

IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of a Board of Inquiry appointed under section 146 of the Resource Management Act 1991 to consider an application by Mighty River Power Limited for resource consents to construct, operate, and maintain a wind farm at Turitea.

STATEMENT OF EVIDENCE OF CHRISTOPHER DAVID JAMES

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1. INTRODUCTION

- 1.1 My name is Christopher David James and I am the lead wind farm Civil Designer for Beca Carter Hollings and Ferner Limited (Beca).
- 1.2 I have the following experience relevant to the evidence I shall give:
- (a) I have over 40 years experience working on the design and construction of a wide range of civil engineering projects.
 - (b) The projects I have worked on have ranged from large industrial sites such as the Mitsubishi car assembly plant in Wellington, to rural roads in the highlands of Papua New Guinea to the Ohakuni - Horopito Rail Deviation.
 - (c) More recently and of specific relevance to this project I have undertaken the roading and turbine assembly area construction designs for three wind farms totalling 138 turbines and 65 km of roads. Two of those wind farms, Te Apiti and White Hill, have been completed and the third, West Wind is currently under construction. I have also undertaken preliminary designs for six other wind farms, including the Turitea Wind Farm, totalling 525 turbines and 320 km of roads. I have also undertaken a peer review of the roading and crane pad designs for a further wind farm. In all a total of 700 turbines and 420 km of roading.
- 1.3 I have read and agree to comply with the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2006. Except where I state that I am relying upon the specified evidence of another person, my evidence in this statement is within my area of expertise. I have endeavoured to be accurate and to cover all relevant matters relating to the topic on which I am giving evidence. I am not aware of any matters which might adversely affect my conclusions which I have not included. The assumptions on which my evidence is based are not, in my view, unlikely or unreasonable assumptions and, therefore, my evidence complies with Section 5.3 of the Environment Court's Code of Conduct for Expert Witnesses.
- 1.4 I have been involved with the Turitea Wind Farm project since late 2005 when Beca was commissioned by Mighty River Power to carry out, among other

things, a preliminary roading design and subsequent earthworks assessment for the project, both of which I personally prepared.

- 1.5 I was involved in the selection of turbine zones from a civil engineering viewpoint by identifying areas of the site where the necessary roads and crane pads could and could not be built. During this process I made numerous visits to the site with Mighty River Power staff, other consultants and some of the landowners to identify turbine locations. Part of this process included identifying areas that were unsuitable for reasons other than civil engineering.
- 1.6 I was also involved in the process of refining and minimising the construction area and the areas of vegetation removal within the Turitea Reserve. Minimising vegetation clearance was an overriding part of my brief from Mighty River Power.
- 1.7 I assisted in preparation of the Construction Effects Report attached as Appendix E to the Assessment of Environmental Effects (AEE) submitted in support of Mighty River Power's resource consent applications.
- 1.8 I was also part of the project team involved in the decision to delete 9 of the originally proposed turbine zones, and the layout revisions that were undertaken as a result. I confirm that this evidence reflects, and is based on, that revised proposal.
- 1.9 The purpose of my evidence is to outline the civil engineering aspects of the Turitea Wind Farm. I also discuss civil engineering requirements relating to the transmission lines and other aspects of the electrical works.
- 1.10 Specifically, in my evidence, I will:
 - (a) describe key construction works (Section 3);
 - (b) describe the construction requirements for the project (Section 4);
 - (c) describe the construction period and anticipated stages of construction (Section 5);
 - (d) discuss the vegetation removal requirements for the project (Section 6);
 - (e) discuss key land disturbance activities (Section 7);
 - (f) discuss the potential sources of discharge for the project (Section 8);

- (g) discuss other construction considerations (Section 9); and
 - (h) outline the key erosion and sediment control measures to be adopted in respect of the project (Section 10).
- 1.11 The current Wind Farm layout has received input from several specialist experts, notably:
- (a) Mr Nichlas Kramer (Wind Modelling) – Mighty River Power,
 - (b) Dr Rod Clough (Archaeology) – Clough and Associates,
 - (c) Mr Willie Shaw (Ecology) – Wildlands,
 - (d) Dr Brian Coffey (Aquatic Ecology) – BrianT. and Associates,
 - (e) Mr Nevil Hegley (Noise) – Hegley Acoustics, and
 - (f) Mr Alan Wyatt (Visual) – ERM.
- 1.12 Many of the above specialist experts will also be providing their own evidence on behalf of Mighty River Power.
- 1.13 A summary of my key points is set out in Section 2 below.
- 1.14 This evidence is given in support of Mighty River Power’s resource consent applications for the construction, operation and maintenance of the Turitea Wind Farm.

