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

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STATEMENT OF EVIDENCE OF DAVID JAMES CAMERON FOR TRANSPOWER NEW ZEALAND LIMITED

(Water quality and aquatic ecology impacts)

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INTRODUCTION

Qualifications and role

1. **MY** name is David James Cameron. I hold the degree of Bachelor of Science Zoology (Hons) from Victoria University of Wellington. I am a member of the New Zealand Freshwater Sciences Society and the New Zealand Water and Wastes Association.

2. I am currently employed as an Environmental Scientist by MWH NZ Limited (**MWH**), based in Wellington, and have been in that position for the last 12 years. Prior to that, I worked for 10 years as a water quality scientist with Wellington Regional Council. My principal role with MWH is to advise on the effects of development projects on natural water quality and aquatic ecology.

3. **MY** involvement with the Transpower North Island Grid Upgrade Project (**Upgrade Project**) has centred on those locations where the development might affect streams and other water bodies, including in one location, the coastal marine area (**CMA**). These locations relate primarily to the proposed underground cable routes and the proposed Brownhill Substation site. I have visited all significant stream crossing locations on these routes. My involvement with the proposed 400 KV capable line (**proposed line**) has been more limited. I have not visited any of the locations where the proposed line crosses water bodies. I understand that no works in watercourses would be required at present at these crossings.[1] Accordingly, I will limit my comments in relation to the proposed line to general statements about the potential effects of tower foundation construction, and appropriate methods of mitigation.

4. 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.

[1] The documentation for the Notices of Requirement does note that future bank protections may be needed in a very few specified locations. Consents have not been sought for that work at this stage.

Scope of evidence

5. **IN** this brief of evidence, I discuss the potential effects on water quality and aquatic ecology of streams and other waterways crossed by the cable routes and by the proposed development of the Brownhill Substation.

6. I do not discuss the resource consent applications or the provisions of the relevant regional plans. This evidence is provided by Ms Allan, Ms Hunter and Ms McGovern.

OVERVIEW OF POTENTIAL WATER QUALITY AND AQUATIC ECOLOGICAL IMPACTS: UNDERGROUND CABLES AND TOWER FOUNDATIONS

7. **TRANSPOWER** has proposed two underground cable routes at the northern end of the Upgrade Project. These are the routes from the proposed Brownhill Substation to the existing Pakuranga and Otahuhu Substations. Both cable routes cross surface water streams and so raise some water quality and aquatic ecology issues. The construction of the proposed Brownhill Substation also raises issues in respect of a minor watercourse. The cable routes are shown in the **Map Book Series 3, pages 5 to 11**.

8. **PRELIMINARY** engineering design for cable installation has been described by Mr Wildash in his evidence. In summary, each of the underground cable sections of the Upgrade Project comprises two cable circuits in parallel for the whole distance. The cable will be installed at an approximate depth of 1.5 metres below ground in parallel trenches, with a minimum circuit spacing of 3.5 metres. The trenches will be backfilled with suitable material and finished with a protective cover. Stream crossing designs are site specific, but I understand that in general terms these will be achieved either by trenching under the streambed, by cable bridge over the stream or culverted fill embankment over the stream. These designs are discussed in the evidence of Mr Joyce and Mr Burns discusses the construction methodologies..

9. **A** range of potential adverse effects have been identified, most of which are related to the removal of riparian vegetation, the discharge of sediments to water courses and the placement of structures in the streambed. I will discuss the potential effects and proposed mitigation measures in my evidence.

10. **IN** respect of the proposed overhead transmission line, potential impacts on surface water quality and aquatic ecology have been largely avoided by selecting tower sites on land rather than in water bodies. The site selection process and site locations are described by Mr Noble and Mr Beale in their evidence. Nevertheless, the construction of tower foundations involves vegetation clearance, earthworks and other construction activities, which will need to be managed to ensure that adjacent watercourses are appropriately protected from potential adverse effects. I will discuss the potential effects and proposed mitigation measures in my evidence.

11. I note that no consents are sought at this stage for access tracks to tower sites that cross watercourses. Ms Allan explains the consenting strategy in her evidence.

OVERVIEW OF EXISTING ECOLOGICAL ENVIRONMENT

The Pakuranga to Brownhill cable route

12. **THE** Pakuranga to Brownhill cable route would affect part of the Pakuranga Creek, Mangemangeroa Stream and Turanga Creek catchments. The locations of these catchments can be seen in **Map Book, Series 2, page 1A**, in relation to the cable route.

13. **THE** Pakuranga Creek catchment is heavily urbanised and highly modified. Some reaches of the Creek are enclosed in culverts and others are within designated stormwater management areas. Much of the original in-stream and riparian habitat has been degraded or lost.

