Gash

248. An ex-RTA employee on his staff had informed Mr. Tony Sullivan of the existence of a Geotechnical Group in the RTA. He contacted the manager of the RTA Geotechnical Group by telephone, explained that some funding had become available and advised of his concerns about the Alpine Way.

249. In his statement to the NSW Police made in 22 January 1998, Mr. Tony Sullivan's reason for arranging an inspection by Mr. Warren-Gash was to obtain:

> *"an initial assessment of sites of potential instability. This was for the section… (which) included the area of road above Thredbo Village. During that inspection, I specifically asked for an assessment of the area of lodges above Thredbo in the vicinity of Winterhaus Lodge."* [16]

250. Mr. Tony Sullivan says that he advised the Manager of the RTA Geotechnical Group that he held concerns:

> *"about potential slip areas along the road (and) asked him to provide a resource to give me an overview of stability issues concerning the Alpine Way. I do not have a recollection of Mr. Warren-Gash's name being mentioned at that stage."* [17]

251. In the short written statement provided by Mr. Warren-Gash to the inquest,[18] he said that he was employed as a scientific officer by the RTA and its predecessor, the DMR, since 1986. He said that his job responsibilities included a range of geotechnical work, including geotechnical site investigations involving supervision of drilling crews, interpretation of bore logs, assessment of slope stability and ground settlement[19].

252. He said that in 1991, the RTA was asked by NPWS to:

> *"Undertake a preliminary visual assessment of areas of potential instability along the Alpine Way near Thredbo."* [20]

253. He said there were two purposes for his visit which occurred in 5 August 1991. The first was to make a preliminary visual assessment of areas of potential instability. The second was to make recommendations for further work to more fully investigate some areas where failure, if it were to occur, could cause property damage.

The Site Inspection

254. On 5 August 1991, Mr. Warren-Gash met with Mr. Tony Sullivan at his office at Waste Point in Kosciusko National Park. Mr. Tony Sullivan says that he drove Mr. Warren-Gash along the Alpine Way examining areas of subsidence, cracking and associated problems.[21] Mr. Tony Sullivan then says:[22]

> *"During the course of the inspection, I specifically showed him the area above Thredbo Village, I recall taking him to the gully above the Alpine Way and slightly to the west of Winterhaus where there was a constantly running stream. It was an area that in my mind, typified a risk-area and deserved attention in particular because the lodge was close to the road and the slope was steep."* [23]

255. Mr. Tony Sullivan says that he and Mr. Warren-Gash observed cracking in the pavement of the Alpine Way on the downhill side above Winterhaus. He recalls Mr. Warren-Gash mentioning the importance of monitoring and that the installation of inclinometers was a means of monitoring stability. Apparently, during the course of the inspection, Mr. Warren-Gash told Mr. Tony Sullivan:

> *"…that there was nothing of immediate concern above the village and that the inclinometer would give adequate warning of slope movement."* [24]

256. Mr. Warren-Gash records some of the concerns that Mr. Tony Sullivan expressed to him in the course of the first site visit. After recording various factors of instability under a heading "Site Description", Mr. Warren-Gash said in his report:

> *"These comments are made as the result of inspecting a number of sites where concern was expressed for the safety of the road."*

257. Mr. Warren-Gash inspected C138 near Winterhaus and found arcuate cracking, although no signs of displacement "or other evidence of instability." He came to a specific conclusion in the following terms:

> *"Although the slope along the edge of the road above the village is steep, no other signs of potential instability were seen."*

258. After the one day site visit on 5 August 1991, Mr. Warren-Gash prepared a report of 15 August 1991 which was described as "Preliminary Investigation of Areas of Potential Instability".[25] The views expressed in that report concerning the road above Thredbo did not alter over the next six years.

259. Mr. Warren-Gash expressed the view in the introduction to the report that there was:

> *"nothing of immediate concern … seen in the Thredbo area and only one slide that will require attention this financial year was seen on the road to the north-east of Thredbo. Even here, the road is not immediately endangered".*[26]

260. In the body of his report, Mr. Warren-Gash then demonstrates an awareness of the method of construction of the road, that arcuate cracking was visible in various places, that the fill under the Alpine Way contained rotting organic material and that slopes were estimated to be greater than 40 degrees in places. He assumed the possibility of creep within the fill materials, as well as settlement.

261. Mr. Warren-Gash noted that it was reported to him that occasionally:

> *"a culvert had failed and as a result water had been discharged into the body of the fill and at least partial failure of the fill had resulted".*

262. Nevertheless, Mr. Warren-Gash made a recommendation that steeper fills be supported "as the need arises and funds are available". The supports he was referring to were not specifically related to steeper fills above the village although he must have had those fills in mind as well. His consideration of the need for support at least demonstrates recognition of the potential instability of the fills.

263. He made suggestions for further investigation which included the installation of inclinometer tubing and the preparation of an inventory of areas with a potential problem.

264. He suggested that the inclinometer tubing be installed in the outer edge of the road above the Winterhaus guest lodge and one or two other "key" buildings.

265. Mr. Tony Sullivan said that, during the site visit, he specifically pointed to the Winterhaus site as an area of concern, but that he left the positioning of inclinometers to Mr. Warren-Gash. Mr. Tony Sullivan knew what an inclinometer was but had not had prior experience of their use.

266. Mr. Warren-Gash provided a general indication of the frequency of readings which should be taken from the inclinometers after installation and then said:

> *"Initially, it is expected that the inclinometers will provide peace of mind that the slopes behind the Village are not moving. If they detect a failure they will provide an indication of the rate of movement, the time when remedial measures become essential and the depth of the failure which will enable the proper design of these measure."*

267. The reference to "peace of mind" must have been a reference to the expression of concern made by Mr. Tony Sullivan to Mr. Warren-Gash. At that time the site visit occurred in August 1991, Mr. Tony Sullivan had a sound appreciation of the problems of the road and particularly, the section of the road above the Village. He had carried out a careful examination of the road. He had consulted with others with experience of the road and he had reported on the problems. He initiated an application for special funding and he had had a role in the report prepared by Sinclair Knight which specifically referred to the possibility of loss of life on the unstable road adjacent to the Village. The Report of Mr. Warren-Gash reflects what had been on Mr. Tony Sullivan's mind and what was conveyed to Mr. Warren-Gash.

268. It is clear Mr. Tony Sullivan was acutely conscious of the possibility of a landslide impacting on the Village. It seems to me to be no coincidence that comments such as those recorded in the Treasury document and the Sinclair Knight report which convey a heightened awareness of landslide risk appear after Mr. Tony Sullivan joined NPWS.

Subsequent Inspections and Reports

269. Mr. Warren-Gash continued to inspect and report approximately annually to NPWS until 1996. In February 1992, consistent with his recommendation of August 1991, Mr. Warren-Gash provided an "inventory of landslides."[27] By that time, he had installed inclinometers at 3 positions, C102, C137 and C138 to each of which Mr. Tony Sullivan had directed his attention. C102 was 3kms to the east of the road above the Village and the site of the landslide three years before.[28] C137 and C138 were in the Village. C137 marked the eastern end of the 1997 landslide. C138 was about 120m to the west of the western side of the landslide.

270. In his first inventory of landslides, he made specific comment about C137 to which he had not referred in his preliminary report. He noted no damage to the pavement of the road, but observed a fill slope of more than 40 degrees with buildings below. Above the road, he noted a small watercourse which disappeared into colluvium at a point which resembled an old and eroded slip back scar. He also observed a small watercourse to the west and concluded that the colluvium in the Valley was still

mobile as shown by "a number of mature trees directly above the road that are leaning down hill".

271. In addition, Mr. Warren-Gash pointed out that either a rise in the water table in the fill or where compaction was reduced by the presence of organic material, reduced stability which could lead to failure.

272. Mr. Warren-Gash was aware of the granular nature of the fill and referred to the importance of culvert maintenance and drainage.

273. The conclusion expressed in his February 1992 Inventory of Landslides was that there was a lack of stability in the road caused by steepness of the natural slopes, steepness of the fills, inclusion of organic material in the fills and a generally high water table.

274. In a facsimile of 25 January 1993, Mr. Warren-Gash reported to NPWS that he had taken inclinometer readings and that there was "nothing to worry about at present". C137 showed no movement and C138 showed:

> *"the very slight continuation of a slight tilting from a depth of 14.5 metres. This is probably normal creep on the existing steep surface of the hillside and has nothing to do with the road."*

275. That appears to have remained the view of Mr. Warren-Gash following readings up to 1996.

276. Mr. Warren-Gash carried out inspections and provided further reports dated 14 January 1994[29] and 24 May 1995.[30] He noted some damage to the inclinometers and in 1995, noted that the C137 inclinometer had been paved over during resealing of the road. The damage was not permanent. He advised that the position be ie. located and cleared of bitumen.

277. In May 1996, about fourteen months before the landslide, he reported the last inclinometer readings before the landslide, noting "no significant movement in the instruments above Thredbo." [31]

Unpredicted Slides

278. On 12 August 1996 at the request of Mr. Reedy, who by then was the NPWS officer dealing with Mr. Warren-Gash, an inspection of another section of the same road occurred. It followed two road failures. Both were well east of Thredbo village. Mr. Warren-Gash analysed the failures and found that both had been due to drainage problems. Those events do not seem to have triggered in Mr. Reedy's mind any need for reassessment of the Thredbo area.

279. Judging from Mr. Warren-Gash's reports, he was told very little about the history of the Alpine Way. Nevertheless, as he worked during the five years from 1991-1996, it must have become apparent to him through his inventory of landslides and his

reassessment of those inventories that new sites become active from one year to the next. In other words, in an inspection in the previous year, it had not been possible for him to identify all areas where instability might have become manifest or active.

280. During the same period, Mr. Warren-Gash identified a number of features of the geology of the Alpine Way which indicated that it was fundamentally unstable and required monitoring and remediation works in a variety of locations. Even in the context of concerns expressed by Mr. Tony Sullivan, neither the knowledge of the instability of the Alpine Way, the remediation demands made, nor the new areas of instability that appeared from year to year, caused him to note in his reports the possibility of unpredicted instability of Thredbo. The only step he recommended for the road above Thredbo was the installation of two inclinometers with annual readings.

Mr. Reedy's Supervision

281. In October 1993, an experienced road design engineer, Mr. Kenneth Reedy was employed by NPWS to assist Mr. Tony Sullivan.

282. Shortly after his arrival,[32] Mr. Reedy was introduced into the job by way of an all-day tour of the Alpine Way and other Kosciusko National Park roads accompanied by Mr. Tony Sullivan. Mr. Reedy made some diary notes concerning the journey and observations made by Mr. Tony Sullivan.

283. In the course of the day, Mr. Tony Sullivan pointed out to Mr. Reedy, the Winterhaus Corner and the fact was noted in Mr. Reedy's diary.[33] The diary note reads:

> *"Thursday 11*
>
> *Trip with Tony*
>
> *Follow up*
>
> *Slip priority Thredbo site*
>
> *Winterhaus realignment"*

284. Mr. Reedy said in evidence that reference to "slip priority Thredbo site" is not a reference to the road above the Village but rather to the section of road between the park boundary and Thredbo which was to be a priority.[34]

285. Mr. Tony Sullivan told Mr. Reedy the purpose of the work being done by both Mr. Warren-Gash and Mr. Ubrihien. He asked Mr. Reedy to take over the task of continuing to co-ordinate with each of them. [35] Like Mr. Tony Sullivan, Mr. Reedy accepted the work of Mr. Warren-Gash as expert work.

286. The Winterhaus Corner was a site about which Mr. Tony Sullivan had made some impression on Mr. Reedy. In oral evidence, Mr. Reedy said that Mr. Tony Sullivan had told him that the culvert 138 area was a site that:

> *"if there was anything going to occur, it would occur at that area because of the wet gully above and the arcuate cracking in the road."*[36]

287. That conversation occurred shortly after Mr. Reedy's arrival in 1993.[37]

288. While Mr. Reedy was co-ordinating the work of Mr. Ubrihien on the retaining wall and Mr. Warren-Gash on questions of stability assessment, Mr. Tony Sullivan remained interested and concerned. He was present in 1995 during a familiarisation visit by a new Minister for the Environment whose itinerary commenced with "Alpine Way Strategy and Funding". Much of the balance of the itinerary related to the Alpine Way. A portion of it appears as follows:

> *"Top of Village, Geotechnical, Slip-Prone Areas Proposed Works."*

289. The visit to the "Top of Village" did not occur for reasons of time but Mr. Tony Sullivan said that he would have directed the Minister's attention to the area being monitored because of the risk that they would be subject to slip.[38]

Presence of the Watermain

290. Mr. Warren-Gash was aware and expressed the opinion in his report that the presence of water in the fill affected stability. It is a matter of note that he never drew attention to the significant potential of the presence of the Alpine Way watermain. He appeared not to have known about it. Nobody in NPWS drew his attention to its presence. NPWS made submissions that the presence of the fire-hydrants along the Alpine Way should have alerted Mr. Warren-Gash to the possibility that a pipeline was present.[39] By the same token, a submission made on behalf of Mr. Warren-Gash was to the effect that he would have been entitled to assume that the pipeline was appropriately installed. Perhaps, Mr. Warren-Gash should have inferred the possible presence of the pipeline or asked for detail of the services in the area. Equally, it would have been preferable if NPWS officers had known about the presence of the watermain and informed Mr. Warren-Gash about it.

Approach to Instability Assessment

291. Mr. Tim Sullivan in his Historical and Planning Report[40] expressed the view that Mr. Warren-Gash's reports gave a false impression of the stability of the Alpine Way and of the risk of landslides above Thredbo. It was supported in Lend Lease's written submissions.[41]

292. Mr. Tim Sullivan outlined the action that a specialist geotechnical engineer might have undertaken in 1991 in the course of assessing stability on the Alpine Way. His view was that the work would have included:

> *"Item 1: Review of historical performance of slopes (cuts and fills) along the Alpine Way, including a review of historical documents (maps, photographs and correspondence) and an assessment of previous failures.*
>
> *Item 2: A visual inspection of the road and the slopes above and below the road with particular attention to any possible landslide sites; at the same time the sites of previously documented instability would be inspected. A classification of all sites having moderate or higher risk would be done.*
>
> *Item 3: Development of geotechnical and hydro-geotechnical models in plan and section, capturing the essential features of the terrain, the geology, the ground water regime, man-made features and material property parameters. Models would have been developed for each of the moderate to high-risk sites along the Alpine Way, particularly in the vicinity of vulnerable facilities such as the village."*[42]

293. Upon gathering the information set out in items 1, 2 & 3 above, Mr. Tim Sullivan considered that the site of the Thredbo landslide and other areas along the Alpine Way adjacent to Winterhaus and the Banjo Drive intersection would have been classified as "very high" risk of instability. Having made that classification, Mr. Tim Sullivan considered that the next step would normally have entailed site specific geotechnical investigations including:

- A geotechnical investigation of each of the above sites including, where appropriate, test pits, bore-holes, piezometers, sampling and laboratory testing.
- Assessment of hydrological data.
- Stability analysis
- Design of remedial measures as appropriate and
- Formulation of an ongoing stability management plan.

294. The reports of Mr. Warren-Gash made no reference to material which would enable an identification of previous major failures. There was no reference to material which could have been used to assist in classifying the nature of previous instability such as speed of movement, warning signals and travel distances and there was no reference to material which could have been used to highlight active or ongoing geotechnical factors. Item 1 set out above was not addressed by Mr. Warren-Gash. Mr. Warren-Gash carried out a detailed visual inspection and to that extent met the requirement of item 2 above but it was done without the benefit of the pre-1991 information on areas of instability. There was no evidence that item 3 was undertaken in any way.

The RTA Slope Risk Assessment

295. Mr. Warren-Gash had available to use in his work in the Park, a System of Slope Risk Assessment developed by the RTA.

296. The RTA Slope Risk Rating System was described in the RTA Guide to the system as being a recommended procedure for assigning a risk-rating to slopes to provide the basis for programs to:

> *"prioritise geotechnical investigations, preventative and/or remedial work."* [43]

297. The system operated in two stages. The first involved the completion of a standard form that specified features of slope stability. The second stage involved the completion of a slope instabilities score sheet by a qualified geotechnical specialist conducting an on-site visual assessment and scoring slope instability features. That in turn leads to an instability classification among five stages from "very high" through "high", "moderate" and "low" to "very low". Each of the five stages is then described in terms of possible consequences covering risk to life, risk to property and risk to a road. Consequence was scored to require action at various levels ranging between immediate or urgent action to regular or periodic maintenance.

298. Mr. Warren-Gash had been involved in the development of the system since 1991. It was available to him in a final form at the time of his Alpine Way assessments in 1995 and 1996. He does not appear to have applied the system to the slopes on the Alpine Way generally or to the Thredbo slope.

299. Mr. Tim Sullivan carried out a Slope Risk Rating Assessment using the RTA system on the slope as it would have been at the time Mr. Warren-Gash was inspecting it. He used the information "which was probably used by or should have been used by Mr. Warren-Gash" at that time.[44]

300. For the slope affected by the landslide in 1997, and subject to an ambiguity that Mr. Tim Sullivan identified in the system, this slope was rated as having an instability risk of "high". According to the system, if it then scored "1", immediate action would be required. If it scored "2", urgent action would be required. If it scored "3", the requirement was for "regular maintenance, action as soon as possible." On the analysis by Mr. Tim Sullivan, action was required ranging between the three highest levels of immediate action to regular maintenance, action as soon as possible.

301. Upon conclusion of his analysis of the results of the RTA Slope Risk Rating System, Mr. Tim Sullivan confirmed a view expressed in his "Historical and Planning Issues Report"[45]that the installation of inclinometers by Mr. Warren-Gash was not an adequate response. The correct response would have been to conduct a thorough geotechnical assessment that would have identified the features of the marginal stability of the slope.

302. Mr. Tim Sullivan conducted the same assessment for the slope, west of C138 with similar results.

Submissions for Mr. Warren-Gash and RTA

303. It was submitted by Counsel appearing for Mr. Warren-Gash that Mr. Warren-Gash had no role in the construction of the Retaining Wall and that he was entitled to assume that a properly designed, constructed and installed water pipe would have been unaffected by creep. Both submissions are correct.

304. It was next submitted that the retainer of Mr. Warren-Gash was limited by NPWS to an initial stability assessment of a type with which NPWS were content to pay for. The Inquest is not an appropriate forum to be determining the contractural relationship between the RTA and NPWS but to the extent that the retainer argument affected the work carried out by Mr. Warren-Gash, I have seen no evidence that NPWS restricted or placed a limitation on the work done by Mr. Warren-Gash. Mr. Tony Sullivan directed the attention of Mr. Warren-Gash to the slope above the Village and expressed his concerns. Mr. Warren-Gash appears to have believed that he addressed it. I would expect if he had thought some limitation on his work was preventing him from undertaking a full assessment of the stability of the slope above the Village, he would have told NPWS.

305. In a related argument, Counsel for Mr. Warren-Gash asserted that the advice of Mr. Warren-Gash from 1991 until May 1996 was appropriate. It is an argument that assumes that Mr. Warren-Gash was entitled to rely on the visual information obtained by reason of his limited Retainer together with the inclinometer results. The written submissions from Mr. Warren-Gash assume that it was appropriate for Mr. Warren-Gash to place reliance upon them rather than to:

> *"prefer other equivocal indicators of movement."*[46]

I accept the evidence of Mr. Tim Sullivan as to the inadequacy of investigation by Mr. Warren-Gash.

306. It was also submitted for Mr. Warren-Gash that the information obtained as a result of wider investigation of the type described by Mr. Tim Sullivan would not have altered Mr. Warren-Gash's view. I reject that submission. The exercise and the result of a Slope Risk Rating would have disclosed a risk to life ranging, on one view, to "high". It would also have required some degree of action. The geotechnical investigation recommended by Mr. Tim Sullivan would have identified the factors creating marginal instability which were not apparent to visual inspection.

307. On the substantive question as to why Mr. Warren-Gash did not use the Slope Risk Assessment System, the RTA's submissions raised the argument that the System was in some way, inapplicable. Reliance was placed on a disclaimer asserting that the document was "unsuitable" for use other than:

> *"qualitatively assessing slopes and cuttings associated with the Authorities Road Network and may not be suitable for other purposes."*[47]

308. I do not believe that submission explains why the Assessment System was unsuitable for Mr. Warren-Gash to use in the Park.

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1 Statement of Mr Sullivan 30 September 1998 ex. 84.02
2 ibid par.8-9
3 ibid par.17
4 Report on Alpine Way by Mr A S Sullivan 2 January 1991 ex. 84.03
5 Letter Mr Bright to NPWS, 16 Nov 1990 ex. 69.11
6 ibid par.20-21
7 Mr Tony Sullivan ex. 84.02, par.29
8 Sullivan T5440.20
9 Memo by R Fisher, Capital Works Unit, 27 May 1991, ex.84.15
10 Sullivan T5441.23
11 Sullivan T5441.8
12 Sullivan T5449.38
13 Facsimile from Sinclair Knight to National Parks, attention to Mr. Costello and Mr. Tony Sullivan, 29 May 1992 ex.84.31
14 Facsimile from Mr. Tony Sullivan to Mr. Sharp of Sinclair Knight,30 May 1991 ex. 84.32 and Sullivan T5624-T5625
15 Sinclair Knight Report May 1991, ex.78.12
16 Statement of Mr. Tony Sullivan, 22 Jan 1998 ex. 84.01 par.9
17 Statement of Mr. Tony Sullivan, 30 September 1998 ex. 84.02
18 Exhibit 86.01
19 ibid par.5
20 ibid par. 6
21 Statement of Mr. Tony Sullivan, 30 Sept 1998, ex.84.02 par.45
22 Statement of Mr. Tony Sullivan, 22 January 1998, ex.84.01
23 ibid par.46
24 ibid par.47
25 Exhibit 70.14
26 ibid P.1
27 Exhibit 70.15
28 The 1989 landslide.
29 Exhibit 70.18
30 Exhibit 82.08
31 Exhibit 82.14
32 11 November, Reedy 5131.30
33 Diary entry of Mr. Reedy, Thursday 11 November 1993, ex. 82.02;Mr. Reedy T5137.21
34 Mr. Reedy T5138.32
35 Mr. Reedy T5127.48 and T5139.57
36 Mr. Reedy T5153.32
37 Mr. Reedy T5154.10
38 Sullivan T5519.54 to T5520.8
39 Nash NPWS Written Submission par.942
40 PSM "Report on Historical and Planning Issues PSM 245.R1 November 1998, ex. 91.02
41 Expert issues par 1.13.5 and Conclusion 1.15
42 ibid page 13
43 RTA "Guide to A Slope Risk Rating System" 2nd addition September 1995 ex.86.14 (the first edition was in identical term)
44 Sullivan "RTA Slope Risk Rating System" PSM4245.R9 August 1999 ex.117.01, p.6
45 PSM 245R1 Section 2.4
46 Written submissions for Mr. Warren-Gash, p.6
47 RTA's submission, p.117

The Development of Thredbo

309. In the early 1950's, Anton Sponar identified the Thredbo Valley as a suitable location to establish an Alpine Resort. At that stage, however, there was no road access to the valley. Later, however, he became aware that the Alpine Way was being built through the Thredbo Valley and in due course identified a site where he thought a Village could be established. The site was between the Alpine Way and Thredbo River. One of the attractions of the location of the Village along the Alpine Way was that the road ran through from NSW to Victoria, thus offering the opportunity of tourists from both States.[1] The Kosciusko Chairlift and Thredbo Hotel Syndicate (the "Syndicate") was formed in the 1950's to develop a resort at Thredbo.[2]

310. In early 1957 the Syndicate was engaged in discussions with SMHEA to obtain its assistance to construct an access track from the Alpine Way to the Thredbo River. SMHEA agreed to construct that road. Part of the consideration for SMHEA's co-operation appeared to be the view of the Commissioner of SMHEA, Sir William Hudson, that "….the Authority, taking the long term view, should co-operate with new development in the Snowy Mountains area…."[3]

311. In November 1957 the Minister for Lands entered into an Agreement with the Syndicate whereunder, in consideration of the Syndicate completing certain building works, including a chairlift, at Friday Flat as well as hotel buildings, the Minister would grant to the Syndicate or its nominee a 99 year lease over the approximately 67 acres of land which became Thredbo Village.[4]

312. Kosciusko Thredbo Limited ("KTL") was incorporated by the Syndicate in May 1957. In January 1958 the Syndicate assigned to KTL (inter alia) the benefit of the Option for Lease with the Minister for Lands.[5]

313. Thredbo was only one area of the Park which was being developed. By 1959 development in the Park had reached such an extent that the Trust appointed a Park Superintendent. The Park Superintendent had one or two rangers who assisted him as well as general outdoor staff. [6]

314. Despite the appointment of the Superintendent the Trust still operated at a fairly low key level until development in the Park became such that it was thought appropriate

to appoint a full time Secretary. In April 1961 Mr. Dwyer became the first, and only, full time Secretary of the Trust, a position he retained until 1966.[7]

315. The members of the Trust were a cross section of representatives of the Department of Lands, Treasury, Tourism and Soil Conservation, the Forestry Commission, political and local government representatives of the community around the area of the Park and Sir Garfield Barwick. The Trustees were not paid, save for travelling and subsistence expenses.[8]

316. The first Park Superintendent, Mr. Neville Gare, was a Bachelor of Science and Forestry. The rangers who were appointed were not required to have any particular professional qualifications.[9]

317. The Trust did not have any in-house experts. Rather, it was assisted in carrying out its activities in the Park by a number of honorary experts.

318. It was assisted in matters of architecture by Mr. Ray Jones of Brewster, Murray and Partners, in matters of surveying by Mr. George Hamm while Mr. Garnett of Rankine and Hill acted as honorary consultant engineer.[10]

319. These honorary experts together with the Superintendent, Mr. Gare and the Assistant Trustee - Mr. Neary, constituted the Park Development Committee. The functions of that Committee were to supervise the creation of subdivision in Perisher Valley, Smiggin Holes, and Charlotte Pass and to assess building development applications.[11]

Identification of Instability in the Eastern Subdivision

320. The first area developed in Thredbo was to the west of the landslide site.

321. In about the middle of 1958, KTL decided to develop a second subdivision to the east.[12] The area where this development was to take place, which became known as the Eastern Subdivision, and is where the 1997 landslide occurred, was much steeper than the area which KTL had first developed.

322. Mr. Peter Lloyd, one of the founding directors of KTL, recalled the whole Board of the company was conscious of unstable areas in the land being developed for the Village. He could recall that there had been a number of slips along the Alpine Way during the period of his association with Thredbo. He said that any boggy or marshy looking land was regarded by the Board as suspect and that he knew that it was basically unstable. He claimed that one of the areas the Board regarded as unstable was the site where the 1997 landslide occurred.

323. Consistently with the concern Mr. Lloyd recalled about the land, it appears that the Chairman of KTL, Mr. Thyne Reid asked Sir William Hudson, the Commissioner of SMHEA, for an opinion on the stability of the hillside at the site of the proposed new development. At Sir William's request, the SMHEA Senior Engineering

Geologist, Mr. D G Moye, inspected the site in company with two other officers of the SMHEA, Mr. Robinson and Mr. Lewis and Mr. Nicholls and Mr. Sponar, the latter being principals of KTL[13]

324. Mr. Moye identified two sites within the area proposed for the Eastern Subdivision which he associated with instability. The first was a creek between the area where Winterhaus and Pindari lodges were later built. This is the creek into which water from Culvert 138 drains. In relation to this creek, he noted that "there is a large risk that this part of the site would prove to be unstable if disturbed by cuttings or if the natural drainage is blocked".

325. The second site was a small valley with two parallel streams which was accepted by all parties in the Inquest as being the valley in which Carinya and Bimbadeen were ultimately built. In respect of this valley, he observed:

> *"There is evidence of slumping having occurred in the part along the floor of this valley. The part of the site within the floor of this valley also very probably would prove to be unstable if cut into or if the drainage was interfered with."*

326. In relation to the first area, he remarked it seemed to be generally similar to the slip area of the Alpine Way above the site "where the deep road excavation cut into and disturbed soil and boulders partly saturated by natural streams." It appears clear that this is a reference to the cut batter collapse of the Alpine Way at the Winterhaus Corner which occurred during the upgrade of the road in 1958.[14]

327. It might be noted that Mr. Moye did not refer to the Alpine Way as posing any threat to development below the road in his report.

328. KT1 submitted that Mr. Lloyd's recollection was not good and that it was really only the occurrence of the 1997 landslide which enabled him to indicate that the Carinya site was one which the Board was conscious of as being unstable. It was also submitted that the focus of the concern appeared to be the actual stability of the ground itself and not the hillside above it.

329. It is true that Mr. Lloyd frankly conceded that his memory was not good.[15] Nevertheless, the site to which he referred is one of those referred to in the Moye Report which was forwarded to the Chairman of the Board of the KTL. I have no doubt that the document itself or at least its content would have been discussed by the Board.

330. Mr. Lloyd was frank in saying he did not recall the Moye Report. He did recall that in late 1961 when Lend Lease was considering taking over KTL, he explained to Mr. Dusseldorp, the Chairman of the Lend Lease, that there were areas in the Village which were unstable and which were not made available for sale by KTL.[16] According to Mr. Lloyd, at the time Lend Lease acquired all the shares in KTL, all KTL business records would have been delivered to Lend Lease. Assuming that to be the case (which seems to be a fair assumption as a matter of ordinary commercial

practice), it seemed highly likely that the Moye Report would have been amongst those documents, and accordingly, would have come into Lend Lease's possession.

331. Others who were involved with Thredbo before Lend Lease took over could recall that the site of the 1997 landslide was not available for lease. Mr. Pelc was employed by KTL in May 1958. He undertook a variety of administrative roles, one of which including arranging for Bobuck Lane to be cut into the hillside in the area proposed for the Eastern Subdivision. At the time that was done, he recalled that the blocks of land which would have formed the Eastern Subdivision and the position of Bobuck Lane had been pegged out.

332. Later, it became his responsibility to show people the lots which were available for lease in the Eastern Subdivision. He was provided with a subdivision plan in 1959. It was his recollection that the area in which the 1997 landslide occurred was not given a lot number on that plan and, moreover, there was a marking on the plan which prohibited the use of the area. His recollection was that there were words like "geological slip" or "geological fault" or words to that effect marked on the plan in area of the 1997 slip. Whatever the words were, he interpreted them to mean that the site was not to be made available to people inquiring for areas to lease.[17]

333. He could remember a Mr. and Mrs. Palmer making inquiries about being able to use part of the Carinya site to build a driveway to allow access to a garage they proposed to build on Lot 63 which was immediately to its west (and later became the Schuss site). He could remember informing the Palmers that such a driveway would pass over the prohibited slip site and would probably not be permitted. He asked Mr. Nichols, the company's architect about Mr. Palmer's request and was told it was out of the question, a fact he communicated to the Palmers. I note that Mr. Pelc first wrote to me on 14 August 1997 advising me of two lots which carried the wording "geological fault". He could not recall then whether one of those lots was the land involved in the 1997 tragedy although he could recall that one was adjacent to a lodge which ultimately became Schuss lodge. That lodge of course, is immediately to the west of the 1997 landslide site.[18] I found Mr. Pelc an impressive witness and I accept his recollection about the words which were marked on the plan and that they concerned the 1997 landslide site.

334. His recollection of events was very similar to Mrs. Palmer's. Mrs. Palmer and her husband inquired as to available sites in Thredbo to build a family club lodge in late 1959. She could remember that her husband wanted to obtain a site with direct access from the Alpine Way, the advantage of that being that the Alpine Way was kept clear of snow whereas the access roads in the Village were not. She could remember being shown a plan in the Village office and seeing that lot 63 was the only lot available on the Alpine Way. Having inspected the site, she and her husband noticed that the land to its east (the 1997 landslide site) appeared to be more advantageous for building. They inquired about that lot at the Village office and were told it was not available because it was a landslip area. She said she was shown

a plan which bore some markings in that area which had the effect of excluding it from use. She said that as a result of the information that the area was unstable and was next to a landslip her husband positioned their lodge as close to the western border of their site as he could, away from the landslip corner.

335. Lend Lease submitted that Mrs. Palmer' evidence was confused and that the events she recalled related to a different site along the Alpine Way.

336. By the time Mrs. Palmer gave evidence before me, she had given two statements and had also been interviewed by an investigator retained by the NPWS. She was then subjected to detailed examination by counsel representing various parties and all of this about events which had occurred some forty or so years before. Despite this, in my opinion, she presented as a credible witness who had a clear recollection of an area to the east of Schuss Lodge which was marked as unavailable for building because it was a landslip area. In this respect, her recollection was remarkably consistent with Mr. Pelc's and Mr. Lloyd's. It was also consistent with Mr. Moye's Report that the area where the 1997 landslide occurred was potentially unstable.

337. The fact that KTL management was concerned about issues of instability is reflected in a number of documents of the period. Many documents relating to building approval in that small part of the Eastern Subdivision which was developed by KTL and applicants for approval reflect concerns about building on the steep slopes some areas of which were referred to as "slip areas".[19] On the evidence, I am satisfied these were areas additional to the 1997 landslide site.

The Lend Lease takeover

338. The probability that the 1997 landslide site was initially excluded for development by the Directors of KTL appears to me to be highly likely in the light of documents produced by Lend Lease in relation to the early period of its involvement with the Village.

339. Lend Lease acquired the shares in KTL in about November 1961. In 1962 KT1 entered a Head Lease with the Trust in respect of Thredbo Village. The Lease gave it the right to subdivide the area and to sub-let lots for building. Building was not to be permitted on those lots, however, without the approval of the Trust.[20]

340. Within a month of its takeover, Lend Lease had commissioned a survey of the Village including the area of the Eastern Subdivision. The plans were prepared by Mr. Wick who was an employee of F. P. Wallis and Moore, Surveyors of Sydney. He prepared at least two plans of two areas of the Village in December 1961. He marked lot numbers on the lots shown in his plans on the basis, he believes, of numbering on a previous plan.

341. He recalled that it was a frequent part of surveying practice at the time he was working in Thredbo and later, for a surveyor to examine an area of land on behalf of

a client with a view to giving advice on how to achieve the best yield of lots from the available land. That task, he recalled, included making judgments about sections of the land that were unsuitable for building. Such advice would take into account the existence of steep gullies, bogs or other features that were inconsistent with construction or whatever use of the land was intended. He acknowledged that the opinion of a surveyor on whether the lots could be used for building was subject to the opinion of an engineer or other qualified person when any such person was used.

342. He said that the existence of unnumbered lots among numbered lots on a plan would usually suggest that the site was not available to release to the public.

343. It is notable, in the light of these comments to observe that the plans Mr. Wick prepared in December 1961 on behalf of Lend Lease showed all areas in the Eastern Subdivision to carry lot numbers except for the land between the Alpine Way and Bobuck Lane where the 1997 landslide occurred. That site, and the site where Bimbadeen was ultimately built, were shown as having running through them the two streams which Mr. Moye had described in his 1958 report.[21]

344. In mid-1962 Mr. John Hughes who was then the Village Manager prepared notes on each lot in the Village with a list of general points applicable to most lots. He submitted it to KT1's in-house solicitor and copied it to a Mr. Young who was the Manager of KT1.

345. The unnumbered lot on Mr. Wick's plan was bounded on the east by lot 60 and the west by lots 62 and 63. It was accepted by all parties in the Inquest that the unnumbered lot was the 1997 landslide site. It was referred to in narrative documents of the period as "lot 61".