2. SUMMARY OF EVIDENCE

- 2.1 As explained in the evidence of other witnesses for Mighty River Power, Mighty River Power proposes to establish and operate a wind farm of up to 122 turbines located within 127 turbine zones sited along approximately 14 kilometres of the northern Tararua Ranges, south of the Pahiatua Aokautere Road. I describe the key elements of the proposed development in my evidence.
- 2.2 In my opinion it is perfectly feasible, from a civil engineering perspective, to construct and operate the Turitea Wind Farm in line with the layout and specifications proposed by Mighty River Power. I have also been involved in developing the suite of conditions proposed by Mighty River Power, which I

believe are appropriate for the Turitea Wind Farm project, and adequately address the potential effects.

3. KEY CONSTRUCTION WORKS

3.1 Construction of the Turitea Wind Farm will involve the following key works:

- (a) Creation of internal equipment laydown areas and construction facilities;
- (b) The construction and upgrading of access tracks and roads within the confines of the site (internal roads);
- (c) The upgrading of public roads providing access to the site (external roads);
- (d) The creation of platforms and foundations at each of the turbine sites;
- (e) The creation of platforms and construction at substation sites within the Wind Farm;
- (f) The creation and management of concrete batching facilities;
- (g) Internal electricity reticulation (buried and above ground) within the confines of the site;
- (h) External electricity transmission providing a connection to the National Grid;
- (i) Disposal of excess excavation material at identified spoil disposal areas;
- (j) Turbine erection and commissioning; and
- (k) Site reinstatement.

3.2 These works will necessarily include, but will not be limited to:

- (a) The movement of vehicles (including heavy vehicles) to, from, and within the site;
- (b) Use of construction machinery at the site;
- (c) The temporary realignment of waterways and placement of structures (culverts) within waterways;
- (d) Vegetation clearance;

- (e) Land disturbance including civil earthworks, disposal areas, and trenching; and
- (f) The discharge of contaminants including sediment laden runoff, stormwater and discharges from concrete batching and other construction areas to sediment and stormwater control devices.

3.3 The overall site layout can be seen in the plans in **Exhibit CDJ01**.

4. CONSTRUCTION REQUIREMENTS – DESIGN PARAMETERS

Geology and Ground Conditions

- 4.1 A preliminary geotechnical investigation was carried out by Beca in 2006 which involved both a desk top study of the underlying geological units and also site visits to undertake field studies and obtain samples for laboratory testing. That investigation established that the site is underlain by two distinct geotechnical units, the Esk Head Belt “greywacke” and the Browns Flat alluvium. The following approaches are recommended for the earthworks, roading foundations and aggregate sources within these geotechnical units. Where appropriate, separate recommendations have been provided for each unit.

Earthworks

- 4.2 The majority of the fill materials for the project will be sourced from the greywacke profile. Due to ground conditions, some materials may be imported or exported from or to the Browns Flat area.
- 4.3 The clay and silt dominated materials found across the site are naturally above the optimum moisture content for the type of compaction typical of civil projects, while the sandy gravel sample was found on testing to be below this. Sandy gravel layers were found within the upper 5 metres of a number of investigations across the site. Mixing of the different soil types will occur during excavation, transporting and spreading, and will result in a material that is closer to optimum moisture content for compaction. Some additional sorting, mixing and moisture conditioning (wetting or drying) will be required in places, and will be controlled during construction to minimise the risk of sediment movement.
- 4.4 Rock excavation will be achieved using a range of techniques, from hard digging (e.g. using a 30-40 tonne excavator) to hard ripping (e.g. D8 bulldozer

with a single tine). Localised areas (e.g. larger lenses of chert, and the strong to very strong rock at the top of the hill immediately north of Browns Flat) will require hydraulic breaking or localised, small scale controlled blasting.