14. **MANGEMANGEROA** Stream has a long narrow catchment, which has been developed as pasture in places, but which contains significant stands of exotic and indigenous vegetation. The Mangemangeroa Stream flows into the Mangemangeroa Creek, which converges with the Turanga Creek and Waikopua Creek to form the ecologically significant Mangemangeroa Creek/Turanga Creek/Waikopua Creek estuary complex. The catchment is less affected by urbanisation than the adjacent Pakuranga Creek catchment. It retains moderate quality habitat and some capacity to support invertebrate and fish populations. Fish species recorded in the middle and lower stream

include short and longfin eel and banded kokopu (Bioresearches 1999). The banded kokopu is the most common and widespread.

15. **THE** Turanga Creek catchment originates on steep hill country to the south and flows in a generally northern direction, eventually forming part of the ecologically significant Mangemangeroa/Turanga/Waikopua Creek estuary Complex. Land use in the upper catchment, adjacent to and above Brownhill Road is predominantly pastoral, but also includes an extensive block of indigenous vegetation and, until recently, an area of plantation forestry.[2] Some urban development has recently taken place on the upper reaches of the catchment area. The lower reaches are known to support a significant freshwater fish population including short and longfin eel, inanga, common bully, banded kokopu and the exotic mosquitofish (NZ Freshwater Fish Database, NIWA).

The Otahuhu to Brownhill Road cable route

16. **THE** Otahuhu to Brownhill Road route is contained largely in the Otara Creek catchment, but also crosses a minor headwater tributary of the Turanga Creek. The route crosses the CMA in the lower Otara Creek, near the end of Johnstones Road.

17. **THE** Otara Creek catchment covers approximately 3,500 hectares of land, which is a mixture of steep slopes to the south and southeast forming the upper reaches, falling through rolling country and then gently sloping towards Otara Creek.

18. **LAND** in the upper catchment to the east is rural and largely in stock grazing, but much of that area is earmarked for future residential development. Significant development is currently underway. Most of the remainder of the catchment is already developed for residential, commercial and industrial purposes, particularly those areas around the Otara town centre.

19. **THE** main marine habitat type on the upper Tamaki Estuary and lower Otara Creek is the mangrove community, which extends upstream past the

[2] The forest block was cleared in 2007, leaving a single isolated stand of indigenous vegetation near the top of the catchment.

footbridge at the end of Johnstones Road. A short distance upstream of this point the mangroves give way to a freshwater community.

20. A total of six species of freshwater fish have been recorded in Otara Creek and tributaries (NZ Freshwater Fish Database, NIWA). These include short and long fin eel, banded kokopu, Crans bully, mosquitofish and koi carp. The short fin eel is the most common and widespread.

The proposed Brownhill Substation

21. THE proposed Brownhill Substation site is located within the Turanga Creek catchment. I described this catchment earlier in my evidence. The site development works could potentially directly affect a minor headwater tributary of Turanga Creek.

APPROACH TO MITIGATION (GENERAL)

22. IN my view, the general approach to mitigation is, as far as is practicable, to minimise disturbance to riparian areas and the streambed. In those areas that are disturbed, the general approach is to minimise discharges of sediment and other contaminants to natural water. Where structures are required to be placed in the streambed, careful design is required to ensure that the existing ecological function is not significantly compromised.

23. I consider that mitigation of construction impacts on water quality and aquatic ecology can be facilitated by the development and implementation of a construction management plan which addresses each of the environmental effects I have identified.

OVERVIEW OF POTENTIAL EFFECTS

24. THE proposed cable routes and the Brownhill Substation development potentially have a number of adverse effects on adjacent watercourses. These effects potentially include the loss of riparian vegetation, disturbance to stream banks or bed resulting in the discharge of sediment into the watercourse, and structures within the active channel that may affect ecological function (ie obstruct fish passage). However, in my opinion these

potential effects can be adequately mitigated by careful design and construction management.

PAKURANGA TO BROWNHILL ROAD CABLE ROUTE - AREA SPECIFIC EFFECTS AND PROPOSED MITIGATION

Cable crossing of Pakuranga Creek near Ti Rakau Drive

25. **THE** proposed underground cable route is aligned within a stormwater management area between Te Irirangi Drive and Ti Rakau Drive (behind the Hub retail area) and also on the northern side of Ti Rakau Drive as it enters the Pakuranga Substation site. The route will generally follow the footpath/walkway through this area, but will cross a tributary of Pakuranga Creek within the stormwater retention basin north of Ti Rakau Drive. (Refer to **Map Book, Series 3, page 5**).