346. In relation to lot 61 Mr. Hughes wrote[22]:

> *"This lot extinguished but so called unbuildable slip area between lots 60 and 62/63 not necessarily unbuildable."*

347. That note appears to me to be further evidence in support of the proposition that the 1997 landslide site was, in this earlier period, regarded as an "unbuildable slip area". This description would be consistent with what both Mr. Pelc and Mrs. Palmer recalled.

348. Lend Lease submits that Mr. Hughes statement most probably reflects a position adopted by the original management of KT1 - by which I assume is meant the management of KTL. It points out that the Moye report did not advise that the valley with two streams was "unbuildable" but, rather, expressed caution about building in the area.

349. I accept those submissions. It is clear that whatever opinion Mr. Hughes expressed in his memorandum ultimately changed because, in due course, the unnumbered lot acquired a number. Nevertheless I would also point out that assuming it be correct

that a lot is regarded as unusable whilst ever it does not bear a lot number, it is notable that no lot number appeared on that site until January 1965.[23]

350. By that stage KT1 had obtained approval in principle from the Trust to a Master Plan, Stage One of which appeared to include completing the development of the Eastern Subdivision.[24]

351. I note, in passing, that the approval in principle to the Master Plan was given only two months after the Winterhaus landslide occurred and at a time when the area of the landslide had not been repaired. Despite this, no reference to the occurrence of the landslide or any significance it might have in relation to the further development of the Eastern Subdivision appears in either Trust or KT1 documents.

352. As I mentioned earlier in this Report, there is an indirect reference which demonstrates Superintendent Gare's concerns about the construction of buildings in close proximity to the Alpine Way. Throughout 1965 KT1 submitted a number of proposed subdivision plans for the Eastern Subdivision to the Trust. Those plans included for the first time, a lot number on the 1997 landslide site which was now referred to as lots 78 and 79.[25] It also showed three lots, 80-82 to the east of lot 79. All four proposed lots were adjacent to the Alpine Way.

353. Superintendent Gare considered that the development of those four lots should only be allowed after a thorough investigation particularly of the proximity of any building to the Alpine Way. He thought that the side slope in the vicinity of the four lots was critical to further road improvement. He suggested that the DMR should be asked to indicate its requirements in relation to further development adjacent to the roads.[26]

354. The DMR was then asked by the Trust what its requirements might be "in the likely event of it assuming some responsibilities for the future improvement and maintenance of the Alpine Way."[27] Its response was that it was not in a position to given any advice.[28] This attitude is understandable as I doubt that any Government Department in the position of the DMR at that time, with no control over the Alpine Way and no certainty that it would acquire same, would have been prepared to commit itself to an opinion about likely improvement work required on such a road.

355. The detail of the Eastern Subdivision was approved by the Trust in October 1965 subject to compliance with conditions which included[29]:

> *"Under no circumstances is any planning associated with the subdivision to extend beyond the boundaries of the head lease as … this aspect is of particular importance in relation to the boundaries adjacent to the Alpine Way, as future road improvement programs could be seriously impaired.".*

356. Superintendent Gare's request to the DMR and the condition imposed on the subdivision development indicate a clear appreciation of the likelihood of substantial reconstruction works being required in the Alpine Way in the future.

357. In August 1965, Mr. James, an architect employed by KT1 to assist in townscaping in Thredbo became concerned about the state of the Alpine Way. Mr. James reported to the Chairman of Lend Lease, Mr. Dusseldorp although most of his instructions came from employees of Lend Lease companies such as engineers employed by Civil and Civic Pty Ltd which was acting as Project and Design Engineer for the development. He wrote to Civil and Civic Pty Ltd noting his concerns that there were continuing signs of danger from subsidence along the Alpine Way. His letter essentially made a number of points about improving the drainage of the road.

358. He warned that there was a long term danger of collapse to the Alpine Way above Palmer's lodge. Palmer's lodge is the lot on which Schuss Lodge was erected immediately to the west of the 1997 landslide site. He pointed out[30]:

> *"Subsidence has occurred to the west of this lot. We should completely block this culvert, direct all drainage to the next culvert, and reseed the subsidence. The cracks in the road should be watched in case they move further."*

359. In his statement he pointed out that his reference to the "west" was incorrect as the culvert to which he was referring was to the east of Palmer's.[31]

360. It is clear that the culvert to which Mr. James was referring was the Schuss Culvert. When that culvert was excavated after the 1997 landslide it was found that a piece of timber had been placed across its inlet on the south side of the Alpine Way to stop surface water ingress. The wood which was found to be blocking it was very old and, indeed, in a rotting state. Mr. Tim Sullivan inferred that the pipe had been blocked some time around 1965 possibly as a response to Mr. James' recommendations.[32]

361. It is unlikely that KT1 or any of the other Lend Lease companies which were undertaking work in the Village at the time would have undertaken the works Mr. James recommended. KT1, understandably, took the view that the Alpine Way was not within its lease area and not its responsibility. Mr. Dusseldorp expressed the practical viewpoint that in 1965 the Alpine Way was under the control of the SMHEA and that if KT1 had taken any steps in relation to the road it would have been in jeopardy of being sued by that Authority.[33]

362. Mr. Van der Lee, the Village Manager at the time, also drew a distinction between matters arising in connection with the Village and matters arising along the Alpine Way. In the latter respect he describes himself as "an observer" whereas, in the Village, matters such as drainage were a part of his normal responsibility.[34]

363. It was Mr. Van der Lee who, in November 1965, prepared a plan of the Eastern Subdivision on which he marked an area on the western boundary of what was then lot 79 (which in due course, as to part at least, was the site of the 1997 landslide) as having been subject to a "slide".[35] In his evidence he referred to it as a "slump" by which he said he meant a "subsidence of soil caused by natural springs in a particular wet area." He said this referred to a feature which was three metres in width and one metre in depth. Mr. Van der Lee accepted that a slump was some indication of some instability and that such signs warranted investigation. He did not, however, undertake any investigations of any potential instability which the slump may have indicated.[36]

364. In early 1967 a version of the plan upon which Mr. Van der Lee had marked "slide" was submitted to the Trust for approval of a proposed extension to Bobuck Lane which would have extended it from a dead-end road to a horse-shoe bend which continued to the north, down the hill to connect with the road running through the lower Village. The approval was given and the plan stamped "approved by the Trust" on 20 January 1967. No comment was made about the word "slide" marked upon it.[37]

365. NPWS submits that there was no need for the Trust to consider the part of the plan which was not related to the extension of Bobuck Lane which was the subject of the application for approval. It also submits that it is very difficult to read the word "slide" on the plan and that unless that part of the plan was essential to the matter under approval, it was not reasonable to expect it to have been considered by the approving officer. No doubt the point might also be made that the Superintendent would have been entitled to assume that whatever was indicated by the word "slide" on the plan, its significance might have been investigated by its author.

366. The feature Mr. Van der Lee observed which led him to mark the word "slide" on the plan was regarded by him as sufficiently significant to warrant recording. It was not, however, regarded as sufficiently significant to warrant investigation as to its implications, if any, for further development in the area.

367. This approach was consistent with KT1's reaction to the 1964 Winterhaus landslide which does not appear to have led any KT1 engineer to examine the Alpine Way's fill embankment to determine whether or not it posed a risk to development of buildings in the area of the new subdivision.[38]

368. As the lot boundaries in the Eastern Subdivision became more refined, a reserve was marked out between the lot on which Schuss Lodge was erected (lot 63) and the lot upon which, in due course, Carinya was built. That reserve included the area Mr. Van der Lee had marked as "slide" on his 1965 Plan. The area marked out as the reserve between the Schuss and Carinya Lodge sites was so marked because the view was taken that that area was not desirable for building.[39]

369. That was because it included the western creek to which Mr. James had referred as draining from the Schuss culvert and which, of course, Mr. Moye had identified in 1958. The creek was sufficiently apparent in 1965 to have been marked by Mr. Van der Lee as passing through the area at the top of which the word "slide" appeared and to have led to the marking out of the area of reserve because of the difficulty it posed to building on the site. By 1965, however, when the first plans for the construction of Carinya Lodge on the site were submitted, it was referred to as an "old creek bed". The effect of creating the reserve, Mr. Van der Lee agreed, was to eliminate from what ultimately became of the Carinya site, areas of wetness and steepness which Mr. Van der Lee was of the opinion were less suitable for building. During the period of development of the plans for the construction of Carinya, Mr. Van der Lee increased the width of the Carinya site to the west by some 18 feet. The effect of that was to take the building site into the area of bog-grass and creek which it had previously been thought appropriate to include in a reserve.[40]

Construction of Carinya Lodge

370. In April 1968 the YMCA Ski Club (Canberra) decided to take an option to erect a lodge on lot 78 in the Eastern Subdivision. By this stage, lots 78 and 79 from the original subdivision plan had been amalgamated into one lot, lot 78, by KT1.

371. At that time any building proposal in Thredbo required the approval of NPWS, KT1 and SRSC.

372. On 9 April 1968, Mr. Paynter, the YMCA Ski Club architect wrote to Mr. Van Der Lee enclosing sketch plans for the proposed lodge. He commented in his letter that "suggested depths of footings would be appreciated although the soil itself appears to be stable."[41] In a letter of 17 April 1968 to Mr. Paynter, Mr. Van Der Lee, advised that he had measured "the position of some trees on the site and increased the width of the block to the west by some 18 feet to make it possible to site the building as planned." He said that "it would be advisable to have the local builder … … check the suitability of the land under Stage 1 as there is an old creek bed there that may require subsoil and pipe drainage."[42] The "local builder" was a reference to a Mr. Bela Racsko.[43] Mr. Racsko provided a statement to the Inquest in which he said that he had never been approached by anyone to ask questions of the type suggested by Mr. Van Der Lee.[44] Mr. Van der Lee forwarded the YMCA's plans to KT1's architect for consideration and commented "it is probably possible to build in the creek bed." [45]

373. In May 1968 the architect advising the Trust wrote to the Acting Superintendent of the Park about the plans for lot 78. He noted:

> *"it would seem that much preliminary discussion has already taken place at Thredbo level between the Area Manager and this club, to the extent that trees considered indispensable or otherwise have been plotted and foundation conditions investigated."*[46]

374. Soon after, NPWS wrote to the Secretary of KT1 noting that the Club had made preliminary investigations in regard to building a lodge at Thredbo on lot 78. It complained that NPWS had not been contacted in relation to the building application. It reminded KTPL that it was a requirement that approval be obtained to the sublease and new building proposals.[47]

375. On 15 October 1968, Mr. Lattin, Secretary of the Club Building Committee, wrote to Mr. Gare, Park Superintendent indicating that the Club intended to commence construction of the Lodge in the coming summer.[48]

376. Mr. Van der Lee agreed that it was his decision to allow the lodge to be built. At that time he was both resident Village manager and a civil engineer, although he had no particular experience of construction in an alpine environment. Although he considered some sites in the Eastern Subdivision as less suitable for building than the others, he did not regard the Carinya site as unstable.[49]

377. In approving the site for construction, Mr. Van der Lee relied on his own engineering judgement. He did not ask for a soil investigation report. That, in his opinion, "was not an appropriate practice at that time",[50] nor was it the practice for him to check the structural design of the building. He presumed that the architect and engineer who designed the lodge would ensure that it was safe and adequate for the site. Whether it was consistent with accepted hillside design and practice at that time was "up to the applicant"[51] and a matter for NPWS.[52]

378. The preliminary sketches for Carinya were submitted to KT and NPWS in June 1968. Mr. Gare wrote to KT on 30 October 1968 asking for final plans. A memorandum from him of 21 November 1968[53] noted that the building "has not yet been approved". There was evidence that clearing and excavation of the site was done on 19 October 1968 and that construction started soon after. A letter from the Superintendent, Mr. Gare of February 1969[54] indicated that "the design principles of the proposed building have been accepted" but NPWS had yet to receive the plans. It was not until April 1969 that KT submitted the plans to the NPWS for approval.[55]

379. Despite the lack of formal approval from NPWS or any approval from SRSC, the Club started to build Stage 1 of Carinya in October 1968. According to the Club magazine and the recollection of Haggstrom who worked on the building, the lodge reached practical completion in May 1969[56].

380. Formal approval by the NPWS of plans and specifications was not granted until July 1969.[57] By that stage the lodge had probably been finished for several months.

381. Formal approval of the specification was stamped on the documents by KT1 in October 1969.

382. In September 1969 Mr. Van Der Lee wrote to the Club indicated NPWS' approval and instructing the Club to complete the building application form and to submit it

together with the plans and specifications to the SRSC "for approval".[58] KT granted the Club a "Permit to Occupy", subject to conditions, in October 1969.[59]

383. SRCS wrote to the Club in December 1971,[60] expressing concern that "this building appears to have been erected without the council approval being obtained beforehand". The Club submitted the application and a form of approval was granted in 20 January 1972, three years after the building had been completed and occupied.

384. No document was brought into existence in the process of considering the application to build Carinya which demonstrated any concern about the possibility of instability of the Alpine Way fill embankment slipping onto the lodge.

385. Many years later, in 1985, the Club was considering carrying out extensions. By then building requirements in the park had changed and a foundation inspection was required. The Club engaged SMEC to perform an investigation of the site and sub-surface conditions. It might be noted the SMEC report did not suggest any danger to the lodge from the Alpine Way. In fairness to him, Mr. Mattick, the SMEC engineer who prepared the Report, regarded his task in relation to Carinya as limited to foundation testing.

Regulation of Building in the Park

386. It is appropriate, against this background, to consider the nature of building regulation in the Park. This overview illustrates in the first instance, the lack of an appreciation of geotechnical issues for a large part of the history of development of Thredbo Village, including the time when Carinya was built. It also highlights the anomaly that even though there was recognition being given to geotechnical issues in relation to building at the time both the watermain and the Winterhaus retaining wall were approved, they were constructed without the benefit of a specific geotechnical study having been undertaken to assess their possible effects on the environment into which they would have been placed.

387. The Trust developed a building code in the 1960's. The Code was largely based on Ordinances made pursuant to the *Local Government Act 1919*. The Park Building Code was to be read in conjunction with the *Local Government Act.*[61]

388. For many years, the Trust and later the NPWS Building Codes dealt with the detail of submitting building plans for approval, the nature of materials to be used in the construction of buildings within the Park, drainage and the like. There was recognition of soil erosion issues but no apparent recognition of geotechnical issues.[62]

389. KT1 also developed Building Codes for the benefit of sublessees intended to deal with approval and building requirements within the Village. Its building code was

also to be read in conjunction with Local Government Ordinances. Those ordinances were to apply unless expressly overridden by the Code.

390. The KT1 Building Code in force prior to late 1967, made it clear that drawings or specifications for buildings within the Village had to be approved by KT1, the Trust and the SRSC. Its role in the approval process included having any plans and specifications examined by its Architect and Resident Engineers. Once the Trust had marked copies of the plans and specifications as approved, KT1 provided the stamped copies to the sub-lessee who was then to obtain approval from the SRSC and complete a Building Application form and then apply to the Council for a Building Permit. Once all these approvals were obtained, building could commence.

391. The KT1 Building Code made it clear that in giving its approval to building construction, the Trust obtained advice from its consulting architect, the Board of Fire Commissioners and the Soil Conservation Bureau.

392. The KT1 Resident Engineer was to be consulted by builders to confirm various site matters. The Resident Engineer was also to inspect the site at regular intervals. It was the Resident Engineer, who inspected the various stages of construction of the building e.g. excavation for footings, concrete cores, construction of footings and the like.

393. The Resident Engineer determined, in consultation with sub-lessees, the location of the building on the site. In undertaking that exercise, he was required to take into consideration, among other matters, "natural site drainage".[63]

394. As development in the Park increased and NPWS became more sophisticated the Park Building Code was substantially revised. The 1974 version of the National Park and Wildlife Service Building Code required buildings on any land under the control of NPWS to be designed by a registered Architect. Civil or Structural Engineers were required in relation to engineering works such as dams, reservoirs, bridges, towers, roads and the like.[64] However there was still no express requirement for engineering reports in relation to building work.

395. In the early Building Codes, emphasis was given to the necessity that buildings constructed within the Park were secondary and complementary to the natural environment. Designers of a structure to be built within the Park were expected to pay particular attention to its unobtrusive siting in the landscape into which it was required to blend.[65] This was the case at least up until 1979.[66] This, no doubt, reflected the fact that NPWS regards itself, as it submitted to me as "a Government Department charged with protecting the natural environment."

396. As development increased in the Park, NPWS became increasingly conscious of the necessity for it to retain employees experienced in supervision of building work rather than entrust that work to employees of the SRSC.[67]

397. In 1974 it briefly secured the services of a Clerk Of Works who quickly determined that there were problems with building work in the Park not being properly supervised by experienced personnel. He recommended the NPWS engage a full-time Clerk of Works.[68]

398. His recommendation was reinforced in mid 1974 when the Park's liaison architect, Mr. Rickard, recommended that a full time building inspector be appointed to supervise building work within the park. He also recommended that the legal responsibility of NPWS be investigated to see if it was in any way liable for defective buildings being built in the Park particularly if resulting in injury and death. He pointed out, perhaps tellingly, with the benefit of hindsight:

> *"It appears that local Councils are in a similar legal position to the NPWS who receive claims for failure of buildings through inclement weather, landslip, poor drainage etc. It is for this reason that Councils go to great ends to see that buildings under construction are constructed according to drawings and relevant ordinances."*[69]

399. Mr. Rickard's memorandum appears to have reflected an increasing concern on the part of NPWS with its responsibilities where building works were approved, albeit not properly designed. This increasing concern led, in turn, to suggestions by some officers, no doubt conscious of the difficulties of building on the steep slopes in the Park, that footings for buildings within Thredbo be certified as appropriately designed by a Structural Engineer.[70]

The Dagger Period

400. In February 1975 Mr. Dagger started work for NPWS as its first full time Clerk of Works appointed to supervise building activities within the Park. He had some experience in building, having previously worked in the building industry, been a Clerk of Works for the Housing Commission of NSW and then a Senior Inspector at the NSW Builders Licensing Board.

401. As Mr. Dagger was the principal NPWS officer involved in the approval of the construction of the watermain in 1984 it is worth reviewing his appreciation of the nature of the risk of landslide in the Park at that time.

402. By mid-1976 Mr. Dagger became aware of concerns of the NPWS' Technical Services Section "at the real possibility of earth slips occurring in such steep terrain - a not uncommon feature of the Alpine Way not far from the Village."[71] He most probably learned that from the NPWS architect Bielschowsky who worked in that Section. He said he understood the reference to "earth slips" to mean subsidence of a minor nature, although he could not recall what his appreciation was, in 1976, of earth slips along the Alpine Way.[72] As he became more familiar with the circumstances of Thredbo, he became increasingly aware of the potential of works in the Village to destabilise the slopes. He became aware of the vulnerability of the slope to subsidence if exposed to water and that these were geotechnical problems which required engineering solutions. [73]

403. In fairness to Mr. Dagger it should be noted that at the time he joined NPWS his technical training had involved three certificates concerning structures and design of retaining walls and drainage undertaken at TAFE colleges. He believed he had sufficient expertise and training to identify a problem of water and its effect on an embankment and to determine that it was one which should be referred to an engineer for a solution. [74]

404. Mr. Dagger became aware of the 1978 landslide after it occurred. He went to the landslide site with Mr. Blakers. According to him they were both amazed at the size of the landslide and discussed the potential of a similar event happening in Thredbo. They agreed that geotechnical advice should be sought thereafter from developers in relation to each site on the slopes in Thredbo.[75] It might be recalled that the 1978 landslide involved the slippage of approximately 50 metres of the Alpine Way into the Thredbo River. Mr. Dagger recalled it travelled about 200 metres.[76]

405. Mr. Blakers could not remember whether he considered the possible consequences of a landslide of the magnitude of the October 1978 one occurring above Thredbo Village. He made an observation which provides some insight into the thought processes of those concerned over the years with the Alpine Way:

> *"…If I did, you would have to say I didn't believe it would have happened, otherwise you would have taken some - you would have looked at that possibility more closely. I guess the degree of risk you felt that …. section above Thredbo Village was not as great as other sections of roadway within the Park… the roadway didn't show as much continual deformation as other sections of roadway within the Park".*[77]

406. He did not deny having the conversation to which Mr. Dagger refers.[78]

407. Mr. Dagger accepted that the 1978 landslide demonstrated the vulnerability of the Alpine Way fill, if saturated with water, to collapse in a catastrophic manner.[79] He drew a distinction between the Alpine Way at the site of the 1978 slide in the sense that he understood the road at that point was completely constructed in fill whereas he understood the road above the Village, was constructed on cut and fill. He also believed that a gully on the south side of the Alpine Way in the location of the 1978 landslide had the effect of damming the water thus assisting in the saturation process.[80]

408. At the time of the 1978 landslide Mr. Dagger and Mr. Blakers were advising NPWS on building and engineering issues as they affected the Park before such matters were referred for final consideration by the Superintendent or the Regional Director. Notwithstanding that it does not appear that they discussed the question whether NPWS should undertake an investigation of the road above the Village to satisfy itself as to its stability.[81]

409. Following the 1978 landslide Mr. Dagger implemented a requirement that geotechnical reports be submitted in relation to building works and extensions to buildings on the Thredbo slope. The requirement was a general one because the

whole slope on which Thredbo had been constructed was regarded as potentially unstable.[82]

410. In 1982 Mr. Dagger prepared a check list for building inspectors involved in checking development and building applications. Among the preliminary matters upon which the District Comment was to be obtained prior to development approval was "geotechnical problems".[83]

411. The 1978 landslide aroused general concerns within NPWS concerning the stability of the slope along the Alpine Way. The Superintendent of the Park referred to those concerns when, in late 1978, KT1 first sought approval in principle for the development of the Western Subdivision.[84]

412. The concerns aroused by the 1978 landslide were heightened by the fact that in about 1979 Mr. Dagger, and many others with whom he worked, became aware of the decision of an English court in which a local government body and individual building inspectors were held liable for negligently approving building works subsequently adversely affected by subsidence.[85]

413. In August 1979 there was a major landslide at Abbotsford near Dunedin in New Zealand. It seems to have been a combination of the 1978 landslide, the common consciousness of the *Bognor Regis* case and the Abbotsford landslide which, in August 1979, led Mr. Blakers and Mr. Dagger to prepare a photographic account of instability along the Alpine Way above the Village. This record was made in the context of the permission KT1 was seeking to develop the Western Subdivision. The purpose of the photo-journal, was to illustrate that the Alpine Way, above the Village, was showing signs of collapse and slip which might indicate the potential to collapse as had the road in the 1978 landslide.

414. Another slip at the Newport Plateau, according to Mr. Dagger which had involved a slip near a roadway on a bend which had "picked up a house and slewed it down a slope" further alerted him to instability and liability issues.[86] Issues concerning potential liability in the context of building approvals did not only concern Mr. Dagger but, according to him, were the subject of discussion with others involved in the part of the Service with building issues and also by SRSC inspectors.[87]

415. Mr. Dagger was aware of the importance of drainage in relation to the sort of soils present in the Thredbo Valley.[88]

416. Indeed, Mr. Dagger says he prepared a plan upon which he marked the "slip zones" in the Village. He said he distributed it to other members of staff, however it is notable that no other NPWS witness who was called ever recalled seeing it.[89] His intention, he said, in preparing the slip zone plan was to ensure that the risks already known within the Village of such matters were identified.[90] He recorded areas where slip had already occurred not areas where it was likely to occur.[91] Despite saying that he discussed the slip zone map with building inspectors as soon as he prepared it and

showed it around, it does not appear in any building code, or building approval document, which was produced to the Inquest. He did not believe he ever listed it as a reference in any advice about building inspection procedures even though he agreed it would have been a very important point of reference.[92]

417. There were thus many occasions when Mr. Dagger identified the conditions, and indeed, risks to which Thredbo was exposed due both to the predictable fragility of the steep slopes on which the Village was constructed and the apparent risk to the Village manifest in other landslides along the Alpine Way. Indeed, at one stage he recommended that all building work within Thredbo cease until the Service was prepared to accept full responsibility apparently for any injury which might arise through the approval of a building erected on land subject to subsidence.[93]

418. These recommendations were made in the context of NPWS considering the proposed development of a Western Subdivision in Thredbo. During that process, as appears elsewhere in this Report, concern was expressed about the possibility of the instability of the Alpine Way above the area of the proposed development impacting adversely upon buildings below the road. In the light of that factor and many others, the Superintendent of the Park, Mr. Robson, recommended that legal advice be sought concerning both personal and Service responsibility for development approvals within the existing Village.[94] There is no doubt that in the context of the Western Subdivision, NPWS accepted it could be accused of being delinquent in its duty if it were to allow development to proceed once it was aware of potential instability problems in and affecting the area proposed for development. It recognised in this context that it had "an avoidable responsibility to protect both the public and environment to the greatest extent possible."[95]

419. In July 1980 the Regional Director responsible for the Park asked the Service's Senior Legal Officer for legal advice concerning the insurance of the Service "in regard to the whole of Thredbo where any claim due to instability may affect the Service."

420. Advice was given that the strictest conditions of an engineering nature should be applied in respect of development on the slopes of Thredbo in view of reports strongly indicating slope instability in the area.[96] It might be noted that this advice appeared to have been widely distributed to those working in the NPWS's building department.

421. This brief outline of the circumstances which developed as Mr. Dagger undertook his work within the Park demonstrates acutely an apparent consciousness by NPWS officers, certainly by the time consideration was being given to the Western Subdivision, of the risks of instability also recognised by all geotechnical experts who gave evidence before me.

422. It might be asked, therefore, how it came about that notwithstanding this apparent appreciation of the risks, the Alpine Way above the Village was not reconstructed so

as to remove any risk it posed to the Village below or why the Service's appreciation of the risk was not brought into any sharp focus by a full evaluation of the magnitude and extent of the risk posed to the Village by landslide. A brief look at the Western Subdivision proposal only heightens the dilemma.

Western Subdivision

423. I have referred in various places to the significance of the debate which took place about the proposed development of the Western Subdivision. The debate brought the question of the stability of the Alpine Way fill embankment and the risk it posed to development in the Village into sharp focus. It appears enlightening because it led to officers of NPWS expressing many concerns about the existing Village which now can be seen to have been tragically accurate. Unfortunately, for reasons which were explored during the evidence but which, in my opinion, were never satisfactorily explained, these concerns were never translated into any increased consciousness of the risk to the Village from the road.

424. In short the Western Subdivision was a development proposed to the west of the Village adjacent to the Alpine Way. The application for approval in principle for the development was made only two months after the 1978 landslide and for once a connection was drawn concerning the instability of the Alpine Way demonstrated by that event and the application. NPWS required the proposal to be the subject of geotechnical investigation. It received geotechnical reports prepared by Coffey Partners on behalf of KT1 which reported the marginal stability of the Alpine Way above the proposed development.[97] It had those reviewed internally. It also sought the DMR's opinion upon them. Both reviews confirmed the expert's advice.

425. The DMR further advised that development of the Western Subdivision should not take place unless the Alpine Way was reconstructed

426. I have set out the detail of the Coffeys results in the section dealing with the construction of the watermain. In substance the reports demonstrated the marginal stability of certain parts of the Alpine Way fill embankment if exposed to water saturation.

427. Both these reports and a number of fortuitously contemporaneous events such as the 1978 landslide and the Abbotsford landslide in New Zealand and cases holding council officers liable for negligent approval of buildings led to officers of NPWS drawing attention to concerns both about the possible impact of a landslide from the Alpine Way onto the Village and to concerns about instability in the existing village.[98]

428. Once the debate took place and the conclusion was reached that the Western Subdivision could not be developed unless the Alpine Way above the area of the proposed development was reconstructed, the concerns the NPWS had expressed

about the stability of the road appeared to sink into obscurity. The records created during the period do not feature in anyone's recollections in any significant manner.

Conclusion

429. The historical records and the evidence of witnesses disclose that in Thredbo :

- areas were being classified as "slip areas/zones";
- areas of the ground had slipped, or had the potential to slip, and were classified as posing a risk to the Village;
- at one time the lot on which Carinya was constructed was classified as a "so-called unbuildable slip site".
- officers of NPWS contemplated the possibility of a landslide of a magnitude of at least 200 metres in length occurring above the Village.
- a subdivision development was rejected on the basis the Alpine Way had to be reconstructed before it could proceed.

430. Despite this there appears to have been no awareness that any works should be undertaken to remove the risk from the Alpine Way or to undertake a systematic review of potential slip zones within the Village.

431. As Mr. Tim Sullivan wrote in his Interpretative Report:

- The stability and geotechnical problems with the Carinya sites were well recognised and understood before any development of the Village in this area.
- At some later time, probably in the early to late 1960s, this knowledge was either lost, ignored or forgotten, not only in relation to the Carinya site but other areas as well;
- As development of the Village increased, the approach to geotechnical and/or stability issues in regard to individual lots was very haphazard and appeared to address a variety of geotechnical objectives. In some cases, stability was not even addressed and the stability of the Alpine Way was not included in the assessments. This approach continued at least into the mid 1980's
- This haphazard approach to stability occurred throughout this time despite the fact the area continued to be referred to as a slip zone at the regulatory and planning level.

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1 Notes on Ski Resort development - Kosciusko State Park, 1 July 1967, ex. 54.02 written by Superintendent Gare.
2 Statement of Anton Sponar, 17 January 1998, ex. 132.0142: Statement of Geoff Hughes, 24 June 1998, ex. 50.01.
3 Minute from W. Hudson to the Field Construction Engineer, 10 January 1957, ex. 132.0267.
4 Agreement between the Minister for Lands, Eric Nicholls, Andrew Thynne Reid, Charles Sponar and G.F Hughes, 13 November 1957, ex. 54.03, Annexure "A" being proposed lease, ex. 133.078.
5 Prospectus for Kosciusko Thredbo Ltd, 3 March 1958, ex. 50.16.
6 Notes on Ski Resort development, op. cit., ex. 54.02: K. N. Dwyer, T1395.53-T1396.03.
7 Statement of K. N. Dwyer, ex. 54.01 par. 5.

[8] Statement of K. N. Dwyer, ex. 54.01 par. 8.
[9] K. N. Dwyer, T1396.35 - T1397.03.
[10] K. N. Dwyer, T1398.39 - T1399.22; Statement of M. W. Garnett, ex. 132.0287 par. 5.
[11] Statement of K. N. Dwyer, ex. 54.01 par. 19, K. N. Dwyer, T1397.49.
[12] Kosciusko Thredbo Limited, Second Annual Report for the year to 30 June 1959, par. ibid.53.01.
[13] Letter, Sir William Hudson to Mr. Thyne Reid, KTL, 25 September 1958 ex. 59.03; SMHEA minute to Sir William Hudson, 24 September 1958 ex. 59.02
[14] Report of inspection at Thredbo Village, 23 September 1958, Mr. D G Moye ex. 59.04
[15] Lloyd T1393.18
[16] Statement of G E Lloyd, 1 May 1998, ex. 63.01 par.7.4.
[17] Statement of C Pelc, 12 August 1998, ex. 52.01.
[18] Statement of C Pelc, 12 August 1998, ex. 52.01 Annexure G
[19] Letter from E Nicholls to E. Pysden dated 4 November 1960, ex. 50.03; letter from E Nicholls to E. Pysden dated 10 January 1961, ex. 50.05 letter from Brewster Murray and Jones to the Secretary of KSPT dated 6 March 1961, ex. 54.30; Letter from Brewster Murray and Jones to the Secretary of KSPT dated 3 October 1961, ex. 54.33
[20] Lease between Kosciusko State Park Trust and Kosciusko Thredbo Pty. Limited, 29 June 1962, ex. 54.22.
[21] Statement of J Wicks, 16 November 1998, ex. 132.0276 and attached plans; see also Plan of Thredbo Alpine Village by Wallis and Moore, 1 December 1961, ex. 50.03.
[22] Memorandum re sub-Leases, 10 July 1962, ex. 56.13.
[23] Thredbo Village - Plan of Proposed Subdivision, 1 January 1965, ex. 57.13
[24] Trust Letter to the Secretary, KT1, 15 December 1964, ex. 54.4; Map of Kosciusko - Thredbo Area Development, ex. 54.39.
[25] Thredbo Village - Plan of Proposed Subdivision with layout of lodges, creeks and public paths, 4 May 1965, ex. 54.46
[26] Superintendent Gare, Memorandum to the Secretary, Trust Engineer and Trust Surveyor, 26 July 1965, ex. 54.55.
[27] Trust letter to the Secretary, DMR, 5 August 1965, ex. 54.56.
[28] DMR letter to the Trust, 10 August 1965, ex. 54.57.
[29] Trust letter to Civil and Civic Pty Ltd, 6 October 1965, ex. 54.63
[30] John James, Letter to Civil and Civic Pty Ltd, 26 August 1965, ex. 57.32
[31] Statement of John James, 3 August 1998, ex. 63.01.
[32] Analysis of Thredbo Landslide, PSM R4, p, 38.
[33] Dusseldorp, T1947.33; see also Van der Lee, T2437.51, T2438.31, T2439.03.
[34] Van der Lee, T2439.03.
[35] Thredbo Subdivision Plan, 19 November 1965, ex. 54.74.
[36] Van der Lee, T2416., T2444.04-.11.
[37] Trust letter to KT1, 20 January 1967, ex.54.85.
[38] Van der Lee, T2435.46-.57
[39] Van der Lee, T2458.56, 2475.17, T2475.22, .39
[40] Van der Lee, T2480.27-.32, T2488.10-.20.
[41] Letter, Paynter to KT1, 9 April 1968, ex. 57. 62.
[42] Letter from A Van der Lee to J Paynter dated 17 April 1968 ex. 57.51
[43] Examination of Van der Lee T2598.20
[44] Statement of Mr B Racsko, 10 August 1998 par.43 ex. 132.0218
[45] Memorandum from A Van der Lee dated 18 April 1968 ex. 57.52
[46] Letter, Brewster, Murray and Partners to the Acting Superintendent, 6 May 1968, ex. 132.0707.
[47] NPWS letter to KT1, 10 May 1968, ex. 132.0413.
[48] Letter from L Latten to N Gare dated 15 Oct 1968, ex. 60.28
[49] Examination of Van der Lee, T2413.53
[50] Examination of Van der Lee, T2599.20
[51] Examination of Van der Lee, T2602.40
[52] T2613.47
[53] Memorandum prepared by N Gare dated 21 November 1968 ex. 60.29
[54] Letter from Mr. Gare, Superintendent to Mr Van der Lee dated 14 February 1969 ex. 62.13
[55] Letter from Mr Van der Lee to Mr Govan dated 2 April 1969 ex. 62.15
[56] Examination of Mr Haggstrom T2254.44
[57] Letter from Mr Gare to Mr Van der Lee dated 24 July 1969 ex. 57.3
[58] Letter from Mr Van der Lee to Mr Bradley dated 8 September 1969 ex. 60.26
[59] Letter from Mr Van der Lee to Mr Bradley dated 27 October 1969 ex. 60.27

[60] Letter from Mr Thew, shire clerk to YMCA Ski Club of Canberra dated 2 Dec 1971 ex. 61.15,
[61] Letter from K N Dwyer to Commonwealth Experimental Business Station, 8 October 1962 ex54.23.
[62] See eg the Building Code current in 1963, Kosciusko State Park Trust Building Code ex. 54.29.
[63] Kosciusko Thredbo Pty Ltd, Building Code for Thredbo Alpine Village ex. 58.11.
[64] National Park and Wildlife Service Building Code, ex. 49.32, cl. 3.02.
[65] NPWS Building Code, July 1974, ex. 49.32 at cl. 1.04.
[66] Statement of W A Dagger, 7 October 1998, ex. 80.02, par. 9.
[67] See eg. Memorandum from Mr. Weeks, Clerk of Works NPWS, 31 May 1974, Report on Supervision and Documentation of Building Program in the Kosciusko National Park, ex. 132.08.68.
[68] J Weeks, Memorandum, 25 April 1974, ex. 132.0871; Memorandum 31 May 1974, ex. 132.0868.
[69] B. Rickard, Report of visit to KNP in March 1974, 8 March 1974, Ex.132.0932.
[70] Memorandum from D.J. Gunn, Clerk of Works, to Mr. Bielschowsky, 25 November 1974, ex. 132.0700.
[71] Memorandum from the Director, NPWS to the Superintendent of the Park, 28 July 1976, ex. 80.09.
[72] Dagger, T4722.53, T4723.31.
[73] Dagger, T4727.20-.40, T4727.58-T4728.14.
[74] Dagger, T4735.21-.40.
[75] Statement of W.A. Dagger, 7 October 1998, ex. 80.02 par.34.
[76] Dagger T4744.04-.18.
[77] Blakers, T45552.15-.28.
[78] Dagger, T4744.16.
[79] Dagger, T4746.02.
[80] Dagger, T4745.05.
[81] Dagger, T4748
[82] Dagger, T4755.03-.10.
[83] Development and Building applications - methods for checking applications, W.A.Dagger, 16 June 1982, ex. 77.02.
[84] Letter from Superintendent Robson to Mr. Chappell, Village Manager, KT1, 14 December 1978, ex. 59.05.
[85] The *Bognor Regis* case; Dagger, T4764.07.
[86] Dagger, T4768.12, T4768.258, Memorandum, 13 August 1979, ex. 65.07.
[87] Dagger, T4780.33.
[88] Dagger, T4789.22.
[89] Statement of Dagger, 7 October 1998, ex. 80.02, par.59, Dagger, T4815.50.
[90] Dagger, T4818.16.
[91] Dagger,T4819.17.
[92] Dagger, T4821.03-.24.
[93] Memorandum, W.A. Dagger to Superintendent and the Regional Director, NPWS, 17 August 1979, ex. 65.07.
[94] Memorandum from J. Robson to B. Leaver, Regional Director, South eastern Region, 23 August 1979, ex. 57.55.
[95] Letter, D.A. Johnston, Director NPWS to KT1, 10 September 1979, ex. 59.12.
[96] Memorandum from S.D. Cook, Legal Officer to the Regional Director, South Eastern Region, 15 September 1980, ex. 132.0282.
[97] Coffey and Partners Pty. Ltd., Investigation of Stability of the Alpine Way, 6 February 1980, ex. 62.26.
[98] Memorandum prepared by R. Knutson (NPWS) titled "Western Subdivision, Thredbo" dated 19 June 1979, ex. 78.15; Report prepared by G. Worboys titled "Potential Slope Instability problem developments, Crackenback Valley" dated August 1979, ex. 78.26; Memorandum prepared by J. Lehane titled "Proposed Western Subdivision, Thredbo - Site Investigation by Coffey & Partners P/L dated 14 August 1979, ex. 65.05.
Memorandum prepared by W. Dagger titled "Thredbo Village Earth Slip Precincts" dated 17 August 1979, ex. 65.07; Memorandum prepared by L. Blakers titled "Western subdivision Thredbo Village" dated 17 August 1979, ex. 65.06; Memorandum prepared by J. Robson and B. Leaver titled "Thredbo Village Proposed Western Sub Division Earth Slip Precincts" dated 23 August 1979, ex. 57.55; Letter from B. Leaver (NPWS) to KT titled "Western Sub- Division Thredbo" dated 24 August 1979, ex. 59.10; Letter from D. Johnstone (Director NPWS) to M Matthews titled "Thredbo: Western Subdivision" dated 10 September 1979, ex. 59.12.