- 4.5 The proposed approach for the majority of cut slopes (e.g. site access roads) will be to cut the batters steep (e.g. 1H:4V) and clean up any dropouts that occur during the construction phase. This is a similar profile to existing cut batters within the site. Using steep batter slopes in competent material will minimise the overall earthworks footprint and total amount of vegetation clearance required. It also reduces the surface area of exposed earthworks subject to erosion. Structural fill batters will initially be set at 2H:1V. Where possible, flatter fill batters are intended to be used in some areas, particularly on the flatter farmland, in order to improve the long term use of the area for farming. The final selection of batter slope will depend on structural fill height and foundation conditions, and will be assessed during the detailed phase of investigation and design.
- 4.6 The appropriateness of all batter slopes will be confirmed on site as construction work proceeds.

Roading

- 4.7 Pavement (roads, pads, etc) design will be based on the underlying rock type. Preliminary design assessments have been based on a pavement depth of between 150mm and 250mm. Allowance will be made for testing and confirmation of subgrade conditions, and local undercutting of weaker materials encountered during construction.
- 4.8 See **Exhibit CDJ02** for an example of what will be a typical road cross section at Turitea.

Turbine Foundations

- 4.9 Spread foundations will be suitable for the turbine platforms that are underlain by greywacke at a relatively shallow depth of less than 6 metres. Specific analysis during the detailed design phase may demonstrate that sites with a moderate depth of weathering will also prove suitable for spread foundations. In areas underlain by thick alluvium (say more than 6 metres), bored pile foundations into the underlying rock are likely to be required.

- 4.10 Further investigation and analysis will be undertaken to confirm the design of each type of turbine foundation required at the detailed design phase.

Aggregate Sources

- 4.11 The underlying greywacke rock at the site is highly variable, and is unlikely to provide a suitable source of high quality base course or concrete aggregate. Off-site commercial sources will be utilised for concrete aggregate and for the running surface of permanent unsealed roads. Selected material won from cuts will be screened and used for surfacing site roads where appropriate. This approach is recommended for access roads throughout the site.

External Road Upgrades

- 4.12 Mr Galloway's evidence considers in detail the level of construction traffic to be generated by the project, and the external roading improvements required to accommodate this.

Internal Access Roads

- 4.13 Access roads within the site will be constructed to accommodate construction vehicles associated with the Project. This will require the upgrading of several existing tracks and the formation of new access tracks.
- 4.14 A total of 57 km of accessway will be required for the site. Of this, 24 km of accessways will utilise existing tracks with up to 33 km of new accessways created.
- 4.15 Road widths are dictated by three primary pieces of turbine erection equipment: the large crawler crane; and the blade and nacelle transporters. The 400t Liebherr LR1400/2 crane is suitable for the heavy lifts required during the turbine erection. It has an overall track width of 8.7 metres, which requires a road width of 10 metres during travel, as shown in **Exhibit CDJ03**. While this crane is not currently available in New Zealand, its specifications have been used as a basis for preliminary design as it is considered to be the 'worst case' scenario.
- 4.16 In all parts of the site, the road width and geometry is determined by the ability to manoeuvre the crane and the turbine components to their platforms and foundations. In addition, during the preliminary design phase of this project,

considerable effort has been made to minimise general earthworks and hence vegetation clearance required, particularly within the Turitea Reserve.

