

**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 BRIAN HUGH KOUVELIS FOR TRANSPOWER  
NEW ZEALAND LIMITED  
(Groundwater issues)**

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## INTRODUCTION

### Qualifications and role

1. **MY** name is Brian Hugh Kouvelis. I am a Principal of MWH New Zealand Ltd (**MWH**) and work as a Senior Environmental Engineer. I have a Bachelor of Engineering from Canterbury University, a Diploma of Management (NZIM), and I have completed a post graduate course in groundwater management and groundwater hydrology at the University of New South Wales. I am a Fellow of the Institution of Professional Engineers New Zealand, a member of the New Zealand Water and Waste Association, and a member of the New Zealand Hydrological Society.
2. I have 25 years experience as a Consulting Engineer with MWH (formerly Royds Consulting Ltd). My previous experience included 6 years as Deputy Chief Engineer of the Manawatu Catchment Board and Regional Water Board, and 7 years with the Ministry of Works and Development.
3. **MY** experience as a Consultant has involved a broad range of assignments, investigations, design and construction of infrastructure work primarily associated with water supply, wastewater, and drainage and flood control development projects both for local authorities and private developers.
4. **DURING** my time with the Manawatu Catchment Board and Regional Water Board, I was specifically responsible for the groundwater investigations in the Board's area and the associated staff reporting on groundwater consent applications under the Water and Soil Conservation Act 1967.
5. **SUBSEQUENTLY**, I have been responsible for a range of water resource studies including groundwater studies and groundwater development for abstractions up to 350 l/sec for the following organisations: Palmerston North City Council, Massey University, NZ Dairy Research Institute, NZ Army (Linton), NZ Pharmaceuticals Ltd and Greater Wellington Regional Council.
6. **MY** specific role in the North Island Grid Upgrade Project (**Upgrade Project**) has been to review the relevant Notice of Requirement documentation, resource consent applications and submissions, and prepare this evidence in

relation to the potential impacts of the Upgrade Project implementation on underground water. I have also read the geotechnical reports prepared by Maunsell Ltd, for Transpower New Zealand Limited (**Transpower**). I am generally familiar with the area and have a general appreciation of the topography, terrain and geology along the route of the proposed 400kV capable line (**proposed line**).

### **Approach**

7. **IN** preparing this evidence, I have drawn on a desktop review of the relevant technical studies undertaken by Transpower to date. An independent assessment has also been undertaken by MWH under my supervision, of the range and type of geological and hydrogeological conditions along the route of the proposed line. MWH have also developed hypothetical case studies under my supervision, which I discuss further below.
8. I have also considered a similar foundation strengthening project recently undertaken by Transpower for its Upper South Island Grid Upgrade Project. The tower strengthening project involved a variety of foundation strengthening techniques over 450km, including some of the types proposed for the Upgrade Project. In particular, drilled casing and placement of grout at, and below, the water table for foundation strengthening in the vicinity of several unconfined aquifers in the upper South Island. I have reviewed background material and spoken with the contractors. It is my understanding (based on comments from the Southern Regional Manager of the construction company responsible for the implementation of the project) that no specific issues in terms of impacts on groundwater arose during that project.
9. I note that Transpower won the IPENZ Utilities, Network and Amenities Award and the Supreme Award for New Zealand Engineering Excellence in 2007 for this tower strengthening project.
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 discuss the potential impact of the Upgrade Project on underground water. In doing so, I focus on the overhead line component of the Upgrade Project, but I also briefly discuss the cable route section of the Upgrade Project. My evidence does not include the substation sites. Aspects of those components of the Upgrade Project are covered by others.
12. **MY** evidence does not address water quality generally. Mr Cameron provides evidence about potential impacts on water quality as a result of run-off from construction activities.

## OVERVIEW OF GROUNDWATER

13. **GROUNDWATER** is that portion of the water beneath the surface of the earth that flows naturally through or to the earth's surface via groundwater bearing formations (**aquifers**), seeps or springs. The spatial scale of aquifers are typically large and measured in square kilometres. Flow patterns within aquifers are typically smooth and velocities low. These velocities are often measured in metres per year.
14. **DEPTHS** to groundwater may range from 1m or less to 1000m or more. There are places where groundwater may not be present due to rock density and/or topography and/or the availability of water (eg hilltop areas). The nature of groundwater is largely determined by the underlying strata through which it passes and the associated geologic materials and structure. There are two basic types of aquifer, unconfined and confined.