The Watermain — Construction

432. The watermain was constructed in April-June 1984 through the uncompacted fill which comprised part of the Alpine Way.

433. It was constructed of AC pipes with supertite joints. The slope in which and above which it was constructed was subject to vertical and horizontal movement. Supertite joints were not designed to resist pull-out forces.[1]

434. There are no extant design drawings or construction drawings for the watermain. There are no as built drawings. Construction commenced in 1984 before any approval was given. A stop work order was issued by NPWS. It is not known for how long the pipeline had been under construction or the extent of construction pre-stop work order. Approval was subsequently given by NPWS and construction proceeded. A drawing is extant showing the pipeline as having an approximate 90 degree bend near to the Schuss-Carinya boundary.[2] (see Appendix 10, Figure 6)

435. The installation of an AC watermain with Supertite joints in ground that was subject of movement meant that there was a risk that joints could separate and/or the pipe could break leading to leakage of water into the surrounding ground.

436. The slope along the Alpine Way was marginally stable. Its continued stability depended on it being kept well drained. The construction of the watermain jeopardised that marginal stability by introducing a potential source of continuous water flow in the event of leakage.

437. The construction of the watermain commenced in April 1984. It was designed and constructed by employees of KT1.

438. Approval for its route was given by the DMR. NPWS approved its construction.

439. By the time it was constructed each of NPWS, the DMR and KT1 knew as a result of their respective involvement in the investigation undertaken in connection with the application for approval of the Western Subdivision:

- That parts of the Alpine Way were, in effect, marginally stable in that the factor of safety against failure of the road and slopes adjacent in the vicinity of the Western Subdivision was in the region of 1.15 rather than closer to the generally accepted standard of 1.5.

- That where slump areas were adjacent to the Alpine Way in the vicinity of the development proposed in the Western Subdivision, the factor of safety approached unity in which circumstances failure of the road embankment could be predicted.

- In other areas of the Alpine Way adjacent to the proposed Western Subdivision, under the most adverse groundwater conditions, the factor of safety at all cross sections along the road approached unity and failure of the road embankment could be predicted.

- Control of groundwater was critical in ensuring the long term stability of the Alpine Way.

440. In December 1980 the DMR advised NPWS that reconstruction of the Alpine Way, including drainage, was required before the proposed Western Subdivision could proceed.[3] Notwithstanding the substantial concerns the geotechnical investigations in connection with the proposed Western Subdivision had revealed, no-one, as I have previously mentioned, from NPWS or the DMR drew any parallels between the matters disclosed in the reports relating to the Alpine Way and the proposed Western Subdivision and the Alpine Way as it ran above the existing village.

441. Mr. Allen of the DMR, the Divisional Engineer who reviewed the Western Subdivision-Alpine Way geotechnical reports, stated the reasons he did not draw any such connection. The first was that the tests done in relation to the Western Subdivision related to an area of the Alpine Way "considered to be less stable than the road embankment above the village". The second was that he expected that the sort of geotechnical investigations required in connection with the proposed Western Subdivision would have been undertaken prior to the granting of the development approval for the existing village. [4]

442. Mr. Allen also said that having walked along the Alpine Way above the Village on a number of occasions he did not recall ever being aware of slip areas and that had he seen any cracking or other signs of movement above the Village he would have taken action. He did note, however, that the essence of the geotechnical reports concerning the Alpine Way above the proposed Western Subdivision was that "water had to be kept out of the embankment" which came as no surprise. He said it was consistent with his view and that of other officers of the DMR about the fill under the Alpine Way [5]

443. Mr. Dagger, who effectively approved the installation of the watermain on behalf of NPWS, did not connect the Western Subdivision-Alpine Way geotechnical reports with the works being undertaken in connection with the laying of the watermain.[6] The fact that Mr. Dagger did not draw this connection is particularly surprising considering that he had been vitally concerned with issues of a geotechnical nature in connection with Thredbo almost from the time he commenced employment with NPWS in February 1975.[7] I have recorded elsewhere Mr. Dagger's extensive concerns with the stability of the Thredbo area. Suffice it to say that subject to the

matters I refer to below in connection with the approval of the watermain, he does not appear to have expressly brought those concerns to bear in giving approval for its construction.

444. The facts concerning the construction of the watermain fall within a relatively narrow compass.

445. In late 1982, the Secretary of the Board of Fire Commissioners wrote to KT1 advising that a fire main and hydrants should be installed on the Alpine Way above the Alpine Way Village to provide a source of firefighting water for nearby lodges and to combat bushfires.[8] In December 1983 Mr. Van der Lee advised NPWS that KT1 intended to install a ring line on the north side of the Alpine Way that summer.[9]

446. Thereafter, there does not appear to have been any further communication with NPWS concerning the construction of the watermain prior to its actual commencement. At some stage, however, Mr. Wright, who was the supervisor of the Village department, walked the proposed path of the pipeline along the Alpine Way with a DMR foreman, Mr. Jim Smith and Mr. Rye of Rye Plant Hire.[10]

447. Construction appears to have commenced in early April 1984. Mr. Baumhammer first saw the works in the evening of 3 April 1984 at which stage he observed a trench and excavations in progress along the Alpine Way above Tyrola Lodge. A pipe had already been lain in the trench and had been covered in places with spoil.[11] He informed Mr. Dagger of the work in progress. On 4 April, on Mr. Dagger's instructions, he issued a stop work notice to KT1.[12] He advised KT1 that the works had to cease until NPWS gave its formal approval.

448. On 5 April 1984 Mr. McConnell, who was KT1's Resort Engineer, wrote to NPWS enclosing a combined Development/Building Approval and 3 copies of drawing No. 84/1 "showing hydrant works to protect the upper lodges along the Alpine Way." Three paragraphs of the letter warrant quotation:

> *"This work has been recommended to us by Technical Risk Insurance Managers Pty. Limited who advise us on potential risk matters.*
>
> *The DMR have already been approached and have walked the proposed line with us indicating the pipe should be approximately 2 metres from the existing road shoulder and at least 600mm below the surface.*
>
> *… We… request that your earliest attention be given to this matter as the added protection is highly recommended before the Easter crowds arrive."*[13]

449. The plan which was attached to the letter was a contour plan of the Village upon which Mr. McConnell had sketched the proposed new ring main which was identified as a 100mm AC pipe (see Appendix 10, Figure 6). The sketch showed the new ring main extending along the Alpine Way from the western most extent of the Village east to just beyond Schuss Lodge where it turned and ran down between Schuss and Gunyang Lodges on the west and Carinya Lodge on the east. It then

appeared to connect with the existing Village water main just above Bimbadeen Lodge in Bobuck Lane.[14]

450. There was nothing on the plan of the nature of a long section or details which would indicate the nature of the backfilling of the trench, the hydrants and air valves or the bedding materials which were to be used in the course of construction.[15]

451. On 6 April 1984 Mr. Dagger stamped the watermain plan as an "Approved Project". Approval was subject, inter alia, to the conditions specified in the letter of approval. The conditions in the letter of approval included obtaining of written approval of the route before further construction, the observance of safety measures directed by the District Building Inspector and the following:

> *"Particular emphasis shall be placed on the consolidation of backfill along the top bank of the road. The area below is a slip zone and a build up of water in a soft trench could increase risk of movement."*[16]

452. Shortly before Mr. Dagger approved the watermain the Superintendent of the Park circulated to those involved in building planning and approval within the Park a memorandum setting out the procedures for processing of District Comment at the District Office. It might be noted that under this procedure, any development application which had operational or engineering aspects was to be referred either to the Chief Ranger or the District Engineer. Mr. Dagger said it was not his practice to refer engineering matters to National Parks engineers unless it was a capital works project. Otherwise it was his practice to use the engineers of the proponent of the project.[17] Mr. Dagger was not trained in hydraulic design.

453. Following receipt of the letter of approval, KT1 completed the ring main. It had been completed by June 1984.[18]

454. No document was provided to the Inquest which gave express approval to the watermain route.

Construction of the Watermain

455. The AC pipeline system which was used for the watermain was widely used for watermain construction at the time. It used rubber ring jointing colloquially referred to as the V-ring. The AC pipes were manufactured by James Hardie and Co Pty Ltd. According to Mr. Nixey, an engineer who worked for the manufacturer for many years, "it was well understood in the industry that these joints were not designed to resist any pull-out forces what so ever."[19]

456. Mr. McConnell did not prepare any design documentation for the watermain system apart from the drawing forwarded to NPWS on 5 April. He said he regarded the new watermain as a "minor work" and a "fairly simple job".[20] He left the execution of the work substantially to the Village Department.[21] Mr. Wright, in turn, delegated the task of installing the watermain to a team lead by Mr. Griffiths,[22] a supervisor in

the Village Department . He had no engineering qualifications.[23] It is important to note that Mr. Griffiths was not called to give evidence. Lend Lease provided a statement signed by him. By and large, however, his evidence did not appear to be controversial.

457. I note that it was common practice at that time for an owner undertaking work of the nature of a minor reticulation main to rely upon experienced personnel to deal with on-site conditions.[24] Acknowledgment of this practice, however appears to be of little utility when a watermain was being constructed in a totally unsuitable location. I shall return to the question of the suitability of the site.

458. Prior to constructing the watermain, Mr. Griffiths had been involved over approximately 2 years in executing the works associated with the major upgrade of water supply pipelines in Thredbo. He had access to detailed plans for this project.[25] Those plans were apparently prepared by a firm of Consulting Engineers, Judell Platt Thomas & Associates Pty Ltd. Judell Platt had provided a report to KT1 on Investigations into Water Supply, Treatment and Reticulation and Fire Protection Services at Thredbo in November 1978.[26] In September 1979 it provided to KT1 Detailed Construction Notes and Specifications of Equipment for what was described as the initial stage of construction, in 1980, for the augmentation of Thredbo's water supply, water reticulation and fire protection.[27]

459. The Water Reticulation System upon which Judell Platt advised did not include a watermain along the Alpine Way in the position proposed in Mr. McConnell's drawing 84/1.[28] The drawings included extensive detail of every part of the Water Reticulation Supply System. Judell Platt specified that the pipes for the carrier mains within the reticulation system should be asbestos cement pressure pipe (class D) with supertite couplings and rubber V-ring joints.[29]

460. Further, the drawings for the proposed Water Reticulation System included details of thrust blocks and angles of bends to be used at every turn or connection of the new system.[30] Mr. McConnell said that KT1 would have relied upon the 1980 Judell Platt specifications for the extent of the size of the pipe, the type of pipe and the supertite couplings as well as thrust blocks and anchor blocks to be used for the 1984 Alpine Way watermain.[31]

461. It was apparent to him, however, that Judell Platt had carefully calculated in relation to each bend in the proposed Water Reticulation System, the precise dimensions of any anchorage used at such points. He knew that those calculations were specific to the locations shown upon the plan for that System and that the calculations had been prepared by having regard to factors such as the size of the pipe, the type of the fitting and thrust and area. [32]

462. He acknowledged that none of the details in the Judell Platt drawings related either to the laying of the watermain parallel to the Alpine Way in the embankment or to the laying of the watermain up the steep slope between Schuss and Carinya Lodges.[33]

463. Mr. McConnell did not recall specifically referring the Judell Platt specifications to Mr. Wright's department to assist in the installation of the Alpine Way watermain. Despite the fact that the Judell Platt details were designed with specific locations in mind, none of which related to the Alpine Way, he saw the Judell Platt details and those set out in a manual prepared by James Hardie and Co Pty Ltd, "to be standard details that an installation crew may wish to refer to if they were unsure."[34] He did not concern himself with the detailed design of the pipe as it was to be installed.[35] The extent of his involvement once the works were proceeding was apparently to drive past the job to see whether it appeared to be progressing satisfactorily.[36]

464. The watermain route was planned to travel in a north-south direction between Carinya and Schuss Lodges because that area, being a reserve, was not subleased to anybody.[37] The detail as to the configuration of the bend where the proposed Alpine Way watermain turned from the east-west direction along the road to the north-south direction down to Bobuck Lane was left to the installation crew as, too, was the decision as to what, if any, restraint to use at any turn.[38]

465. In the result it fell to Mr. Griffiths to supervise the installation of the Alpine Way watermain. Bearing in mind that he had no detailed design drawing of the work provided to him by any engineer on behalf of KT1, it appears that he undertook the installation of the watermain relying upon experience he had gained in his involvement with the earlier upgrade of Thredbo's water supply system.

Configuration of the Schuss Bend

466. An issue was raised as between the geotechnical experts who gave evidence in the Inquest concerning the likelihood of joint separation in particular locations having occurred depending, in part, upon the configuration of the bend of the watermain where it turned from running along the Alpine Way to running north-south between Schuss and Carinya (the "Schuss Bend"). The debate concerned whether two 45 degree or 1 approximately 90 degree bend had been used at that point.

467. Mr. Griffiths could not recall how he configured the Schuss Bend.[39] There are no "as-built" drawings of the watermain. Mr. Wright gave evidence, however, that a master plan was kept in the Village Department office which was intended to depict, as accurately as possible, the location of pipes in the village. It would have been Mr. Griffiths' responsibility to enter the details of the route the Alpine Way watermain took on that master plan. He said Mr. Griffiths was aware of the need to record the precise route of each water pipe on the master plan and assumed that any plan he produced would have been entered with as much detail as possible.[40]

468. Mr. Griffiths acknowledged that it was both his, and the Village Department's, practice to keep the plan indicating services as installed. In accordance with that practice he would have marked on the plan the position of the pipeline installed along the Alpine Way. He believed he would have marked the plan while he was in

the office, but did not believe he would have indicated any particular configuration of bends but, rather, the location of the pipeline and position of valve stand pipe.[41]

469. Several plans of the Thredbo Village Water Supply System were prepared soon after the installation of the Alpine Way watermain, all of which showed an approximately 90-100 degree angle at the Schuss Bend.[42]

470. In November 1984 Technical Risk and Insurance Management Pty. Limited ("TRIM") reported to KT1 that the only record of modifications to the water supplies to the Village was a "marked up" print in the Valley Terminal offices which was very vulnerable to damage or loss. They recommended that a proper reproducible drawing of the Village water supplies as known should be compiled and kept in a separate building from the original. The "marked up" print is no doubt a reference to the master plan. It appears probable that it was then used to prepare the recommended drawing. The later plans were most probably prepared from the master plan marked up by Mr. Griffiths or from the drawing produced at TRIM's recommendation.

471. It seems most probable to me that, in accordance with Mr. Wright's requirement, and sensible practice, Mr. Griffiths marked on the master plan the route of the watermain he had recently installed. The difference in location which would result if he had used two 45 degree angles at the Schuss Bend as opposed to the approximate 90 degree- 100 degree bend shown on all the plans is such that I would have expected two 45 degree angles to have been marked on the master plan if they were used.

472. No plans were tendered which showed the configuration of the Schuss Bend to be two 45 degree angles. The suggestion that it might take that form was first advanced, as far as I am aware, by one of the parties during the Inquest.

473. Having regard to the extant plans, I am satisfied that the Schuss bend was most probably configured at an approximate 90 degree-100 degree angle.

Thrust Blocks

474. Another issue which was considered by the geotechnical experts called during the Inquest and several parties, was whether the watermain was adequately restrained by thrust blocks at the Schuss Bend.

475. Mr. Griffiths said that he learnt what he understood to be the approximate size or thrust for anchor blocks for different situations during his work on the general water pipeline upgrade while he was being supervised by engineers involved in that process. Later during that work he made his own judgment of the block size required as he did, subsequently, in work he undertook on other water pipelines in the village. He also had access to the Hardies pipe installation manual and referred to it, too, to determine the size and location of thrust or anchor blocks. In order to

ensure that a pipeline would not present him with any maintenance problems in the future he would make sure the volume of concrete used for thrust or anchor blocks was "if anything excessive." It was also his practice to encase bends, including the collars, of pipelines in concrete blocks.[43] This was not the shape of thrust block shown on the Judell Platt plans or in the Hardies manual.[44] They show thrust blocks as constructed adjacent to the pipe it was intended to restrain.

476. Following the landslide, the remains of that part of the watermain which travelled in the north-south direction between Schuss and Carinya were excavated. It was found that each coupling was completely encapsulated by roughly formed concrete blocks.[45] Having regard to that fact, Mr. Griffiths has expressed the view that he believes thrust or anchor blocks would have been installed at the Schuss bend.[46]

477. According to Mr. Macoun and Mr. Winter if no or an inadequate thrust block had been installed at the Schuss bend it is virtually certain that the watermain would have failed soon after the pipeline was first put under pressure.[47] I am, accordingly, satisfied that it is most probably the case that a thrust block encased the Schuss Bend.

Suitability of Watermain Site

478. The effect of completely encasing the watermain at the Schuss Bend with a concrete thrust block was that any flexibility of the joints was removed.[48]

479. According to Mr. Tim Sullivan, the nature of the fill embankment was such that it could only remain stable if kept dry. In such circumstances it was inappropriate to place a large, potential source of water in a marginally stable area above a residential development.[49] All the geotechnical engineers who gave evidence agreed that the Alpine Way embankment where the landslide occurred was marginally stable and that its marginal stability could be adversely affected by water.[50] It was also common ground that an AC pipeline system of the sort used to construct the watermain should not be used in a marginally stable embankment which was subject to creep, especially in proximity to an essentially urban development. It seems surprising, in these circumstances, at least with the benefit of hindsight, that approval was given for the construction of the Alpine Way watermain.

480. It is apparent from the steps taken to approve the watermain that Mr. Dagger gave little or no attention to the potential adverse effect of leakage from the watermain on the stability of the Alpine Way, let alone the danger to the lives of occupants of lodges posed by a collapse of the Alpine Way caused by a leak from the watermain saturating the surrounding ground. This was all the more remarkable having regard to Mr. Dagger's longstanding concern with issues of a geotechnical nature in connection with the Village.

481. Mr. Dagger took comfort from several factors in connection with approval of the watermain in explaining why he had not considered its effect on the stability of the

road or required KT1 to obtain a geotechnical report before constructing it. First, he pointed out he had drawn KT1's attention to the questions of potential slip in the area and the need to take appropriate precautions such as proper compaction of the trench in the road verge. Once he had done that, he said, it was a matter for KT1's engineer to determine whether he obtained a geotechnical report.[51] He also professed reliance upon the fact that the route had been approved by the DMR's engineer.[52] He also took into account the fact that the proposal was submitted by KT1's engineers[53] and that he would expect the watermain would be laid in accordance with engineering principles including the design of appropriate thrust blocks and observance of manufacturer's instructions.[54]

482. His claim that he had relied in 1984 upon the DMR having approved the route does not sit well with the condition he imposed that "written approval of the route shall be obtained before further construction."[55] It appears to me to have been a product of Mr. Dagger reconstructing events to fit a model of what he would have preferred to have been influential in his approval process.

483. At the time he approved the construction of the watermain, it was NPWS practice to require geotechnical reports in relation to buildings and major alterations to buildings on the Thredbo Village slope.[56] This was a requirement which Mr. Dagger had instituted after the October 1978 landslide on the Alpine Way. As already noted, at the time of that event, he had discussed with Mr. Blakers, the NPWS Regional Engineer, the potential of a similar event happening in Thredbo.[57]

484. In stark contrast to the requirements imposed in relation to the approval of the watermain, it might be noted that only 3 days after it was approved, Mr. Dagger drafted a letter to be sent by NPWS to KT1 in connection with an application for extensions and renovations to Schuss Lodge. The letter required the provision of a site geotechnical report considering (inter alia) "site stability (slip zone)".[58] Further, in August 1984 the NPWS Health and Building Surveyor when providing district comment on the proposed redevelopment of Schuss Lodge noted:

> *"There is no evidence of recent ground slip, however this location is in a known slip zone and geotechnical advice should be sought."*[59]

485. The requirement that a geotechnical report be submitted was reaffirmed in the letter granting development approval to Schuss Lodge which made that approval conditional upon "a full geotechnical report … for the site."[60]

486. I have given anxious consideration to the question whether Mr. Dagger's evidence that the whole of the hill upon which Thredbo was constructed was "marginal" [61] was made with the benefit of hindsight. The difficulty with this is that in August 1979, Mr. Dagger wrote:

> *"Since 1975 I have verbally questioned the stability of the general Thredbo development area and as a result have insisted on Structural Engineers design for fittings, retaining walls and the like"*[62]

487. In the same memorandum he referred to the 1978 landslide and speculated about the extent of damage which would occur if a similar slip occurred over the Thredbo Village precinct. He had also noted that in 3 or 4 locations above the village, the Alpine Way was showing definite signs of collapse and slip. In fairness to Mr. Dagger, it should be noted that he is, in essence, a builder. He holds no engineering qualifications. However, despite this, it was not his practice at the time to consult anyone with engineering expertise within the service in relation to building matters.[63]

488. While that may have been his practice in relation to building matters, as I have already discussed, it was a requirement of the 1974 NPWS Building Code that engineering works be designed in consultation with a Civil or Structural Engineer. In the case of the Village water supply or plantation works, NPWS's Technical Services Section had been involved in considering the plans. Mr. Dagger did not submit the watermain plan to that Section.

489. He was, nevertheless, concerned about the fact that the area below where the watermain was to be laid was, in his view "a slip zone". His concern was that if the trench within which the watermain was laid became a drainage line with water penetrating down to the area he regarded as a slip zone, the land could become unstable.[64] He did not give any consideration to the possibility that the new watermain could be subject to soil creep even though he was conscious that soil creep was a phenomenon which had occurred in other areas of Thredbo.[65] The "slip zone" to which he says he was referring was the Winterhaus location.[66]

490. Mr. Dagger did not consider, however, that if water leaked from the watermain and destabilised the ground, it could lead to a landslide of the proportions of the 1978 occurrence. Rather, he believed, that it might lead to a somewhat lesser slump such as subsidence.[67]

491. He regarded giving approval to the works as something which was desirable, because he saw the works as part of a fire safety upgrading.[68] He was conscious that the end of the building season was approaching.

492. Nevertheless, Mr. Dagger did not seek any engineering assistance from Mr. Blakers or anybody else in NPWS with engineering qualifications. He relied upon KT1's engineers.[69] Essentially in approving the watermain, he relied upon the fact that he considered it had been approved by the DMR and submitted by KT1 engineers.[70]

493. Mr. Dagger explained the reference to "slip zone" in the letter of 9 April 1984 concerning the application for development approval for Schuss Lodge on the basis that that did not refer to a specific area in the vicinity of the lodge but, rather, to the fact that he regarded the whole of the Thredbo development as "slip zone".[71] That stands in contrast to the memorandum received providing District Comment on the Schuss Lodge redevelopment proposal. In response to a request from Mr. Dagger that the District comment, in relation to the development application in respect of

Schuss, whether there was any evidence of "ground slip zones", the Health and Building Surveyor responded:

> *"There is no evidence of recent ground slip, however, this location is in a known slip zone and geotechnical advice should be sought."*[72]

494. In due course a geotechnical report was prepared in relation to the redevelopment of the Schuss Lodge and submitted to NPWS as part of the approval process.[73]

495. In addition to his reliance upon the fact that the watermain proposal was submitted by KT1's engineer, Mr. Dagger relied upon the fact that the pipes being used to construct the watermain were in common use in Thredbo and other areas of the Park.[74] Not surprisingly, he expected it to be laid in an engineering manner, in accordance with manufacturers instructions.[75] It does not appear ever to have been brought to his attention that the task was to be delegated to the Village Department and was not to be undertaken under direct supervision of any engineers.

496. Although Mr. Dagger had said in his statements that he had relied upon the route of the watermain being approved by the DMR, he had to recognise, under cross examination, that the letter from KT1 made it clear that the DMR's involvement had been to satisfy itself that a route proposed by KT1 complied with its minimum set back specifications.[76]

497. Mr. McConnell was under the impression that all new building works throughout the steeper part of Thredbo required a geotechnical report. It never occurred to him, however, to obtain any geotechnical advice in relation to positioning the watermain in the vicinity of what NPWS described as a "slip zone".[77]

498. Lend Lease submitted that the installation of the watermain was minor work in respect of which a civil engineer would not ordinarily be expected to have obtained a geotechnical report. If submitted it was a reasonable assumption on KT1's part that the road shoulder into which the watermain was installed would be stable and that the AC materials used for the watermain were commonly used at the time by local authorities installing town water supply pipelines.

499. Lend Lease also submitted that KT1 was entitled to rely upon the fact that approval for the pipeline route had been given by the DMR foreman and by NPWS.

500. There is certainly more force in this submission. Nevertheless it should also have been apparent to KT1 that the only engineer apparently involved in the pipeline approval process was Mr. McConnell.

501. It is, quite properly, submitted that the appropriateness of constructing the watermain with the materials that were used in a position that was selected should not be judged by reference to present day standards or knowledge. That is so. However, it was well established by 1984 that the Alpine Way fill embankment was extremely sensitive to water saturation. If not before with the 1978 landslide, that fact had certainly been clearly established through the extensive geotechnical

investigations undertaken in connection with the Western Subdivision. Mr. McConnell was not employed in Thredbo at the time of the Western Subdivision but he recalled from discussions with existing staff when he was there that there was "some risk of slip in this area".

502. Mr. Dagger was aware that there was soil creep in the area adjacent to location it was proposed to place the watermain although he had no information of its extent.[78] Nevertheless it is clear that he was alert, to a certain extent to the possibility that the watermain may impact adversely on the slope through which it was to be place because of his warning about the area below being a "slip zone". That reference, as already noted, arose because he connected the works being undertaken in connection with the laying of the watermain with the Winterhaus location which he had previously identified as a slip zone.[79]. It is perhaps, even more remarkable, in the circumstances, that he did not connect it with the Coffey's reports concerning the Western Subdivision, not least because another of the areas he identified as a "slip zone", was further to the west of the intersection of Banjo Drive and the Alpine Way, adjacent to Happy Wanderers Lodge which was just below the Alpine Way.

503. Mr. Blakers said that he would have been concerned in 1984 after he had become aware of the Coffey's work in relation to the Alpine Way embankment with any proposal which introduced into the Alpine Way fill embankment a potential source of water in the form of a water pipeline.[80] He said that if the matter had been referred to him in 1984 he would have taken into consideration the possibility of the embankment into which the watermain was to be laid being subject to ground movement. He accepted that there was an essential risk in installing any watermain in an embankment which was susceptible to ground movement, he would have preferred that at least where the watermain turned at Schuss Bend and passed through fill and then in situ material on a slope of approximately 35 - 40 degrees that ductile iron be used as material.[81]

504. From KT1's point of view, it is remarkable that Mr. McConnell made no inquiries of NPWS or, apparently, any body within KT1 to obtain any better appreciation of the reference to "slip zone" in the NPWS letter of approval. To the extent he could recall, he said he understood the reference to be to a point along the road where there could have been localised slippage.[82] Nobody within KT1 had told him that there had been any slippages along the road or that the Alpine Way was not properly consolidated.[83] He took it as a given that the Alpine Way was a properly built road.[84]

505. There was a remarkable similarity in Mr. Dagger and Mr. McConnell's lack of information about the area into which the watermain was to be constructed. Thus, neither knew about the degree of compaction of the fill of the Alpine Way into which the watermain was to be constructed.[85] Neither knew about the drainage in the area.[86] Neither, either knew or considered the possibility of the effect of lateral movement of the Alpine Way upon the watermain.[87] Neither knew that the area adjacent to Carinya Lodge was a site of an old creek.[88]

506. NPWS has submitted that it was acceptable for it not to require a geotechnical report for the installation of the watermain which, in the context of the 1980 upgrade of the Water Reticulation System as a whole, was said not to be a significant development. This submission tends to beg the point. First, the 1980 upgrade of the Water Reticulation System, as already noted, had not included a watermain along the Alpine Way. Secondly, it must have been apparent to NPWS that detailed engineering advice had been obtained by KT1 in relation to that upgrade. The degree of detail obtained in relation to the 1980 upgrade could not have stood in starker contrast to the sketch obviously prepared hastily by Mr. McConnell and submitted for approval in early April 1984.

507. NPWS accepts that the uncompacted fill of the Alpine Way is an inappropriate location to install an asbestos cement watermain in circumstances where soil was moving and some of the joints of the watermain were encased in concrete.

508. As I have already indicated, the evidence of the experts as to the unsuitability of the watermain relates not so much to the fact that joints of the watermain were encased in concrete but, rather, to the fact that the supertite joints which were used were incapable of resisting the pull out forces imposed by moving ground.

509. NPWS also submits that there is no evidence to support an adverse inference concerning NPWS failing to inspect the watermain during construction to ensure it was rendered safe by the use of appropriate restraining devices. It is said that there being no expert evidence before me as to the practice and obligations of consent authorities in respect of the inspection of the installation of services in 1984, such an adverse inference ought not to be drawn.

510. This is a curious submission having regard to the system of building inspection NPWS had in place at the time the watermain was constructed, but which Mr. Dagger, apparently did not see fit to evoke having regard to his expectation that the watermain would be laid in an engineering manner.[89] Indeed, Mr. Baumhammer thought that "time permitting" he should inspect the works to establish whether suitable anchor blocks had been used.[90] Like Mr. Dagger, however, he relied upon the fact that Mr. McConnell was an accredited engineer and, further, did not have the time in the course of his duties to be at Thredbo 24 hours a day. He had to trust people that work was carried out in accordance with requirements or standard practice.[91]

511. According to Mr. Baumhammer the watermain matter was taken out of his hands and the watermain completed without him undertaking a final inspection. It does appear, however, that he had inspected the watermain at least along the Alpine Way prior to some part of it being backfilled because he served a further order on KT1 on 10 May 1984 requiring the watermain to be bedded in sand and backfilled with sand to 100mm above the pipe.[92] Mr. Baumhammer did not see the plans submitted for the watermain until after approval had been given. He was of the opinion that the lack of specifications on the plan such as the proposed location of anchor or

thrust blocks or testing to be carried out in relation to the proposal were necessary for a full and proper assessment of the works prior to approval by the Service.[93]

512. It is notable that Mr. Blakers said that if he had been consulted about the watermain, his first approach would have been not to have it in the Alpine Way but to try and put it within KT1's lease area. He would also have sought the advice of the DMR if it was thought the watermain had to go on the fill embankment. He would have left it to the DMR to advise whether a geotechnical report was necessary.[94]

513. One of the difficulties with Mr. Dagger's role in the whole approval of the watermain was that, as he frankly acknowledged, he had no in-depth knowledge of the Alpine Way and its management as a road and its drainage system as such.[95]

514. Although Mr. Dagger relied upon what he understood to be Mr. McConnell's engineering qualifications in terms of designing and constructing the watermain, he knew nothing at the time of Mr. McConnell's qualifications or experience in relation to the design of watermains in an alpine environment.[96] Mr. McConnell had only joined KT1 in mid-1983 and there was no reason for Mr. Dagger to have any confidence that Mr. McConnell would have even the most elementary knowledge about either the history of instability of the Alpine Way, the marginal stability of the fill embankment or the vulnerability of the fill through which the watermain was to be constructed let alone the fact that the fill was subject to creep.

515. In short, NPWS failed to have regard to the fact that it was inappropriate to install the AC watermain along the Alpine Way in ground which was subject to vertical and horizontal movement. The effect of that was that the watermain was installed without any proper or adequate attention being paid either to the potential adverse effect of leakage from the watermain on the stability of the road or the danger to the lives of occupants of lodged posed by a collapse of the Alpine Way caused by a leak from the watermains saturating the surrounding ground.

516. The watermain should never have been constructed in the Alpine Way fill embankment. Having regard to the conclusion I have reached that a leak from the watermain, was, on the balance of probability, the cause of the saturation which triggered the landslide, I regard the approval and construction of the watermain in that position, as a matter of probabilities, to have been causally related to the deaths which resulted.

517. Counsel for the families submitted that I should draw adverse inferences against the DMR for failing to give any or proper consideration to the potential impact of a leak from the watermain in this area and failing to advise KT1 that the watermain should be laid in the route walked with Mr. Smith. In my opinion there is insufficient evidence to draw either conclusion against the DMR. The only evidence available is that Mr. Smith walked the proposed route with Mr. Wright and probably Mr. Rye. There is no evidence that he was ever informed of the materials of which the watermain was to be constructed. Moreover, Mr. Smith was a foreman and not,

according to the evidence, an engineer. There is no evidence that anybody else on behalf of the DMR was ever made aware of the proposal to construct the watermain. Mr. Smith was not called due to ill health.