- 4.17 Road grades (i.e. steepness) are determined by the erection crane, which is capable of climbing/descending a maximum grade of 17.6%. Wherever possible the grades of accessways have been kept below 14% to avoid having to prepare special surface treatments to provide better traction for transport vehicles. Steeper grades have been used where extensive earthworks or clearance would be required to achieve lower grades. These steeper grades (over 14%) will require the roads to be either chip sealed or lime/cement stabilised to provide increased traction for the heavy haulage vehicles. Lime/cement stabilisation is a common method of improving road pavement strength and to bind the upper surface of the pavement.
- 4.18 Road curves are determined by the trailer used to transport the blades. Manoeuvring the blades around the Wind Farm requires a minimum radius of 30-35 metres, depending on road width and side clearance.
- 4.19 Vertical curves are dictated by the ground clearance of the trailer used to transport the turbine nacelles.
- 4.20 For those roads not required for use by the turbine erection crane, an alternative specification can be used. The road width for these can be reduced down to 6-7 metres thereby reducing the overall footprint. For all site roads, a cut batter ratio of 1H:4V has been used for the preliminary design, in line with the current cut batters on existing tracks within the Turitea Reserve and on adjacent farms. Some minor maintenance and remedial works will be required during and post construction, where localised fallout from roadside batters may occur.
- 4.21 A standard road design criteria will be used wherever possible. However, analysis of the site has identified that a section of the Water Catchment Access Road between turbine 0027 and turbine 0034 requires specific alternative design. Sections of the ridgeline in this area are too narrow to construct the required road width using conventional structural fills, so an alternative methodology will be used. This may consist of large gabion baskets and/ or no-fines concrete blocks that are anchored into the fills, as shown in **Exhibit CDJ04**.

Turbine Platforms and Foundations

- 4.22 Turbine locations have been selected by examining the turbine layout relative to wind patterns, ecological constraints, noise constraints and general topography and constructability, as well as to minimise the need for new track formation. At each turbine location, a flat platform will be formed for construction of the turbine foundations and to provide working space for crane operations.
- 4.23 As previously discussed, two turbine foundation types are necessary, depending on the underlying ground conditions:
- (a) Spread Foundations: for locations underlain by greywacke at relatively shallow to moderate depth; or
 - (b) Bored Pile Foundations: for other locations where the piles can penetrate the underlying rock to the required depth.
- 4.24 Final turbine foundation design, and the specific foundation type for each platform, will be confirmed once further geotechnical investigations have taken place during the detailed design phase of the Project.

Substation Platforms and Construction

- 4.25 It will be necessary to construct two substations for this Project. These are required to allow for the energy generated on site at 33 kV to be converted to 220 kV for transporting over distance. The substations will be located at Browns Flat in the south west of the site and within the Pine Plantation area in the north east of the site. The substation location at Browns Flat is currently an area of pines on the inside edge of the water supply catchment, and the substation location at the Pine Plantation is inside the Turitea Reserve but outside the water supply catchment area, as shown in **Exhibit CDJ05**. For pragmatic reasons, both sites will be designed so that all drainage is away from the water supply catchment.
- 4.26 A typical substation layout has been provided in **Exhibit CDJ06**. Permanent operational buildings will be incorporated within the boundary of each substation to provide the following: control room, switchroom, workshop, storeroom, staff meeting rooms and staff amenities. The maximum height for these buildings is 8 m.

- 4.27 During the operational phase of the project a septic tank will be installed at each substation site to treat wastewater from the building for collection and disposal outside of the catchment. The disposal field for each site will be outside the water supply catchment. During the construction phase of the project there will be temporary porta-loo type facilities provided, again, outside the water supply catchment (wherever possible), which will either be regularly emptied or replaced, depending on the contractor's preferred methodology.
- 4.28 The construction of each substation will involve:
- (a) The removal and disposal of any exotic vegetation. Any native vegetation may be re-used;
 - (b) Earthworks for and preparation of the flat platform for the substation;
 - (c) Construction of the substation building including the installation of facilities and plant within the building;
 - (d) Foundations and other civil works associated with the substation plant to be installed on site;
 - (e) Installation of the substation plant along with the associated gantries, stands and support structures;
 - (f) Excavation for the installation of buried services, cables, earthing conductor and site drainage;
 - (g) Installation of metal chip and asphalt surfaces within the substation; and
 - (h) Installation of the security and farm fences around the substation.
- 4.29 The above activities will require materials, labour and equipment to be brought to site. Excavation and filling will be necessary and any material that is excavated will be reused or reinstated where possible, with the remaining excess spoil deposited in nearby disposal areas. Lifting equipment will be required for the installation of most substation plant.
- 4.30 Final design of these substations will be undertaken during the detailed design phase of the Project.