## Unconfined aquifers

15. **AN** unconfined aquifer is like an underground lake in porous materials. There are no restricting materials, such as clay, above the groundwater. The top of an unconfined aquifer is the water table, or free water surface.

### **Confined aquifers**

16. **A** confined aquifer is a layer of water-bearing material that is sandwiched between two layers of much less porous material. These confining layers are called aquicludes.
17. **CONFINED** aquifers are completely filled with groundwater and do not have a free water surface. Confined aquifers often occur as a succession of different aquifers separated by aquicludes, typically below unconfined aquifers.
18. **TYPICALLY**, confined aquifers can be found at depths 20m or below.

### **Characteristics and performance of aquifers**

19. **THE** characteristics and performance of both types of aquifers are dependent on the geological and hydro-geological conditions in the area, both from a quantity and quality perspective.
20. **THE** uniformity of the geology, the geological structure, and the type of geological material through which the aquifer flows, together largely determine the quality of the groundwater.
21. **THE** aquifer yields, or quantities of groundwater available, in any particular aquifer are largely determined by geologic structure and porosity of the material through which the groundwater passes.

### **Overview of groundwater along the proposed line**

22. **THE** initial review of the geology and potential hydrogeologic conditions by MWH indicated a highly variable situation, with mixed geology and varying groundwater levels.
23. **THE** actual groundwater situation can only be determined at the time of the detailed geotechnical investigations at each tower site. These investigations would be typically undertaken at, or just prior to, the time of detailed foundation design. However, given the relatively shallow nature of the

construction activities (discussed in more detail below), in my opinion it is unlikely that any confined aquifers will be encountered in most cases.

## OVERVIEW OF POTENTIAL IMPACTS ON GROUNDWATER

24. **THE** potential impacts on groundwater from the Upgrade Project are likely to occur with below ground activities, which include trenching, tower foundations and possibly cuttings for access roads to tower sites.
25. **THE** dimensions of the final form of any of the Upgrade Project activities are small in relation to the spatial scale of any aquifer, and as such any impacts will be minor and localised.
26. **AS** noted above, any water encountered is most likely to be in an unconfined aquifer due to the relatively shallow depth of the foundation of the towers and other construction activities. The foundation depths for the proposed lattice towers are expected to be less than 30m, with 80% expected to be less than 20m using the bored and cased foundation construction techniques.
27. **THE** expected maximum foundation pile diameter of 2.4m is very small in relation to the spatial extent of any aquifer, which is typically measured in hundreds of metres or even kilometres.
28. **IF** monopoles are used, the type of foundation and scale of below ground construction activity will be slightly larger in scale than the cumulative tower leg foundations. As a result, the comments on lattice foundations and associated potential impacts on groundwater also apply to the monopole foundations.

### Construction phase

29. **DURING** construction, flow patterns around the immediate area of the foundations would be temporarily interrupted or affected due to the removal of the natural material. Groundwater would migrate from the adjacent area and fill the excavated hole. This water may then need to be removed by a dewatering process as part of the construction process. The removal of water is a temporary effect at the site and would not affect groundwater quantity for abstraction, or groundwater quality in the long term.

30. **TWO** aspects of the construction phase that could potentially, or theoretically, impact on groundwater are:
- (a) dewatering and potential drawdown effects on adjacent shallow wells;  
and
  - (b) concrete placing in the tower foundations holes impacting on water quality of the aquifer.
31. **BASED** on my previous experience and understanding of the typical characteristics of an unconfined aquifer, the dewatering operations are unlikely to impact on water levels in existing water supply bores outside the easement zone, other than in a minor way for a short period (eg a matter of a day or two). In terms of water quality, impacts would be temporary and minor if any. The water quality effects are likely to involve temporary minor changes in pH due to the cement, or the grout and concrete, and some localised and temporary change in turbidity due to the disturbance of the substrata.
32. **AS** discussed above, MWH developed case studies on the effects of dewatering processes on water levels. These case studies, were based on a range of permeability and aquifer depth parameters associated with unconfined aquifers, and confirmed the expectations stated above. The results indicated effects on water levels due to the dewatering process of a foundation hole on any shallow bores in the same aquifer to be less than 1m at a distance of 100m from the dewatering activities at the construction site.
33. **THIS** potential effect on the water levels is unlikely to affect any water supply pump operations, as they would operate at a deeper level.
34. **ANY** water quality effects would be temporary, with dispersion and dilution taking place to return water quality to normal conditions within 100m – 200m from the edge of the ground disturbance activity.