518. In all those circumstances, in my opinion, no adverse inferences should be drawn against the DMR in relation to the approval of the route of the watermain.

519. KT1 made a number of submissions concerning the adverse inferences proposed by Counsel Assisting in relation to the construction of the watermain. Some of these submissions depended upon propositions I have rejected to the effect that the Alpine Way slope was not subjected to significant vertical and/or horizontal movements and that there was no significant creep impact upon the pipe during the relevant period.

520. A more remarkable submission, however, is the assertion that KT1 did not know of the marginal stability of the shoulder of the Alpine Way in the area of the Carinya landslide and, moreover, was entitled to make the assumption that the road shoulder would be stable. Those submissions pay no regard to the instability of the Alpine Way which should, by 1984 have been well known to KT1. The history is well recorded elsewhere. Suffice it to say that only a few years before development had not proceeded above the Western Subdivision because of the DMR's acceptance of geotechnical reports as to the instability of the Alpine Way in that location. In 1978 the Alpine Way had collapsed in such a manner as to cut Thredbo off for a number of weeks. This had been the subject of justifiably vociferous complaint by KT1.

521. In March 1980 the Managing Director of KT1 wrote to NPWS expressing concern about the possibility that another landslide of the magnitude of the 1978 one would occur on the Alpine Way.[97] He referred to:

> *"…suggestions by officers of the Service that sections of the Alpine Way near Thredbo could be unstable and subject to subsidence under unusually wet conditions."*

522. Further, Mr. Dagger spelled out the fact that the area below that proposed to construct the watermain was a "slip zone". As Mr. Winter said it would not be reasonable to assume the area was stable in the light of either the warning from the approving authority or knowledge of the history of slippage's along the Alpine Way.[98]

523. There could have been no doubt in the corporate mind of KT1 that the Alpine Way was extremely vulnerable to instability if saturated by water. Moreover only a few years before the possibility of an adverse effect on underground services in the light of creep movement in the area proposed for the Western Subdivision had been the subject of discussion and report.[99] The Coffey report into the investigation of the Alpine Way adjacent to the proposed Western Subdivision had made it clear that satisfactory factors of safety against instability of the road embankment and the natural slope below it could only be obtained by maintaining the groundwater levels below the surface of the extremely weathered granodiorite and by keeping the

existing road embankment free of water. That groundwater condition, it was suggested, might be achieved by the installation of a sub soil drainage system Coffey and Partners recommended that to keep the existing road embankment free of water, the section between the top of the embankment batter and the edge of the sealed pavement should also be sealed.[100]

524. KT1 submitted that on the basis of what was now known of the slope above Carinya in consequence of the detailed investigations and excavations carried out since the landslide, present day standards and pipeline materials now available it is apparent that a watermain of the type installed in 1984 would not be constructed in the marginally stable ground forming part of the Alpine Way batter.

525. It is clear from Mr. Blakers' evidence and from the history of instability of the road prior to 1984 and from the Coffey and Partners report, that there was sufficient information available in 1984 to lead to the conclusion that a large source of water should not be placed in the marginally stable fill embankment of the Alpine Way above the village.

526. The design and construction of the watermain by KT1 stands in stark contrast to the approach taken both to the investigation of the stability of the Alpine Way in the context of the Western Subdivision development and the detailed engineering plans which were obtained for the upgrade of the Village water supply system in the early 1980's. It is difficult to believe that if similar investigations had ever been sought and obtained in connection with the watermain proposal, that it would have ever been installed along the Alpine Way.

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1 Report on Assessment of the Water Supply Pipeline System, 16 July 1998, ex. 100.01; Report by P. Nixey, 4 August 1999 part. ex. 127.01.
2 Based on par 24.1.1. of the Report of Convocation of Engineers, ex. 99.01.
3 Telex to DMR from B. Leaver with telex from DMR to Leaver, 2 December 1980, ex. 133.131.
4 Statement of R. Allen, 31 August 1999, ex. 116.01, pars.78-80.
5 ibid, par.75.
6 Dagger, T4830.51, 4903.43.
7 Statement of W. Dagger, 7 October 1998, ex. 80.02, par.28.
8 Letter from the Board of Fire Commissioners to KT1, 9 November 1982, ex. 57.65.
9 Minutes of the Thredbo/NPWS meeting 13 December 1983, ex.75.11.
10 Statement of P. Wright, 22 January 1999, ex. 75.01 at par.18.
11 Statement of A. Baumhammer, 21 September 1998, ex. 77.01, par 19.
12 Mr.Baumhammer's notes, 3 April 1984, ex. 77.03, p.39, 4 April 1984 notice to KT1, ex. 57.66.
13 KT1 letter to NPWS, 5 April 1984, ex. 76.01.
14 Drawing 84/1 - KT1, 5 April 1984, ex. 69.12.
15 Bright, T3431.23 -.37.
16 NPWS letter, 6 April 1984 to KT1, ex. 57.49.
17 Memorandum from Superintendent Robson, 26 January 1984 re D.A. and B.A.Procedures - South East Region, ex. 77.04, Dagger, T4888.58 - 4888.06.
18 Memorandum from Mr. McConnell to Mr.. Hagley, 12 June 1984, ex. 57.47.
19 Report no. PN013, 4 August 1999 by P.R. Nixey at p.4, attached to a report by K.G. Macoun on Water Supply Pipeline system, 19 October 1999, ex. 127.01.
20 McConnell, T4306.54 -.58.
21 McConnell, T4307.5.
22 Wright, T4217.20.
23 Wright, T4219.08.

[24] Winter, T9484.52.
[25] Statement of A. Griffiths, 24 March 1999, ex.129.01.
[26] Investigations into Water Supply Treatment and Reticulation and Fire Protection Services at Thredbo, November 1978, ex.75.04.
[27] Construction Notes and Specification of Equipment to be purchased for KT1, ex. 75.07 and plans, 4 September 1979, ex. 75.08.
[28] See Judell Platt Drawings, ex. 75.08, J128-1B.
[29] Construction notes and Specification of Equipment to be purchased for KT1, Judell Platt, ex. 75.07 at p.33.
[30] Judell Platt Drawings, ex. 75.08, J1286 and 7.
[31] McConnell, T4300.35 - .48.
[32] McConnell, T4304.57 - 4305.17.
[33] McConnell, T4339.39 - .45.
[34] McConnell, T4306.24.
[35] McConnell, T4306.20.
[36] McConnell, T4307.33.
[37] McConnell, T4309.45.
[38] McConnell, T4310.42 - .48.
[39] Statement of A.Griffiths, 24 March 1999, ex. 129.01, par.14.
[40] Wright, T4279.55 - 4280.52.
[41] Statement of A Griffiths, 24 March 1999, ex. 129.01, par.24.
[42] TRIM, Investigation into Mode of Operation of High-pressure Boosted zone within Public Water System Thredbo Village, 21 June 1985, ex. 134.044at p.15, p.12, TRIM diagrammatic sectional layout of Thredbo Village water supply system, 1 April 1986 at p.16 and TRIM plan, 17 April 1986, referred to in K.G.Macoun's report ex.100.01, in appendix B under the heading "Drawings".
[43] Statement of A.Griffiths, 24 March 1999, ex. 129.01, pars.14-17.
[44] Winter, T9482.47.
[45] Inspection of the Remaining Water Supply Pipeline between Schuss and Bobuck Lane, PSM R8, par.4.1.
[46] Statement of A.Griffiths, ex. 129.01, par.23.
[47] K.Macoun, facsimile, 12 February 1999, ex. 100.29, Winter T9480.52.
[48] Winter, T9840.40.
[49] Interpretive Report, PSM R4, p.120 see also Dr.. de Ambrosis, T6652.37 -6653.8, Mr.. A Shirley, T6042.32.
[50] See, for example, Dr. McMahon, T8596.35.
[51] Statement of W Dagger, 7 October 1998, ex. 80.02, par.68.
[52] Dagger, T4834.15 and 56.
[53] Dagger, T4853.13.
[54] Dagger, T4929-30.
[55] NPWS letter to KT1, 6 April 1984, ex. 57.49
[56] Dagger, T4853.55.
[57] Statement of W Dagger, 7 October 1998, ex. 80.02, par.34.
[58] Letter, NPWS to KT1, 9 April 1984, ex. 76.03.
[59] NPWS internal memorandum marked to Mr.. Dagger's attention, 1 August 1984, ex. 80.22.
[60] Letter NPWS to KT1, 26 September 1984, ex. 80.23.
[61] Dagger, T4886.10.
[62] W.Dagger, Memorandum to Superintendent Robson, 13 August 1979, ex. 65.07.
[63] Dagger, T4852.46.
[64] Dagger, T4836.30.
[65] Dagger, T4836.41.
[66] Dagger, T4837.19.
[67] Dagger, T4838.3.
[68] Dagger, T4842.31.
[69] Dagger, T4852.04-.49.
[70] Dagger, T4853.08.
[71] Dagger, T4862.27 - .41.
[72] Memorandum from South East Region to the Superintendent, Kosciusko District, 25 July 1984, ex. 80.21, Memorandum from Health and Building Surveyor, Kosciusko District, 1 August 1984, ex. 80.22.
[73] November 1984, report on Site Investigation at Schuss Lodge Thredbo, ex. 85.01, building approval re Schuss Lodge, 25 June 1985, ex. 80.24, Dagger T4897.41.
[74] Dagger, T4892.25.

[75] Dagger, T4892.36.
[76] Dagger, T4932.51 -.57.
[77] McConnell, T4332.11.-.38.
[78] Dagger, T4886.46, 4897.58.
[79] Dagger, T4830.51, ex. 80.20, Plan of Thredbo Alpine Village marked by Mr. Dagger to indicate the areas shown on his slip zone map.
[80] Blakers, T4600.51.
[81] Blakers, T4602.15 - 4603.26.
[82] McConnell, T4328.57.
[83] McConnell, T4330.55.
[84] McConnell, T4330.37.
[85] Dagger, T4896.12 -.22, McConnell, T4359.02.
[86] Dagger, T4896.39, McConnell, T4359.
[87] Dagger, TT4836.41, McConnell, T4360.44.
[88] Dagger, T4896.56, McConnell, T4359.33.
[89] Dagger, T4928.31 - 4930.53.
[90] Baumhammer, T4434.01.
[91] Baumhammer, T4434.14.
[92] Baumhammer, File Note, 10 May 1984, ex. 77.03.
[93] Baumhammer, T4465.19 -.49.
[94] Blakers, T4630.53 - 4631.31.
[95] Dagger, T39.
[96] Dagger, T4892.58.
[97] Letter KT1 to the Director NPWS, 20 March 1980, ex. 54.76.
[98] Winter, T9469.53 - 9470.33.
[99] Minutes of meeting with KT, 26 September 1979, ex. 64.10.
[100] Coffey and Partners, Investigation of Stability of the Alpine Way, 6 February 1980, ex. 62.26.

The Winterhaus Retaining Wall — Construction

Purpose of the Retaining Wall

527. The Winterhaus Corner was a recognised traffic hazard. The road was narrow and blind and the dish drain on the uphill side became muddy and boggy.

528. The dish drain was a soil depression along which water flowed mainly to the east from the high point of the Winterhaus Corner until the drain entered culvert 137.

529. In 1992, Mr. Tony Sullivan formed the view that the area around the Winterhaus Corner was unsafe for traffic. He proposed to Mr. Ubrihien that the road be widened and asked him to design a retaining wall which would be used to retain the widened road. From November 1993, Mr. Reedy took over management of the project.[1]

Preliminary Design and Investigations

530. Mr. Roger Ubrihien was a draftsman specialising in road engineering work who lived in Bega. He worked on contract for NPWS. At any one time, NPWS had him designing various road engineering works in Kosciusko National Park.

531. Mr. Ubrihien had previously been employed by the DMR and had worked on the Alpine Way. He was not an engineer but he had accumulated some engineering knowledge relating to the stability of the road as a result of this experience with the DMR.

532. Mr. Tony Sullivan formed the view that the most practical course was to widen the road along a length of approximately 120 metres into the hillside. He engaged Mr. Ubrihien to design an appropriate retaining wall.

533. Mr. Ubrihien visited the site in 1993, took photographs and commenced work on the design. He had not previously designed a wall of that type but nevertheless, appears to have produced a design that met the requirements of Mr. Tony Sullivan and later of Mr. Reedy.

534. No geotechnical report was obtained which assessed the effect the construction of the wall might have on the surrounding environment. NPWS submitted such a report was not necessary. Mr. Reedy said that he had spoken to Mr. Warren-Gash about the wall when Mr. Warren-Gash happened to be on site in January 1994. At that stage, Mr. Ubrihien had not completed a design for the wall.[2]

535. Mr. Reedy said that he "set out the proposal that we were looking at - even though it was not definite, what we were doing in the final retaining wall design".[3] Mr. Reedy does not recall having the plans on site to show Mr. Warren-Gash and agrees that the plans in existence at that time, were "certainly not final plans for the wall."[4] As already noted, Mr. Warren-Gash declined to give evidence. Assuming the conversation took place as recounted by Mr. Reedy, nothing in the version he advanced satisfies me that NPWS could be said to have obtained geotechnical approval for the wall. At best, Mr. Reedy made a casual remark about a proposal. Mr. Warren-Gash would have been entitled to a more formal approach if his advice was to be relied upon as part of a process of approving a major work in the Park.

536. Funding difficulties prevented the wall from being built at the time it was designed. Some form of design appears to have concluded in about 1995 but construction on the wall did not commence until January 1997.

537. In the meantime, Mr. Warren-Gash was continuing to do his work of assessing the stability of the Alpine Way and of reading the inclinometers at C137 and C138.

The Final Design

538. Mr. Ubrihien's retaining wall was about 117m in length. Its height above ground level depended on the height of the slope being retained but did not exceed 2.5m. It consisted of pre-fabricated concrete panels slotted into position between I-beams (49 in total) positioned about 2 ½ meters apart.

539. The retaining wall works consisted of the wall which was above ground and a drainage trench below ground level.

540. While the wall was designed to retain the hillside uphill to its south, the drainage trench beneath the wall was designed to receive and remove surface and sub-surface water that flowed from up slope of the wall. It collected the water that had previously been transported away from the site by the old dish drains. The trench was dug to a depth lower than the old dish drain and should therefore have received not only dish drain water but also ground water which might previously have flowed beneath the dish drain.

541. The retaining wall drainage system designed by Mr. Ubrihien had four components:

- A body of gravel between the retaining wall and the cut bank which could receive groundwater allowing it to travel quickly downwards into the drainage trench.

- A metal open flume drain sitting above the gravel between the retaining wall and the cut bank designed to receive surface water and transport it along the length of the wall to a culvert eastward and well away from the site.

- A pair of parallel inter-connected agricultural pipes each running the full length of the wall one of which was on the south side of the wall. The other and much larger was sitting at the bottom of the trench on the northern side of the wall. Any water entering the smaller and slightly higher pipe to the south then flowed to the larger lower pipe through short connecting pipes that ran between the two parallel pipes.

- As with the area between the wall and the cut bank, the whole of the drainage trench was filled with gravel packed around the two pipes and the various connectors between them to operate as a medium through which water which did not enter the agricultural pipes would travel along the trench floor to C137.

542. Subject to an argument referred to below, the floor was cut into extremely weathered granite and was not lined with any impervious material.

543. When functioning as designed, the retaining wall drainage system would have received waters from the uphill surface, the Schuss spring and any other groundwater intersected by the cut and the drainage trench. The gradient on the floor of the drainage trench should have been sufficient to accept a flow of water along the length of the drainage trench without downward percolation, of any significant degree, through the floor of the trench.

544. Whilst Mr. Ubrihien designed the two-pipe system and the concept of the drainage trench, he did not provide specific design parameters for the trench itself. He also provided no construction guide leaving those matters as engineering detail to be dealt with on site or by the design or other engineers to whom he reported.

545. Mr. Ubrihien suggested some foundation testing for the wall. He arranged the testing by having a local officer of SMEC inspect the site, take samples and, carry out tests and report. In the course of reporting, the officer made a hand-written comment at the foot of his document in the following terms:

> *"As discussed at the time this testing was commissioned, I suggest you pay particular attention to the influence of groundwater, as the stability of your slope may be particularly sensitive in this parameter."*[5]

546. The SMEC officer's recommendations came to the attention of Mr. Ubrihien and Mr. Reedy. Mr. Reedy thought the suggestion related to the slope above the proposed wall. I accept that is the way the document could have been read. Mr. Reedy said that he did not consider a geotechnical report because the intention of the wall drainage system was to "improve drainage conditions in that area so that's what I thought would happen".[6] Mr. Reedy considered that the wall, unlike the area across the road where the inclinometers had been inserted was not sensitive. The construction of this wall was "pretty standard straightforward civil construction".[7]

547. NPWS approved its design and construction after first carrying out in 1994, a Review of Environmental Factors (REF). The author of the REF had access to and relied upon two of Mr. Warren-Gash's reports as indicating that while the cut batter above the proposed wall had an approximate slope of 40 degrees and evidence of past slip movements, it was regarded as being relatively stable. The REF was produced three years before the construction of the wall and three years before the SMEC Report which recommended groundwater observations. No update on the REF was undertaken during the three-year gap prior to construction.

548. The author of the REF makes no mention of the presence of the watermain on the other side of the road. This is hardly surprising as no-one associated with the construction of the retaining wall appears to have known about it.

549. The REF is not a statutory requirement. It is an informal process undertaken to determine whether a full environmental impact study is required. After the REF, the wall was approved.

Construction of the Retaining Wall

550. In the period prior to, as well as during the construction of the retaining wall, Mr. Tony Sullivan was on extended leave. Mr. Reedy acted in his position during his absence. Mr. James O'Connor, an engineer, was seconded from SMEC to assist Mr. Reedy by providing contract administration services in respect of works being undertaken on 12 sites along the Alpine Way as part of the 1996/1997 Alpine Way Improvement Programme.[8]

551. Mr. O'Connor supervised the construction of Mr. Ubrihien's design. He reported to Mr. Reedy. The plant labour and on-site supervision for the construction of the Winterhaus retaining wall was provided by a local company, Rye Plant Hire, the principal of which was Mr. Philip Rye. He was overseas during much of the period of the construction of the retaining wall. His company's work was supervised by an experienced site foreman and supervisor, Mr. Jim Johnston.

552. By the time construction occurred, Mr. Ubrihien's role had ended. His role in connection with the retaining wall was confined to drafting and design.

553. Mr. Reedy visited the site regularly. Mr. O'Connor visited the site most days. Mr. Johnston had other jobs to attend to but was on site almost every day for lengthy periods and was present for any significant work. None of those persons was aware of the presence of the water supply pipeline which ran parallel with the retaining wall on the other side of the road for more than half of its length even though Mr. Rye had walked the pipeline route with Mr. Wright and Mr. Smith and had provided the plant and equipment which had been used, at least, to compact the watermain and lay a layer of gravel over the Schuss carpark after the watermain was sealed up.

554. NPWS was contractually responsible for ascertaining the location and depth of any underground services that were near or passing through the work site. Once notified to Rye, it was responsible for ensuring no damage was caused to such services.[9] No one on behalf of NPWS notified Rye of the presence of the watermain.

Absence of a Geotechnical Study

555. A surprising feature of the implementation of the design for a retaining wall at the Winterhaus Corner was the absence of a geotechnical study to assess the impact of the plan on groundwater, and stability in the area.

556. The plan for the retaining wall probably passed from Mr. Tony Sullivan to Mr. Reedy at a stage too early to have captured Mr. Tony Sullivan's proper consideration. So far as Mr. Reedy was concerned, he certainly did not discuss it with Mr. Tony Sullivan and appears to have considered, at least at the time he gave evidence, that a geotechnical study was unnecessary[10]

557. All later geotechnical engineers held the view that the general area in which the Winterhaus Retaining Wall was built was acutely susceptible to groundwater changes.[11] That view was not confined however, to post-slide expert opinion. Mr. Tony Sullivan had held a similar view about the Winterhaus Corner and it was for that reason that he specifically pointed out the Winterhaus Corner to Mr. Warren-Gash.

558. Mr. Reedy was aware of the presence of inclinometers on the north-side of the road at C138 and C137. Mr. Ubrihien was also aware of the existence of the inclinometers.[12] Mr. Ubrihien's general qualifications and the limited nature of his task, restricted as it was to design, may have prevented him from having a detailed understanding of the implications of the presence of the inclinometers. The same cannot be said of Mr. Reedy. His explanation for the failure to obtain a geotechnical study despite his awareness of the reason for the presence of the inclinometers is that the inclinometers were on the other side of the road from the retaining wall. He appeared to draw a distinction between stability on the south side of the road and stability on the north side of the road.

559. Although I have decided that the landslide was most probably triggered by a leak from the watermain. It is appropriate for me to comment that it seems unusual that NPWS had retained the services of a geotechnical engineer to advise on the stability of the Alpine Way, yet assumed it was safe to conduct major work, along that road without obtaining specific advice. That fact indicated to me that the full implication of the utility of geotechnical advice in this context had not been appreciated.

Method of Construction

560. The construction of the wall took about three months. It was examined in detail in evidence because it was in the design and method of construction that the argument propounding the wall as trigger was found.

561. The first construction task was to cut into the slope. During the course of that work, it was found that a section of the slope in the area of the Schuss spring was too wet to remain rigid when cut. Accordingly, sheet piling was hired by Rye Plant Hire and hammered into the slope in order to support the wet slope after its toe had been cut away. The sheet piling was later removed upon completion of the wall.

562. After cutting away the toe of the slope, the drainage trench was dug. The holes were bored into the floor of the trench approximately 450mm in diameter and about 3.3m deep. Into each of those holes was placed a steel I-beam around which was poured concrete to hold it in place.

563. In the case of four of the 50 bored holes, the ground was found to be too sloppy and wet for the hole to retain its integrity. Accordingly, metal sleeves with a spiral corrugation were inserted into the holes and water in them pumped out before the concrete pour occurred. The four wet holes were approximately in line with the Schuss spring.

564. Mr. Johnston observed most of the work and recalls seeing water rise in some of the holes bored by I-beams. His evidence as to the rate of filling and the height to which water rose was understandably uncertain but it was consistent with the presence of a body or flow of water which was either the Schuss spring or as Dr. McMahon contended, an aquifer which was penetrated by the holes dug for the I-beams.

Floor of the Trench

565. There were two particular features of the floor of the trench which were observed upon deconstruction of the wall in December 1998. The first was that the floor of the trench had two levels, the lower of which was to the north of the trench. That lower level tended to carry the water of the trench and to do so at a level distant from the point at which the I-beams and their concrete surrounds entered the ground.

566. The second feature of the floor of the trench was that a portion of it around I-beams 30, 32, 33 and 34 was covered with a layer of cement. It is believed by both Mr. Tim Sullivan and Mr. Johnston that the concrete lining of the floor of the trench may have been the result of accidental spillage of cement during the pouring of concrete for the I-beams. Certainly, it was not part of Mr. Ubrihien's design. It is not known to what degree water was able to pass beneath the concrete. There appears to have been some water under the concrete in places. In general terms however, it would

appear that some of the trench opposite the south west corner of the landslide, had an impervious layer on its floor.

567. It is a matter of concern to me that NPWS undertook substantial new drainage works above the Alpine Way in 1997 without obtaining a geotechnical report to assess their implications. Even though I have concluded the wall did not trigger the landslide, this indicates a lack of appreciation of the sensitivity of this marginally stable area.

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1 Statement of Tony Sullivan, 30 September 1998, ex. 84.02, par. 79 and 80
2 Reedy T5180
3 T5180.10
4 T518.12
5 Facsimile from F Hawkins (SMEC) to R Ubrihien, 15 February 1994, ex.70.20
6 Reedy T5230
7 Reedy T5230.16
8 Statement of James O'Connor, 1 November 1998, ex. 81.01
9 NPWS letter to Rye Plant Hire, ex. 67.29
10 T5371.24
11 Shirley T6129/32-35; T6158/22-31; de Ambrosis T6924/22-27; McMahon T8616/58-8617/10; Sullivan T10354/30-35
12 T5177.39

Engineering Cause

568. A substantial portion of the Inquest was devoted to considering competing experts' evidence as to what actually triggered the landslide.

569. In order to understand the way that issue was approached, it is necessary first to understand the nature of a landslide. A landslide is "the movement of a mass of rock, debris or earth down a slope."[1] Engineers use the expression "trigger" to describe "some change of a material nature [that] has occurred which resulted in the landslide happening at the time it did." The function of the "trigger" was well described in the Convocation Report in the following terms:

> *"The trigger is plainly a factor material to the occurrence, but it is not the only factor because without pre-existing conditions the trigger would have been ineffective to produce the landslide. The trigger may be an instantaneous event or it may be the accumulation of apparently insignificant, undetected and possibly undetectable circumstances. In general terms, however, the investigation is likely to centre upon circumstances or events which could have produced a trigger mechanism. The weighting given to the time factor by different engineers may influence their ultimate view as to the triggering mechanism. This is illustrated by two theses investigated. One thesis is that the Winterhaus Retaining Wall, constructed four months before the landslide, resulted in additional infiltration of water increasing groundwater pressures within the slope thus causing collapse. The proponents of that view regard the timeous relationship between the event of wall construction and the event of landslide as material. Another thesis is that a water pipeline installed in 1984 in the failed slope leaked. The rate of any such leakage would determine the time when water pressures would so increase as to produce slope failure. The date upon which any such leak commenced cannot be determined, but once it did commence the time clock started. A slow leak may create a trigger mechanism two or three years after commencement; a faster leak may produce the mechanism in a matter of months or shorter."*[2]

570. At the end of the Convocation, the experts were agreed that the following were factors material to the mechanism of failure which resulted in the landslide:

> *"26.1 The method of construction and upgrading of the Alpine Way. This road was constructed and upgraded by side-casting down-slope loose fill comprising topsoil, colluvium, boulders, tree stumps, logs and vegetation. This down-slope fill was not*

> *compacted. The fill was in a fragile condition and the slope had only marginal stability.*
>
> *"26.2 An increase in the groundwater pressure in the slope above Carinya in the material placed there during the Alpine Way construction or upgrading. The increase in the groundwater pressure was due to an influx from a source upon which they could not agree. That source is either additional flows resulting from the construction of the Winterhaus Retaining Wall permitting additional groundwater infiltration to that pre-existing, or a leaking joint in the water pipe laid in uncompacted fill adjacent to the Schuss lodge near the top of the slope which failed."* [3]

571. These, and a number of other theses, were examined by Mr. Tim Sullivan in his Interpretative Report.

572. Mr. Tim Sullivan concluded that there was strong evidence from a number of sources to indicate that the source of water in the upper south- western corner where the landslide was initiated was probably derived from a leak in the water pipe.[4]

573. Dr. de Ambrosis, the geotechnical engineer engaged by NPWS, agreed with Mr. Tim Sullivan's assessment that the most likely cause of the landslide was a leak from the pipeline consequent upon creeping of the ground into which the pipeline was laid leading to separation of the pipeline.[5]

574. Mr. Shirley, who was engaged by the LRO, and Dr. McMahon, who was engaged by Lend Lease, disagreed with Mr. Tim Sullivan and Dr. de Ambrosis' conclusion. They expressed the opinion that the trigger for the landslide was probably water infiltration from the Winterhaus retaining wall.[6]

575. The engineers at the Convocation agreed on certain matters concerning slope failure and the manner of failure of the slope behind Carinya which are important to an understanding of what triggered the landslide.

576. It is important to note in assessing the competing theories that all depend to a large extent on the geology and hydrogeology of the area around the landslide site. Mr. Sullivan, Mr. Kotze, Dr. de Ambrosis and to a slightly lesser extent Mr. Jewell spent substantial periods of time on site studying and investigating these matters. Mr. Sullivan and Mr. Jewell carried out their work to assist me.

577. Dr. de Ambrosis and Mr. Kotze carried out their work both to determine the trigger of the landslide and also to determine what work was necessary to render the Alpine Way safe along the length of the Village. In the case of Mr. Kotze, for example, he was assigned to the project 2 days after the landslide and remained on site an average of three to for days for seventeen months after the landslide. Their reconstruction works on site have involved extensive excavations which have given them the opportunity to make detailed and consistent observations of the geology and hydrogeology of the area.

578. On the other hand Dr. McMahon and Mr. Shirley came to the site much later and after substantial and important excavations and investigations had been undertaken.

Dr. McMahon first visited the site in October 1997 then did not go there again until December 1998.[7] Mr. Shirley's first visit was in January 1998. He visited once more for a day in February 1998 and then again in December during the deconstruction of the retaining wall.

579. Dr. McMahon had worked in the Snowy Mountain region many years before, but I accept the NPWS submission in this respect that that experience was no substitute for diligence on site.

580. Mr. Dundon did not visit the site until about a year after the landslide. He agreed that he had based his opinions essentially on two visits to the site after that year and other people's investigations and results.[8]

581. I found Mr. Sullivan, Mr. Jewell, Dr. de Ambrosis and Mr. Kotze to be impressive witnesses on matters of the geology and hydrogeology of the region. I prefer their evidence on these matters where it differs from that of Dr. McMahon, Mr. Dundon and Mr. Shirley.

Slope Failure

582. It was agreed at the Convocation that, in simple terms, the three main components for stability of a slope are the geotechnical character of the soil, the presence and location of water, and the slope angle of the ground surface. Uncompacted topsoil or colluvium in a slope is more likely to fail than the undisturbed rock below. Introducing water into a slope alters the character of the slope. In partially saturated material in a slope there exist negative pore water pressures. That means there is an internal suction which imparts an apparent cohesion to the soils. When the soil becomes saturated the internal suction effect disappears and the materials become cohesionless. If the angle of friction in a cohesionless slope is less than the angle of the slope, it will fail. The friction angle of the materials in the landslide slope ranged between 30 and 38 degrees. The slope which failed had an angle in excess of 40 degrees, probably in the order of 45 degrees. Thus if the slope became saturated it would fail.

583. Failure of a slope can also be caused by an increase in groundwater pressure which increases the driving forces and decreases the resisting forces.[9]

Description of the Manner of Failure of the Slope

584. It was also agreed at the Convocation that the first component of the landslide site was confined to the southern portion of the landslide area largely between Carinya and the Alpine Way. The second component comprised a mudflow/debris tongue which extended from Carinya to just behind Wolf's Lair at the northern portion of the landslide site.

585. The failure of the slope occurred in two stages (see Appendix 10, Figure 2).

586. The landslide was quite small, being approximately 1300m^3 in volume and irregular. It varied from 30 metres wide adjacent to the Alpine Way decreasing to approximately 13 metres width behind Carinya. Evidence and engineering studies show that the soil materials immediately behind the western wing of Carinya were displaced to the north-east into stage one and two of the Carinya building, that stage two of Carinya was pushed to the north-east and toppled forwarded, that mudflow then impacted on stage one of Carinya carrying it forward resulting in Bimbadeen being struck by the mudflow and Carinya stage one debris, Bimbadeen then collapsing forward in a pivoting movement about the south-eastern corner.

587. The main landslide scarp formed by the second landslide event (stage two) is parallel to older relict scarps identified during remedial excavations. The probability is that the main landslide scarp (stage two) was formed by sliding along an older pre-existing scarp; that is, it was a re-initiation of an older failure.

588. It was agreed that the slope failure occurred because of groundwater changes within the mass which failed. As it was agreed that the slope failure was due to groundwater changes, it was not necessary to determine whether the initial failure of the slope occurred towards the top of the slope mass or at its toe. The agreed view was that the landslide was not initiated by failure at the toe of the landslide surface in the zone behind Carinya.[10]

Nature of the Landslide Site

589. A number of other matters concerning the slope which was the subject of the landslide were also substantially agreed during the Convocation.

590. Prior to the landslide the slope above Carinya and below the Alpine Way was a slope comprising base material of weathered granodiorite overlain by ancient landslide material on top of which had been placed uncompacted fill pushed downslope by side casting when the Alpine Way was constructed or upgraded. This uncompacted fill comprised a mixture of top soil, weathered material, boulders, tree stumps, logs and vegetation.

591. This slope was subject to movement in both a horizontal and vertical direction. The vertical movement resulted from settlement of the uncompacted material. The down-slope or horizontal movement resulted from the normal application of geotechnical forces operating in downhill slopes in uncompacted material.

592. Prior to the landslide there was no measurement of the extent of lateral or vertical movement in the landslide area above Carinya.

593. Prior to the landslide there were inclinometers, which measure such movement, placed in other positions along the Alpine Way which were intended to measure slope movement. Two such inclinometers, at C137 and at C138, were close to the

landslide area. Additional inclinometers were placed around the Thredbo area post-landslide.

594. The engineers considered the data available from the pre-landslip inclinometer readings. In addition, post-landslide investigations revealed cracks or separations which were indicative of movement in slopes surrounding the Munjarra Culvert, the Schuss Culvert, and a cement rock drain below the Schuss car park. Cracks in fill along the Alpine Way were noted. Videos of the interior of the water pipeline were also considered in relation to the question of movement in the slope above Carinya.

595. It was agreed that the landslide area, was subjected to vertical and horizontal movement pre-landslide. The extent of that movement could not accurately be determined empirically and the assessment of movement necessarily involved the application of engineering judgement. Amongst the engineers the assessment of likely movement based on pre and post landslide data ranged from approximately 1mm per annum to 10mm per annum.

596. Movement occurs over time. Movement is not uniform and thus does not have a direct linear relationship with time. The extent of movement also varies with depth, the extent normally decreasing with depth. The surface movement is greater as the depth of uncompacted material increases. Engineers expect to find more movement in uncompacted material close to the surface than in undisturbed formations below.

597. A factor of relevance in relation to movement of the slope is any effect such movement may have had in relation to the suggested failure of the water pipeline which was placed in this slope.

598. The nature and lack of compaction of the fill placed on the landslide site when the Alpine Way was constructed or upgraded was agreed to be a factor material to the occurrence of the landslide.[11]

Primary Landslide

599. Prior to any development in the Thredbo area the site of the landslide had been subjected to at least one prior landslide which is referred to as the primary landslide. It is not possible to determine when the primary landslide occurred although it is ancient having occurred hundreds of years ago. Such a landslide is part of the normal mass wasting process of the Crackenback Valley and is common in the Snowy Mountains. Some engineers contended that the site was subjected to later smaller landslides.

600. The existence of the primary landslide was not recorded prior to investigations into the 1997 landslide. Mr. Moye, in 1958, made reference to a previous slump.

601. The primary landslide resulted in the slope into which the Alpine Way and Carinya were later constructed being in a state close to instability prior to the construction of the Alpine Way or any lodges. The slope, prior to any construction, was also very

sensitive to any build up in ground water pressures. Engineers, by appropriate methods and calculations, are able to determine a safety factor for a site. In simplistic terms a safety factor greater than one indicates stability and a safety factor less than one indicates instability. The safety factor depends on the slope, geology, material properties, groundwater conditions and other factors. Thus the safety factor of a site depends in part upon the extent of groundwater pressure. An increase in the groundwater pressure reduces the stability of the site. It is assessed that whilst the pre-development slope remained sufficiently drained it had a safety factor marginally greater than 1. However as the water table increases the safety factor reduces until it becomes less than 1 at which time failure occurs.

602. It is likely that the slope survived for hundreds of years because there was sufficient drainage through the colluvium to prevent build up of water pressure in either the top soil, the colluvium or underlying weathered granite.[12]

Two Major Fills on the Site

603. Construction activity resulted in two major areas of fill being placed on the site.

604. The first fill and the largest was placed at the time the Alpine Way was upgraded in about 1958. This area of fill was formed by side casting by a bulldozer without compaction. The material in the fill was highly organic with abundant boulders, trees and roots and consists of reworked primary landslide, debris, topsoil, colluvium, residual soil and extremely weathered granodiorite.