33 kV Internal Reticulation

- 4.31 The power generated by the turbines is taken to the substations via either underground or overhead cables, or a combination of both.
- (a) Underground 33kV Reticulation. All cables will be direct-buried between turbines where feasible. This method will both protect the cables and remove visual impact. The cables will be installed along the access tracks and existing roads where possible, as these access ways are generally flat and have low inclines.
 - (b) Overhead 33kV Reticulation. 33kV overhead lines will be used in place of some underground cable connections for internal reticulation where ground conditions, the number of cable circuits, and distance by road from the substation make underground cabling unsuitable. Effects from construction will be reduced where overhead lines are used due to the smaller earthworks footprints involved in constructing structures when compared to the trenching required for the underground connections. Structures will be of monopole design.

220 kV Transmission

220kV Internal Connection

- 4.32 An internal transmission route links the Plantation Substation to the Browns Flat Substation. This internal connection will be a 220 kV double circuit line involving steel lattice towers up to 56 m in height. Towers of this height are required so that longer spans can be utilised and therefore reduce the number of towers in the Reserve and the amount of vegetation required to be cleared. The typical structure geometry is shown in **Exhibit CDJ07**. The final locations of these towers will be selected based on topography, ground conditions and ecological sensitivity.
- 4.33 As the internal connection route passes through the upper valleys of the Turitea Reserve, care will be taken when locating and constructing the transmission towers to minimise disturbance of existing vegetation. Whilst most of the structures through this area have been sited close to turbine access tracks for ease of construction and maintenance, a number of towers pose specific access issues where located away from these tracks. The use of a helicopter is proposed for the transportation of materials, linesmen, and

structure erection in these cases. It is anticipated that up to four towers will require the use of a helicopter during construction.

- 4.34 All other structures will require access tracks up to 4 m wide to each of the tower sites. The access to each structure will follow the most practical and direct route. Where possible, existing tracks or proposed turbine access tracks will be used and upgraded, if necessary. **Exhibit CDJ01** shows the indicative transmission route construction corridor. Final pylon positions will be chosen in consultation with Mighty River Power's ecological experts so as to avoid impacting on Tawa forest or mature trees of other species.
- 4.35 The lattice tower foundations will generally be augered piles or pad and column foundations. Where geotechnical requirements dictate, anchored pads would be utilised. A description of each type is given below.

220kV External Connection

- 4.36 The external 220 kV transmission line will connect the Browns Flat Substation to the national grid at Linton Substation. The connection will be a 220 kV double circuit steel monopole line with structures up to 45 m in height. The typical structure geometry is shown in **Exhibit CDJ08**.

Tower Foundations

- 4.37 The tower foundations are designed to resist the loads applied to the tower by conductor, wind and ice loads to maintain the tower stability throughout its lifespan.
- 4.38 The three different foundation types are used where ground conditions dictate:
- (a) Pad and Anchor type foundations are used where weaker or unstable conditions are encountered.
 - (b) Augered pile foundations are the most efficient and used in relatively flat ground with good access where strong ground materials are present.
 - (c) Pad and Column type foundations are used where either weaker soils and/or sloping terrain are encountered.
- 4.39 Typical foundations for both towers and monopoles are shown in **Exhibit CDJ09**.

- 4.40 Anchored or gravity pad foundations will be used for most of the pole foundations, although augered monopile foundations would be utilised where the ground conditions allow.

Spoil Disposal Sites

- 4.41 A large proportion of the Wind Farm site falls within the Water Supply Catchment area for Palmerston North located within the Turitea Reserve. Potential spoil disposal site locations have been selected outside of the catchment wherever possible, and will be designed in such a way that the finished surfaces remain productive. It should be noted that these sites are subject to final design, geotechnical and other investigations, and consultation with the landowners.

Structures within Waterways

- 4.42 For this project, in-stream works refers to works resulting from stream crossings by turbine pads and access roads.
- 4.43 Ford crossings have not been proposed for consideration for any of the crossings at this stage, but in an extreme flood event, the access roads will be designed to act as a secondary flow path.
- 4.44 All structures will be designed to comply with the relevant design standards from Horizons Proposed One Plan (Rule 16-11). They will also include provision for fish passage.
- 4.45 The selection of the type of culvert is dependent on the catchment size and site specific requirements. Indicative culvert designs are shown in **Exhibit CDJ10**.

