

BEFORE THE BOARD OF INQUIRY

IN THE MATTER of the Resource
Management Act 1991

AND

IN THE MATTER of applications for
resource consent and
notices of requirement
by Transpower New
Zealand Limited for the
North Island Grid
Upgrade Project

**STATEMENT OF EVIDENCE OF PHILIP JAMES PATRICK ON BEHALF OF
TRANSPOWER NEW ZEALAND LIMITED
(Construction Processes and Management: Lines)**

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INTRODUCTION

Qualifications

1. **MY** name is Philip James Patrick. I am employed as a Transmission Line Field Engineer by Transpower New Zealand Limited (**Transpower**).
2. I hold a New Zealand Certificate of Engineering (Civil).
3. **MY** role for the North Island Grid Upgrade Project (**Upgrade Project**) involves the following duties/responsibilities:
 - (a) Providing engineering support to the property group responsible for acquiring property agreements for Transpower;
 - (b) Investigating and evaluating proposed tower sites, potential access routes and assess constructability issues associated with building the proposed 400kV capable line (**proposed line**);
 - (c) Identifying least impact methods of construction and access to tower sites;
 - (d) Preparing Access and Construction Assessment (**ACA**) reports.
 - (e) Providing general advice on, and input to, construction aspects of the Upgrade Project, including preparation of material for inclusion in the Notices of Requirement (**NOR**) Documentation.
4. I have 35 years work experience in the high voltage power industry, which includes 29 years involved with design, construction and maintenance of High Voltage Transmission Lines.
5. **MY** work experience includes 22 years working for Transpower, and its predecessors the New Zealand Electricity Department (**NZED**) and the Electricity Division of the Ministry of Energy (**MoE**) responsible for development and operation of the New Zealand electricity grid, 1 year for a private contracting company specialising in high voltage maintenance and

construction work, 10 years as a partner in an engineering consultancy providing project management and engineering services to the high voltage transmission sector, 2 years as a self employed project management consultant and 10 months working in Australia for a large multinational engineering consultancy.

6. I have worked directly for Transpower for approximately 5 years. From 1990 to 1994 I held management positions with responsibility for managing the maintenance of Transpower's North Island transmission line network, and later to include the group that managed all non-routine maintenance projects undertaken on the North Island electricity grid.

7. **TRANSMISSION** line construction projects I have worked on in various capacities include:

- (a) Wairakei – Whirinaki 220kV transmission line;
- (b) Tuai – Wairoa 110kV transmission line;
- (c) Redcliffe – Whirinaki 220kV transmission line;
- (d) Opunake – Stratford 110kV transmission line;
- (e) Bunnythorpe – Wilton 220kV transmission line;
- (f) Three Mile Hill – North Makarewa 220kV transmission line;
- (g) Hillside – Winton 66kV transmission line;
- (h) Benmore – Twizel 220kV transmission line;
- (i) Hairini – Mt Maunganui B 110kV transmission line; and
- (j) Te Awamutu Cogen 110kV transmission line.

8. **SIGNIFICANT** transmission line maintenance or uprating projects I have managed include:

- (a) Bunnythorpe – Whakamaru A 220kV transmission line thermal uprating;
- (b) Wairakei – Whakamaru A 220kV transmission line thermal uprating;
- (c) Wairakei – Whakamaru B 220kV transmission line thermal uprating;
and
- (d) Hamilton – Waihou A 110kV transmission line thermal uprating.

9. TRANSMISSION line dismantle projects I have managed include:

- (a) Bombay – Glenbrook A 110kV 2CCT steel lattice tower line; and
- (b) Arapuni – Ongarue A 110kV 1CCT wood pole line.

10. I confirm that I have read and am familiar with the Code of Conduct for Expert Witnesses in the Environment Court Consolidated Practice Note (2006). I have approached the preparation of this evidence in the same way that I would for the Environment Court.

SCOPE OF EVIDENCE

11. IN this brief of evidence, I provide an overview of the construction processes for building the proposed line and I describe the effects and the measures that will be used to mitigate potential effects from the construction activities, and the processes and mitigation measures for dismantling the 110kV ARI-PAK A transmission line (**ARI-PAK A line**).