605. The second major fill was associated with the extension of the Schuss Car Park and overlies the south-western corner of the Thredbo Landslide. Although this fill disappeared in the landslide its existence has been determined by examination of earlier photographs.

606. The fills in the area above Carinya resulting from the two construction processes referred to are up to approximately 6 metres in depth with an average depth of 3-4 metres. These fills overlie the primary landslide.[13]

Geohydrological Description of the Carinya Site Pre-slide

607. The landslide site and the Carinya and Bimbadeen lodges overlie, in part, two known streams. The streams were described by Mr. Moye in 1958 when assessing a proposed subdivision development.

608. There are no relevant geohydrological records preceding the landslide. Much measurement and testing has occurred since the landslide. It follows that the sub-surface geohydrological conditions prior to the landslide must be inferred. On any view, they are complex.[14]

Change Necessary to Cause the Slide

609. As the preceding discussion demonstrates, the safety factor of the landslide site was low. All experts agreed that the change required to trigger the landslide was very small.[15]

Nature of the Landslide

610. The landslide covered an area varying from approximately 30 metres in width at the rear to a length of 90 metres. It extended from the edge of the Alpine Way to just above the base of the Carinya slope. At its maximum it was about 5-6 metres deep thinning to about 1 or 2 metres deep immediately behind Carinya. It had two components, the landslide itself and a combined mud-flow and debris tongue.[16]

611. The mudflow of the landslide was distributed in various ways. There were two lobes of mudflow material located outside and to the east of the landslide scarp and the eastern wing of Carinya. They sat on top of the original ground surface separated from the landslide scarp by a sub-vertical surface of rupture.[17]

612. The main mudflow covered the lower western side of the landslide.[18]

613. Aerial photographs of the landslide taken early on the morning of 31 July 1997 clearly depict the two stage movement.[19] (see Appendix 10, Figure 2)

614. The landslide scarp stood at an angle of approximately 60 degrees. Despite the distribution of mud already referred to, only two areas of the main scarp were observed to be wet or have concentrated groundwater flows. The main area was at the base of the landslide where the slide surface intersected the true groundwater table. The second area was the upper south-western corner of the landslide.[20]

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1 Interpretative Report, PSM R4, par.2.1.
2 Report of the Convocation of Engineers, ex. 99.01, par. 5.91.
3 ibid, par. 26.1 and 26.2.
4 Interpretative Report, PSM245. R4, ex. 94.016 at p. 142.
5 GHD-Longmac Pty Ltd, Investigation into the Cause of the Landslide, ex. 106.01 at p. 47-48.
6 Shirley Constructing Engineers Pty Ltd, Report on Issues relating to Winterhaus Coroner Retaining Wall - Design and Construction, ex. 103.01 at p. 28; Dr.. B K McMahon, Report on Geotechnical Assessment of the Thredbo Landslide, ex. 110.01 at (iii).
7 Dr. McMahon T8378.46-.57.
8 Dundon T8243.36.
9 Report of Convocation, ex. 99.01, pars 17.1 and 17.2.
10 Report of Convocation, ex. 99.01, pars 18.1-18.5.
11 Report of Convocation, ex. 99.01, pars 21.1-21.7 21.9-21.10.
12 Report of Convocation, ex. 99.01, pars 8.5.1 -8.5.3.
13 Report of Convocation, ex. 99.01, pars 9.1-9.2.
14 Report of Convocation, ex. 99.01, pars 11.1-11.3.
15 Mr. Tim Sullivan, T10354.54; Dr.de Ambrosis (agreeing the area was acutely susceptible to changes that would cause a build up of groundwater and thus an increase in groundwater pressure) T6924.27; Dr. B McMahon (agreeing that the unstable environment which became the landslide mass required a change of a relatively small magnitude to trigger the landslide) T8616.4-8617.18; Mr. Shirley; see also written submissions submitted on behalf of Kosciusko Thredbo Pty Ltd, par 11.1.3.s.
16 Interpretative Report, PSM245.R4, par 11.2.

[17] Interpretative Report, PSM245.R4, p. 83; Site Factors Report, ex. 92.0435 and 92.0438.
[18] Interpretative Report, Ops Site, p. 83-84.
[19] Site Factors Report, ex. 92.0166, 92.0167, 92.0168, 92.0169, CR018026.
[20] Interpretative Report, ex. 94.016, p. 142.

The Watermain Theory

615. It appears to have been common ground that the nature of the watermain and its position was that, assuming conditions sufficient to produce sufficient leakage from the pipe, water from the watermain could have wetted up the fill embankment sufficiently to trigger the landslide. The main controversy between the experts was as to:

- whether the conditions existed sufficient to cause sufficient separation of the watermain couplings so as to lead to leak;
- whether, assuming there was separation of the watermain couplings, there was sufficient separation to produce a leak sufficient to wet up the fill embankment so as to trigger the landslide.

616. In other words was there enough creep to produce enough separation to produce enough water.

617. The watermain was excavated after the landslide. It was clear a significant portion of it had been carried away in the first stage of the embankment collapse. The Schuss bend had gone. The pipe was severed in a carrot stick fracture at the top of the embankment and in a torsion fracture in that part which travelled north-south between Carinya and Schuss/Gunyang. Of the part that remained, the coupling closest to the landslide scarp (joint 1) was found to be separated from the coupling by approximately 50mm. There was a separation of approximately 13mm at the second joint (joint 2).

618. A great deal of time was spent during the Inquest considering whether those separations had been caused by creep. A further debate was whether there would also have been similar separation at the hypothesised joint 0 being the joint which would have been to the east of joint 1 on the basis, which I have found, that the Schuss Bend was approximately 90-100 degrees.

619. The evidence concerning what may appear to be a narrow area of controversy was extensive and technical. Every point raised in favour of the proposition that it was a

leak from the watermain which triggered the landslide has been examined in minute detail. This is not said critically but, rather, to demonstrate that no stone has been left unturned in exploring the thesis that it was a leak from the watermain which triggered the landslide.

Observations after the Landslide

620. After the landslide only two areas of the main scarp were observed to be wet or have concentrated ground water flows. The main area was at the base of the landslide where the slide surface intersected the two ground water tables. The second area was the upper south-western corner of the landslide. The remainder of the landslide scarp was dry. Observations to this effect were made by a number of witnesses who came to the site soon after the landslide occurred both around midnight and in the early hours of the morning.

621. Mr. Kite inspected the landslide area at around 1.30am. He observed that to the east of Schuss Lodge, the soil had liquefied and slumped in an area of approximately 6 metres in diameter. He observed that the area directly below the road shoulder appeared to be dry. He observed an under road culvert draining the area of soil liquefaction. He observed that water appeared to be coming out of the fill several meters to the east of a culvert which he observed on the south western corner adjacent to Schuss. The culvert itself was dry around the pipe and he concluded that it was not the source of the water he could hear.

622. He observed signs of substantial water scouring which he concluded could possibly have originated from the damaged watermain. He also observed that paper debris and leaf and vegetation had been moulded around stones and other matter. He observed that the stones had been washed clean. In the south western corner of the slip area he observed that the soil was slumping and water running from within it.

623. He also saw water flowing from the scarp about 10 metres below the Alpine Way. He concluded that more water however, was flowing from the upper south-western corner that from the site at the foot of the slide.

624. He says he observed the face below the scarp carefully at various times during the night. He observed that the eastern side of the scarp and the vertical face below it were quite dry and appeared to be stable. In contrast, the western side of the face next to Schuss was, he opined, not only unstable but continuing to slump in the sense that sections of the fill at the top of the face were becoming totally saturated and dropping off from the upper areas down into the bottom of he slip. After each slump of material, he observed that there would be water visibly flowing out of the face in about the same area as the slump occurred. There would then be a slowing of the water flow followed by another slump when water would start flowing again. He observed the cycle slump followed by water flow followed in turn by slump again

occurring regularly within sections of the south-western corner of the top of the face, gradually moving westwards into the carpark area above Schuss.[1]

625. He also saw water trickling above the retaining wall opposite Schuss Lodge. That water was coming down behind the retaining wall and then diverted roughly at a right angle parallel along the Alpine Way.[2]

626. Mr. Kite formed the view that of the water on the site, 60% was coming from the south-western corner and approximately 20% from the area 10 metres below the road.[3]

627. Mr. Kite said that he observed the water scouring to have been between the edge of the scarp and a large tree to the west. He said the water ran down into a concrete drain which ran diagonally from the end of the Schuss culvert.[4]

628. Under cross examination Mr. Kite clarified that where he had used the words "approx soil liquefaction" he was referring to what he understood would have existed prior to the landslide.[5] He was very clear in his recollection that there was water coming from directly underneath the Alpine Way and flowing downstream.[6]

629. Mr. Jordan, too, gave evidence about the western corner of the slide scarp being, and remaining, wet.[7] Indeed, there was a concern that the wet corner might be productive of instability and imperil the rescuers below.[8] This issue arose, in particular, because Mr. Jordan observed that the wet area in the western corner would freeze overnight and form needle ice. At about 10 am in the morning the needle ice would begin to melt and, indeed, would melt suddenly so that "the whole face would be flowing with water".[9]

630. The mud from the slide although wet, formed a dry crust.[10]

631. Mr. Jordan marked the area of the scarp which he observed to be wet and that he observed to be dry clearly on a photograph of the area.[11] It appears from that photograph that the area he described as wet included the area where the watermain was located and an area around that extending up to the Alpine Way and further down the slope. This area was approximately coextensive with the area he marked up on another photograph[12] as being where needle ice formed overnight. The dry area was the area of the scarp to the east.

632. Mr. Jordan observed that in an area to the west of the scarp, near a large boulder the grass was flattened as though a sheet of water had been flowing over it.[13] This area was most noticeable along the wall of Schuss Lodge.[14] Another photograph[15] showed the area of soil which, according to Mr. Jordan, appeared to have been affected by water run off.[16]

633. Mr. Jordan said the area of flattened grass was on the original ground surface above the severed southern end of the watermain as it travelled in a north-south direction from the Bimbadeen pumps.[17] He did not eliminate the possibility that that flattened

grass was caused either by water discharge from a broken end of the pipe coming up the hill or from rain the weekend before.[18]

634. It is significant to note that Mr. Bell consulted Professor Fell on the morning of 31 July and described the scene to him. Professor Fell expressed the opinion that he suspected that the slide was "liquefaction slide." From this Mr. Bell understood that the road fill had been saturated with water, he assumed near the foundation, and the factor of safety of the fill area had dropped leading to shearing.[19] Professor Fell confirmed that opinion when he arrived and inspected the site with Mr. Bell.[20]

635. Mr. Bell, too, described that ground below the Schuss carpark as saturated.[21]. He observed saturation both above to the left and the right of the watermain.[22] He estimated the extent of the area of saturation above the pipe and going in a northerly direction at between 1 and 2 metres deep.[23] It was his observation that the saturated area was tending to dry up prior to his departure from the site 4 days after the landslide. He, too, had observed the area of formation of needle ice.[24]

636. Mr. Bell also observed the flattened grass in front of Schuss Lodge indicating water had passed over the surface.[25] He also observed tree roots which were hanging over the edge of the western side of the scarp dripping water on the first morning.[26]

637. Mr. Bell concluded that the saturated material was all the carpark fill.[27] He concluded that the saturation he observed indicated water in the soil behind, not just surface saturation.[28]

638. A number of residents and visitors to Thredbo Village sought to enter the landslide site soon after the landslide. They, too, found that they encountered large quantities of water. Mr. Eager, for example, who had been staying in Schuss Lodge attempted to walk onto the landslide site from a position about 2 or 2.5 metres below the rear of that lodge. He found he had to retreat very quickly because the material was like quicksand and came up to his thighs.[29] He could hear water flowing above him from near the Alpine Way.[30] Mr. Eager formed the view that "the subsoil had been fluidised and this had caused the slippage." He also noted that by about 40 minutes after the landslide the water, presumably from the watermain, had stopped flowing.[31] Mr. Eager is a mechanical engineer with experience in open cut and underground mining.[32] His description of the mass he encountered when he tried to walk on the slippage area as "fluidised" was an engineering term intended to indicated it was like a scree slope with the scree having been fluidised so as to make it like quicksand. [33]

639. Mr. Eager's observations were not challenged.

640. A number of witnesses gave evidence of the considerable water, indeed quicksand, they encountered when seeking to venture onto the landslide site soon after its occurrence.[34]

641. Mr. Vardy, a civil engineer employed by the Department of Public Works and Services attended the landslide as part of his role in the District Engineering Services

Functional Area Co-ordinator ("DESFAC") in the Monaro area.[35] He arrived in Thredbo at around 9 am on 31 July 1997. His inspection of the site "revealed that a landslide had occurred due to the liquefaction of embankment material by water from a yet to be determined source".[36]

642. Mr. Tim Sullivan found it difficult to explain the mobility of the landslide without there having been significant saturation in a substantial proportion of the landslide mass.[37] It was his opinion that it was necessary to get some water into some large component of the landslide where the pressure would fail to cause landslide.[38] The area where it was necessary, in his opinion, for the water to penetrate in order to trigger the landslide, was the mass of the fill in the upper zone which went in the landslide.[39] He also referred to the landslide as having occurred as a mudflow.[40]

643. As he put it, when contrasting the proposition that the landslide was caused by a leak from the watermain as opposed to increased water pressure behind the scarp:

> *"We had to actually saturate a significant percentage of the landslide mass to adequately explain the landslide behaviour. It could not be attributed to water pressure behind the south-west corner or elsewhere on the landslide…. the pressure may give a push, but it is not going to explain the mobility that happened, that formed the landslide afterwards."* [41]

644. Mr. Tim Sullivan agreed, in a broad sense, with the proposition that the mobility of debris flows was not readily distinguishable from the mobility of mudflows.[42] He did not accept, however, that that bore any relevance to the situation in Thredbo as he pointed out that debris flows were a "whole mix of boulders and soils and trees".[43]

645. Mr. Tim Sullivan described the landslide as having occurred in the following way:[44]

> *"…. The stage 1 landslide, which was caused by the leak in the pipeline at the top, saturated that upper material. When the failure occurred - it had much less travel than stage 2. When the failure occurred, it deposited the wetter material immediately in the base of the landslide …. and that wetter material then had stage 2 of the landslide collapsing onto that wetter material, forming the mudflow that was observed."*

646. It was this thesis which, according to Mr. Sullivan, explained the fact that stage 2 of the landslide was a mudflow, even though the materials of which it was substantially comprised, came from that part of the landslide scarp which, according to all eyewitnesses, was dry to a depth of at least 10 metres immediately after the landslide.[45]

647. Dr. McMahon expressed the opinion in his Report that "most of the soil involved in the landslide was only partially saturated before the slide".[46] He drew this conclusion from his observation of two photographs extracted in his report as figures 3.10 and 3.11. He concluded from those photographs that "although the debris was wet it did not have a mud-like consistency in mid morning of 31 July 1997 except below the springs in the scarp where the soil was wetted by post slide water flows". He concluded that the parts of the landslide that "became saturated after the slide did so

because they were in the path of water flows originating from the ground water seepage's and the destroyed Bimbadeen pump intake and outlet pipe."[47] Dr. McMahon was operating at a considerable disadvantage in advancing this thesis, he not having visited the landslide site at all until well after the area had been cleared. Mr. Sullivan, by contrast, had the advantage of having seen the site within a few days of the landslide occurring, having walked all over it and dug it up as part of his investigation.[48]

648. It is, moreover, entirely consistent with the observations of Professor Fell and Mr. Vardy that the slide was a liquefaction slide, that the area whence it originated in the south-western corner had been saturated immediately prior to the slide.

649. It might also be noted that Dr. McMahon disagreed with Mr. Svenson's assessment of the 1964 landslide as having "… occurred as a result of complete saturation of an essentially uncompacted and differentially settling fill of completely weathered granite."[49] Notwithstanding the fact that Mr. Svenson had inspected the landslide site adjacent to Winterhaus Lodge some days before the landslide occurred and had inspected it within at least 3 days of the landslide having occurred and advised on steps which should be taken to remediate the area, Dr. McMahon disagreed with the descriptions he applied to the area in question. He did so on the basis of his assessment of one of the photographs of the landslide which he interpreted to be inconsistent with the characteristics he would expect from either saturated fill or mudflow.[50]

650. It was asserted by Lend Lease that Mr. Tim Sullivan's contention that the stage 1 material was saturated was inconsistent with the evidence from witnesses and photographs.[51] Again, the criticism of Mr. Tim Sullivan in this respect is based, in part, upon an analysis by Lend Lease of photographs. Further, the criticism does not give sufficient weight to Mr. Tim Sullivan's proposition that substantially all of the saturated material from the stage 1 slide became intermixed with materials which then formed the stage 2 slide and hence were distributed in the main area where mudflow was observed after the landslide on the western side of the slide and below Bobuck Lane.

651. Lend Lease also asserted that rescuers were able to walk and work in the area of stage 1 immediately after the slide. Mr. Tim Sullivan, however, has made it clear that stage 1 of the slide did not extend far, if at all, beyond the boundaries of stage 2 of Carinya.[52] The fact that rescuers could walk on the site below Bobuck Lane (where most of the Rescue effort was concentrated) does not mean materials from stage 1 of the landslide were not wet.

652. As Mr. Tim Sullivan noted, however, in his Interpretative Report, there were two lobes of mudflow material located outside and to the east of the landslide scarp and the eastern wing of Carinya. Those lobes of mudflow material were separate from the main mudflow covering the lower western side of the landslide. They sat on top

of the original ground surface, separated from the landslide scarp by a sub-vertical surface of rupture.[53] (see Appendix 10, Figure 7)

653. It might also be noted that in paragraph 18.5 of the Convocation Report the engineers "agreed that the slope failure occurred because of ground water changes within the mass which failed."[54] Although Dr. McMahon contended that this paragraph could not be taken literally[55] (and, it was also put, that it was inconsistent with paragraph 22.3.1 of the same Report) I am impressed by the fact that that statement appears in a section of the Report expressly recording an agreement of the assembled engineers. It appears to me to be consistent with that recorded agreement, that it could be expected that the materials which comprised stage 1 of the landslide would have been substantially wet. The observations made of the wet area in the south-western corner of the landslide appear to me to be consistent with such groundwater changes.

654. Observations of mudflow material behind and on the east side of the stage 2 (eastern) section of Carinya were also made by representatives of Longmac who were present on the site from the morning after the landslide.[56]

655. I am satisfied that prior to the landslide the fill embankment in the south-western corner of the landslide scarp was saturated with water. I am also satisfied that it was the changes brought about to that fill embankment by the water infiltration which triggered the landslide.

Observations prior to the Landslide

656. There were several reports of observations of abnormal water in and around the landslide site prior to its occurrence which warrant mention.

Mr. O'Reilly's Observations

657. Mr. O'Reilly was the manager of Schuss Lodge. He arrived in Thredbo to carry out his duties for the Winter 1997 season on 5 June 1997. Almost immediately he observed that the end pine post delineating one of the 4 carpark spaces in the Schuss carpark had been moved so that the Schuss Club's car space had been considerably reduced. He moved the post from its altered position to a position approximating the correct position. As he did so, he observed that the natural ground around the carpark spaces was quite boggy and damp, with the earth making a squelching sound when he walked across it and stood up on it. Indeed, he observed that the old post was easy to pull out of the ground even though it was buried approximately 18 inches down due to the dampness of the material. He saw free water in the bottom of the hole from which he pulled the post. As he dug the hole into which he intended to place the post, he observed that the earth he dug from that position was ordinarily damp. He thought the whole area excessively and unusually wet since there had been no rain for some time.[57]

658. In the first two weeks of July Mr. O'Reilly observed that the area of the carparking spaces after a series of sunny days was not quite as damp or boggy as it had been in June.[58]

659. Mr. O'Reilly made a number of statements. The first was made a day or so after the landslide. The second was made in January 1998. In the second statement, Mr. O'Reilly repeated substantially what he had said in the first statement again pointing out that after he had moved the carpark posts, he noticed that the area of the first carparking space which had been damp continued to be damp although the degree of dampness appeared to vary.[59]

660. He made a third statement in May 1998 after a telephone conversation with Mr. White, the solicitor for KT2. In that statement he said that the areas of the fourth and third carparks which he observed to be wet in June 1997 "did not remain wet and soggy. By early July they were dry."[60] He subsequently agreed that the reference in paragraph 8 of his third statement to the carpark area being "dry" by July was an error.[61] Mr. O'Reilly described the change in the condition of the carpark as having gone from an area where it was not safe to put a car, to one where it was safe enough to put a car.[62] Mr. O'Reilly explained the reference in paragraph 8 of his third statement to the carpark as being "dry" as meaning "it was no longer squelchy".[63]

661. The area Mr. O'Reilly identified as having been wet and soggy in early June 1997 lay directly above and adjacent to (on either side) the watermain.[64].

662. Mr. Tim Sullivan concluded that the observations Mr. O'Reilly made of wetness in the south-west corner of the Schuss carpark was a manifestation of general water within the upper fill layer of that area. He related Mr. O'Reilly's observations that when he extracted the car post from the ground, the material below was muddy and sloppy, to the character of the material interacting with moisture in the upper fill layer.[65] He concluded that Mr. O'Reilly's observations that the area appeared drier in July was consistent with new channel ways and pathways opening in the fill and drainage occurring.[66]

663. He concluded that Mr. O'Reilly's observations related to a leak from the pipeline in the area around joint 0 to the 90 degree bend. He rejected the hypothesis that Mr. O'Reilly's observations could be attributed to rainwater on the basis that later on, when Mr. O'Reilly observed the ground was less wet and squelchy than in June, there had, in fact, been more rainfall.[67].

664. Dr. de Ambrosis also rejected the proposition that it was rain that lead to the observations Mr. O'Reilly made in the carpark. He relied on the fact that the amount of rain that had fallen most recently prior to the events reported by Mr. O'Reilly (38.6mm on 6 June) was insufficient to lead to the observations. He also pointed out that Mr. O'Reilly's observations in the hole from which he withdrew the post where there was free water were very different from his observations in the area where he dug the second hole to reposition the post. He pointed out that if

rainwater had been the cause of the matters Mr. O'Reilly observed, one would expect the response to have been uniform across the carpark. He said the only explanation he had for Mr. O'Reilly's observation was that it was from the leaking watermain.[68]

665. He explained the apparent diminution of the manifestations of wetness and squelchiness in the carpark as a product of the water leaking from the watermain welling up at the time Mr. O'Reilly observed it at the bottom of the post hole, but at the same time creating larger diameter seepage conduits in the fill beneath the watermain thus allowing more water to dissipate through the subsoil. This way the amount of water that was under the fill at the time Mr. O'Reilly observed it would have subsided somewhat at a later stage.[69]

666. Dr. McMahon rejected the hypothesis that a leak from the watermain was responsible for Mr. O'Reilly's observations.[70] He rejected the draining mechanism described by Mr. Tim Sullivan and Dr. de Ambrosis. This was partly on the basis that the carpark had "dried out".[71] As already set out this is not an accurate account of Mr. O'Reilly's evidence. His evidence was that the area earlier observed as wet and squelchy continued to be damp, although the degree of dampness appeared to vary.[72] Dr. McMahon rejected this hypothesis on the basis that if a soil pipe was the explanation for the drainage from Mr. O'Reilly's wet area one would have expected to have seen evidence of them post-slide.[73] He appeared to suggest that investigation after the landslide had not revealed the necessary number of soil pipes.[74]

667. He was also asked whether the area could have drained through "deleterious fill material — vegetation, old drums, coils of wire — that sort of material in the fill." As might be expected, his answer was equivocal, being qualified by him having to hypothesise about the nature of such materials. If such materials formed isolated pockets then he thought that was unlikely to affect the drainage characteristics of the fill. If the deleterious material formed continuous layers which were close to the surface of the slope he said he would have expected any water flowing from the water pipe to have been intersected by such layers and drained to the surface of the slope. He noted, however, that there was no evidence of such continuous layers.[75]

668. Mr. Tim Sullivan's explanation of how Mr. O'Reilly's observation could logically be related to the leaking watermain should be rejected according to Lend Lease as exposing an "inconsistency in the effect and/or behaviour of a build up in water pressure".

669. The inconsistency upon which Lend Lease principally relied was to query why the build up of water in the ground necessary to lead to the surface manifestations of wetness in the carpark seen by Mr. O'Reilly, did not lead to the landslide at that stage. This proposition was based, however, on an assumption Mr. Sullivan did not accept[76], namely that at the time of Mr. O'Reilly's observations the whole area was saturated. Mr. Sullivan also explained that it was possible that the build-up of water

which had led to the features Mr. O'Reilly observed could have drained through cracks in the ground of one or two millimetres.[77]

670. The difficulty with resolving one way or the other, the question how it came about that Mr. O'Reilly's damp area became less damp in early July, are compounded by both the removal by the landslide of most of the area where he made his observations (see for example ex.99.22, figure 21 from the Convocation Report) and the digging up of the area around the watermain as part of the safety measures taken during the Rescue process. Nevertheless there is evidence from Dr. de Ambrosis that the seepage paths he contemplated assisting in the drainage affect from the area around the watermain would be "…through the fill. They would be in areas where there would have been old timber, accumulations of, say, boulders or small pervious layers or zones. There is no defined place for them - because the fill has been built up over a period of time.[78] He pointed out that the seepage path water takes in fill ground can be quite haphazard, depending what is buried in it.[79] He identified the rubbish as having been in the area between joint 0 and the 11 1/4 degree bend, the area which was excavated immediately after the watermain was removed from the trench.[80] He explained the lessening of moisture in the car Park as a product of pipe holes opening up providing a drainage path for the water.[81]

671. It is clear from the extent to which the various experts are required to hypothesise about the nature of the material in and around the watermain, that the precise mode of draining of the car park surface apparently observed by Mr. O'Reilly may never be satisfied beyond doubt. I am, however, satisfied from the observations Mr. O'Reilly made and the close correspondence between his observation and the position of the watermain, that the water he observed in the car Park in early June 1997 emanated from a leaking watermain. (See Appendix 10, Figure 8)

Water Observations in and around Carinya prior to the Landslide

672. Shortly after the landslide a member of Brindabella Ski Club observed what appeared to them to be unusual manifestations of water both inside and outside the lodge. These water observations were analysed in great detail by Mr. Tim Sullivan both in his Interpretative Report and subsequently in his supplementary Interpretation and Analysis Report (PSM R7). In essence, Mr. Tim Sullivan concluded that:

- In general there was no clear pattern for a change in the area of water inflow to Carinya with a possible exception of the sauna and cavity in the east wing of the lodge.
- Water inflow occurred approximately hours after rainfall which, given the nature of the site and the construction of Carinya was to be expected.
- Water inflows were recorded in the month prior to the landslide even in periods when there was little or no rainfall

- While the data was conflicting, overall there appeared to have been an increase in inflow over the 12 to 18 months prior to the landslide.

673. It must be borne in mind that the reports of water in and around Carinya were made by lay observers who, at the time they made the particular observations, did not attach to them the significance they might, in other circumstances have, in relation to the cause of the landslide. Thus, it is not surprising as Mr. Sullivan frankly acknowledged, that "quite a few of the witnesses were very equivocal and it was difficult to exactly pigeonhole them."[82] I note that Mr. Sullivan did not rely upon the witness observations of water manifestations in or around Carinya prior to the landslide as part of the evidence available in relation to hypothesis G in which he considered whether a leak from the watermain had triggered the landslide.[83]

674. In his Supplementary Interpretation and Analysis Report he drew attention to the fact that an analysis of the information relating to observations of water inside Carinya indicated a significant number of people observed water there in the month before the landslide even when there was little or no rain.[84]

Observations of water around Carinya

675. In his Supplementary Interpretation and Analysis Report, Mr. Tim Sullivan concluded that witness observations demonstrated that there was an increase in flow along the western side of Carinya and under stage 1 of the lodge which commenced or was noticed in December of 1996 and may have become worse. He concluded that the increase could not readily be explained by changes in rainfall and that the increase added weight to the hypothesis of a higher ground water mound caused by long term leakage from the pipeline.[85]

676. Mr. Tim Sullivan's conclusions concerning these observations of water in and around Carinya prior to the landslide were criticised both by Lend Lease and KT2. It was put that the witnesses' observations were consistent with other scenarios.[86] Further, both Lend Lease and KT2 challenged Mr. Tim Sullivan's analysis of the lay observations both as being factually inaccurate and logically flawed."[87]

677. It is not necessary to determine the question whether these witnesses' observations record, as a matter of fact, an increase in water distribution around and within Carinya. In fairness to Mr. Tim Sullivan, he only had the statements and running sheets provided to him in the course of the investigation for analysis. As a matter of case management, I determined that it would not be appropriate to call all, or any, of the witnesses whose observations he sought to analyse. On the same basis, however, it does not appear to me that it is appropriate to criticise his analysis as incorrect and/or inaccurate. I accept that he sought, to the greatest extent possible, to place a fair interpretation upon what were, essentially, incidental observations.

Noises heard prior to the Landslide

678. A number of occupants of lodges around the landslide site heard loud noises from a time early in the evening of 29 July until about 5 or 6 am on the morning of 30 July. Residents of Schuss and Gunyang Lodges heard noises between 9 pm and 10.30 pm on the evening of 29 July. They variously described the noise as a "loud, unusual creaking or squeaking noise…", "….unusual enough and of significant volume to cause comment…." and "a loud screeching noise".[88]

679. Other witnesses in Gunyang, which lodge, it might be noted, was located almost due west of Carinya, reported hearing noises between 12.30 am and 6 am on the morning of 30 July which were variously described as "a major creaking or groaning, "… a scraping sound". Mr. Tim Sullivan concluded that the noises heard from Gunyang were "commensurate with the sounds that may be interpreted as related to ground movement."[89]

680. Mr. Eager who was staying in Schuss Lodge on the night of the landslide, described the sound of the landslide as a "loud low-frequency rumbling noise with some screeching noise imbedded within it not unlike a steam train coming to a halt." He said that he had heard a similar low frequency noise on the evening of 29 July at approximately 10.30 pm.[90]

681. KT2 submitted that the noises indicated that movement of the ground at the toe of the landslide probably started a day or two before 31 July 1997.[91]

682. Dr. McMahon said the possibility that the noises heard by occupants of Schuss and Gunyang were caused by initial movement of the landslide could not be ruled out.[92] Dr. de Ambrosis, too, was of the opinion that the first stage of the landslide was mobilised some 24 hours before the sudden collapse at 11.30 pm on the evening of 30 July. He thought the noises heard by witnesses some 24 hours before the event was an indication the toe of that part of the landslide which started in the south-west corner moved down and actually started to crush or damage the rear of Carinya thus leading to noise and possibly dislodging tree roots.[93]

683. I accept their evidence. On that basis it would appear that in order for a leak from the watermain to have been instrumental in triggering the landslide, the effects of that leak must have been operative for at least that period of 24 hours prior to the landslide.

Creep

684. Creep has been defined as a displacement of a mass of rock, residual soil, or sediments adjoining the slope, in which the centre of gravity of the moving mass advances in a downward and outward direction … at an imperceptible rate.[94]

685. At the Convocation, disagreement about creep was limited to its extent and to individual items of evidence of creep. The following statement was agreed by the experts:

> *"The extent of … movement could not accurately be determined empirically and the assessment of movement necessarily involved the application of engineering judgment. Amongst the engineers the assessment of likely movement based on pre and post slide data ranged from approximately 1mm per annum to 10mm per annum."* [95]

686. There was compelling evidence from Dr. de Ambrosis that creep will be greater in thicker and steeper fill.[96]

687. Mr. Tim Sullivan was of the view that there were "abundant signs of soil creep on the slopes and the creep is worse, as evidenced by leaning trees, in the valleys or creeks".[97]

688. Apart from the separation of joints in the watermain, other evidence of creep to which Mr. Tim Sullivan and other engineers pointed, consisted of tension cracks in the fill, cracking in a stone dish drain between Alpine Way and Schuss Lodge and separation and displacement of pipes at the Munjarra and Schuss Culverts between which was the landslide. Mr. Tim Sullivan referred to cracking in road surfaces, leaning of road posts set in fill embankments and cracking in buildings noted at least since 1979. He saw subsidence in road surfaces and noted the readings of inclinometers at C137 and C138.

689. Other evidence of creep consisted of black bands on the spigot of pipes which were too wide to be explained by any cause other than a pull-out of the pipe from the coupling over time. Mr. Macoun gave what I regarded as impressive evidence that black marks on the spigots of pipes one and two (to which respectively joints one and two were attached) differed markedly from the black marks on pipes where there was no separation. This difference, he said, could only be explained by the pipe having been pulled out from the joint, so that the position of the V-ring within the coupling which was the cause of the black mark had moved relative to the pipe.

690. Mr. Tim Sullivan considered that there was adequate evidence of creep to explain separations in the watermain joints capable of causing leakage.

691. Dr. de Ambrosis who had completed a doctorate in creep agreed with Mr. Tim Sullivan. He pointed to inclinometers he had placed after the landslide which showed creep rates of between 3 and 5 millimetres being different from the creep rates shown in inclinometers 137 and 138 which were limited to approximately 1 millimetre. These inclinometers positioned by Dr. de Ambrosis were 2 metres from the crest of an embankment of fill and are likely therefore to show a lesser rate of creep than that which affected the joints of the watermain.[98] Dr, de Ambrosis estimated the rate of creep in the location of the thrust block of the watermain at 5mm per annum.[99]

692. Dr. McMahon contested evidence claimed for creep such as the Schuss Culvert and flat spots and grooves found on the spigots of the watermain pipes. He said that the stone dish drain and the inclinometers readings at 137 and 138 indicated a rate of creep limited to about 1 millimetre per annum.

693. I am not persuaded that the flat spots and grooves are evidence of creep. Some of the Schuss culvert pipes were in material unlikely to be affected by creep.

694. I prefer the evidence of Mr. Tim Sullivan and Dr. de Ambrosis. Both found evidence that creep varied locally. It was greater where the fill was deepest. The fill was shallower beneath the stone dish drain, part of the Schuss Culvert and inclinometers 137 and 138. The fill was deepest at the crest of the Schuss car park where the pipe was positioned.

695. I accept that the ground was moving in that vicinity at a rate of about 5mm per annum.

696. That was more than enough to produce over the thirteen years since its construction, the separation of 50mm found at joint 1. Further, Mr. Sullivan demonstrated in his Interpretative Report that creep can cause separation at more than one joint. On this basis it is probable that there was also separation at joint 0 which is a location where Mr. Sullivan believes the watermain probably leaked.

Rate of Leak

697. Mr. Nixey who had worked for Hardies, the manufacturers of the pipes and thus had special experience and expertise with the type of pipe in question, said minor leakage could occur if a pipe was withdrawn from a coupling by only 14mm. Major leakage in the same joint would be present at 36mm of pull-out.

698. Mr. Nixey said that variations that would increase the risk of leakage could arise during the laying of the pipes. For example, sand introduced into the joint under the rubber V-ring would have that effect.

699. Another hydraulic engineer, Mr. Polin, as well as Mr. Shirley, considered leakage likely to occur between from 25 to 30 mm of pullout. Dr. Stark for Lend Lease did tests on cleaned joints finding no significant leakage until 39 mm.

700. Tests were conducted by Turner and Groskops for Lend Lease on two undisturbed joints from the watermain in Thredbo. They did six tests in total by monitoring leakage during slow pullout in each joint then repeating the tests with clean, soaped joints. The tests were limited but showed:

- Leakage to some degree, was possible from any joint even before separation..
- High levels of variation occurred both in leakage time and rate. For example, leakage varied between .1 and 33 millimetres of pullout. Mr. Tim Sullivan pointed out that a variation of that size has a factor of 333.