#### **Post construction**

35. **THE** effect of the finished foundation would be to replace the in situ soil material of the foundation volume into the equivalent volume of concrete. The

impervious nature of the concrete will cause minor flow disturbance. The impact of a constructed tower foundation, or other construction activities, on the flow pattern within an unconfined or confined aquifer would be localised and very minor.

36. **THE** water displaced from the foundation area (or cut) would be quickly absorbed into the existing flow patterns resulting in very minor changes in water levels in the order of millimetres (if any).

#### **Resource consents in Auckland region**

37. **THE** consent applications cover specific activities in relation to construction including any trenching and foundation holes. These applications are made in accordance with the rules and requirements of the respective Regional Plans. I note that diversion of groundwater for the Upgrade Project activities in the Auckland Regional Council (**ARC**) area are permitted activities (refer to **Attachment A** of my evidence – a letter from ARC dated 5 July 2007). As such, no consent application is required for the diversion of groundwater in the ARC area.

#### **MANAGING POTENTIAL EFFECTS ON GROUNDWATER**

38. **PRIOR** to detailed design of each tower foundation, or other construction activity that may affect groundwater, a geotechnical investigation will be undertaken. This is a typical approach to construction of foundations for this type of project. During these investigations, groundwater conditions will be assessed for design purposes and construction purposes. At this stage, mitigation plans (if required) would be developed for any potential effects on the groundwater supplies in the area, and groundwater quality.
39. **IN** the unlikely event of any site specific issues being identified during the detailed investigation phase, I understand that there are two project planning documents that would address specific mitigation aspects as may be necessary. These are the:
- (a) Construction Management Plan; and
  - (b) Site Works Plan.

Subject to the detailed investigations indicating a potential impact, then those plans would provide for mitigation measures such as monitoring, supplementary pumping, or in an extreme case, temporary alternative water supply.

40. I recommend that any condition in relation to the development of those plans specifically provide for such mitigation measures to be put in place should the detailed investigations identify potential groundwater issues.
41. **MITIGATION** of the effects from dewatering activities would be required. This is covered in the evidence of Mr Patrick.
42. **IT** may also be appropriate to have a specific precautionary condition along the following lines. Such a condition would mitigate any movement of groundwater between aquifers:

"All aquifers and permeable zones of differing pressure, water quality, or temperature shall be sealed to prevent the interconnection or movement of groundwater between aquifers and permeable zones."

43. **TYPICALLY**, these discharges would require the control of sediments and any contaminants before discharge to any natural water courses or water bodies. These methods would include temporary settlement ponds or other similar mechanisms that are commonly used for stormwater treatment.

**ISSUES RAISED BY AGRICULTURAL INVESTMENTS LIMITED (AIL) (Submission No. 0852)**

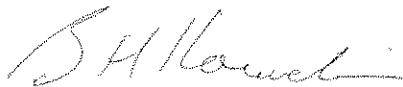
44. **AIL** raises an issue in relation to groundwater. It submits that drilling below the water table may have adverse effects on groundwater supply for the property.
45. **AIL** has 10 towers across its property. These are towers 354 - 360 shown on **Map Book, Series 2, pages 22 and 23.**

46. **THE** general geologic description for the property is a moderately strong columnar jointed rock (ignimbrite) overlaid by up to 5m of clayey sand (ash). Topography in the area is rolling (5 – 10 degrees) and hilly (10 – 25 degrees).
47. **THE** provisional estimated depth to groundwater on this property, as set out in the Maunsell report "*NI 400KV Investigation Desktop Geotechnical Assessment – Revised Structure Locations*" (April 2007), is between 10m and 20m.
48. **A** search of the bore records at Environment Waikato indicates that there are only two bores within 500m of the proposed line across the AIL property. Both bores, as recorded in these records, are deep, with one at 90m and the other at 120m.
49. I consider that the depth of these bores mean that they are highly unlikely to be affected or impacted in any way by the construction of the tower foundations, because they are drawing groundwater at a much greater depth than could conceivably be affected by tower construction activities in terms of water quantity, water levels, or water quality.
50. **ANY** management of potential impacts revealed by the detailed site investigation would be covered under the two types of construction management plans discussed earlier in this evidence, following detailed investigation.