CONSTRUCTION MANAGEMENT PLANS

12. MR Rasul, in his evidence, has described how the construction of the proposed line would be undertaken using an Alliance contract. Mr Rasul also provides an overview of the management systems and management plans that the Alliance would use to control all aspects of the design and construction of the proposed line. In my evidence I will provide detail on the role of the Construction Management Plans in controlling the construction activities and managing the effects of construction.

Construction Management Plan (CMP)

13. **THE** CMP is a fundamental management tool that would be prepared for the project by the Alliance. The CMP will define all construction processes that have been approved by the Alliance to be used during the construction phase of the Upgrade Project and will include detail of how construction activities will be managed, controlled and monitored. It ensures that only approved processes, designed to incorporate the required quality, safety and timeliness targets are implemented. The CMP also provides a benchmark for auditing and monitoring construction processes and work quality.
14. **THE** CMP would define the organisational structure for the construction team and define responsibilities and delegation levels within the construction team. It gives reference to, and provides guidance and instructions on aspects such as compliance with resource consent and designation conditions, and other regulatory or statutory obligations and the level and detail of record keeping that is required for construction activities.
15. **THE** CMP would usually include a list of sub-contractors and suppliers that have been approved to be used on the project and the services they are able to provide.
16. **IT** is usual for a CMP to contain a comprehensive construction programme as an appendix. Construction programmes are discussed in detail in paragraphs 21 to 24.
17. **IT** is usual for a CMP to contain a comprehensive set of construction procedures that have been approved to be used on the project. For this project, the procedures would be approved by a senior member of the Alliance management team, who would have been given delegated authority for approval of work procedures. The purpose and content of construction procedures is explained in more detail in paragraphs 25 and 26.
18. **THE** CMP would also identify methods of dealing with, and the minimum requirements for, issues such as:
 - (a) Work on, or adjacent to, roads;

- (b) Work adjacent to other utilities (eg low voltage (LV) overhead power lines);
- (c) Work adjacent to waterways;
- (d) Methods for handling, transporting and storing materials; and
- (e) Methods for managing, handling and storing hazardous materials or contaminants.

Site Works Plan (SWP)

19. FOR a project of this nature, it is normal practice to produce a Site Works Plan for each work site or property crossed by the proposed line. The SWPs would identify the works to be carried out on each property, and all issues associated with working on the property. Such detail would include:

- (a) the approved access routes to each work site;
- (b) measures to be taken to protect infrastructure and waterways etc;
- (c) where fences would be relocated to;
- (d) the size of gates to be installed and the locations;
- (e) the nature of material to be used as toppings on roads;
- (f) times of work;
- (g) landowner agreements relating to entry;
- (h) reinstatement arrangements; and
- (i) the means of disposal of excavated material and cut vegetation.

20. INPUTS to SWPs include the ACA reports, subsequent discussions with landowners and occupiers, pre-construction inspections, geotechnical reports,

any other constraints imposed (eg by resource consents or the designation), and transmission line construction expertise.

Construction programme

- 21.** A comprehensive construction programme would be developed to coordinate all issues associated with constructing the proposed line. A construction programme is a very detailed schedule of all of the tasks to be carried out to complete a construction project. A construction programme is a forecast, which is used to determine the best order of undertaking construction tasks; forecast the timing of future activities; monitor and manage progress of the works. The programme is loaded with a vast amount of detail that impacts on or is associated with all of the tasks required to complete the works. The construction programme will provide dates and times that tasks are required to be started, and completed by, to ensure that key milestones are achieved, and is used for forecasting and monitoring progress vs time and consumption of resources.
- 22.** **AT** the most detailed level, a construction programme would identify the timing of each activity, at each site, and the labour, plant and resources necessary to undertake each activity. The construction programme is a means of planning the sequence of construction activities and coordinating these with resource availability, and other external factors such as access dates to work sites, resource consents, and availability of design information. A construction programme is used to identify the critical activities (sometimes referred to as the "critical path"), which are those activities which, if delayed, will impact on the overall completion date of the construction project. The construction programme is regularly (sometimes daily) updated with actual progress to ensure it reflects, as best as possible, what has actually happened on the project.
- 23.** **THE** construction programme would incorporate matters such as:
- (a) Design milestones;
 - (b) Material deliveries;
 - (c) Access agreements to land;

- (d) Seasonal weather and ground conditions;
- (e) Labour, materials and plant resources;
- (f) The time allocated to completion of each task;
- (g) For any particular task, any other task(s) that must be logically completed, before the task can be started (programme logic)
- (h) Local constraints (eg earthworks seasons in Auckland Regional Council (**ARC**) area);
- (i) Resource consent and designation conditions; and
- (j) Landowner agreements and preferred access times.