- Leakage could occur at measurable rates between 24.5 mm and 30.5 mm of pullout.
- More leakage occurred in joints which were undisturbed and had been buried in ground in Thredbo for a number of years before being subjected to testing.

701. The tests demonstrated that the pipes in situ in Thredbo could leak at a variety of rates but the leak rate could not be predicted with certainty.

702. It was Mr. Tim Sullivan's opinion that there was:

> *"A long term leak stretching back probably of the order of 12 months or longer, that the leak exacerbated over time, increased, probably in the same way as the pipe pullout test results show, that it increased substantially with further separations and movement and in the short period of time, perhaps 24 hours or 26 hours, as indicated by the noises from the witnesses surrounding the site, that the leakage would have been quite substantial in that period."*[100]

703. I accept on the basis of the evidence of creep in and around the site that the watermain's couplings, at least at joints 0, 1 and 2 were separated prior to the landslide sufficiently to lead to the leaking of water into the uncompacted fill embankment. On the evidence of Mr. O'Reilly that leak had been occurring for at almost two months before the landslide. It seems probable that during that period the separations gradually increased leading to greater leaking.

704. It is also probable that separation leading to leaking had been occurring for a substantially longer period of time, possibly 12 months as Mr. Sullivan suggested, having regard to the movement of the pipes demonstrated by the black marks.

705. Although it does not appear to be possible to predict the amount of water which would have leaked from the pipe, it was clearly substantial as evidenced by the saturation of the south-west corner.

706. Accordingly, I am satisfied that on the balance of probabilities it was a leak from the watermain which caused the landslide.

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1 Statements of John Patrick Kite, Ex.73.01 and ex. 73.03.
2 Evidence of J.P.Kite, T3779.13 - 3780.04.
3 Evidence of J.P.Kite, T3789.01.
4 Evidence of J.P.Kite, T3791.54, ex. 42.14, photograph, 31 July 1997, view of the rocks and concrete Drain near Schuss Ski Club.
5 Kite, T3.853.25
6 Kite, T3858.9.
7 Jordan, T871.20.
8 Jordan. T876.3-.9.
9 Jordan, T876.36.
10 Jordan, T878.47.
11 Photograph ex 42.06.
12 Photograph ex 42.07.
13 Jordan, T3241.32.
14 Jordan, T3266.01.
15 Photograph ex. 42.17.
16 Jordan, T3252, see also ex. 42.18.

[17] Jordan, T3290.09.
[18] Jordan, T3290.55.
[19] Bell, T3304.02-.26.
[20] Bell, T3305.51.
[21] Bell, T3308.39.
[22] Bell, T3309.09.
[23] Bell, T3309.48.
[24] Bell, T3311.07 -.13.
[25] Bell, T3319.48 -.58.
[26] Bell, T3320.28, ex. 31.02.
[27] Bell, T3333.05.
[28] Bell, T3338.04.
[29] Eager, T2805.44.
[30] Eager, T2806.26 -.56.
[31] Personal account by David Eager, ex. 64.01.
[32] Statement of David Eager, 5 August 1997, ex. 64.02.
[33] Transcript of a tape recorded interview between Michael Maher and David Eager, 27 August 1997, ex. 64.03.
[34] Bartley, T527.18, 527.32,582.5: Kuhn, T243 and ex. 19.02, Denham, T149.51 and ex. 12.02 and Hoyer, T140.50 and ex. 11.02.
[35] Ex.31.01, Statement of Glen Vardy, 1 October 1997,
[36] Ex.31.01, p.2.
[37] Sullivan, T9868.27.
[38] Sullivan, T9869.10.
[39] Sullivan, T9955.7-.4.
[40] Sullivan, T9955.01, 10014.10 -.23.
[41] Sullivan, T10014.10 -.23.
[42] Sullivan, T11124.52.
[43] Sullivan, T11125.1, 11125.36.
[44] Sullivan, T9894.19.
[45] Sullivan, T9894.14 -.28.
[46] Ex.110.033.
[47] Ex. 110.32 -.33.
[48] Sullivan, T11121.04.
[49] Report on landslide failure of gully fill on the Alpine Way at Thredbo Village - Winterhaus Slip, author D. Svenson, ex. 56.19, Drawing of Alpine Way landslide on a gully fill at Thredbo Village, 5 October 1964, ex. 62.03.
[50] McMahon, T8949.24, ex. 110.67 - figure 5.15.
[51] Lend Lease submissions, pars.4.122ff
[52] Ex. 99.24, summary of landslide movements - figure 23, Convocation Report, seel also ex. 68.03, enlarged aerial view of the landslide taken on 31 July 1997.
[53] Interpretive Report, PSM R4, p.83.
[54] Convocation Report, ex. 99.01, p.18.
[55] McMahon, T8976.36.
[56] GDH-Longmac Pty Ltd, investigation into the cause of the landslide, ex.106.01 at p.3, Interpretative Report, figure 59, ex. 94.077, showing loves of mudflow on top of the natural ground surface to the south east and east of Carinya as well as across all its foundations.
[57] Statement of R. O'Reilly, 1 August 1997, ex. 71.01.
[58] ibid, p.3.
[59] Statement of R. O'Reilly, 22 January 1998, ex. 71.02, par.20.
[60] Statement of R' O'Reilly, 1 May 1998, ex. 71.03.
[61] O'Reilly, T3702.06.
[62] O'Reilly, T3681.42.
[63] O'Reilly, T3709.48.
[64] Interpretative Report, PSM R4, ex. 94.069, figure 51.
[65] Sullivan, T9971.19.
[66] Sullivan, T9971.38.
[67] Sullivan, T9992.15.
[68] de Ambrosis, T6687.52 - 6688.15.
[69] de Ambrosis, T6699.50 - 6700.11.

[70] McMahon, T8535.54.
[71] McMahon, T8541.55, Lend Lease submissions par.4.88.
[72] Statement of O'Reilly, 22 January 1998, ex. 71.02 at par.20, Statement of O'Reilly, 1 August 1997, ex. 71.01 at par 10.
[73] McMahon, T8542.17 - 8544.25.
[74] McMahon, T8545.24.
[75] McMahon, T8546.39 - 8547.17.
[76] Sullivan, T11087.48.
[77] Sullivan, T11088.32.
[78] de Ambrosis, T7014.21, T7024.31-.52.
[79] de Ambrosis, T7040.33.
[80] de Ambrosis, T7044.24 -.40.
[81] de Ambrosis T7049.17.
[82] Sullivan, T10893.16.
[83] Interpretative Report, PSM R4, ex. 94.015, par.14.5.8.
[84] PSM R7, ex. 97.01, par.7.2.4.
[85] PSM R7, ex. 97.01, par.7.3.
[86] Lend Lease submissions on expert issues, par.4.72.
[87] Lend Lease submissions on expert issues, par.4.76, KT2, written submission to the Coroner, par.14.3.1.
[88] Interpretative Report, PSM R4 par.11.3.
[89] Interpretative Report, PSM R4 par.11.3.
[90] Eager, ex. 64.01, p.1.
[91] KT2 submissions, par.17 4.
[92] Dr. McMahon Report, ex. 110.035.
[93] de Ambrosis, T6606.52, 6802.10.
[94] T4035.30
[95] Report of Convocation of Engineers, ex. 99.01 par 21.6
[96] de Ambrosis T6666.11
[97] Mr. Tim Sullivan, Interpretative Report, PSM245.R4, July 1998, ex. 94.016
[98] de Ambrosis T6666.45.
[99] de Ambrosis T6674.06.
[100] Mr. T. Sullivan T9998.26

The Retaining Wall Theory

The Theories of Wall Leakage

707. There were two different theories propounded by which it was said that leakage from the wall drainage trench crossed under the Alpine Way to the fill embankment and triggered the landslide.

Mr. Shirley's Hypothesis

708. Mr. Shirley suggested that leakage from the wall trench occurred at a point more than 20 m to the east of the south west corner. That is a significant starting point because he is alone in holding the view that this was the area of leakage from which the landslide was initiated.[1] Whatever other differences may exist between theories of Mr. Tim Sullivan, Dr. McMahon and Dr. de Ambrosis, each are of the view that the landslide was initiated in the south west corner.

709. The position of principal leakage propounded by Mr. Shirley was near I-beam 41 of the 50 I-beams. The I-beams closest to the south west corner were numbers 30 & 31. Mr. Shirley relied for his analysis on a cross-section of the slope drawn by Mr. Tim Sullivan through a section known as Section C.[2]

710. Most of the drainage trench was cut through extremely weathered granite but Mr. Shirley contended that at Section C the trench was cut through a section of colluvium which was much more permeable than extremely weathered granite. It would have allowed water, he says, to flow through the floor of the drainage trench more easily at that point.

711. The mechanism for which Mr. Shirley contended was the descent of water through the drainage trench floor to the groundwater table below causing pressure at the toe of the slope to increase thus causing a failure at the toe of the slope.[3]

712. I am not persuaded by the mechanism propounded by Mr. Shirley for three reasons:

- It was agreed at the Convocation of Engineers that the landslide commenced in the south-west corner and proceeded in two distinct movements of the type described by Mr. Tim Sullivan in his Interpretative Report.[4] I accept the view of Mr. Tim Sullivan that a failure at the toe of the type for which Mr. Shirley contends is more likely to produce a single movement straight down the slope, rather than two movements the first of which was partially across the slope, which I have found occurred. Further, it was agreed at the Convocation the landslide was not initiated by a failure at the toe of the landslide in the zone behind Carinya, yet this is where Mr. Shirley's theory would lead to failure.

- Mr. Kotze, Dr. de Ambrosis, Mr. Price (a geologist employed by Dr. McMahon) and Mr. Tim Sullivan gave evidence which I accept, that the geological conditions in the trench floor at post 41 required for Mr. Shirley's mechanism to operate did not exist. In particular, I reject the suggestion of Mr. Shirley that wetness was visible during excavation as a downflow from the trench at I-beam 41.

- Mr. Shirley's mechanism if it were correct, should have resulted in wetness in the scarp of that section of the trench during excavation. No such wetness was visible.

713. It is worthy of comment that after the evidence had concluded, Counsel for the LRO submitted that neither the watermain or wall theories were sufficiently persuasive to enable a preference for one theory over the other. Thus there is no longer an active proponent for Mr. Shirley's theory. For this reason too, it may, in my view, be properly set aside.

Dr. McMahon's Wall Leakage Hypothesis

714. The mechanism suggested by Dr. McMahon is more complex than Mr. Shirley's.

715. Dr. McMahon identified three components to his theory. The source of the water, a pathway of the water from the source to the back of the landslide scarp and a mechanism of failure.

The Source

716. Dr. McMahon described the source of water as the drainage trench beneath the wall. The water which gathered in the drainage trench emanated from a body of water perched in colluvium beneath the surface of the slope above the wall. There was no contest as to the existence of that body of water, generally described as a perched aquifer and in Dr. McMahon's theory described as the upper aquifer.

717. The drainage trench, said Dr. McMahon, received or contained more water than had flowed into the old dish drain at the side of the road which was replaced by the retaining wall drainage system. He asserts that the drainage trench received all of the water that the old dish drain received both as surface flow from the hillside above and any oozing groundwater which had then flowed into the dish drain. In addition, the drainage trench also received such ground water as flowed into the trench from the cut face of the slope that constituted the southern side of the retaining wall drainage trench.

718. It is reasonable to assume that Dr. McMahon is correct that the retaining wall drainage trench may have received more groundwater than the old dish drain. The cut face of the slope which was the southern side of the drainage trench was, at its highest point, about 2m. The trench descended to a depth which was lower, although not significantly so, than the lowest point of the previous dish drain.

719. Prior to the construction of the wall, groundwater flowing approximately parallel with ground surface would have continued its downward path passing beneath the road until it reached the base groundwater table.

720. The source of the water which triggered the landslide was on Dr. McMahon's theory, the retaining wall drainage trench which contained a volume of water greater than the previous drainage system.

Pathway

721. It is in the area of pathway that Dr. McMahon met the greatest objection from other experts and in cross-examination. Dr. McMahon's theory requires a pathway to get the water from the wall to the point at which it is said to operate as a mechanism of failure. In the case of the pipeline theory, no such pathway is required because the pipe joints alleged to have caused the leakage sit immediately above and within the south west corner, recognised by Mr. Tim Sullivan, Dr. de Ambrosis and Dr. McMahon as the initiating area of the landslide.[5]

Volume of Water

722. Although considered elsewhere in more detail, Dr. McMahon said only a small amount of water caused the landslide. He correctly asserted that there was some consensus among geotechnical engineers that only a relatively small leakage is required to bring about the landslide. Dr. McMahon raised the matter in answer to evidence about the volume of water capable of leaking from the drainage trench to the intermediate aquifer but leakage identified by Dr. McMahon would have been very small.

Criticism of Dr. McMahon's Theory

723. Dr. McMahon's theory was the subject of detailed consideration at the hearing. It was Dr. McMahon's theory rather than that of Mr. Shirley which provided the foundation for the consideration of questions relating to the retaining wall.

724. The body of the material relating to the retaining wall (expert reports, oral evidence and written submissions), was very substantial and greater than the material in respect of any other expert issue.

Investigation of Land between the Landslide Scarp and the Retaining Wall

725. After the landslide, Mr. Tim Sullivan excavated behind the wet face on the landslide scarp and the retaining wall to test the thesis that water from the retaining wall could have triggered the slide. The work was undertaken in the first week following the landslide.[6] He found no evidence of wetness or seepage in that zone.[7]

726. The next excavation was in the vicinity of the old Schuss culvert. This excavation was also undertaken in the first week after the landslide. It was for the purpose of ascertaining whether the Schuss culvert had operated in some way to redirect water from the retaining wall drain to the wet area in the south west of the landslide.[8]

727. Only one seepage, which was identified as "CJ5" was identified. The remainder of the excavation was dry. There was seepage at the boundary between the fill on the north of the excavation and the extremely weathered granodiorite. It was very small in magnitude and was typical of the isolated, unconnected seepages which were found at a number of locations in the long-recognised wet area to the south of Schuss Lodge.

728. Many more excavations were undertaken in various test pits around the landslide over the succeeding months. The most that could be said was that isolated manifestations of seepage were observed in several test pits.

729. Mr. Sullivan said it was difficult, in the light of these conclusions to see how the retaining wall could have distributed water across in the area postulated by Dr. McMahon having regard to what he described as the "remarkable dryness" demonstrated by these excavations.[9]

730. If the source of the water which triggered the slide had been leakage from the retaining wall, the flow should have continued after the landslide and would have been apparent in the excavations Mr. Tim Sullivan carried out and in the south-west corner. Unlike the pipe, the flow of water from the retaining wall for which Dr. McMahon contends should have continued to flow. Certainly I can see no reason why it would have stopped.

731. Dr. de Ambrosis observed that within days of the landslide the wet south-west corner started to dry up and within weeks had dried up completely.[10] Dr. de Ambrosis said that he believed the seepage that was observed in that area after the landslide was the result of leakage from the watermain so that once the leakage from that source ceased, the south-west corner dried up. I find that evidence compelling.

732. Further, in the course of reconstructing the Alpine Way, NPWS substantially excavated down into the toe of the slope to provide support for the road. In the course of those excavations no seepage was found from alongside the retaining wall trench or from the area of Dr. McMahon's intermediate aquifer.[11]

The Intermediate Aquifer

733. Critical to Dr. McMahon's theory was the existence of an "intermediate aquifer".

734. Mr. Dundon relied upon what he termed "Intermediate Aquifer Observations in Bores and Test Pits" as evidence of the intermediate aquifer.[12]

735. Mr. Jewell rejected the proposition that those observations demonstrated the existence of an intermediate aquifer. He said that the matters Mr. Dundon relied upon were observations of locally saturated flow in the predominantly unsaturated zone above the true water table but that the observations lacked the lateral continuity necessary to fit the definition of an aquifer.[13] As Mr. Sullivan explained, the area in which Mr. Dundon said he identified the intermediate aquifer through the various bore holes and test pit observations was the area where there was a series of isolated local seepages which were not continuous.[14]

736. Mr. Dundon also hypothesised that the intermediate aquifer was a fractured rock aquifer. This, in essence, meant that there were joints in the rock system in and around the site capable of allowing water to flow through them in a continuous and connected manner, as opposed to areas above and below where such fractures would not exist.[15] Mr. Jewell disagreed with the proposition that there was present in the area, the persistent or significant fracturing within the extremely weathered granodiorite which would be necessary to give support to the existence of a fractured rock aquifer.[16] Mr. Sullivan, too, said that the structures which would support a fractured rock aquifer did not exist.[17]

The Disappearance of the Schuss Spring

737. Dr. McMahon asserted that the flow of the Schuss spring as it appeared at the surface on the southern slope and in the dish drain had disappeared upon construction of the retaining wall. He concluded that the retaining wall had "captured" the Schuss spring flow and directed it into the retaining wall trench thereby increasing the volume of water and leading to a greater available flow down the I-beam route into the intermediate aquifer.

738. Dr. McMahon relied on an interpretation of evidence given by Mr. O'Connor about his observations after the retaining wall was constructed.

739. The evidence of Mr. O'Connor upon which Dr. McMahon placed reliance was that a spring feature on the slope had dried out.[18] Dr. McMahon related that evidence to an observation made by Mr. Ubrihien prior to the construction of the wall in December 1993 and January1994.[19]

740. Mr. Ubrihien submits that Dr. McMahon's evidence on this point amounts to a staggering misinterpretation of the evidence upon which it is based. While strongly expressed, I am inclined to agree. The short point is that the spring Dr. McMahon said had dried up, vanished in the construction of the retaining wall because the retaining wall was located behind it. In other words, the excavation was to a point further south than the spring.[20] Hence the spring no longer existed.

The Boundary Zone

741. Essential to Dr. McMahon's theory was the presence of a relatively impermeable boundary zone above the intermediate aquifer but below the retaining wall drainage trench. It is only by reason of the presence of an aquitard, both above and below the intermediate aquifer that an inflow of water from the drainage trench can increase pressure in the aquifer which is the trigger for failure of the slope.

742. The boundary zone was said to consist of residual soil of a type that could only have formed in geological time in a horizontal layer, as part of a natural slope.

743. NPWS was an active opponent of the retaining wall theory and in particular of the boundary zone. NPWS agreed in its written submissions that there were some recordings of the presence of residual soil in the specific places but that those recordings:

- did not support the existence of a continuous layer;
- were in at least one case, explicably anomalous;[21]
- did not overcome the more profound difficulty that any layer of residual soil formed over geological times had been removed from the area by the batter slide of 1959 but in any event, would have been at too high a level in the pre-slide slope to have acted as an aquitard at the elevation required to enable Dr. McMahon's theory to operate.

744. Dr. de Ambrosis produced a document which extrapolated in a very persuasive way both the original ground surface and the layer of residual soil that may have existed prior to the construction of the Alpine Way and the batter slide in 1959.[22] That diagram is evidence in my opinion of the unlikelihood that there existed a relatively horizontal layer of residual soil in the area in which Dr. McMahon says it existed.

Water Rise in the I-Beam holes

745. Great reliance was placed on Mr. Dundon's opinion that the water seen by Mr. Johnston of Rye Plant Hire rising in the I-beam holes was consistent with the presence of the intermediate aquifer.

746. Dr. McMahon relied upon observations of water in the I-beam holes made during construction of the wall. Those observations were made in postholes which intersected the area where the Schuss spring had traditionally flowed and where wet conditions had been observed for many years. The observations relied upon were made by Mr. Johnston who said the water rose in the post-holes to a level of about 1.5 metres and Mr. O'Connor who thought he recalled the water rose to the top.[23]

747. The significance of these observations was that they were said to indicate that the connection between the upper and intermediate aquifers led to a change in the pressure in the intermediate aquifer. These observations were agreed by Dr. McMahon to be at the heart of his theory.[24]

748. Assuming, for present purposes Mr. Johnston's observations of a rise of 1.5 metres, NPWS point out that seasonal changes in groundwater are likely to have exceeded such a rise. NPWS monitored a seasonal surcharge in the area of the Schuss Spring of 3.1m between July 1998 and September 1998. On this basis the suggestion that a rise of 1.5 metres, or even three, would have lead to an unusual situation does not stand up.

749. Moreover while Mr. Johnston gave impressive evidence I am reluctant however, to rely too heavily on the evidence he gave as to the level to which water rose in the I-beam holes. While generally a good observer, Mr. Johnston seemed doubtful about the detail of the rises in water level. He was aided in his recollection by some diary entries but they only concerned de-watering prior to a pour of concrete. Further Mr. Johnston and Mr. O'Connor's observations, or at least recollections, appear inconsistent. That fact, too, places the reliability of their observations in this respect in doubt.

Dry Holes

750. NPWS places some weight on the absence of water in holes which penetrated the area of the intermediate aquifer. They referred in particular to test pit 5, test pit 11 and post hole 31. NPWS argued, consistent with the evidence of Dr. de Ambrosis, Mr. Tim Sullivan and Mr. Jewell that where water did appear, such as in post holes 30, 32, 33 and 34 and in some test pits, it was localised flow consistent only, with conduits and not the presence an of intermediate aquifer.

751. It was common ground among all experts that the landslide gully had an extensive and complex ground water system. The soils were in an advanced weathered state and there was evidence of inter-granular flow. In addition, in the south west corner,

there was an alteration zone which received at least a portion of the flow of the Schuss spring.

752. Localised flow is a plausible explanation for the presence of water in holes. It is a likely explanation for the absence of a structural intermediate aquifer.

753. Related to these points, is a reliance placed by Mr. McMahon on water in a bore-hole dug by Mr. Mattick in 1985. Hole 2A was dug on the south side of Schuss Lodge and disclosed the presence of water. Reliance was placed by Mr. McMahon on that water as evidence of the intermediate aquifer.[25] In the NPWS' submissions, it is pointed out, in my view correctly, that Mr. Mattick put down three holes, only one of which produced water. That appears to be more consistent with localised flow than the presence of an intermediate aquifer. He asserted that seepage in the scarp consistent with the presence of an intermediate aquifer may not have been visible because it evaporated. He also asserted that the seepages that could be seen, although very minor, were evidence of an intermediate aquifer.[26]

754. Dr. McMahon asserted that the face of the test pit[27] did not disclose signs of the intermediate aquifer because its surface was unclean. He pointed to the phenomenon of stress relief as an explanation for water flow through the extremely weathered granite.

Conclusion on the Retaining Wall theory

755. Dr. McMahon relied, as I have said, upon a number of matters to support his theory. In order to get to the more complex parts of his theory relating, for example, to the mechanism of failure it would be necessary to find that the geological and hydrogeological conditions upon which it depends. I am satisfied that those conditions do not exist and, accordingly his argument must fail.

756. There was no basis for concluding that there existed an intermediate aquifer of the type described by Dr. McMahon overlain by a residual soil boundary zone and underlain by another aquitard. Were such layers to have been present with sufficient continuity to amount to an intermediate aquifer, I accept the view of Mr. Sullivan that one could reasonably expect to observe geology in support of those structures. I accept the observations of Mr. Kotze in particular but also of Dr. de Ambrosis and Mr. Sullivan that no such geology existed.

757. In my opinion, Dr. McMahon's and Mr. Shirley's theories that the retaining wall caused a leak of water which triggered the landslide must fail.

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1 The sections were plotted by Mr. Tim Sullivan on a plan as part of his site factors work. Sections are developed for a specific purpose related to either the geometry or geological features of a site that are believed to require investigation to understand the nature of a landslide: Sullivan T9895.40; Interpretative Report, PSM R4, ex. 94.053

2 This Section was plotted by Mr Sullivan on a plan as part of his site factors work. Sections are developed for a specific purpose related to either the geometry or geological features of a site that are believed to require investigation to understand the nature of a landslide

[3] Shirley T6093.10
[4] Interpretative Report, PSM245.R4 July 1998 p. 86
[5] Noting of course that Dr. de Ambrosis considers that the slide was initiated at the toe of the south west corner whereas Mr Sullivan and Dr. McMahon considered that it was at the top of the slope.
[6] Interpretation and Analysis Report, PSM R7, ex. 97.35; Sullivan T9882.32
[7] Sullivan T9883.12
[8] Sullivan T9883.21
[9] Sullivan T9889.47-9890.07
[10] de Ambrosis T6652.13
[11] de Ambrosis T6647.45-6648.14, 6650.09-.21
[12] P Dundon, Supplementary Report on Thredbo Groundwater, October 1999, ex.115.01
[13] Jewell T9505.48-T9506.17
[14] Sullivan T9954.35-39
[15] Dundon T7944.09, T7946.41
[16] Jewell T9506.24
[17] Sullivan T9911.13, T9913.05-.20, T9926.37-9929.57; "Deconstruction of the Winterhaus Corner Retaining Wall" PSM245.R6 ex.95.596
[18] Mr. O'Connor T5061.7
[19] Mr. Ubrihien T3959.25 and Sketch drawn by Mr. Ubrihien on plan, ex. 70.12 reproduced by Dr. McMahon as figure 9.1 ex. 110.107
[20] O'Connor T 5061.41-5062.11
[21] NPWS submission, par.321
[22] Diagram by Mr de Ambrosis "Extension of Section E" ex.124.11
[23] Johnston T3126.39. O'Connor T4959.45-.47
[24] McMahon T8668.17-.37
[25] McMahon T8436 & T8536
[26] McMahon T8440-1
[27] Test pit 11

The Rescue

758. As one might expect the first people on the scene after the landslide were the residents of the nearby lodges. Almost immediately people, wisely or not, tried to climb over the debris in an attempt to rescue those trapped. Mr. Alan Duff, from Inala Lodge, recognising the "disastrous enormity of the situation" called Emergency Services on 000[1]. The call was logged by Senior Constable Gower, who was told by Mr. Duff that a building "had slid down the hill and collapsed onto a car park and that he believed that there may be people trapped inside or under the building". Senior Constable Gower immediately contacted the Goulburn Ambulance Co-ordination and the Police Communications Room at Queanbeyan Police Station and advised them of the call.[2] The centres he contacted were responsible for the coordination of Emergency Services in the Thredbo Village.

759. Subsequently, at 11.42 pm Senior Constable Gower received another call from Mr. Duff who told him "he could hear voices of at least two people who appeared to be trapped inside the collapsed building, however he could not get to them". Senior Constable Gower passed this information onto the Goulburn Ambulance Co-ordination and the Police Communications Room at Queanbeyan Police Station[3].

760. At 11.49 pm Senior Constable Gower received another call about the landslide. The caller advised that "the electricity to the area had been isolated and that heavy equipment would be required". During this conversation Senior Constable Gower could hear the arrival of Emergency Services vehicles in the background[4].

761. The Snowy River DISPLAN was activated at a very early stage post landslide, with arrangements made to activate the Emergency Operation Centre at Jindabyne at the National Parks and Wildlife Headquarters. Sergeant Ingram in his role as Local Emergency Operations Controller (LEOC) began making calls from the Jindabyne Police Station to the emergency management personnel, including the duty officer, National Parks and Wildlife Service and the Local Emergency Management Officer of the Snowy River Shire, Mr. Keith Dawe. Steps were taken, after activation of the DISPLAN for all relevant personnel and resources to be made available at the site.[5]

762. It was not known at this stage exactly how many persons were trapped under the debris other than it was thought there could be 50 to l00 persons in the lodges at the time. It was subsequently learned that there was only 1 person in Carinya and 18 persons in Bimbadeen at the time of the slide.

763. From almost immediately after the landslide there were reports of voices, heard crying for help,[6] from under the rubble in the area of what became known as the A-frame.[7] Some witnesses said they had difficulty distinguishing between whether the voices came from people under the rubble or voices of other people scrambling over the rubble.[8] Others, who were either friends or acquaintances of one or both of them, directly identified the voices as those of Mr. and Mrs. Michael and Mariam Sodergren,[9] residents of Bimbadeen Lodge. It is not clear for how long the voices were heard, however on the evidence it is reasonable to assume the voices were heard for a period of 10-15 minutes after the landslide.[10]

764. There were early attempts at locating persons within the debris. Senior Constable Hoyer in the company of Ambulance Officers Carey and Bartley entered the slide site "in the chance that we may be able to locate a victim on or close to the surface of the slide site."[11] The men walked across the debris to the area where the A-frame was located and heard the voices of a male and female. Ambulance Officer Bartley crawled into the area from where he heard the voices but could not see anyone.[12] A decision was made to vacate the site because as Senior Constable Hoyer described they "could hear concrete above us moving, it appeared as though the concrete slabs were grating against each other".[13]

765. At 11.47 hours, Senior Constable Warren Denham was advised of the event at his Jindabyne home, and thereafter proceeded to Thredbo arriving there at 12.40 am. Upon his arrival he immediately assumed control as the Forward Police Commander pursuant to the provisions of the Snowy River DISPLAN.[14]

766. Senior Constable Denham took command of the situation as the Forward Police Commander from Senior Constable Hoyer after his arrival. Senior Constable Hoyer as the first police officer to attend the landslide area had assumed command, on behalf on the New South Wales Police Service, of the site prior to the arrival of Senior Constable Denham. The taking of command by Senior Constable Warren Denham was assumed pursuant to the Snowy River DISPLAN.[15]

767. Senior Constable Denham was told by Senior Constable Hoyer that he had heard voices coming from the rubble and that "the site was very unstable and that he had determined that it was unsafe for any person to be on the site at that time".[16]

768. Senior Constable Denham then went with Ambulance Officers Carey and Bartley onto the lower section of the landslide site below Bobuck Lane. On the site Senior Constable Denham could "hear grating noises coming from the debris and I could see wreckage of buildings still moving down the slope and settling on top of each other. A large amount of water and mud was running through the site both through

the debris and over it". Senior Constable Denham determined that the entire site was unstable and a danger to anyone entering the site because of the risk of further slippage.[17]

769. Senior Constable Denham was then taken to the A-frame. He and Ambulance Officer Carey went inside. Ambulance Officer Carey called out and both men could hear what they believed was a male voice. The three men then had a conversation about the danger of remaining in the area and about "the person who we had made contact with in the rubble and the possibility of their rescue and possible survival".[18] A decision was made that a rescue attempt was impossible at that time and would place rescue personnel in extreme danger. The men then left the area.

770. Commander of the South Eastern Police Region, Superintendent Johnston, was advised by Superintendent Sanderson of the landslide shortly after midnight. Commander Johnston thereafter made numerous calls to other operational police thus effectively putting the District DISPLAN in place.[19]

771. As the District Emergency Operations Controller (DEOCON), Commander Johnston made the following appointments:

- Superintendent Sanderson as the Site Controller;
- Inspector Garry Smith as the Rescue Coordinator;
- Detective Inspective Cocksedge as the leader of the investigative team.[20]

772. From the time the DISPLAN was activated, whether it be local or district level, there was an assumption of control by the requisite authority responsible for the emergency.

773. At about 12.55 pm Senior Constable Hoyer was contacted by Commander Johnston, who was located in Sydney. Senior Constable Hoyer briefed Commander Johnston on the situation. He told him that there were two, perhaps three, lodges which had collapsed upon each other with suspected multiple deceased persons. Commander Johnston was told the slide was considered "very unsafe with hip deep loose dirt and mud, fallen trees, rocks and there was water running through the site". Commander Johnston was also advised that there were concrete slabs which "were apparently still moving and grating together" and that the site had been cleared by Police and Fire Brigade personnel. Commander Johnston supported the decision to keep emergency workers off site until a further assessment could be made.[21]

774. At 01.10 am, Senior Constable Denham briefed Sergeant Chris Ingram, who was at that time located at the Jindabyne Police Station, of the situation by mobile phone, and Sergeant Ingram concurred with Senior Constable Denham's decision not to allow anyone onto the site at that point in time.[22] Persons were then prevented from entering the site, with Sergeant Forbutt and the other State Protection Group members ensuring that a perimeter was maintained.[23]

775. At about 1.30 am, Senior Constable Langdon of the Cooma Police Rescue Squad arrived at the site and was briefed by Sergeant Peter Forbutt. Senior Constable Langdon agreed with the earlier decision to evacuate the site and the surrounding lodges. An outer perimeter was established.[24]

776. Mr. John Kite, a Senior Building Officer with NPWS, arrived at 1.00 am.[25] Mr. Kite advised Senior Constable Denham that from his initial assessment "another major slide could occur at any time, and a number of adjoining lodges were in grave danger of also collapsing". Senior Constable Denham acted immediately on this information and ordered that the perimeter be extended another 50 metres and that the further lodges be excavated.[26]

777. A further inspection, with a view to commencing rescue operations was undertaken by Mr. Kite, Senior Constable Langdon and Sergeant Forbutt at approximately 2.00 am.

778. At 2.40 am a meeting was held in Christiana Lodge with all assembled emergency services present. Christiana Lodge had been previously commandeered and established as the Site Control Centre.[27] An assessment was still being made by Senior Constable Langdon, Sergeant Forbutt and Mr. Kite. There was general agreement that rescue efforts would be limited at that stage as the land was still very unstable.[28]

779. A report on the findings made during the inspection by Mr. Kite, Sergeant Forbutt and Senior Constable Langdon was given to Senior Constable Denham at 3.16 am.[29] Mr. Kite reported that, in his opinion, "recovery work, above Bobuck Lane, could be safely commenced on the eastern side of the slip area, but not on the western side". Further, "the area below Bobuck Lane was steeper and there was a high probability that slippage from water saturated soils would continue".[30]

780. When further inspections were carried out by Senior Constable Denham during the course of the morning, the site was still found to be very unstable with constant movement, a large amount of water running through the site, and rubble and debris was seen to be settling.[31] From having gone on to the site itself and made his own observations, Senior Constable Denham believed that it was extremely dangerous prior to 3.00 am that morning.[32]

781. Mr. Jordan, Senior Engineering Geologist with the Snowy Mountains Engineering Corporation (SMEC) was contacted at 4.30 am Thursday 31 July 1997 by Mr. Tony Sullivan, of the NPWS, and asked to attend the site. Together with Mr. Graham Bell, Mr. Jordan proceeded to the site arriving at about 7.15 am.[33]

782. Mr. Bell and Mr. Jordan met with Inspector Smith and a quick briefing was given. They were instructed to make an assessment of the stability of the slide site above Bobuck Lane.[34] They were able to report back to Inspector Smith at 8.00 am.[35] Mr. Bell and Mr. Jordan reported that "the actual search for victims within the building

debris could be started almost immediately as the debris was slightly to the right of the main slide path". Further, they advised that Bobuck Lane should be cleared from the southern end and that several large trees needed to be toppled so as to no longer pose a danger to the rescue workers. Mr. Bell and Mr. Jordan also identified the need to control the ongoing water seepage.[36]

783. The Local Police Area Commander Superintendent David Sanderson arrived, by helicopter, at 8.06 am with Mr. Warren-Gash. Upon arrival, Mr. Warren-Gash immediately began an on-site inspection and evaluation. Commander Johnston spoke at length with Superintendent Sanderson and thereafter conducted his own inspection of the site.