26. **TRANSPOWER** proposes to install the cables in the stormwater management area by open trenching, at times of low stream flow (when the potential adverse effects of in-stream works can be more readily mitigated). Cables are to be installed at a depth of 1.5 metres below ground with the trench dimensions the same as for the rest of the route.

27. **THE** stormwater management area north of Ti Rakau Drive consists of a series of stormwater retention basins with overflow structures. The retention basins collect runoff from the surrounding residential and commercial developments and release the flow at a controlled rate into a larger tributary of Pakuranga Creek.

28. **THE** local stream environment at the proposed cable crossing location is highly modified, being within a stormwater retention basin. The overflow structures probably prevent upstream movement of fish into the stormwater management area. The low base flow, soft sediment bed and periodic inundation provides poor quality habitat for invertebrate fauna.

29. **THE** proposed cable installation by open trenching would temporarily disturb the stream banks and streambed and would release sediment into the stormwater retention basin during the construction phase.

30. **SEDIMENT** is a component of most natural aquatic systems, which is transported as suspended sediment and bed-load, mostly at times of high flows and floods. Increases in suspended sediment reduce water clarity, reduce primary production (aquatic plant growth), and may interfere with fish movement.

31. **IN** my opinion, none of these effects will be more than minor, provided effective sediment control measures are implemented. I note that fish are unlikely to be present within the stormwater management area because their upstream migration is likely to be prevented by the existing retention basin overflow structures.

32. I consider that appropriate sediment control measures should be implemented during construction through a construction management plan. The construction management plan should detail all of the work to be undertaken, including the extent of vegetation removal and earthworks required. It should also specify control measures to be implemented. Such measures should be consistent with ARC TP90[3] and should include:

(a) Minimising the area of disturbed land as far as is practicable.

(b) Protecting the watercourse by appropriate methods, which may include temporary diversion of stream flows to provide dry working conditions.

(c) Employing detention devices to reduce the sediment load in runoff from disturbed areas, where appropriate.

(d) Covering stockpiles of excavated material to decrease sediment runoff.

(e) A provision in the construction management plan that requires the contractor to cease working in an area in wet conditions where the risk of sediment run-off is greatest and associated impacts on watercourses would be unacceptable. Work could resume once dry conditions return.

(f) Stabilising areas of exposed soil rapidly after completion of works by re-grassing or straw mulching or other methods.

[3] ARC Technical Publication No. 90 (1999): Erosion & Sediment Control – Guidelines for Land Disturbing Activities.

(g) Assigning responsibility for implementing and monitoring the measures included in the construction management plan.

Cable crossing of an unnamed tributary of Pakuranga Stream between Point View Drive and Dunvegan Rise

33. **BETWEEN** Point View Drive and Dunvegan Rise the cable route passes across a minor unnamed tributary of Pakuranga Stream. The unnamed tributary drains a small basin below Point View Drive and above Dunvegan Rise which comprises 'lifestyle' land-use, featuring several residential houses, limited areas of pasture, a block of fenced vegetation, and several small dams.

34. **THE** unnamed tributary begins some 300 to 400 metres upstream of the proposed crossing location. Immediately downstream of the proposed crossing location the watercourse enters a culvert, passing under the Dunvegan Rise residential development within the reticulated stormwater network. It eventually reappears nearly 2 kilometres downstream in the stormwater management area between Te Irirangi Drive and Ti Rakau Drive, which discharges into Pakuranga Stream.

35. **TRANSPOWER** is seeking consent for two options for crossing the unnamed tributary above Dunvegan Rise. They are:

(a) fill embankment; and

(b) cable bridge.

36. **THE** embankment option would extend the existing culvert (and fill over the culvert) upstream by some 30 metres. The extended embankment would accommodate placing both cable circuits in the compacted fill over the extended culvert.

37. **THE** alternative, a bridge crossing, would require a steel truss supporting cable trays. The width of the structure would be approximately 3 metres and the ends would be supported on concrete abutment blocks. The length of the structure would be approximately 30 metres. The concrete support blocks at the ends of the bridge would be embedded in the ground and would be well

clear of the watercourse. No temporary or permanent construction would be required in the watercourse channel.

38. **POTENTIAL** adverse effects of the embankment option on stream water quality and ecology would include the loss of 30 metres of existing streambed and a temporarily increased suspended sediment load in the stormwater system downstream of the works during the construction phase.

39. **THE** 30 metre reach that would be lost is already modified and has been formed as a stormwater channel. It is also constrained by the existing culvert. The existing riparian vegetation is limited, consisting mostly of low growing species, such as grasses and bracken fern. Due to its modified character and limited extent, the loss of this reach would, in my opinion, have no more than a minor effect on the aquatic ecology of this watercourse.