24. THE construction programme would be a "living document" in that it would be updated regularly with actual achieved progress, and other changed conditions (such as changes in resource availability, weather conditions and changes in land owner requirements regarding access times). The construction programme would be revised to reflect changes in future work patterns that result from changed conditions and actual progress. The continued updating of the construction programme enables the timing of construction activities and resource consents to be coordinated, and landowners/stakeholders to be kept well informed.

Construction procedures

25. MANY construction activities are complex, and involve numerous sub-tasks that must be carried out in specific sequence, have specific requirements for managing safety and quality, require specific tooling and plant to be used and may require specific checks and tests to be carried out at particular stages. It is common practice (and in some instances mandatory) to use formal construction procedures to control such activities.

26. CONSTRUCTION procedures are formal documents used to detail the processes, tools, materials and labour requirements necessary to carry out a

work activity. The procedures detail the steps to be taken, the sequence of work and quality and safety requirements to be applied. The process for developing procedures is intended to ensure that sufficient technical and construction expertise has been included in each procedure so that only safe, technically sound work methods are approved for use on the Upgrade Project.

Work method statements (WMS)

27. **WMS** are often used within the industry to describe an overall process (such as tension stringing) which may require numerous construction procedures to cover the many activities undertaken in the total process. WMS are often used to provide an overview of the principles and general methodology to be used for a construction process. I would expect WMS to be prepared for some activities associated with the Upgrade Project.

Summary

28. **IN** summary it is common to implement a comprehensive system of formal management plans and programmes when undertaking a construction project such as construction of the proposed line:
- (a) A CMP is an overarching document that is used to define the total scope of the construction works at a high level; identify key persons in the organisation and the responsibilities of those key persons; identify methods to be used for particular situations or aspects of the construction work; contain a comprehensive set of construction procedures that define specific methods for undertaking construction tasks; and will reference all other documents; rules and regulations necessary to be applied to ensure proper execution of the construction phase of the project.
 - (b) A SWP is a very "property specific" report, used to identify the particular works to be undertaken on any individual property or at any individual work site. SWPs contain precise detail on access routes to be used on the property, and detail such as the size of gate to be installed in a particular fence, the number of trees to be felled, where the debris is to be disposed of, and provide information on agreements made with the owner of the property, such as times of

access to the property. A SWP would be prepared for every property on which construction work would be undertaken.

- (c) A construction programme is used to coordinate and forecast the timing of and duration of all construction activities, the availability of resources, and identify critical activities/resources that have potential to impact on the timely completion of the project.
- (d) A WMS is used to provide an overview of a general work methodology that is intended to be applied to a segment of a project. By way of example, a WMS may be prepared to describe the fundamentals of tension stringing of conductor, and might highlight key aspects of the process, such as protection methods to be used at road crossings.

PROCESS FOR CONSTRUCTING THE PROPOSED LINE

General sequence of construction activities

29. THE order of activities required to build a transmission line tower is as follows:

- (a) Landowner and other stakeholder liaison to confirm timing of the work and agree access times;
- (b) Site survey to peg and set out the tower site;
- (c) Installation of any measures necessary to control or mitigate construction effects;
- (d) Formation of access to the tower site and site preparation, including earthworks, clearing of vegetation and relocation of fences or other obstacles at the site;
- (e) Construction of tower foundations;
- (f) Construction of the tower;

- (g) Installation of temporary hurdles and other measures during stringing to protect roads, power lines, railways and other assets crossed by the transmission line;
- (h) Installation of earth wires, electrical conductors and insulators; and
- (i) Final reinstatement and repair of property damage.

30. **WHEN** building a transmission line the above sequence of events must occur at every individual tower site along the line. However, when building a long line such as the proposed line it is not necessary or usual to complete an activity at all sites before progressing to the next activity in the process. By way of example, it is not necessary to complete the construction of all foundations along the proposed line before commencing construction of towers. Instead, foundation construction, tower erection and conductor installation activities would be carried out simultaneously over different sections of the proposed line.