784. An indication of the devastation which confronted the Emergency Services in the morning of 31 July 1997 can be gained from the evidence of Inspector Garry Smith, Commander, Police Rescue who arrived at the site at approximately 8.30 am. He described:

> *"the area of the slide which was on the up side of Bobuck Lane was covered in mud, soil and fallen trees, what appeared to be a stone/concrete type wall was partly visible…… Further to the east large sections of what appeared to be roofing material were wedged against a large tree trunk. A short distance further east on the up hill side was large amounts of building debris.……On the downhill side from Bobuck Lane on the western side, fallen trees, soil and mud covered the area and extended downhill for some distance. The scene towards the centre and further eastward revealed large amounts of building debris including large concrete slabs, furniture, clothing, skis, roofing material and a number of motor vehicles. Two of these vehicles were on the lower section to the rear of the remaining lodges in the path of the slide……Amidst the ruins above and below Bobuck Lane large boulders were also visible……Approximately two thirds of the area below Bobuck Lane were covered with large amounts of debris, roofing, concrete and personal effects. There was the sound of timbers and roofing moving and settling".*[37]

785. By 9.45 am Mr. Warren-Gash had completed his inspection of the site and reported to Commander Johnston that he was concerned that "there could be further slippage". He advised that steps should be taken to minimise the risk of slippage, and suggested "that rubble be removed from each side of the landslip in Bobuck Lane". In order for this to occur, the roadway first needed to be tested to ensure that the weight of the digging equipment and trucks could be handled. After the tests were carried out, this activity of clearing Bobuck Lane became the initial major activity in the rescue and recovery operation.[38]

786. Mr. Grant Douglas and Mr. Con Stroemer, members of the Southern Mines Rescue team, arrived at the site at 8.15 am having been called to attend at 4.30 am. On arrival the men were met by Inspector Smith who instructed them to "inspect the site and assist the Operations Command Centre in developing a strategy to search the area in the hope of rescuing any survivors".[39] When Mr. Douglas first inspected the site on his arrival, he found the site to be in equilibrium, but the robustness of that equilibrium or the risk involved in that equilibrium was doubtful.[40]

787. The recovery operation commenced at approximately 9.00 am. The strategy that was first adopted was to remove roofing and building material from the eastern side of Bobuck Lane, whilst an excavator cleared soil and rubble from the western side.[41]

788. Motor vehicles which were precariously situated on the car park slab had to be secured or removed prior to work commencing below them. Constant monitoring of the slabs was also required as they were moving and settling during the operation. Surveyors monitored those slabs from the northern side of the river and remained in contact with the Forward Command.[42]

789. To constantly monitor the upper area of the slide a number of personnel were placed along the Alpine Way to "inform and warn the persons in the area directly below".[43] A system was instigated whereby three blasts of a whistle or air operated horn would indicate to all rescuers that the site was to be cleared immediately for safety reasons. The instability of the site was confirmed by the fact that work had to cease on a number of occasions due to movement on the actual site, from above the site or because of the need to make safe large rocks and objects above the site. The performance of these tasks at times required the stoppage of all work on the lower side of the site. Movement detected by the surveyors and rescue personnel on the site caused total site evacuation on numerous occasions.[44]

790. Mobile telephone numbers of any person believed to be under the debris were obtained and they were rung for a period of time. No person answered and the ringing of the telephones could not be heard by the rescuers.[45]

791. On a number of occasions during the rescue operation total silence was requested on site to enable optimum use of trapped person locaters, on various locations on the site. The use of these locaters gave no indication of persons alive within the rubble.[46]

792. At 1.00 pm on 31 July 1997 a major briefing and planning session was held at the site control. It involved engineers, geologists, Superintendent Sanderson and Commander Johnston and other senior personnel for the Emergency Services. Various site assessments were provided by the engineering and geological professionals and a plan was devised for the site to allow the rescue to be carried out safely[47].

793. It had become obvious that the rescue would be a prolonged operation and whilst the rescuers appreciated that speed was important at no time could the safety of the persons trapped in the debris or the safety of the rescue personnel be compromised. Rescuers had to be rotated every two to three hours. The hostile climatic conditions severely affected the capability of rescuers and machinery to operate effectively. Work during the hours of darkness was particularly demanding. Whilst keeping in mind the safety of all persons the operation went ahead as quickly as possible. Great emphasis was placed on teamwork and minimising risk to the safety of rescuers and victim.

794. The first body was recovered at 8.50 pm on 3l July l997. It was that of Mr. John Cameron who had been in the Carinya Lodge. The force of the impact of the landslide on Carinya can be seen from the fact his body was found at the bottom of the slope below Bimbadeen lodge.

795. At a briefing held in the afternoon on 1 August 1997 Mr. Grant Douglas and Mr. Con Stroemer raised concerns about the rate of progress of the operation. They believed that because of the rate at which debris was being removed and given the weight and size of the concrete slabs that had to be cut and then removed it would be more effective to commence tunnelling under the slabs to search for trapped people. The restraint of the horizontal movement of the slabs using chains and pins was also discussed. It was agreed that both these methods would be adopted immediately.[48]

796. From then on the recovery of victims was achieved primarily by tunnelling beneath the landslide debris rather than the piece by piece removal of debris. The tunnelling operation consisted of the removal of sufficient debris to allow the erection of timber props at regular intervals, supporting the walls and roof of the tunnel.[49] The disposition of the material and the angle of the slope meant that any major movement of any part of the site affected the stability of the remainder of the site. Tunnelling was difficult and dangerous. Bimbadeen Lodge had consisted of four stories of small residential units. When the lodge and car park collapsed five concrete slabs became part of the debris. In places where slabs were touching the distance increased from a few centimetres to in excess of one metre as the slabs sloped away. Items such as refrigerators, washing machines etc. were reduced to the size of the space between the slabs and within this mass of material were the victims. To reach the victims the material had to be removed to facilitate tunnelling.

797. Endeavours were made to use helicopters to assist in the location of persons in inaccessible parts of the slide. However, the updraught caused by the helicopter tossed loose material around the site and the vibrations from the rotor blades shook the soil causing renewed fears that the operation would trigger further land slippage.

798. Once Bobuck Lane was cleared at about 2.00 am on Friday l August 1997 the site became more accessible to cranes which performed the lifting tasks. However the slabs could not be moved until they had been sectioned into manageable pieces by cutting.

799. The sole landslide survivor, Mr. Stuart Diver, was located at 5.37 am on Saturday 2 August 1997 and eventually released at 5.l0 pm the same day. Mr. Diver was trapped in a small pocket of air in the bottom of Bimbadeen Lodge. He was at a position deep below the surface of the rubble. Although he could hear some movement above him, his own cries for help could not penetrate the mass of debris. The trapped person locator was unable to detect his presence, no doubt because of the massive slab of concrete, the angle of which saved his life. It took a day of delicate

drilling, tunnelling and debris removal from the time he was discovered until the time he was removed.

800. Shortly after 4.00 pm on the Saturday 2 August 1997, Dr. Gray arrived at the site.[50] Dr Gray had been asked to attend the site by Mr. Douglas because of his previous experience with landslides in Hong Kong. Upon arrival he was told that "the engineering group had enough geotechnical capacity and that he was asked to focus attention on providing advice to the direct rescue operation".[51] The majority of Dr Gray's time on site was spent advising emergency services personnel of the proper approach to securing the slabs using chains and rock bolts. Stabilising the concrete mass enabled the tunnelling operation to be carried out safely and effectively.

801. Dr Gray confirmed the dangers confronting the rescue workers. He stated that the wreckage of the destroyed lodges was precariously balanced with some sections near the limit of stability. He believed attempts at lifting large sections of slabs would most likely have brought about a collapse with danger to any survivors, to rescue personnel and to buildings at the foot of the slope.[52]

802. By Sunday, 3 August 1997, the stability of the site was still an ongoing problem, and there was a concern about more serious landsliding in the area of the scarp posing a danger to rescuers.[53] Mr. Jordan advised the police at that stage that there was a danger of further slide and for his part Mr. Jordan considered the lower part of the site to be exceedingly dangerous at that time.[54].

803. The last body, that of Anthony Weaver, was recovered at 2.00 am on 7 August l997. At that point rescuers were satisfied that all missing persons had been accounted for. The weather then deteriorated. Rescue teams were stood down and the operation recommenced when the weather improved. Rubble was further checked to ensure that there were no further victims, to recover as much personal property as possible and to clear the site of all danger. The latter was completed on 11 September l997.

Criticism of the Rescue Approach

804. There have been many theories put forward by persons not involved in the rescue operation as to how it should have been carried out. I have received a great deal of correspondence from well meaning persons in that regard. There has been public criticism of what was said to be the slowness of the rescue operation. Many suggestions were made at the scene during the course of the operation as to how the recovery should have been carried out.

805. Despite all the criticism and suggestions put forward it is quite clear that because of the extreme danger involved in moving the debris, the rescue and recovery was carried out in a thoroughly professional way and with proper and due regard for the safety of the emergency personnel and those trapped by the debris. The recovery of Stuart Diver alive was most certainly due to the careful and professional manner of the operation.

806. The rescue was closely examined in the Inquest, principally at the instigation of the families. At the conclusion of the hearing the Legal Representation Office, representing the families, made submissions about the rescue including a series of recommendations designed to assist future rescue. The approach taken by the LRO is demonstrated by the following comments made by Mr. Green QC on behalf on the families:

> *"Finally, your Worship, I come to the rescue operation. It is incontrovertible that the emergency services did a magnificent job at Thredbo, and I want to say publicly what we have already said in our written submissions to Your Worship:*
>
> *The families of the victims of the landslide wish to record their sincere gratitude and appreciation to each and every member of the emergency services, the management and staff of KT, the chaplains, counsellors, the journalists and all who contributed to the rescue operation for their wonderful work.*
>
> *Any criticisms that we make in our submissions in no way are to be taken to diminish those sincere sentiments. Such criticisms are simply based on the belief that no operation of this nature can be perfect and that things can be learnt and that recommendations can be made which may assist in the future management of similar disasters."*

Delay in Starting the Rescue Operation

807. The LRO acknowledge that the rescue operation adopted an understandably cautious approach. [55]

808. It is clear from the evidence of Superintendent Sanderson that two days after the landslide, there was "a constant fear that another landslide would occur and that material that was below Bobuck Lane would move further down the hill".[56]

809. According to Mr. Douglas, the rescue effort could not have been done any quicker or better than that in which it was carried out. The best that the engineers or rescuers could have done was to save, say, one or a couple of hours over the full seven day period.[57] In support of this view, Commander Johnston was satisfied in his own mind that the operation was carried out as speedily as possible, and this belief is reinforced by the fact that at the time of the event itself, not one person suggested to him that the operation could have been done in a quicker or better manner.[58]

810. It was suggested in cross-examination of Superintendent Sanderson, Commander Johnston and Inspector Smith that the original plan, namely to retrieve victims by lifting and cutting of slabs had been shown to be wrong and that they had been persuaded that tunnelling was the only practical approach. They all denied this, maintaining that the rescue plan was "something that developed over time",[59] and that the site had to be stabilised as far as practical before any rescue could be attempted. That they did develop a plan that proved to be successful in the rescue of

Stuart Diver and in the retrieval of the bodies of all the victims is a tribute to their ingenuity, skill and dedicated efforts.

811. Understandably the first persons on the scene wanted to try and move debris in an endeavour to rescue whomever they could. Some of the trapped persons were their friends. However, due to the precarious and dangerous nature of the debris everyone was warned to move back from the site out of harms way.

Clearing Bobuck Lane

812. The Legal Representation Office on behalf of the families has raised some doubt as to the decision to commence the rescue by clearing Bobuck Lane. The criticism is based on the question of whether, given the amount of time necessarily invested in the clearing operations; was this part of the operation necessary?[60]

813. The rescue plan, involving the initial clearance of Bobuck Lane, was one which appears to have been developed during the morning of the 31 July 1997.[61] The motive for initially clearing Bobuck Lane was to introduce heavy lifting equipment onto the site.[62]

814. The criticism of this methodology appears to assume that the clearing of Bobuck Lane occurred in isolation. However evidence was given that multiple tasks were undertaken at the same time Bobuck Lane was cleared.[63] The clearing of Bobuck Lane took until 2.00 am on Friday, 1 August 1997.[64] In the meantime the emergency services continued to remove loose debris from the edges of the site. This situation continued until Friday afternoon when Mr. Douglas and Mr. Stroemer, were allowed on site and the tunnelling began.[65]

815. The decision to clear Bobuck Lane early was reasonable. It allowed access to heavy lifting equipment necessary for the removal of concrete slabs and other material to enable a complete search for survivors.[66] I am not satisfied that the decision, made on expert advice, warrants any criticism. It was a useful task undertaken necessarily early.

Voices in the A-frame

816. As I have said, some of the first people on the scene thought they heard Mr. and Mrs. Michael and Mariam Sodergren cry out after the landslide.

817. In relation to the death of Mrs. Mariam Sodergren, Dr. Bradhurst's opinion in his autopsy report was that the cause of her death was "a combination of positional asphyxia and chest and pelvic injury". The scene and autopsy appearances indicated that, once her final position was reached death would have occurred quickly.[67] At that stage he gave no more precise estimate of the time of her death.

818. When he gave evidence at the Inquest however, Dr. Bradhurst had viewed the video of the recovery of the bodies, photographs of the body in situ, and had received

descriptions from police about the debris on and around her. With that additional information he said Mrs. Mariam Sodergren could have survived "up to one hour, perhaps, at the most two hours following that".[68]

819. As for Mr. Michael Sodergren, Dr. Cala's opinion at autopsy was that he died of "tramatic asphyxia", but he expressed no survival period. In evidence he said that "considering all the factors, I think he may have survived for a period of perhaps up to two or three hours following the landslide…".[69]

820. Dr. Collins, an imminent pathologist from Victoria who provided a report at the request of the LRO, opined that the injuries of both Mr. and Mrs. Michael and Mariam Sodergren would not have caused rapid death, but did not give precise survival times. Both Doctors Collins and Bradhurst agreed that Mr. and Mrs. Michael and Mariam Sodergren would have been capable of talking for some time prior to their deaths.

821. The evidence leads me to the conclusion that it was the voices of Mr. and Mrs. Michael and Mariam Sodergren that were heard under the debris near the A-frame immediately after the slide.

822. Criticism has been made of the emergency services in that the rescue effort was not directly targeted at the A-frame, the area where the voices of Mr. and Mrs. Michael and Mariam Sodergren had been heard and from where ultimately several bodies were recovered.[70] The A-frame was a structure, located on the eastern side of the landslide tongue, formed when a concrete floor slab, cracked and the separated slabs came to rest perpendicular to one another.[71]

823. The location of the A-frame was below Bobuck Lane and in an area considered by Mr. Vardy and Mr. Douglas to be "in a more fragile state than other areas of site".[72] Superintendent Sanderson stated that it was understood early on that the area below Bobuck Lane was potentially more dangerous than any other, given the existence of slabs and debris above it. Superintendent Sanderson states that it was the knowledge of this danger which deterred the rescuers from either attempting to stabilise or commence tunnelling in the A-frame area.[73]

824. I am satisfied that given the location of the A-frame and the imminent danger from above, the decision not to commence tunnelling in the area until stability was assured was a correct one.

Level of Expertise

825. The LRO criticised the absence of suitable geotechnical experts with an expertise in landslide on site at a sufficiently early stage.[74] I regard this criticism as unfounded.

826. Geotechnical experience in landslide is not a common requirement in Australia where landslide is a limited natural phenomenal. The task of finding and bringing to the relatively isolated site of Thredbo, a geotechnical engineer with landslide

experience would have been demanding at any time. Yet, within hours of the landslide Mr. Warren-Gash, was contacted at his Northern Sydney house, collected by helicopter from Hornsby Hospital and flown into the site arriving at 8.00 am. The LRO does not appear to acknowledge the efforts made to find and bring Mr. Warren-Gash to the site as speedily as possible. Under the circumstances, that appears to me to have been a speedy and appropriate response.

827. Mr. Warren-Gash was not the only geotechnical expert to arrive on site in the early morning after the slide, also present were Mr. David Jordan, a geologist, and Mr. Graham Bell, a civil engineer, both engaged by SMEC.

828. The assessment of risk and the prevention of landslide is part of the expertise of any geotechnical engineer. Although not made specifically clear in their submission, I infer that the LRO have in mind an absence of engineers with experience in managing the aftermath of a landslide which presents a risk to human lives. Expertise of that type would be rare but it was located eventually. Dr. Ian Gray who had landslide aftermath experience, obtained in Hong Kong, presented himself and provided assistance from at early stage.

Location of Bodies

829. The LRO has raised as a criticism of the rescue operation that an early identification of the probable resting places of the structure and of persons was not made.[75] The effect of the movement of the buildings was to project the occupants into substantially new positions. (see Appendix 10, Figure 7)

830. The LRO submitted that it was not until Saturday, 2 August 1997 that an attempt was made to plot the resting position of the Bimbadeen slabs. The LRO further submitted that it was somewhat surprising that no specific graphic exercise to plot possible body positions was made until Tuesday, 5 August 1997, six days after the landslide. It is submitted by the LRO that this attempt to plot the resting place of the bodies and the structure was too late in taking place and that task should have been a top priority on the first day of the rescue. Moreover, it did not appear to have been carried out according to recognised scientific method.[76]

831. The reason why the attempt to plot the resting position of the Bimbadeen slabs was not undertaken until Saturday, 2 August 1997 is to be found in the evidence of Mr. Vardy. When asked the reason why the exercise was not carried out until Saturday Mr. Vardy described the scene facing the rescuers as being:

> *"one of absolute mayhem with the western side of Bimbadeen Lodge….. covered in mud and trees and boulders and the like, and, on the eastern side, the area was left affected by mud and the like, but overlaying the whole affair was very unstable miscellaneous material, such that it was extremely difficult to get a picture of what was there. Only after time were the rescuers able to get a more accurate picture of where things were".*[77]

832. I accept this as a valid reason why the exercise was not taken earlier.

Mention of Landslide in the DISPLAN

833. The *State Emergency and Rescue Management Act 1989* contemplates the existence of a three tiered emergency management system. The embodiment of the system is the DISPLAN at State, District and Local levels enabling a co-ordinated response to emergencies by all agencies having responsibilities and functions in emergencies.[78]

834. Pursuant to *State Emergency and Rescue Management Act 1989*, State, District and Local Disaster Plans (DISPLAN) have been established in all defined areas of New South Wales. Relevant to the Thredbo Landslide were Monaro District DISPLAN and the Snowy River DISPLAN. Following notification of the Thredbo landslide, the Local DISPLAN was initially activated but as the scale of disaster was recognised it was overtaken by the District DISPLAN.

835. The LRO raised two criticisms of the DISPLANs. The first criticism was that neither the local nor the district DISPLAN included in the list of hazards the occurrence of landslide involving building and people. The second criticism is that the DISPLAN did not include a sufficiently detailed contact register.[79]

836. Under cross examination, Commander Johnston acknowledged that it would useful to include, in both the local and district DISPLAN, landslide as a potential hazard.[80] Commander Johnston also pointed out that the inherent difficulty associated with the DISPLAN is that it is "a very generic document, whilst it does mention some hazards, it doesn't go into any detail at all in relation to them. It simply identifies a number of hazards, the purpose of the plan is an all-risk, all-agency, all-hazard plan" that can be tailored to fit the emergency. Commander Johnston mentioned that it was impossible to write a plan for every emergency that may happen.[81]

837. Questioned on the local DISPLAN, Senior Constable Denham said that it would be "a logistical nightmare" and a "physical" impossibility to develop and maintain a detailed contact register.[82]

838. I agree with the reasoning of Commander Johnston and Senior Constable Denham. I do not believe that it is feasible, or desirable, to make a DISPLAN so detailed that it loses its usefulness. The purpose of the DISPLAN is to co-ordinate the extraordinary management measures necessary when an emergency occurs. It is necessary that the document is adaptable to the innumerable different types of emergencies which may arise.

839. On 22 May 2000, I received into evidence a letter from Mr. Brian Goodes of the State Rescue Board of NSW which annexed the NSW Major Structural Collapse Sub-plan dated in December 1998. The Major Structural Collapse Sub-plan was prepared after the Thredbo Landslide. It was prepared as an interim sub-plan to the NSW State DISPLAN to detail the arrangements for the control and coordination

of, preparation for, response to, and immediate recovery from a major structural collapse. It encompasses urban search and rescue. It was prepared by the State Emergency Management Committee in consultation with the State Rescue Board and takes into account provisions of the State Rescue Policy. The subplan is authorised in accordance with the provisions of the *State Emergency and Rescue Management Act 1989*.

840. Taking into account the letter from Mr. Brian Goodes and the Subplan, I believe the concerns expressed by the LRO's criticism have been met.

Commendation

841. I commend the work of all those in the Emergency Services engaged in the rescue. I am pleased to note that since the landslide, their exceptional skill and dedication has been rewarded and praised by the community at large.

842. The Emergency Services must be highly commended for the manner in which they went about the rescue of Stuart Diver and the recovery of the eighteen deceased persons. In many cases they placed their own lives on the line in their efforts to rescue those trapped.

843. Special mention must also be made of the efforts of the State Disaster Victim Identification team activated immediately after the disaster became known. The team comprised personnel from the Police Missing Persons Unit, Police Forensic Unit, NSW Institute of Forensic Medicine, Forensic Dentists, Forensic Counsellors, Westmead Department of Forensic Medicine, NSW Funeral Directors Association and Officers and Police personnel from the State Coroners Office. The majority of the DVI team attended the site whilst others prepared to receive the bodies of the deceased at Glebe.

844. The identification of each deceased by the State Disaster Victim Identification team was completed and bodies released for burial within a week of the disaster. Proper identification of the deceased was the step after recovery and I commend that team for the efficient manner in which its members carried out their tasks. Families were notified as soon as practicable after the recovery and identification of the deceased.

845. The part played in the proper identification of the victims by the Police Missing Persons Unit cannot be understated particularly as the victims included persons from overseas.

846. In accordance with International Protocol in dealing with disaster victims the bodies of the deceased were conveyed to the Institute of Forensic Medicine at Glebe where post mortems were conducted by a team of Forensic Pathologists. The efficiency of that team is to be commended.

847. There was some disquiet at the scene at the fact that I had directed the bodies of the deceased were to be taken to Glebe for identification and post mortem. I accept that

a press statement by me in the early stages of recovery would have assisted families to better understand and accept my directions. An early statement by the State Coroner as to the procedures to be adopted in the case of a disaster will be a matter of priority in the future.

848. Members of the Forensic Counselling Team were available to family members. They conducted viewings of the deceased with the families and discussed the post-mortem findings with them. Arrangements were made with the Institute of Forensic Medicine and the NSW Department of Health to ensure appropriate counselling was available to all the families.

849. Local community health services and the Department of Community Services were also in attendance in addition to local Red Cross, Emergency Services Chaplains and psychologists from the NSW Police Service.

850. Inspector Ruming, of the Tactical Operations Unit, had the exceptionally difficult task of being a point of contact and of finding and supplying information to relatives of the persons trapped in the landslide. There were 19 families concerned, none of whom were resident in Thredbo. Some lived in Sydney, many interstate and some overseas. Some elected to travel to Thredbo.

851. Over the six day period until the recovery of the last body a huge rescue operation was underway, information was constantly changing, as were personnel because of the need to maintain the rescue efforts 24 hours a day. Inspector Ruming was involved in answering inquiries of relatives, meeting and briefing those relatives who came to Thredbo and dealing with information in a constantly changing situation.

852. After Inspector Ruming gave evidence, the LRO appearing for the families tendered a letter by Mr. and Mrs. Sodergren. It made complaints that they had received misleading information and was expressed in angry and critical terms. Their letter arose because they had read material which appeared to contradict information provided to them during the rescue by Inspector Ruming. Inspector Ruming was recalled to give evidence. He also provided an additional statement in answer to the complaints that had been made of him.

853. No more needs to be said other than that I do not accept the validity of Mr. and Mrs. Sodergren's complaints. The information and opinions provided during the rescue may have differed from what emerged over the succeeding year. By that time everything was much clearer and there was time to collate the material in a way not available during the urgency of a rescue. I do not accept that any criticism can be made of Inspector Ruming. On contrary, he appears to have performed a difficult task in an outstanding way.

854. The management of disaster counselling requires a delicate balancing of resources while being sensitive to the needs of those persons directly involved (e.g. families of victims, survivors etc.) and the expectations of the community. There is little doubt

that the counselling response at Thredbo was successful and played a significant role in responding to the needs of the families of victims at the site. Each team brought with it various degrees of expertise and their efforts need to be recognised in what was a very difficult situation.

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1 Statement of A Duff, 3 August 1997, ex 17.01
2 Statement of SC Gower, 26 August 1997, ex. 132.0118 par. 4
3 ibid
4 ibid
5 Statement of Sgt. Ingram, 19 August 1997, ex. 132.0131
6 Statement of W Reeve, 31 July 1997, ex. 10.01, par. 7; Statement of A Ganz, 5 August 1997, ex. 132.0046, par. 6-7; Statement of SC R Duncan, 2 September 1997, ex. 16.01, par. 13-14, Duncan T216.01; Statement of Sgt P Forbutt, 10 September 1997, ex. 14.01, par.6 & 11, and T198.24, T198.41; Statement of J Ellard, 3 August 1997, ex. 3.01, par. 15; Statement of D Milliken, 10 August 1997, ex. 28.02, par. 7-8, T464.52, T474.33, T475.47; Statement of C Thompson, 3 August 1997, ex. 21.01, par. 8; Statement of S Dowd, 3 August 1997, ex. 132.0025; Statement of M Thomas, 1 August 1997, ex. 18.01, ex. 18.02, and T229.11, T230.30, T233.46; Statement of D Kuhn, 2 August 1997, ex. 19.01 par. 10, and T244.12, T248.04, T247.24, T247.50; Statement of SC Hoyer, 16 August 1997, ex. 11.01 par. 19, and T142.58; Statement R Carey, 8 August 1997, ex. 32.01 par.10, and T608.57, T609.11, T609.34, T609.38; Statement J Bartley, 3 October 1997, ex. 30.01 and 30.02 par. 5, and T526.08, T526.08; Statement of DS A Dent, 13 November 1997, ex. 37.01; SC Denham, 26 August 1997, ex. 12.01 par. 8, and T155.35, Statement of J Turner, 1 August 1997, ex. 132.0011 par. 9; Statement of A Duff, 3 August 1998, ex. 17.01 par. 15; Statement of G Milne, 6 August 1997, ex. 132.0056 par. 11.
7 T609.38
8 T526.08
9 Statement of D Kuhn, 2 August 1997, ex. 19.01, par. 10
10 J Bartley, T496.49, T505.10, T528.19
11 Statement of S.C. Hoyer, 16 September 1997, ex. 11.01 par. 17
12 Statement Ambulance Officer Bartley, 12 July 1998, ex. 30.02 par. 7
13 Statement of S.C. Hoyer, 16 September 1997, ex. 11.01 par. 19 and 20
14 SC Denham T152
15 SC Denham, T152
16 Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 5
17 Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 6, W Denham, T152.30
18 Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 8, Statement of Ambulance Officer Carey, 8 August 1997, ex. 32.01, 37.01 par. 12.
19 Statement of Commander Johnston, 25 June 1998, ex. 48.01, par. 8-9
20 Statement of Commander Johnston, 25 June 1998, ex. 48.01, par.15
21 Statement of Commander Johnston, 25 June 1998, ex. 48.01, par.10; Statement of S.C. Hoyer, 16 September 1997, ex. 11.01, par. 29
22 Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 10
23 Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 9
24 Statement of Sgt. Forbutt, 10 September 1997, ex. 14.01, par. 14
25 Statement of J Kite, 15 September 1998, ex. 73.03, par. 41
26 Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 11
27 Statement of S Breathour, 4 August 1997, ex. 132.0035, par. 14; Statement of P Brotherton, 6 October 1997, ex. 25.01 and 37.01, par. 15; and Statement of S.C. Denham, 26 August 1997, ex. 12.01, par. 10 and T155
28 Examination of S.C. Denham, T160.32
29 Examination of S.C. Denham, T160.47
30 Statement of J Kite, 20 August 1997, ex. 73.01 par. 17
31 Statement of DC Denham, 26 August 1997, ex. 12.01, par. 13
32 DC Denham, T149-150 and 165
33 Statement G Bell, 12 May 1998, ex. 41.01 par. 3.1
34 G Bell T852.03
35 Statement G Bell, 12 May 1998, ex. 41.01 par. 3.2
36 Statement G Bell, 12 May 1998, ex. 41.01 par. 3.2

[37] Statement of Insp. Smith, 29 October 1997, ex. 20.01 par. 3
[38] Statement of Commander Johnston, 25 May 1998, ex. 48.01, par. 14
[39] Statement of G Douglas, 19 May 1998, ex. 45.01, page 1
[40] G Douglas, T925.56
[41] Statement of Inspector Smith, 29 October 1997, ex. 20.01 par. 3
[42] ibid
[43] ibid
[44] ibid
[45] ibid
[46] ibid
[47] Statement of Commander Johnston, 25 June 1998, ex. 48.01, par. 16
[48] Statement of G Douglas, 19 May 1998, ex. 45.01, page 2
[49] Statement of G Douglas 19 May 1998, ex. 45.01, page 2
[50] I Gray, T985
[51] Statement of I Gray, 25 April 1998, ex. 47.01, page 2
[52] Statement of I Gray, 25 April 1998, ex. 47.01, page 3
[53] D Jordan, T875
[54] D Jordan, T876, 886
[55] Submissions of a Legal Representation on behalf of the families, par. 7.8
[56] D C Sanderson T364.02
[57] Douglas, T952, T956
[58] Commander Johnston, T1027, 1045
[59] D C Sanderson T399.30
[60] LRO Submissions, par. 7.3.1
[61] G Vardy, T569.09, T569.02 and T569.21
[62] Commander Johnston, T1021.53
[63] Statement of D C. Sanderson, 24 April 1998, ex. 23.01, par. 26; T361.57, T387.14
[64] D C Sanderson, T402.4
[65] D C Sanderson, T396.24
[66] D C Sanderson, T361.34; Commander Johnston, T1021.53
[67] Autopsy Report of Mariam Sodergren by Dr. P G Bradhurst, 16 September 1997, ex. 1.00
[68] Dr. P G Bradhurst, T973
[69] Dr. A Cala, T977
[70] Letter from J and J Sodergren, ex. 8.04; Submissions of Legal Representation Office behalf on the families, par. 8.4.1.
[71] Statement of Y Serediuk, 24 April 1998 ex. 35.01, par. 16
[72] G Vardy, T653; Examination of Douglas, T935.
[73] D C Sanderson, T388.3, T389.47
[74] Submission of Legal Representation Office on behalf of the families, par. 7.5.3
[75] ibid, par. 7.11.1
[76] ibid, par. 7.11.2 - 7.11.4
[77] Explanation of G Vardy T547.42
[78] State Emergency and Rescue Management Act 1989, ss. 12, 13, 21, 22, 23 & 28
[79] Submission of Legal Representation Office on behalf of the families, par. 7.13.2, 7.13.3, 7.13.10.4, 7.13.5 & 7.13.6
[80] Commander Johnston T1039.15
[81] Commander Johnston T1039.22
[82] SC Denham T181.52

Acknowledgments

855. These Inquests have been extremely lengthy and complex and much strain has been placed on families of the deceased, witnesses and those representing the interested parties. It is nearly three years since this tragic incident and I wish to thank you all for your patience and cooperation.

856. I especially wish to thank the three Counsel Assisting, Ruth McColl SC, Jeremy Gormly and Nick Floreani and the Solicitor Assisting, Karin Harrison and her team from the State Crown Solicitor's Office and Detective Inspector Bob Cocksedge, the Officer in charge of the Investigation. No stone has been left unturned in the investigation of this tragedy and I feel sure that Detective Inspector Cocksedge will be happy to return to his normal duties. Other Counsel appearing will no doubt agree that the expert manner in which the evidence has been collated is an indication of the enormous amount of time and effort Ms. McColl and the others have put into ensuring a fair and proper presentation at the hearing. Thank you all for you invaluable assistance.

857. The expertise provided by Mr. Tim Sullivan, Mr. Chris Jewel, Mr. Ken Macoun and Mr. Peter Winter, in investigating this landslide on my behalf must also be recognised. I extend to Mr. Sullivan and his colleagues my sincere appreciation for the time and effort they have spent in the investigation.

858. The work Mr. Cole R.F.D.Q.C. undertook in conducting the Convocation and preparing a comprehensive report was invaluable, and, I am sure had a considerable effect in shortening the hearing. I extend my appreciation to him for his work.

859. I wish also to thank my staff, Kay, Carol, Dawn and Ailsa for their assistance and forbearance during these last two years. It has required a lot of patience at times from the Court Officers and I appreciate their efforts. Likewise it was not easy for Computer Reporters and the Auscript team in recording the evidence and they did an excellent job and I thank them also.

860. Finally I extend to the families of the deceased heartfelt sympathy for their loss. We all realise that it is the families who suffer - they are the ones who have to come to terms with this tragedy. I only hope that this public hearing has in some way assisted in that regard.

Note

861. When the landslide occurred I was the State Coroner for New South Wales. The course of the hearing was extended for four months when I was unable to sit due to ill-health. I retired as State Coroner in February 2000. I completed the hearing as Acting Coroner.

Findings

862. Dianne Elizabeth Ainsworth

On or about 30 July 1997, at Thredbo, Dianne Elizabeth Ainsworth died of the effects of mechanical asphyxiation, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

863. John Anthony Cameron

On or about 30 July 1997, at Thredbo, John Anthony Cameron died of the effects of multiple injuries, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

864. Barry Achim Decker

On or about 30 July 1997, at Thredbo, Barry Achim Decker died of the effects of multiple injuries, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

865. Sally Sophia Diver

On or about 30 July 1997, at Thredbo, Sally Sophia Diver died of the effects of drowning, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

866. Diane Lee Hoffman

On or about 30 July 1997, at Thredbo, Diane Lee Hoffman died of the effects of chest and abdominal injuries, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

867. Werner Jecklin

On or about 30 July 1997, at Thredbo, Werner Jecklin died of the effects of mechanical asphyxiation, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

868. Oskar Walter Luhn

On or about 30 July 1997, at Thredbo, Oskar Walter Luhn died of the effects of traumatic asphyxia, sustained then and there, when an increase in groundwater

pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

869. Andrew Stuart McArthur

On or about 30 July 1997, at Thredbo, Andrew Stuart McArthur died of the effects of chest injury and mechanical asphyxiation, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

870. Stephen Thomas Moss

On or about 30 July 1997, at Thredbo, Stephen Thomas Moss died of the effects of blunt force head trauma, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

871. Wendy Anne O'Donohue

On or about 30 July 1997, at Thredbo, Wendy Anne O'Donohue died of the effects of multiple injuries, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

872. Mary Frances Phillips

On or about 30 July 1997, at Thredbo, Mary Frances Phillips died of the effects of traumatic asphyxia, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

873. Aino Valgamae Senbruns

On or about 30 July 1997, at Thredbo, Aino Valgamae Senbruns died of the effects of mechanical asphyxia, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

874. Mariam Alice Sodergren

On 31 July 1997, at Thredbo, Mariam Alice Sodergren died of the effects of chest and pelvic injury combined with positional asphyxia, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

875. Michael Lee Sodergren

On 31 July 1997, at Thredbo, Michael Lee Sodergren died of the effects of traumatic asphyxia, sustained then and there, when an increase in groundwater pressure

resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

876. Steven Urosevic

On or about 30 July 1997, at Thredbo, Steven Urosevic died of the effects of traumatic asphyxia, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

877. Colin John Warren

On or about 30 July 1997, at Thredbo, Colin John Warren dies of the effects of traumatic asphyxia, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

878. David Glenn Watson

On or about 30 July 1997, at Thredbo, David Glenn Watson died of the effects of multiple injuries, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

879. Anthony John Weaver

On or about 30 July 1997, at Thredbo, Anthony John Weaver died of the effects of head and chest injuries, sustained then and there, when an increase in groundwater pressure resulting from a leaking watermain caused the fill embankment of the Alpine Way to collapse onto Carinya and Bimbadeen lodges.