40. **I** consider that the potential adverse effects associated with the discharge of sediments from the works area into the stormwater system and eventually to Pakuranga Creek can be adequately mitigated by appropriate sediment control measures.

41. **MITIGATION** should include the development and implementation of a construction management plan, including the sediment control measures outlined earlier in relation to the Pakuranga Creek Crossing.

Cable crossing of Mangemangeroa Stream

42. **THE** proposed cable route crosses the Mangemangeroa Stream at the location of the road reserve for the unformed Caldwells Road. The cable route follows the road reserve to the stream from Sandstone Road to the south and Point View Reserve to the north.

43. **AT** the proposed stream crossing, the true left bank is very steep to a height of about 12 metres above stream level. It is heavily vegetated with a mix of exotic and native trees and shrubs. The true right bank is gently sloping and is in pasture, except for a riparian fringe of trees approximately 10 metres wide.

44. **THE** Mangemangeroa Stream in this vicinity has a channel width of approximately 3 to 5 metres. The channel consists of a series of pools up to

0.6 metres deep, linked by shallow runs and the occasional riffle. (A "*riffle*" is a reach of fast 'whitewater' where stony or wood substrate may occur above the surface. A "*run*" is a reach, intermediate in character, between a riffle and a pool). The streambed in this area generally has a low gradient and a soft sediment substrate. Rocky substrate is exposed intermittently in steeper reaches. Well developed riparian vegetation provides a semi enclosed canopy, giving extensive overhead shading and shelter. The invertebrate and fish habitat in this reach is of moderate quality and, as already discussed, the long and short fin eel and banded kokopu have been recorded in this vicinity.

45. **TRANSPOWER** is seeking consent for two options for crossing the Mangemangeroa Stream. They are:

(a) fill embankment; and

(b) cable bridge.

46. **THE** fill embankment option includes placement of twin concrete box culverts in the streambed and construction of a fill embankment over the culverts. The fill embankment would accommodate both cable circuits. The twin culverts would be 3 metres wide by 2.8 metres high and 50 metres long. The embankment would be approximately 12 metres high at the left bank, with the crest sloping down at about 10 degrees to the right bank. The embankment volume would be approximately 5000 m^3 of fill.

47. **THE** alternative, a bridge crossing, would be a steel-framed structure that supports trays or troughs carrying the cables. The bridge would be approximately 50 metres long and approximately 3 metres wide. The ends of the bridge would be supported on concrete blocks, with an intermediate support pier on the gentle slope well beyond the true right bank. The left bank abutment block would be about 12 metres above stream level and the bridge would slope at about 10 degrees down to the right bank block, which would be approximately 35 metres from the stream channel.

48. **BOTH** options would require the clearance of riparian vegetation on both sides of the stream at the crossing location. The bridge option would require clearance of a 20 metre wide swath, whereas the fill embankment would required a 50 metre wide swath to be cleared. Well developed riparian

vegetation can provide a number of functions that benefit the aquatic ecology. These include:

(a) maintenance of channel and bank stability;

(b) maintenance of an optimal light climate;

(c) maintenance of an optimal temperature regime;

(d) providing a source of terrestrial carbon input (i.e., leaves, woody debris, spiders, beetles etc which are a food source and which help drive the production of invertebrate and fish populations); and

(e) reducing inputs of contaminants via overland flow.

49. **WHILE** the loss of large areas of well developed riparian vegetation can have serious consequences for the ecology of small streams, in this case the reach that would be affected is small. It amounts to no more than 1 percent (or 0.5 percent if the bridge is used) of the approximately 5 kilometre length of Mangemangeroa Stream on which substantial riparian vegetation remains. In my view, this loss would not amount to a significant adverse effect on the habitat quality or aquatic ecology of the Mangemangeroa Stream.

50. **THE** fill embankment option would involve extensive earthworks, including disturbance of the stream bed and banks, and placement of culverts in the streambed. These activities all have the potential to cause sediment to be discharged to the stream.

51. **THE** juvenile migratory stage of the banded kokopu, which has been recorded in this stream, is known to be sensitive to suspended solids concentrations and may avoid waters in which levels are elevated. The short and long fin eel, also recorded in this stream, are less sensitive to suspended solids.

52. **JUVENILE** banded kokopu migrate upstream mainly between September and November. Adverse effects on their migration could therefore be avoided if in-stream works were confined to late summer (January to March), when little if any fish migration through the works area would occur.