31. **FORMATION** of access and construction of foundations would commence almost simultaneously. I expect that tower assembly and erection would commence as soon as materials are available, and sufficient foundations have been installed to provide continuity of sites for the tower erection crews. Conductor installation (wiring) would commence when materials are available and sufficient towers have been erected to provide continuity of work for the wiring team. (Mr Rasul discusses the work teams and crews required for the construction of the proposed line in his evidence.)

32. **AS** well as the work at tower sites, vegetation would be felled or trimmed along the easement between towers to ensure the minimum required electrical clearances are not compromised and other services (such as LV lines) would be relocated. It is proposed that vegetation work and relocation of other services would commence early in the construction programme and continue simultaneously with other construction works.

33. **THE** areas of proposed line that would be worked on at any particular time and the order of working in particular areas would be determined by the Alliance management team when developing the construction programme which will take account of available resources, access agreements to property,

coordination with other land use, seasonal changes of weather and ground conditions.

34. **WIRING** (the process of installing the aerial cables and insulators) is carried out on sections of line (**wiring runs**) up to about 6km long. Wiring is the most constrained activity throughout the construction process, as it can only be completed when there are contiguous property access agreements along a wiring run, when all towers have been erected along the run and when obstacles along the wiring run (such as trees and utilities) have been removed or protected. Wiring is also constrained by the physical requirements for the equipment set up sites (**wiring sites**) at each end of the run. Wiring sites must have good access that will support numerous heavy vehicle movements, be of relatively gentle contour over a sizable area (approximately 4000m²), be relatively well drained and suitably positioned between adjacent towers.
35. **THE** intent when developing the Construction Programme will be to complete tower erection in a sufficient number of wiring run blocks to provide continuity of work for a wiring crew as early in the overall construction programme as possible. Because of the large amount of heavy plant and equipment required for wiring, the continuous nature of the process and the wish to avoid multiple intrusions onto properties, it is preferable for wiring to progress along consecutive runs along the line. For the Upgrade Project, it is expected that delayed access rights to some properties will prevent successive wiring runs being available in some instances. Any such delays will impact on the efficiency of wiring, the time taken to complete the wiring, and at some wiring sites, the number of times that the site is occupied, and the duration of disruption.
36. I discuss each stage of construction in more detail in the following sections of my evidence.

Landowner and other stakeholder liaison

37. **THERE** is potential for the construction of the proposed line and dismantling of the ARI-PAK A line to have high impacts on the lives and activities of affected landowners, local communities, and other stakeholders. Some disruption is inevitable. Stakeholder Management Plans (**SMPs**) and Landowner Management Plans (**LMPs**) would be prepared to control and define

interactions with stakeholders and landowners. Mr Rasul gives details of these in his evidence.

38. A key performance area for this project will be the degree to which the impacts on stakeholders are managed and kept to acceptable levels. To this end there will be a comprehensive ongoing programme of consultation with each stakeholder to keep them informed of the timing and nature of work to be undertaken in relation to their property/asset and the impacts that may result. Measures to limit the potential adverse effects would be discussed with each stakeholder and, where practical, agreed and, in all instances, documented.
39. **STAKEHOLDERS** would be consulted whenever there were changes to the potential impacts (eg due to weather, construction methods or timing of work). Where there were changed impacts, the mitigation measures would be revised as required, and again where practical, agreed with stakeholders.
40. **IN** the lead up to work on any property, documented liaison would occur with the relevant stakeholder at successively shorter intervals. I expect this liaison would occur with increasing frequency, such as one month, one week and one day before the construction activities have been planned to be undertaken, except where other timeframes for liaison had been agreed.

Setting out

41. **THE** first physical construction phase activity would be to accurately establish the centre of each tower site, and to establish survey marks for the foundation excavations.
42. **THIS** process would involve a two or three person survey party accessing each tower site with survey equipment. Access to tower sites would be by 4WD utility type vehicle or on foot if vehicle access was not achievable. Survey pegs would be installed for future reference points, including to denote the centre of the tower site, and the centre or extremities of foundation excavations and the limits of other site earthworks, such as formation of level platforms (**benching**) where tower sites are on sloping ground.