Recommendations

880. At the outset of this Report, I referred to a NPWS submission that issues of foreseeability were not relevant to determining the existence of a causal connection. I accept that proposition. I also noted, and rejected, a submission that I was not entitled to include in this report "whatever human failure might be thought to have contributed to the death". I rejected that submission because the effect of it was, in my opinion, to restrict my power to make recommendations pursuant to s. 22A of the *Coroners Act*.

881. As I also said, in the course of considering the submissions on the scope of my power to consider issues of causation, the events which preceded the tragedy on 30 July 1997 span a period of some 39 years. I have attempted, in this Report, to refer to what appear to me to be critical events along that timeline - events such as the various landslides along the Alpine Way and the incidents of instability within Thredbo itself. I did this, not because they might, in the coronial context, be thought to have been determinative of the issue of causation. As I have said, I accept that foreseeability is not relevant to the identification of a causal connection in the coronial context. Foreseeability is a concept which is relevant to notions of civil liability which play no part in an inquest.

882. However critical events such as those I have referred to in this Report and the reaction to them of the various parties responsible for both the Alpine Way and the care, control and management of Thredbo Village can serve to illuminate my recommendation making power.

883. Throughout the history of the Alpine Way, events which to the observer, blessed with the benefit of a hindsight would have sounded loud alarm bells calling for immediate work to be undertaken to the Alpine Way above Thredbo Village did not evoke that response. I recognise and accept the submission of NPWS that it was not alone in failing to recognise the full nature of the risk or the immediacy of the need for remediation works to the road above the village. The DMR/RTA has been pivotally involved in the Alpine Way in two capacities, first as agent for NPWS from 1968 until 1988 and then as NPWS' technical adviser from 1991 until at least 1996. It did not advise NPWS to undertake such works to the Alpine Way above Thredbo at any time during this period.

884. I accept the submissions of both of those bodies that throughout the relevant period, policy and statutory constraints on funding for works on the Park roads have inhibited the works they were able to undertake on the Alpine Way.

885. I acknowledge also, however, the submissions made on behalf of the families that the authorities involved with the Alpine Way over the years have refused to acknowledge responsibility for the condition of the Alpine Way and the fact that building was allowed to take place under the road without any real geotechnical

assessment of the affected areas. That said, I accept that those authorities may feel some constraint in the light of possible civil suits.

886. Having regard to all that, I still entertain reservations about the extent to which submissions such as NPWS and the RTA advance can be accepted uncritically.

887. My recitation of the events indicates that prior to the landslide nobody on the part of NPWS or the DMR had undertaken detailed geotechnical investigation of the stability of the slope above the Village. The only work of that nature which was undertaken was Mr. Warren-Gash's visual inspection which led to the installation of two inclinometers. This inaction occurred despite grave reservations which were expressed in the early 1970's by NPWS concerning the possibility that materials slipping from the Alpine Way road embankment could lead to the destruction of lodges and more recent concerns expressed in the early 1990's that slippage was apparent adjacent to the Village and that a landslip in that location may endanger human life - a self evident proposition, I should have thought. It also occurred despite landslides of the magnitude of those which occurred on the Alpine Way in 1978 and 1989 which travelled distances which, had they occurred in Thredbo, would clearly have impacted upon lodges adjacent to the road. A reasonable observer might have thought that these warnings and events would have immediately led to a thorough investigation being undertaken of the road above the Village and its immediate reconstruction to remove any risk.

888. While foreseeability plays no part in my decision as to cause, failure to respond appropriately to events is a matter I must be entitled to take into account in exercising my recommendation making power.

Risk Assessment

889. A quantitative assessment of the risks associated with landslides from the Alpine Way was carried out by Mr. Tim Sullivan[1]. The assessment was undertaken to provide a basis for understanding the Thredbo Landslide in terms of risks accepted or understood in society. The assessment used information which was available prior to the 1997 landslide.

890. The assessment involved the classification of the geometry, geomorphology, groundwater conditions and stability of the main fills along the Alpine Way from the Park Boundary to Dead Horse Gap. From this information Mr. Sullivan was able to determine the annual probability of failure of a given fill along the Alpine Way. Estimates were then given for the expected deaths from mobile landslides above Carinya.

891. The analysis showed that, at the time of the Thredbo landslide, the risk of death from a mobile landslide at the Carinya-Bimbadeen site was over 2000 times the level suggested by the N.S.W. Department of Planning for tourist developments. A lower bound estimate was assessed by Mr. Sullivan and was over 200 times the limit

suggested. Whatever the correct figure, I am sure the community would regard the range as totally unacceptable.

National Parks and Wildlife Service

892. Because it was NPWS and its predecessor, the Kosciusko State Park Trust, which have been responsible for the care, control and management of the Park and Thredbo Village since at least 1957, it is inevitable that my concerns are principally addressed to that organisation.

893. NPWS submitted that it is "a Government Department charged with protecting the natural environment." That submission underlines the tension which must inevitably exist between it being a body primarily concerned with over one million acres of parkland and, at the same time, required to exercise both local government and road maintenance functions in those parks.

894. Although I ruled that it was not the role of the Inquest to undertake a full investigation into Planning systems within the Park, or particular hillside building practices, I did so in the context that I had sufficient information generally available to me to enable me to exercise my recommendation making power concerning such matters.

895. In the same vein, I have not undertaken, nor would it have been within the scope of the Inquest, an investigation of the capacity of NPWS to function as a road maintenance authority.

896. I have seen and heard sufficient in the course of this Inquest to be concerned about the capacity of NPWS to assess properly slope stability issues in relation to the roads in the Park.

897. I have seen and heard sufficient about the planning systems which developed within NPWS throughout the period under review to be concerned that they reflected a sense of isolation from the development of hillside building practices in the local government sphere. There appeared to be no formal recognition of the developments throughout this period within various municipalities affected by landslip issues such as the Warringah and the Illawarra Shires and Tasmania of landslip risk zoning such as Mr. Sullivan referred to in his Report on Historical and Planning Issues.

898. Although the RTA was, from 1994, developing a system of Slope Risk Assessment to use in conjunction with its responsibilities for road construction and maintenance in NSW, information about the need for such systems or the availability of same was not communicated to the NPWS even though it should have been apparent to the RTA that such a system could have been put to a great effect within the Park.

899. It appears to me that it is necessary that there be an independent assessment of the ability and appropriateness of NPWS to retain responsibility for essentially urban

communities and for road maintenance within the parks under its care, control and management

900. I recommend that the Minister for the Environment consider appointing an appropriate independent committee which I would expect would include, at least, representatives of Local Government, Road Authorities and the Planning and Engineering communities to undertake that review.

The Roads and Traffic Authority

901. The RTA and its predecessor the DMR never expressly advised NPWS of the need to reconstruct the road adjacent to the village to avoid the risk of death or injury due to landslide. It is a matter of grave concern to me that a representative of the RTA inspected the Alpine Way, including above the village for a period of some 6 or so years from 1991 until 1996 and never recommended that the road above the village should be reconstructed. I am aware that during that period the RTA developed a system of Slope Risk Assessment intended for use in assessing the stability of roads and slopes into which they were to be built. That system appears never to have been used to assess the Alpine Way during this period.

902. **I recommend that the RTA examines its system of assessment of slope stability in the light of the lessons I would hope it has learned from this landslide.**

The Alpine Way

903. Since the 1997 landslide, NPWS has undertaken extensive reconstruction works to the Alpine Way above Thredbo Village. Evidence was given that the Alpine Way has been reconstructed immediately above Thredbo Village to a factor of safety of 1.5. Prior to the landslide a factor of safety of generally less than 1.2 existed. Longmac Associates, the geotechnical consultants engaged to assist NPWS with the Inquest have advised NPWS that the risk associated with a further landslide occurring in that part of Thredbo which has been reconstructed is very low to very low/low. The possibility of further work being undertaken is under consideration. Instruments are monitoring slope movement, rainfall is being measured and the area is being inspected every three months by a geotechnical engineer.[2]

904. The effect of these works has been to remove most of the original marginally stable Alpine Way fill from above the Village. There is still an area of Alpine Way fill above the western end of the Village above Riverside Cabins. KT2 has asked me to make a recommendation that the fill be removed from that area of the Alpine Way.

905. The families have also asked that I recommend that the Alpine Way be constantly monitored by NPWS experts in order to detect areas of instability particularly above the Village and that the Alpine Way and its associated areas be subjected by NPWS

to regular and expert geotechnical assessment. It appears from the letter from NPWS of 1 March 2000 that the road is being monitored above the Village.

906. I do not know enough about the area of fill which remains above the western portion of the village to make the recommendation sought by KT2. I recognise, however, the concerns of KT2 and the families concerning the possible continuance of any of the conditions which led to the 1997 landslide.

907. I request that urgent consideration be given by NPWS to take account of KT2's request concerning the removal of Alpine Way fill from above the western portion of the Village. If possible it should provide a detailed explanation to KT2 of what, if any, risk it sees arising from leaving that fill in situ.

908. **I recommend that the Alpine Way and other Park roads inherited from the Snowy Mountains Hydro-Electric Authority which suffer from the same poor construction which affected the Alpine Way be monitored by appropriate experts in order to detect any areas of instability in the manner monitoring is being undertaken above Thredbo Village.**

909. **I also recommend that the Alpine Way along its length and the other like roads under the jurisdiction of NPWS be subjected to regular and expert geotechnical assessment.**

910. I referred in this report to the utility of organisations such as NPWS and the RTA maintaining a detailed history of instability affecting particular areas so as to obtain a full appreciation of risks of instability.

911. **I recommend that NPWS establish and maintain in a central location a record setting out a detailed history of incidents of instability and the like on the Alpine Way and other like roads under its jurisdiction which should include regular reports of problem areas and remedial action taken.**

912. KT2 drew to my attention the fact that it has received no "as constructed" drawings from NPWS or NPWS certification that the Alpine Way reconstruction works have been carried out satisfactorily and in accordance with "as constructed" drawings. They asked me to recommend that NPWS provide such drawings to it, together with the relevant certification as soon as possible.

913. That does not appear to me as an appropriate matter for recommendation, however, I do note KT2's concerns

914. I suggest that they be brought to the attention of NPWS with a view to any concerns in this respect being allayed as soon as possible.

Planning

915. It is apparent from my review of the planning history in the Village that until the 1997 landslide NPWS had not put in place a detailed system of requiring the submission and consideration of geotechnical or other engineering reports which took into account fully the difficulties of building in a steep alpine environment. Since the 1997 landslide, NPWS has prepared a draft Planning Manual which I understand has been released for public comment. I note, without saying anything further, that it appears to contain extensive provisions concerning the consideration of geotechnical and like engineering issues.[3]

916. I make no comment about that draft Planning Manual, save to say that I would hope that it has been reviewed by independent experts thoroughly familiar with the technical concerns which arise in the particular geological environment of the Park.

917. As Mr. Tim Sullivan pointed out in his Report on Historical and Planning Issues, as urban development increasingly encroaches into steep environment, issues of instability of slopes will become increasingly apparent. It is essential that the local government community generally be fully conversant with those issues.

918. On the last day of the Inquest I was provided with a report on *Landslide Risk Management Concepts and Guidelines* prepared by the Australian Geomechanics Society's Sub-Committee on Landslide Risk Management. The purpose of the report was to establish new guidelines for assessing the geotechnical risk associated with hillside development. The guidelines were said to have a role in explaining to the public, regulators and the legal profession the process and limitations of Landslide Risk Management.

919. **I recommend that the Building Code of Australia and any local code dealing with planning, development and building approval procedures, be reviewed and, if necessary, amended to include directions which require relevant consent authorities to take into account and to consider the application of proper hillside building practices and geotechnical considerations when assessing and planning urban communities in hillside environments.**

920. **I further recommend that the report on** Landslide Risk Management Concepts and Guidelines **be taken into account in undertaking this exercise.**

Rescue

921. I have noted that, in my opinion, the Rescue Services performed an excellent rescue in all the circumstances which confronted them in July and August 1997.

922. I do note, however, that neither the District nor Local DISPLANs recognised the potential hazard of landslide in the Alpine area.

923. On 22 May 2000, I received into evidence a letter from Mr. Brian Goodes of the State Rescue Board of NSW which annexed the *NSW Major Structural Collapse Sub-plan* dated in December 1998. It was prepared as an interim sub-plan to the NSW State DISPLAN to detail the arrangements for the control and co-ordination of, preparation for, response to, and immediate recovery from a major structural collapse. It encompasses urban search and rescue. It was prepared by the State Emergency Management Committee in consultation with the State Rescue Board and takes into account provisions of the State Rescue Policy.

924. The document was prepared in response to the lessons learned in the rescue undertaken during the 1997 landslide. It is apparent from the letter from Mr. Goodes that the intention of the plan is to ensure a basic level of knowledge of urban search and rescue amongst all rescue operators so that the first responding agency can make an informed assessment of the situation.

925. It is also apparent that rescue personnel are being sent overseas for first-hand experience with rescue techniques in structural collapses which have followed such events as the recent major earthquakes in Turkey. They are also attending conference and establishing links with countries that maintain significant capabilities in this area of expertise.

926. Counsel for the families asked that I make recommendations that all services involved in rescue management take steps to include landslide in the courses and training programmes that are conducted for their officers.

927. In the light of the information I have received about the Sub-plan, it appears to me that such a recommendation is unnecessary.

928. At the time of the 1997 landslide the District and Local DISPLANs did not take into account the risk of landslide in the Alpine area. As far as I am aware that position has not changed .

929. I recommend that both the District and Local DISPLANs be revised taking into account the risk of landslides in the Alpine area and their management.

930. Having regard to Mr. Sullivan's comments concerning the increasing likelihood of slope instability as development in hilly areas increases, I commend to the authorities revision of all DISPLANs to ensure they reflect appropriately the risk of landslides in the relevant area.

D. Hand

Coroner

1 Report on Historical and Planning Issues dated November 1998 PSM R1, ex. 91.01, par.4.
2 NPWS letter to the Solicitor assisting the Coroner, 1 March 2000, ex. 137.02.
3 NPWS Draft National Park Environmental Planning and Assessment Manual, 13 October 1999, ex. 137.03.

Appendices

Appendix 1: Witness list

Baker, Terrence Patrick -	Detective Inspector of Police
Bartley, John Howard -	Ambulance Officer
Baumhammer, Artur Herman Ernst -	Clerk of Works and Building Inspector
Bell, Graeme John -	Engineer, SMEC
Blakers, Leslie -	Engineer, NPWS
Bradhurst, Peter Graham -	Pathologist, NSW Institute of Forensic Medicine, Glebe
Bright, Robert Charles -	Engineer, Snowy River Shire Council
Brodie, David John -	Senior Constable of Police
Brotherton, Phillip George -	Ambulance District Inspector
Burke, Anthony John -	Service Station Owner
Cala, Alan David -	Pathologist, NSW Institute of Forensic Medicine, Glebe
Carey, Ronald John -	Ambulance Officer
Cocks, Andrew Mark -	Engineer, KT2
Clague, John Patrick -	Operations Officer, State Emergency Services
Criss, Dale Phillip -	Building Inspector, NPWS
Crosky, Alan Gordon	Associate Professor Metallurgy, School of Material Services University of NSW
Dagger, William Arthur -	Regional Building Surveyor, NPWS
De Ambrosis, Laurence Peter -	Engineer, GHD - Longmac Pty Ltd
Denham, Warren Neville -	Senior Constable of Police
Dent, Allan William -	Ambulance Superintendent
Diver, Euan -	Village Manager, KT2
Douglas, Grant -	Manager, South/West Region Mines Rescue Service NSW
Duff, Alan Cumming -	Resident, Inala Lodge Thredbo
Duncan, Ray -	Senior Constable of Police
Dundon, Peter Joseph -	Consultant Hydrogeologist
Dusseldorp, Gerardus Jozef -	Chairman of Lend Lease Corporation and a director of KT1
Dwyer, Kenneth Noel -	Secretary, Kosciusko State Park Trust
Eager, David Marshall -	Engineer and member of Schuss Ski Lodge, Thredbo
Edwards, Douglas John -	Resident, Woodridge Thredbo
Ellard, John Carlos -	Casual Worker, Thredbo
Ellard, Manos -	Hospitality Worker, Thredbo
Forbes, David Ian -	Detective Senior Sergeant of Police
Forbutt, Peter Craig -	Sergeant of Police

Gray, Ian -	Engineer, Managing Director, Signa Pty Ltd
Grayson, Mallory John -	Ski Instructor, Thredbo
Haggstrom, Kurt Arvid -	Builder, Member of Brindabella Ski Club
Hagley, John Karl -	Employee of Lend Lease in various capacities from 1962 - 1987
Hetherington, John William -	Engineer, Department of Public Works
Hoffman, Mark John -	Lecturer, School of Materials Science and Engineering University of NSW
Hoyer, Paul Rowland -	Senior Constable of Police
Hughes, Geoffrey Eyre Forrest -	Solicitor and founding member of Kosciusko chair-lift and Thredbo Hotel Syndicate
James, John Roger Haughton -	Architect whose firm was employed by Lend Lease
Jewell, Christopher Martin -	Hydrogeologist, Principal C.M. Jewell & Assoc. Pty Ltd
Johnston, Bruce Wallace -	Commander of Police, South Eastern Region
Johnston, Raymond James -	Works Supervisor, Pye Plant Hire
Jordan, David Warren -	Engineering Geologist, SMEC
Kite, John Patrick -	Environmental Health and Building Officer, NPWS
Kotze, Gregory Phillip -	Geologist, GHD Longmac Pty Ltd
Kuhn, David Stuart -	Manager, Thredbo Professional Ski Patrol
Law, John Frederick -	Member of Gunyang Lodge
Leaver, Bruce Herbert -	Regional Director, South Eastern Region NPWS
Lloyd, George Alfred -	Member of the Board of Kosciusko Thredbo Ltd until the sale of Lend Lease in 1961
Macoun, Kenneth George -	Civil Engineer with a speciality in Hydraulic Engineering
Martin, Michael Adrian Edward -	Occupant in Schuss Lodge
Mattick, Brian -	Geotechnical Engineer employed by SMEC
McCaffrey, John Joseph -	Engineer, Consultant to Insearch Limited and Unisearch Limited
McCarthy, Desmond John -	Health Surveyor SRSC and later Surveyor, Environmental Health and Building, NPWS
McConnell, Michael -	Resort Engineer KT1 from 1983 to 1985
McMahon, Barry Keys -	Consulting Geotechnical Engineer, McMahon Associates
Meakin, Terrence Charles -	Registered Surveyor, PW Rygate & West
Milliken, David Bruce -	Captain, New South Wales Fire Brigades
Moll, Victor Raymond -	Member of Schuss Ski Club

Murray, David -	Retired Firefighter, NSW Fire Brigades
Neuhaus, Stephen Peter George -	Senior Constable, Australian Federal Police
Newson, Noel Henry -	Assistant Commissioner Region South, NSW Fire Brigades
O'Connor, James John -	Engineer, SMEC
Oldfield, Ross Allan -	Engineer, Kosciusko State Park Trust
O'Reilly, Ronald James -	Manager, Schuss Ski Club Lodge
Owen, Ian Neville -	Retained Firefighter, NSW Fire Brigades
Palmer, Loria Elvina -	Built ski lodge which later became known as Schuss
Pelc, Charles Karel -	Kosciusko Thredbo Ltd.
Polin, Michael John -	Civil Engineer, Gutteridge Haskins and Davey Pty Ltd
Price, Jeffrey Richard -	Senior Engineering Geologist, McMahon Associates
Price, Timothy Patrick -	Snow Maker, KT2
Reedy, Kenneth Barry -	Design Engineer, NPWS
Reeve, William -	Occupant of Gunyang Lodge
Reid, Nicholas John -	Snow Groomer and permanent resident of Thredbo
Robinson, Roy George -	Field construction engineer for the Snowy Mountains Hydro-Electric Authority in 1958
Ruming, Daniel Michael -	Detective Inspector of Police
Ryan, Stephen Paul -	Retained Firefighter, NSW Fire Brigades
Rye, Philip Michael -	Manager of Oxbara Pty Ltd, a company hiring plant, equipment and associated labour
Sanderson, David Charles -	Superintendent of Police
Serediuk, Yurgen Erick -	Senior Engineer, Structural and Civil, Department of Public Works and Services
Shirley, Andrew Francis -	Consultant Engineer, Shirley Consulting Engineers Pty Ltd
Smith, Garry -	Inspector of Police
Stanley, William George -	Occupant of Gunyang Lodge
Stark, Hugh Lithgow -	Senior Lecturer School of Mechanical Engineering, University of NSW
Stiebel, Ronald Robert -	Occupant of Gunyang Lodge
Sullivan, Anthony Stephen -	Engineer NPWS
Sullivan, Timothy Daniel -	Consultant Engineer, Pells Sullivan Meynink Pty Ltd
Svenson, David -	Engineering Geologist, Snowy Mountains Authority

Thomas, Martin Philip -	Occupant of Bobuck Apartments
Thompson, Cameron Roy -	Occupant of Celesia Lodge
Travers, Michael Desmond -	Senior Constable, Australian Federal Police
Turner, John Clarence -	Occupant of Gunyang Lodge
Ubrihein, Rodger John -	Civil Engineering Designer
Van der Lee, Albert Gysbertus Wilhelmus -	Resident Manager in Thredbo for KT1
Vardy, Glenn Francis -	Construction Engineer, Department of Public Works and Services
Vassallo, Stephen Charles -	Plumber, KT2
Warren-Gash, David John -	Scientific Officer, RTA
Williamson, Warren James -	Sergeant, Australian Federal Police
Winter, Peter Robert -	Engineer, Department of Public Works and Services
Wright, Peter Charles -	Village Department Supervisor KT1

Appendix 2: Those assisting the Coroner

The Coroner was assisted by a team which included investigatory, legal and administrative staff. There was some turnover of personnel during the course of the Inquest. The following is a list of those who provided assistance to the Inquest.

Barristers

Ms. Ruth McColl S.C.
Mr. Jeremy Gormly
Mr. John Ayling
Mr. Nick Floreani

Solicitor

Ms. Karin Harrison

Paralegals

Mr. Jonathan Horton
Mr. Prabhu Raman
Mr. Sean Graham
Mr. Seth Eeles
Mr. Michael Rehberg
Mr. Giri Sivaraman

Administration Staff

Ms. Samantha Struthers
Ms. Marie Appleby
Ms. Dorothy Cheng

Police Investigation

Detective Inspector Robert Cocksedge
Detective Senior Constable Steve Ashton
Detective Senior Constable Kevin Coady
Senior Constable Philip Daniels
Detective Senior Constable Tony Hinton
Detective Senior Sergeant Rex Little
Senior Constable John Mares
Detective Senior Constable Phil McCloskey
Detective Senior Constable Peter McLay
Detective Sergeant Neil Parsons
Detective Sergeant Eric Pearson
Detective Senior Constable Michael Porta
Constable Adam Sutton
Senior Constable Chris Varley
Senior Constable Jon Wall
Detective Senior Constable Dean Wright

Coroner's Staff

Mr. Graham O'Rourke
Ms. Kay Dawson
Ms. Ailsa McPherson
Ms. Dawn Stratford
Ms. Carol Hopping

Appendix 3: Expert advisers to the Coroner

Tim Sullivan BA MSc DIC CPEng MIEAust FAusIMM MMICA

Mr. Sullivan has over 25 years of experience in geotechnical engineering. His fields of special competence included:

- slope stability
- landslide stabilisation
- engineering geology
- hydrogeology and
- soil and rock slope design

He has carried out geotechnical investigations and studies for over 150 landslides on natural and man made slopes. These landslides have been at all scales from less than 1000m^3 to more than 50 million m^3 and entailed slopes up to 650m in height. In addition to the above, assessments of urban land stability have been undertaken throughout the region from Newcastle to Wollongong on individual lots, major subdivisions and included the western extension of the land stability zoning for Warringah Shire Council.

Mr. Sullivan is currently geotechnical adviser on slope stability for some of Australia's largest mining operations and companies; including Hamersly Iron, Normandy Poseidon, Mt Keith Nickel, Griffin Coal, Mt Leyshon Gold, Kelian Gold and RTZ and Newcrest.

In addition to all the states and mainland territories of Australia Mr. Sullivan has lived and worked extensively overseas. Major projects have been located in India, Papua New Guinea, Hong Kong, Indonesia, Thailand, Philippines, New Zealand and Fiji.

Ken Macoun CPEng FIEAust BE (Civil) MSc (Hydraulics) MCIRCEA

Mr. Macoun has over 30 years of experience as a Civil Engineer with a speciality in Hydraulic Engineering. He has experience in providing engineering services and advice and preparing reports and papers to the many organisations for example, government departments such as the NSW Department of Public Works and Services, NSW Department of Land and Water, NSW Ministry of Transport, Road and Traffic Authority, NSW Department of Urban Affairs and Planning, Department of Water Resources and many Local Councils. He has had experience in England, France, Malaysia and the Cook Islands.

Chris Jewell BSc MSc Cgeol MIWEM

Mr. Jewell has over 25 years experience as a Hydro-geologist. He has experience in over one hundred projects involving soil and groundwater contamination undertaken in all Australian States. These projects have involved assessment and re-mediation of

contaminated industrial sites; landfill, landfill leachate and landfill gas investigations; leading underground storage tanks, feedlots; stream and lake-bed sediment evaluations, and subsurface waste injection studies. Mining Studies to mine water management in Australia, New Zealand and Oman. These projects have included de-watering, water resources, mine water disposal (including re-injection) and tailings management. Engineering studies relating to groundwater in Australia and Iraq. Water resource evaluation projects in Australia, New Zealand, United Kingdom, Saudi Arabia, Oman, Bahrain, Zimbabwe and Ethiopia. Projects have ranged in scope from major regional studies involving extensive numerical modelling and the development of large wellfields to the siting and construction of single-source village water supplies in Africa.

Peter Winter Dip(Civil) Eng

Mr. Winter is an qualified civil engineer with 38 years experience in strategic planning, concept/project development and implementation across a broad spectrum with an engineering bias towards the water industry.

Appendix 4: Parties to the Inquest

PARTY	COUNSEL	SOLICITOR
National Parks and Wildlife Service	Mr. Peter McClellan QC Mr. Brian Preston S.C. Ms. Gail Furness	Ms. Vivienne Ingram Mr. Rasheed Khan National Parks and Wildlife Service
Kosciusko Thredbo Pty Ltd	Mr. Chris Gee QC Mr. Miles Condon	Mr. Philip White Philip Densham White Mr. Rowan McKenzie Michael Harmer & Associates
Roads & Traffic Authority	Mr. John Gleeson QC Mr. Bruce Smith	Mr. Paul Heath Sparke Helmore Solicitors
Snowy River Shire Council	Mr. Peter Garling S.C. Mr. Jeremy Morris	Mr. Michael Down Ms. Tina Lawrence Phillips Fox
Snowy Mountains Hydro Electric Authority		Mr. Greg Kathner Australian Government Solicitor
Brindabella Ski Club	Mr. Peter Brereton	Mr. Chris Pagent Corrs Chambers Westgarth
Lend Lease Corporation	Mr. Malcom Craig QC	Mr. Geoff McClellan Freehill Hollingdale & Page
Police, NSW Fire Brigade, Ambulance Service, State Emergency Services, Public Works and Services	Mr. Paul Menzies QC Mr. Patrick Saidi	Ms. Christine Johnpulle Crown Solicitor's Office
HIH Winterthur		Mr. Michael Samios Solicitor
Victims' Families	Mr. Michael Green QC Mr. Todd Alexis	Ms. Marilyn Bartole Legal Representation Office
Victims' Families	Mr. Harry Bauer Mr. Bernard Gross QC	Mr. Bernard Collaery Bernard Collaery & Associates
Roger Ubrihien	Mr. Stuart Donaldson	Mr. Peter Tredinnick Ms. Harriet Price Phillips Fox
Oxbara Pty Ltd (Rye Plant Hire)	Mr. Chris Barry QC Mr. Chris Moore	Mr. Chris Behrens Ms. Jacqueline Wharton Mallesons Stephen Jaques
Lodges Owners - Thredbo Village		Mr. Peter Tyson Turner Freeman Solicitors
Snowy Mountains Engineering Corporation	Mr. James Crowley QC	Mr. Ron Ashton Minter Ellison
Mr. David Warren-Gash	Mr. Peter Hennessy S.C. Mr. Eugene Romaniuk	Mr. Clive J Curwood Curwood & Partners

Appendix 5: Parties who made written submissions

- National Parks and Wildlife Service
- Lend Lease
- Koscuisko Thredbo Pty Ltd
- The Legal Representation Officer on behalf of the families it represents
- Mr. R. Ubrihien
- The Police Service of NSW; the NSW Fire Brigades; the Ambulance Service; the State Emergency Service; and the Department of Public Works and Services
- Snowy River Shire Council
- Oxbara Pty Ltd
- Mr. Warren-Gash
- Snowy Mountains Hydro Electric Authority
- Roads and Traffic Authority
- Brindabella Ski Club

Appendix 6: Public submissions

There were a considerable number of letters as well as calls received from members of the general public dealing with their concerns in relation to what had happened, offering information, and making comments.

They were also some detailed written submissions which are listed below:

Mr. John Modra, dated 31 July and 1 August 1998

Dr. Vicki Sanderson, dated 29 July 1999

Thredbo Sub-Lessees Association Inc., dated 3 March 2000

Ms. Patricia Hecher and Mr. A P Goodman, dated 4 May 2000

Mr. Albert Van der Lee, dated 5 June 2000

I take this opportunity to thank those who contributed for their interest and effort.

Appendix 7: Reports of experts assisting the Coroner tendered in evidence

Reports prepared by Mr. T Sullivan of Pells Sullivan Meynink Pty Ltd:

R1 Report on Historical and Planning Issues dated November 1998 (ex. 91.01 -08)

R2 Thredbo Site Factors Report dated March 1998 (ex. 92.0001 - 1228)

R3 Thredbo Supplementary Site Factors Report dated May 1998 (ex. 93.001 - 154)

R4 Analysis of Thredbo landslide dated July 1998 (ex. 94.001 - 323)

R5 Examination of Water Supply Pipeline dated October 1998 (ex. 95.01 - 83)

R6 Deconstruction of Winterhaus Corner Retaining Wall dated March 1999 (ex. 96.001 - 632)

R7 Supplementary Report Further Interpretation and Analysis dated May 1999 (ex. 97.01 - 89)

R8 Inspection of the Remaining Water Supply Pipeline between Schuss and Bobuck Lane dated March 1999 ex. 98.01 - 12)

R9 RTA Slope Risk Rating System dated August 1999 (ex. 117.01 - 05)

R10 Additional stability Analysis of Section E dated October 1999 (ex. 125.01 - 31)

Other Reports

Report on Assessment of the Water Supply Pipeline System dated 16 July 1998 by Mr. K G Macoun (ex. 100.01 - 37)

Further Report on Water Supply Pipeline System dated 19 October 1999 by Mr. K G Macoun (ex. 127.01)

Report on Aspects of the Water Supply Pipeline dated 3 February 1999 by Mr. P R Winter (ex. 101.01 - 25)

Appendix 8:
Reports of parties' experts tendered in evidence

Report on Alpine Way Watermain Construction and Leakage, dated 16 March 1999 by Mr. A F Shirley, Shirley Consulting Engineers Pty Ltd
(ex. 102.01 - 20)

Report on Winterhaus Corner Retaining Wall Design and Construction dated 31 March 1999 by Mr. A F Shirley, Shirley Consulting Engineers Pty Ltd
(ex. 103.01 - 37)

Thredbo Landslide Coronial Inquiry - Investigation into the cause of the Landslide dated 8 March 1999 by Longmac Associates Pty Ltd
(ex. 106.01 - 06)

Report on Water Supply System and its Relationship to the Landslide dated October 1998 by Gutteridge Haskins and Davey Pty Ltd
(ex. 107.01 - 13)

Report on Geotechnical Assessment of Thredbo Landslide dated March 1999 by Dr. B K McMahon, McMahon Associates
(ex. 110.001 - 479)

Report re Spigot and Coupling Dimensions dated 21 June 1999 by Prof. A G Crosky (ex. 111.01 - 17)

Report - Thredbo Landslide Asbestos Cement Water Supply Pipe Damage on Spigot 1 dated 1 June 1999 by Dr. Stark (Dr. Stark's First Report)
(ex. 112.01 - 85)

Report - Thredbo Landslide Asbestos Cement Water Supply Pipe Damage on Spigot 1 dated 24 June 1999 by Dr. Stark (Dr. Stark's Second Report)
(ex. 113.01 - 11)

Supplementary Report on Thredbo Ground Water dated 5 October 1999 by Mr. P Dundon of P Dundon & Associates Pty Ltd
(ex. 115.01 - 30)

Analysis of Pipeline Marks dated 17 November 1999 by Prof. A G Crosky
(ex. 126.01 - 24)

Appendix 9: List of issues

List of Issues

1.0 Planning Scheme

1.1. determining authority
- (a) for NPWS area
- (b) for KT area
- (c) for Alpine Way

1.1. relevant instruments
1.2. responsible authorities
1.3. historical profile
1.4. suitability of Thredbo Valley for building construction

2.0 Planning Issues (administrative)

1.1. building applications]
for Carinya
1.2. building approvals]
for Bimbadeen
1.3. development]
for high pressure water supply pipeline
1.4. suitability of site for development]
for retaining wall and associated road widening and associated drainage works

2.1 State of Geotechnical knowledge throughout development of Thredbo Village

3.0 Alpine Way

1.1. design, construction and maintenance

1.2. inclinometers

1.3. piezometer

1.4. road widening, resurfacing
1.5. fill

3.1 Schuss carpark construction

4.0 Vegetation

1.1. exotic trees

1.2. native trees

1.3. tree poisoning

1.4. impact of development

5.0 Hydrology

5.1 Climate

5.2 Groundwater Hydrology

1.1. groundwater information

5.3 Surface Water Hydrology

1.1. drainage

1.2. diversion culverts behind Schuss and Munjarra

1.3. retaining wall

1.4. stormwater drains

1.5. stream diversion

6.0 Lodge Construction

1.1. design, approvals, construction

1.2. Carinya

1.3. Bimbadeen

1.4. other lodges (especially Schuss, Gunyang and Munjarra)

1.5. fill

1.6. retaining walls

1.7. footings

7.0 Geotechnical

1.1. historical geotechnical studies

1.2. surveys

1.3. maps/plans

1.4. history of landslides/earth movements in Kosciusko National Park

8.0	High Pressure Water Supply Pipeline

1.1. design

1.2. approval

1.3. construction

1.4. installation

1.5. couplings

1.6. maintenance

1.7. modification

1.8. historical performance

9.0	Retaining wall and associated drainage work on the Alpine Way above Thredbo Village

1.1. technical assessment of associated/resultant impacts

1.2. design

1.3. approval

1.4. construction

1.5. installation

1.6. monitoring

10.0	Earthquake

11.0	Rescue Operation

1.1. Immediate reaction
- KT, NPWS, RTA
- Emergency Services
- Police
- Ambulance
- Fire Brigade
- S.E.S
- timeliness of arrival
- co-ordination

- availability of expertise
- chronology of conduct

12.0 Recommendations

- Future prevention
- Planning process
- Remedial work
- Future geotechnical assessment

Appendix 10: Figures

1. Locality plan of Kosciusko National Park
2. Aerial view of the landslide
3. Map showing landslip locations along the Alpine Way prepared by PSM according to RTA chainages
4. Photograph of the 1964 landslide
5. Photograph of the 1964 landslide
6. Drawing 84/1 showing sketch of proposed location of the watermain
7. Figure depicting vectors of concrete slabs and victims bodies during landslide
8. Figure depicting location of watermain and observations of water leakage