53. **THE** fill embankment option involves placement of twin 50 metre long box culverts in the streambed. A large structure, such as this, has the potential to interfere with fish passage, although in this instance all three fish species known to be present in the stream are climbers, capable of negotiating a well designed culvert. The culvert should incorporate "fish-friendly" features that are suitable for climbing species (from Boubee *et al* 1999; and ARC TP131)[4],[5]. These features are:

(a) the culvert being designed primarily on flood capacity requirements;

(b) the streambed upstream and downstream of culvert being well armoured to prevent erosion resulting in an overhung culvert;

(c) water/bed level control devices at inlet/outlet;

(d) a smooth rounded transition between river bank and barrel, entrance and outlet, to ensure continuous wetted margin at low and average flows;

(e) no breaks or sharp angles within the culvert barrel;

(f) smooth-walled (at least in the lower half of the culvert); and

(g) the culvert never being more than 45% and preferably less than 30% full at average flows.

54. **THE** bridge option would involve less extensive earthworks than the fill embankment option and would not require the placement of structures in the streambed. Potential adverse effects on stream water quality and ecology would therefore be less than described for the fill embankment option.

55. **FOR** both options, I recommend that appropriate sediment control measures be implemented during construction through a construction management plan. Such measures would include those listed previously in relation to the Pakuranga Creek Crossing.

56. **MITIGATION** for the fill embankment option should also include the culvert design features outlined previously in this section of my evidence.

[4] Boubee, Jowett, Nichols and Williams (1999) "Fish Passage at Culverts - A review, with possible solutions for New Zealand Indigenous species". NIWA and Department of Conservation.
[5] ARC Technical Publication No. 131 (2000): Fish passage guidelines for the Auckland Region.

Cable crossing of Turanga Creek

57. **THE** proposed cable route crosses Turanga Creek in the vicinity of the existing small concrete bridge that serves the Brownhill Substation site.

58. **THE** Turanga Creek in this vicinity has an approximate width of 3 metres and an approximate depth of 0.5 to 1.5 metres. The channel has a low gradient and water velocity is normally low. The Creek has an incised channel and a soft sediment bed of fine silt and clays. Riparian vegetation is semi continuous, consisting of crack willows and poplar trees. The invertebrate and fish habitat is generally of moderate quality. All of the fish species recorded in the Creek (discussed earlier in my evidence), with the possible exception of inanga, may be present in this reach from time to time.

59. **TRANSPOWER** proposes to construct a new single span bridge a few metres upstream of the existing structure. The new bridge would carry the cables across the creek. It would have a clear span of 15 metres and would be supported on piled abutments located at the crest of each bank. No support structures in the channel would be required. The new bridge deck would be approximately 3.5 metres above the existing bridge deck level. The existing bridge deck would be removed and the concrete abutments removed down to Creek bank level.

60. **THE** proposed Turanga Creek crossing would not involve any works directly in the creek bed. Nor would it require the removal of significant areas of riparian vegetation. Earthworks required close to the stream would consist primarily of abutment fill. I note that Transpower proposes that abutment fill would only be placed once the abutment walls are constructed. This measure is intended to prevent fill material from entering the waterway. I would support a requirement to develop and implement a construction management plan incorporating this measure and the more generic sediment control measures outlined in relation to the Pakuranga Creek Crossing.

61. **SUBJECT** to these mitigation measures, in my opinion none of the proposed works will have more than a minor adverse effect on stream water quality or aquatic ecology.

OTAHUHU TO BROWNHILL ROAD CABLE ROUTE - AREA SPECIFIC EFFECTS AND PROPOSED MITIGATION

Cable crossing of Otara Creek between Johnstones and Franklyne Roads

62. **THE** proposed cable route crosses Otara Creek between Johnstones and Franklyne Roads, immediately upstream of the existing footbridge. Otara Creek at this location is a tidal estuary just inside the CMA. It has a high tide width of up to 30 metres and a water depth of up to 1.5 metres. The Creek bed is typically littered with a variety of items, including household rubbish, plastic bags, bicycles and shopping trolleys.

63. **THE** riparian vegetation along the Creek margins is dominated by mangroves which, in the vicinity of the footbridge, grow along a 15 metre wide band on the west bank and a 5 metre wide band on the steeper east bank. Beyond the mangroves the terrestrial vegetation includes a variety of native and exotic species including flax, taupata, willow and pine.

64. **TIDAL** influences carry water both upstream and downstream past the footbridge. Water movement is generally slow, but moderate velocities can occur on the outgoing tide. Water is normally turbid with low clarity in this reach, apparently due to inputs of fine particulate material from the catchment. The streambed has a soft sediment overlay.