Formation of access and site preparation

- 43. THIS** section of my evidence covers the work necessary to form access tracks to work sites, and to prepare work sites for construction activities.
- 44. LARGE** heavy plant is required to efficiently construct tower foundations and towers of the size and height planned for the proposed line. The lattice towers are proposed to be up to 70 metres high, with an average height of 59 metres. Foundation excavations are expected to be up to 1.5 metres in diameter and 10 metres deep, and are expected to contain up to 80 m³ of concrete (in total for the four legs).
- 45. THE** required heavy plant and their likely weights would be:
- (a) truck mounted drilling plant (to excavate the required foundation holes) would weigh up to 40 tonnes each;
 - (b) concrete agitator trucks will weigh up to 27 tonnes when loaded;
 - (c) cranes capable of lifting tower sections to 60 metres would weigh in the order of 50 tonnes. The cranes would be up to 12 metres long and 3 metres wide.
- 46. AS** well as the heavy plant, many lighter vehicles would be required to access each tower and work site during the construction process.
- 47. TO** ensure that vehicles are able to access work sites safely and efficiently it is usually necessary to provide robust and well designed access tracks. The exception to formation of access tracks would be where the natural ground surface had sufficient strength and was of suitable gradient to enable safe access, or the nature of the terrain to be crossed was sufficiently challenging to make other construction and access methods more efficient. By way of example, if ground access to a particular tower site was across challenging terrain for long distances, it may be more efficient to change the design of the tower such that the necessary components and plant could be flown to the site by helicopter.

48. **ON** this project, substantial access tracks would be constructed, or existing tracks upgraded, to most sites. Solid carriageway surfaces would be required to support the heavy plant and high traffic volumes. Access tracks to most sites would be constructed to provide all-weather access.
49. **TYPICALLY** the access tracks would have a gradient not exceeding 1 in 8, and would be nominally 4 metres wide. At corners, tracks would be wider to accommodate the large turning radius of longer vehicles. In some instances, where access routes are long, pull-over bays would be established to enable vehicles travelling in opposite directions to pass. Short sections of track may be steeper than 1 in 8.
50. **DIFFERENT** track construction methods would be used for different topographic and geological conditions.
51. **IN** hill country, construction of tracks often involves forming cuts across sloping faces, leaving a cut batter (a sloping face of soil) on the uphill side of the track. This process might result in substantial quantities of soil to dispose of. By way of example, a 100 metre long track, cut across a slope of 1 in 3 could result in up to 1,000 cubic metres of soil to dispose of. Hill country tracks usually require installation of channels (water tables) along the side of the track to control the flow of stormwater.
52. **IN** most instances, the tracks would be metalled to provide all-weather traction. However, in some instances the underlying material may be sufficiently hard to not require surface metalling.
53. **ON** flatter terrain, the road surface may be formed by removing unsuitable material (topsoil) and spreading suitable compactable material onto the carriageway. In some areas, where there is a significant depth of soft ground (such as in peat areas), geotextile fabrics may be laid to reinforce the subgrade surface before installing the compacted base course, and to prevent the base course material from sinking into the subgrade. Geotextile may also be used as a means to keep the topsoil and base course material separated where the track is to be removed after construction is complete (see **Image 1**).



Image 1: Road construction using Geotextile

- 54. SITE** preparation work at tower sites may include:
- (a) removal of trees or other vegetation;
 - (b) relocation of farm and other infrastructure, such as fences, water pipes and utility services; and
 - (c) earthworks to provide level working platforms (benches), where tower sites are on sloping ground.
- 55. THERE** are a range of potential impacts associated with construction of access tracks and work site preparation. These potential impacts include:
- (a) conflict with the owner's use of the land;

- (b) damage to existing infrastructure, such as fences, existing tracks, drains and culverts;
- (c) environmental impacts associated with waterway crossings;
- (d) stormwater run-off causing siltation of streams and pasture;
- (e) destabilisation of erosion prone land;
- (f) road construction plant causing noise and dust nuisance;
- (g) injury to the public (including the landowner) during road construction activities; and
- (h) felled vegetation causing nuisance to the landowner.

I address each of these potential effects below.

Potential to conflict with the owner's use of the land

56. SIGNIFICANT effort has been put into identifying practical access routes to tower sites and work sites. Where landowners have allowed Transpower personnel to access their properties, engineering staff have visited each tower and work site to identify potential access routes. These routes have been discussed with the owners, to identify routes of least inconvenience to them, and to identify specific issues, such as geology or topography, and farming or other land use activities, that may impact on, or be impacted by, the location of and timing of construction of the access tracks. By way of example, some dairy farmers have indicated that they do not want construction access routes to use the main cattle raceways that their stock use each day to walk to the milking shed. In these instances alternative routes have been found that do not involve use of the main raceway.