## CONCLUSIONS

51. **THE** geology and hydrogeologic conditions along the route of the Upgrade Project are highly variable with mixed geology and varying groundwater levels.
52. **THE** dimensions of the Upgrade Project construction activities are small in relation to the spatial scale of any aquifer that may be encountered.
53. **ANY** effects on groundwater quantity, levels, or water quality during construction are likely to be minor and very localised.
54. **IT** is extremely unlikely that there would be any effects on groundwater quantity, levels, or water quality post construction.

55. **DETAILED** geotechnical investigation at each site would determine whether any specific groundwater management or mitigation measures are likely to be required.
56. **THE** two types of construction management documents will be able to specify any necessary mitigation measures such as temporary or alternative supply, or supplementary pumping, following a detailed investigation at each site.



**Brian Hugh Kouvelis**

**30 January 2008**



Auckland  
Regional Council  
TE HAUHĀTANGA TĀIAO

5 July 2007

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File Ref 19831

Dear Sir

**RESOURCE CONSENT APPLICATION – ACKNOWLEDGEMENT &  
37A(2)(B) EXTENSION OF TIME LIMIT**

**Application Details:**

Application Numbers:	34102, 34372, 34373, 34370
Applicant:	Transpower New Zealand Limited
Activity Types:	Earthwork, River/Stream Diversion, Stream Work, Discharge Other
Location:	Whakamaru to Auckland Transmission Line - through Franklin District & Manukau City

The Auckland Regional Council has accepted the above applications for processing. The applications are currently being checked for completeness. You will be advised of any additional information requirements as soon as possible.

Section 37A(2)(b)<sup>1</sup> of the Resource Management Act 1991 allows the Auckland Regional Council to extend the period specified in the Act in relation to the processing of consent applications with the agreement of the applicant.

Accordingly, the Council has extended the time period for the processing of this consent until further notice. The status of the applications will be reviewed again on 1 September 2007.

Application Numbers:	34371
Activity Types:	Groundwater Diversion

The above application meets the permitted activity criteria and consent is therefore not required.

For your information, it is usual practice for the Council to forward details of resource consent applications to appropriate Local Authorities, Government Departments, environmental organisations, and Iwi Authorities. It is possible that one of these groups will contact you directly to discuss your application.

If you have any queries regarding the processing of the applications, please contact Christine Mitchell on 366 2000 ext 8293 and quote the application numbers.

Yours faithfully

Charlotte Boyd  
Client Services  
Consents & Consents Compliance

Encl

<sup>1</sup> Section 37(5a) if the application was accepted before the 1 August 2003



## Application & Monitoring Fees and Annual Charges Information

### Application Fees:

The Application fee for your consent is a deposit, based on the average cost of processing this type of consent application. It may not necessarily be the total cost of your application. The Council charges actual and reasonable costs of processing resource consents directly to the applicant. As a result, the deposit fee may not cover the total cost of your application.

Once processing of an application is completed, or if an application is withdrawn, the Council calculates the total costs incurred in processing the application. If the cost is greater than the application fee charged, an invoice for the difference and an additional fee to cover monitoring costs will be sent. Where the total costs are less than the fee paid the difference will be used to offset monitoring costs.

Once the site has been adequately protected against erosion the Council will determine the total monitoring costs incurred. If the cost is greater than additional fees paid or transferred from consent processing, an invoice for the difference will be sent.

If the total costs of processing are less than the fee paid, a refund is made or the balance is credited to the account to off-set the annual administrative charge payable by the consent holder (see below).

If the total costs of processing an application exceed the application fee paid by a significant amount before processing is completed, then an Interim invoice for costs incurred to date will be sent to the applicant. The Council may also request an additional application fee be paid at this time, to off-set the estimated processing costs.

Where a consent application is required to proceed to a hearing, an additional deposit to cover the estimated costs of the hearing will be charged prior to the commencement of the hearing.

Note: In all cases we charge the actual cost of processing the application and monitoring.

### Annual Administrative Charge:

Under Section 36 of the Resource Management Act 1991, the Council can fix charges payable by the holders of resource consents for some of its resource management functions and activities.

Where these environmental programmes result from, or are of benefit to, a class of consent holders, the Council recovers a proportion of the cost of programmes through an annual Administrative charge payable by consent holders. The balance of these costs are paid by the regional community through rates.

The environmental programmes and their costs are reviewed annually and are open for public submission through the preparation of the Council's Annual Plan. Similarly, the Schedule of Administrative Charges is also reviewed annually and open for public submission.

For further information on the annual administrative charge payable on your consent, please call 09 366 2000 or 0800 80 60 40 if calling from outside the Auckland area.