65. **TRANSPOWER'S** preferred option is to cross the creek by trenching to embed the cables within the Creek bed. I would consider it likely that either a coffer dam or barge would be used to provide a working platform to dig the trench and lay the pipeline. I understand that a construction methodology has not yet been developed and that Transpower do not intend to install cables on this section of the route until sometime after 2020. This is considered by Mr Joyce in detail in his evidence.

66. **THE** Creek crossing would probably involve the removal of a 10 to 20 metre wide swath of vegetation. The area of mangroves affected would be 150 to 300 m^2 on the west bank and up to 100 m^2 on the east bank, which is a very small proportion of the Otara Creek mangrove forest. In my view, the loss of this area of mangroves would have no more than a minor adverse effect on the ecology of Otara Creek.

67. **TRENCHING** across Otara Creek would inevitably release significant quantities of sediment into the water column, potentially causing a local reduction in water clarity and an increased rate of sedimentation on the Creek bed. However, being at the upper end of a tidal estuary, this part of the Creek is a natural deposition zone in which sedimentation rates are naturally high compared with elsewhere in the Creek. Consequently, many of the potential adverse effects associated with the release of sediment to the water column would be minor at this location because of its low sensitivity.

68. **ONE** potential effect that may be more than minor, but which can readily be mitigated, is the possible interruption of the upstream migration of the juvenile banded kokopu due to increased suspended solids concentrations in the lower Creek.

69. **JUVENILES** of this species migrate upstream mainly between September and November. Adverse effects on their migration could therefore be avoided if the in-stream works were confined to late summer (January to March), when little if any fish migration through the works area would occur.

70. **MITIGATION** should include the development and implementation of a construction management plan, which incorporates this timing requirement for fish passage and includes the sediment control measures outlined earlier in relation to the Pakuranga Creek Crossing.

Cable crossing of Otara Creek tributary near Te Irirangi Drive

71. **THE** proposed cable route crosses an unnamed tributary of Otara Creek some 300-400 metres west of Te Irirangi Drive.

72. **THE** unnamed tributary at this location is a minor watercourse, having a low base flow and a low flow channel width of 1 to 2 metres. It lies within a designated stormwater management area, which extends between Chapel Road and East Tamaki Road. The stream passes through a series of stormwater detention basins within the stormwater management area, each with its own overflow structure. It is highly modified and is inundated by detained stormwater from time to time. This was a rural farming area until fairly recently, but is rapidly being converted to commercial and residential use. Virtually none of the original riparian vegetation remains in this reach.

However, significant planting has been undertaken throughout the stormwater management area in order to stabilise the recently developed detention ponds.

73. **TRANSPOWER** proposes to install the cables in the stormwater management area by open trenching at times of low stream flow. Cables are to be installed at a depth of 1.5 metres below ground with the trench dimensions the same as for the rest of the route.

74. **THE** proposed cable installation by open trenching would disturb the streambed and would potentially release sediment into the stormwater retention basin during the construction phase. In my opinion, provided normal sediment control practices are implemented, neither of these effects would be more than minor because of the low ecological value of this reach of stream.

75. **MITIGATION** should include the development and implementation of a construction management plan, including the sediment control measures outlined earlier in relation to the Pakuranga Creek Crossing.

Cable crossing of unnamed tributary of Turanga Creek

76. **THE** proposed cable route crosses an unnamed tributary of Turanga Creek between the proposed Brownhill Substation and Regis Lane, in the upper headwaters of the Turanga Creek catchment.

77. **THE** unnamed tributary is a minor watercourse which, at the location of the proposed cable crossing, runs through an area formally in plantation pine, but recently harvested. The stream has no significant riparian vegetation in this reach and is highly modified by forestry activities.

78. **TRANSPOWER** proposes to install the cables across this watercourse by open trenching, at times of low stream flow. Cables would be installed at a depth of 1.5 metres below ground with the trench dimensions the same as for the rest of the route.

79. **THE** proposed cable trenching would disturb the streambed and would potentially release sediment into the watercourse. In my opinion, provided normal sediment control practices are implemented, this effect would be no

more than minor because of the small size and modified character of this reach of stream.

80. **MITIGATION** should include the development and implementation of a construction management plan, including the sediment control measures outlined earlier in relation to the Pakuranga Creek Crossing.

DEVELOPMENT OF THE PROPOSED BROWNHILL SUBSTATION SITE

81. **THE** proposed Brownhill Substation site is currently in pastoral land use, being grazed with cattle. The existing topography is hilly with a general sloping aspect to the north east.