57. THE results of these visits are documented in detailed Access and Construction Assessment (**ACA**) reports, and site plans that clearly identify the intended access routes, and the works necessary to form or upgrade the tracks. The locations of culverts, gates, fences and vegetation that may be affected by the access tracks are identified. Potential problems such as

adjacent waterways, land forms and infrastructure that need to be considered when designing the final access route are documented. Draft reports have been provided to the respective property owners for consultation and for finalising the agreed routes and works involved. The ACA reports form part of the legal easement documentation. (See **Appendix 1** for an example of an ACA report and **Appendix 2** for an example of an Indicative Site Works plan.)

58. **AS** at 18 January 2007, 164 of the 200 properties affected by construction works have been visited and draft reports have been completed for 132 of those properties. Draft reports have been provided to approximately 120 property owners.
59. **BEFORE** commencing track construction or upgrading work on a property, the Alliance would inspect the intended route and (in the case of new construction, mark the route) to confirm that the implications of using the route are the same as at the time of initial identification. Any new or previously unidentified issues would be documented and where necessary discussed with the owner, and solutions/measures determined.

Potential to damage existing infrastructure such as fences, existing tracks, drains and culverts

60. **THE** ACA reports referred to above identify most of the infrastructure in the vicinity of the proposed access track routes. The need to avoid, protect or modify the infrastructure would be identified in the ACA reports. Further on-site inspection and consultation with landowners would be undertaken before commencing construction works for the purpose of finalising the construction work and identifying items not previously identified. In the event that infrastructure was accidentally damaged during construction activities, repairs would be organised immediately once the damage was identified. Temporary repairs would be undertaken, if necessary, to provide an immediate response, where permanent repairs would take a longer period to be completed.

Potential for environmental impacts associated with waterway crossings

61. **CONSTRUCTION** or modification of water crossings, such as culverts (see **Image 2**), bridges or fords would be assessed to determine if resource consents were required. Any conditions associated with resource consents

would be included in the CMP and the SWPs. Construction activities in waterways have potential to cause serious impact such as; siltation problems in the waterways, impact on the aquatic life in the waterways and contribute to flooding by restricting water flows.

62. A wide range of engineering and construction practices are available to mitigate the potential problems associated with working in waterways. Some examples of such measures are:

- (a) Undertake works in stream beds during periods of low water flow;
- (b) Avoid stockpiling material excavated from the waterway near the waterway so it cannot be washed back into the waterway and cannot overload banks causing collapse;
- (c) Construct hard standing areas for construction plant adjacent to the waterway by removing soft material and installing and compacting compactable material before undertaking other work within the waterway;
- (d) Ensure installed culverts are of sufficient capacity for the catchment that is drained by the waterway;
- (e) use appropriate head and tail walls for culverts to prevent scouring and erosion;
- (f) Ensure that the invert (lower surface), of culverts are permanently submerged to enable fish to travel through them.

63. **FOR** each work site/property, a comprehensive SWP would be produced and implemented. This SWP would address all issues associated with the site, including the controls to be implemented at the site to ensure environmental requirements (including measures to be taken at waterway crossings) are complied with.



Image 2: Culvert installed in drain crossing

Potential for storm water run-off causing siltation of streams and pasture

64. **WHERE** tracks are formed across sloping ground such as hillsides, there is potential for storm water to be concentrated and channelled by the track formation and the resulting water flow can cause scouring and erosion and may carry water born material (silt) into streams and onto pasture.
65. **STORMWATER** run off from track construction work is typically controlled by forming a permanent channel (water table) along the side of the track formation to direct any water in a controlled manner to planned dispersal points (in much the same way that a gutter does for paved city streets). Culverts would be installed at suitable intervals and locations to direct water under the carriageway. Measures to prevent scouring include installing rock (rip-rap) into water tables to provide energy dissipation and armouring in the water table or “steps” to interrupt the water flow and reduce the water velocity
66. **SILT** traps would be used at culverts or other dispersal points as appropriate.
67. **MATERIAL** that was cut to waste would be stored in a stable manner (if required for future use), or removed to some other location on the property

where it could be usefully used, or would be removed to another approved disposal area.