82. **A** minor headwater tributary of the Turanga Creek flows in a gully which bisects the site. A series of small farm dams are positioned at intervals along the gully and stock have free access to the watercourse. Consequently, the banks are badly trampled and the channel is modified to the extent that it now consists of wet "boggy" soils. The watercourse terminates in a small farm dam near the north eastern property boundary, which has a culverted overflow to a larger tributary of Turanga Creek. The riparian and in-channel vegetation consists of low growing pasture grasses, rushes and sedges. In my opinion, this watercourse in its current condition is not a significant component of the Turanga Creek system and has low ecological value.

83. **MR** Bell and Mr Burns have described the proposed works at this site in detail. I understand that development of the Brownhill Substation site would involve a significant amount of earthworks to create a level area of suitable size to accommodate the transition station and substation infrastructure.

84. **TRANSPOWER** proposes that the site development would be undertaken in stages. Initially (from 2011 to approximately 2021) site development would comprise the northern most tower of the overhead line and a transition station.

85. **FROM** approximately 2021, earthworks for the full site development would be carried out (although the full substation development would not be completed until after 2033).

86. **THE** initial stage would not directly affect the minor watercourse, but would involve significant earthworks that would need to be appropriately managed.

87. I understand that from 2021 flows currently conveyed by the minor watercourse would be diverted around the entire platform. A streambed length of approximately 350 metres could be affected.

88. **POTENTIAL** adverse effects on the water quality and aquatic ecology of Turanga Creek and its tributaries include those associated with the runoff of silt laden stormwater from the site and the diversion of a 350 metre length (approximately) of highly modified streambed.

89. **THE** potential discharge of sediment to the Turanga Creek system can be adequately mitigated by the development and implementation of appropriate sediment control measures including those listed earlier in relation to the Pakuranga Creek Crossing. Such measures could be implemented during construction through a construction management plan.

90. **THE** potential diversion of a 350 metre reach of highly modified rural stream would in my opinion have no more than a minor effect on the aquatic ecology of the Turanga Creek system.

TOWER FOUNDATION CONSTRUCTION – POTENTIAL EFFECTS AND PROPOSED MITIGATION

91. **TRANSPOWER** has identified six potential tower foundation types, which are described in the resource consent applications. Five of these types are described by Mr Lake in his evidence (see Appendix 1 to the evidence of Mr Lake). All options involve site preparation works (which may include access tracks and vegetation clearance), excavation of foundations and placing of mass concrete. At some locations, where groundwater is encountered, the foundations may need to be dewatered prior to or during concrete placement. Any potential effects on adjacent watercourses would be temporary, and would principally arise from the potential runoff of silt laden stormwater from disturbed areas, and the potential discharge of silt or cement laden groundwater pumped from the foundations.

92. IN my opinion, neither of these effects will be more than minor, provided effective sediment control measures are implemented during construction. I consider it appropriate to require a site works plan (within the context of the overall construction management plan) that would detail all of the work to be undertaken, including the extent of vegetation clearance and earthworks to be undertaken, and the control measures to be implemented. Such measures include those listed earlier in relation to the Pakuranga Creek crossing. The site works plan should state whether dewatering is required, and provide details of measures proposed to control siltation during the dewatering process.

ISSUES RAISED IN SUBMISSIONS

93. A number of submissions raise issues in relation to water quality, which I discuss below.

Issues raised by Auckland Regional Council (ARC) (Submission no. 1065)

94. ARC raises issues in relation to transmission lines. Its submission relates to the NOR in Manukau City. ARC submits that there are a number of ecological areas along the proposed line route that are significant in terms of Policy 6.4.7 - Evaluation of Natural Heritage of the ARPS. The values of these areas need to be protected from significant adverse effects of the proposal, in accordance with Policy 6.4.1-3 of the ARPS.

95. AS already stated, in my opinion all of the potential adverse effects on freshwater ecosystems identified in relation to the proposed underground cable route can be appropriately mitigated. In the case of the overhead line, potential impacts on aquatic ecosystems have been largely avoided by selecting tower sites on land rather than in water. Subject to the mitigation measures proposed, it is my view that the freshwater ecosystem values of these watercourses will be protected from significant adverse effects as required by Policy 6.4.1-3 of the ARPS.

96. ARC also raises concerns about the range of direct physical impacts of construction, for example, vegetation clearance for access to, and the construction of, the towers.

97. I have made general comment in my evidence on the potential effects of tower foundation construction activities on adjacent water bodies. I have also suggested measures that I believe will provide an appropriate level of protection for water bodies, in accordance with Policy 6.4.1-3 of the ARPS.

Issues raised by Waipa District Council (Submission no. 0919)

98. **WAIPA** District Council raises issues in relation to the preservation of lakes, rivers and their margins. Its submission relates to all NORs. The Council submits that:

(a) notwithstanding the NORs "*Landscape and visual effects assessment*", inadequate consideration has been given to the preservation of lakes, rivers and their margins (section 6(a) of the RMA).

(b) the NORs acknowledge the importance of consistency with Part 2 of the RMA but state that section 6(a) is not considered relevant to the NOR;

(c) it is inconsistent with an assessment process, taking into account the structure and purpose of the RMA, for the NOR to say that section 6(a) is not relevant;

(d) the RMA identifies section 6(a) as a matter of national importance – it is not an optional consideration, it is a matter of primacy under Part 2 of the RMA;

(e) the NOR impacts directly on the natural character of Waipa's lakes and rivers and their margins as it crosses the Waikato River at Arapuni and Lake Karapiro, and for that reason it is clearly a pivotal consideration.

99. **THE** proposed overhead line crosses the Waikato River at three locations (at Lake Karapiro, Arapuni and Whakamaru) and crosses an arm of Lake Maraetai. In all cases, the proposed tower locations are set back from the water body by at least 75 metres. No works will need to be undertaken in the bed of these water bodies. As already discussed in my evidence, I consider

that the potential adverse effects of tower foundation construction on the water quality and aquatic ecology of adjacent water bodies can be adequately mitigated through the development and implementation of a site specific construction management plan. In my view, from a water quality perspective, this approach is consistent with RMA section 6(a).

SUMMARY OF MITIGATION MEASURES

100. **THE** following paragraphs summarise the mitigation measures I have proposed in the body of my evidence.

101. **FOR** all of the proposed underground cable route crossings of water courses, for the development of the proposed Brownhill Substation site, and for construction of each tower foundation on the proposed overhead line, mitigation should include the development and implementation of a site specific construction management plan. I understand that for the overhead line section, there will be a general construction management plan, and site works plan for each property, as discussed in the evidence of Mr Rasul. The construction management plan or site works plan should detail all of the work to be undertaken, including the extent of vegetation removal and earthworks required. It should also specify control measures to be implemented. Such measures should include:

(a) Minimising the area of disturbed land as far as is practicable.

(b) Protecting the watercourse by appropriate methods, which will vary from site to site, but may include temporary diversion of stream flows to provide dry working conditions.

(c) Employing detention devices to reduce the sediment load in runoff from disturbed areas, where appropriate.

(d) Covering stockpiles of excavated material to decrease sediment runoff.

(e) A requirement for the contractor to cease working an area in wet conditions where the risk of sediment run-off is greatest and

associated impacts on watercourses would be unacceptable. Work could resume once dry conditions return.

(f) Stabilising areas of exposed soil rapidly after completion of works by re-grassing or straw mulching or other methods.

(g) Assigning responsibility for implementing and monitoring the measures included in the construction management plan.

102. **FOR** the underground cable crossing of the Mangemangeroa Stream by fill embankment or cable bridge, and for the underground cable crossing of Otara Creek at Johnstones Road by open trenching, the construction management plan should include a requirement that works in the active stream channel should be confined to late summer (January to March) so as to minimise impacts of fish migration.

103. **FOR** the underground cable crossing of Mangemangeroa Stream by fill embankment, the construction management plant should require that the culvert incorporate 'fish-friendly' features which are suitable for climbing species. These features are:

(a) the culvert being designed primarily on flood capacity requirements;

(b) the streambed upstream and downstream of culvert being well armoured to prevent erosion resulting in an overhung culvert;

(c) a smooth rounded transition between river bank and barrel, entrance and outlet, to ensure continuous wetted margin at low and average flows;

(d) no breaks or sharp angles within the culvert barrel;

(e) smooth-walled (at least in the lower half of culvert); and

(f) the culvert never being more than 45% and preferably less than 30% full at average flows.

104. **FOR** the underground cable crossing of Turanga Creek by new cable bridge near the existing Brownhill Road bridge, the construction management plan should include a requirement that abutment fill would only be placed once the abutment walls are constructed, so as to prevent fill material from entering the waterway.

105. **FOR** the construction of tower foundations on the overhead line route, the site works plan for each property should state if foundation dewatering is likely to be required and provide details of measures proposed to control siltation during the dewatering process.

106. I understand that Transpower agrees to the construction management plan (and relevant site works plans) including the mitigation measures that I propose above. In this regard, I recommend that the condition on the various NORs and/or resource consent applications incorporate the mitigation measures I propose above.

CONCLUSION

107. A number of potential adverse effects on freshwater ecology have been identified in relation to the proposed underground cable routes and in relation to the construction of tower foundations. In my opinion these adverse effects will be minor provided the mitigation measures proposed above are implemented.

David James Cameron

31 January 2008