Potential to destabilise erosion prone land

68. **DESTABILISATION** of erosion prone land can be caused by installation of road cuttings by concentrating, and directing, stormwater to localised areas, and by removal of existing ground cover vegetation, which assists in the retention of the soil and absorption of storm water.
69. **THE** measures described previously for control of run off would also provide protection against destabilisation. Further measures include forming stable slopes on cut and fill batters, sowing of vegetation on batters to assist with absorption of storm water and retention of soil. Methods such as hydro-seeding would also be used to enhance the speed of germination and growth where necessary.

Potential for road construction and site preparation activities to cause noise and dust nuisance

70. **TYPICALLY** the type of plant used for access track construction would include tip trucks, bull dozers, hydraulic excavators, graders and compaction plant. Felling of trees from access track routes and at work sites would involve the use of chainsaws.
71. **CONSTRUCTION** activities would be assessed in accordance with the requirements of NZS 6803: 1999, Construction noise. Measures to be implemented to control noise will be included in the CMP and individual SWP's.
72. **THE** potential for dust nuisance from access track formation work would be relatively limited, and would have most potential to occur where track formation work is carried out near houses. Potential mitigation for dust nuisance includes measures such as watering the dust source, restricting traffic speed on tracks and installing a non dust producing surface as soon as possible. This surface may involve installing a clean metal covering to road ways, and hydro seeding batters as soon as is practical.

73. **NORMAL** construction activities will be confined to particular hours (which would typically be between 7.00am and 6.00pm Monday through Saturday. If work was required to be undertaken outside of these hours, special measures to be implemented to mitigate the potential for noise and/or dust nuisance. By way of example, where any track formation work or tree felling was required to be carried out in close proximity to houses, or other sensitive locations, and there was the potential for excessive noise or dust nuisance, the timing of the work would be coordinated with the owners/occupiers, to target periods of least sensitivity.

Potential for injury to the public during road construction activities

74. **CONSTRUCTION** activities associated with the proposed line come under the jurisdiction of the Health and Safety in Employment Act 1992, and subsequent amendments, and the Health and Safety in Employment Regulations 1995. All activities undertaken during the construction of the proposed line would be required to comply with the Act and Regulations.
75. **THE** practical means of protecting the public, (including landowners and occupiers) is to exclude them from the work sites while construction related hazards are present. This would normally be achieved by liaising closely with property owners to ensure that construction activities are coordinated (as much as possible) with the activities of the owners. Other means to protect the public would include the erecting of temporary fencing around work sites, and by the use of safety observers to monitor work sites while work is underway, to prevent the public from entering the work area, except in a controlled manner and under the supervision of the person in charge of the site.
76. **THE** Health and Safety Plan (**HSP**) will address public safety measures in general and the SWP will define specific safety measures to be implemented at each site.

Potential for felled vegetation to cause nuisance

77. **WHERE** vegetation was to be felled, there would be prior consultation with the owner to agree on the method of disposal of the vegetation. In most cases, the methods of disposal would be documented in the ACA reports, which are

currently being prepared. It is preferable to dispose of vegetation on the property that it originated on. Disposal on the property that the vegetation originated from reduces the risk of transferring noxious plants and plant diseases from one location to another, reduces the amount of traffic on roads and the amount of traffic across the property. Typical methods of disposal would include:

- (a) Vegetation being left to decay naturally where it is felled;
- (b) Mulch and spread or leave the mulch stockpiled for the owner to spread;
- (c) Logs of commercial size dressed and stacked for the owner's disposal;
- (d) Vegetation/logs being cut into firewood lengths, and left at a suitable location for the owner;
- (e) Burn felled vegetation on site (particularly noxious plants, eg blackberry), which would in addition be subject to District Council policies/bylaws regarding fires; and
- (f) The removal of all material from the site for disposal at an off site location. This method is the least preferred option because of the impacts listed above.

Foundation construction

78. THERE are a range of tower foundation types that could be used on the proposed line. The selection of foundation type would be determined by the nature of the soils in which the foundations are to be constructed. The main foundations types that are likely to be considered are (note that terminology used to describe foundation types is not consistent throughout the industry and some of the terms used in my evidence may not always be the same as terms used by others giving evidence):

- (a) Bored concrete pile foundation – would be used for the majority of foundations. This foundation type is suitable for soils in which the