Wind Farm Water Requirements

- 4.46 Water will be required during construction for concrete production, dust suppression on gravel roads, hydro-seeding and potable requirements for the construction workforce. Structural fill material will be monitored to ensure it is at optimum moisture content for compaction, but the water demand for this would be within the allowance made for dust control. Likewise, the hydro-seeding is expected to have a relatively small water demand and is unlikely to be simultaneous with the other demands, so has not been calculated separately.

- 4.47 A major portion of Palmerston North's water supply is sourced from the Turitea Reserve reservoirs. These are located within the Wind Farm area, but have no direct access from the Wind Farm roads.
- 4.48 Palmerston North City Council (PNCC) has indicated that the construction water demands can be met from the city water supply. There is an existing bulk supply point at the Summerhill sub-division, and tanker distances can be reduced by using hydrants close to the bottom of the Pahiatua Aokautere Road and Kahuterawa Road, which will be used for access to the Wind Farm. PNCC will be consulted during the detailed design phase regarding water supply requirements.
- 4.49 On-site storage of water will be required for the concrete batching plants. The minimum storage volume would be the water required for one foundation pour, i.e. 70 m³. This storage would be provided using multiple HDPE (High Density Poly-Ethylene) tanks: most likely up to three 25 or 30 m³ tanks.

Summary of Design Parameters

- 4.50 A summary of key design parameters is provided in **Exhibit CDJ11**.

5. CONSTRUCTION SEQUENCE

- 5.1 Due to the size and geographical location of the Wind Farm, construction will take approximately three years to complete. The geographical distribution of turbines within and outside the Turitea Reserve means that the construction will be staged as outlined below.
- 5.2 Browns Flat is the location for the main 33 kV/220 kV substation, from which the external transmission line runs north to connect the Wind Farm to the National Grid at the Linton Substation. It is proposed that turbines will be commissioned in stages and begin generating electricity whilst construction continues. The establishment of the Browns Flat Substation and external transmission connection has therefore been scheduled for early in the construction sequence.

Anticipated Stages of Construction

- 5.3 The construction is anticipated to proceed in the following sequence. However, the final sequence will be confirmed during the detailed design phase.

- 5.4 Stage 1 will develop the western side of the Wind Farm. Stage 2 will develop the eastern side of the Wind Farm.
- 5.5 Stage 1 involves the construction of up to 54 turbines and includes:
- (a) Site establishment;
 - (b) Upgrade to the Water Catchment Access Road, South Range Road, Greens Road and the private farm drive (off Greens Road);
 - (c) Civil earthworks and roading;
 - (d) 220 kV double circuit transmission line mounted on steel monopoles between Linton Substation and Browns Flat Substation;
 - (e) 33 kV/220 kV substation construction at Browns Flat;
 - (f) Construction of turbine foundations on the western side of the Wind Farm;
 - (g) Internal reticulation;
 - (h) Turbine installation;
 - (i) Turbine commissioning; and
 - (j) Site rehabilitation.
- 5.6 Stage 2 involves the construction of up to 68 turbines and includes:
- (a) Civil earthworks and roading;
 - (b) 33 kV/220 kV substation construction at Pine Plantation;
 - (c) 220 kV double circuit transmission line mounted on steel lattice towers linking the Pine Plantation Substation and Browns Flat Substations;
 - (d) Construction of turbine foundations;
 - (e) Internal reticulation;
 - (f) Turbine installation;
 - (g) Turbine commissioning; and
 - (h) Site rehabilitation.

5.7 **Exhibit CDJ12** shows the indicative construction timeframe. The construction period for the project is expected to take around three years. A two year lead time for turbine delivery has been assumed for this programme.

6. VEGETATION REMOVAL

6.1 The Turitea Reserve (including Hardings Park) includes an area of 3,500 ha of largely native vegetation, together with some exotic plantations (e.g. pine) and rank pasture land. For the project it will be necessary to remove up to 25 ha of indigenous vegetation from within the Turitea Reserve (consisting of mainly horopito-dominant and other secondary vegetation, as described by Mr Shaw). The majority of the indigenous vegetation to be cleared is derived from removal of a narrow strip along the edges of the existing Water Catchment Access Road. This vegetation clearance figure does not include the removal of the pine plantation areas or grassland or pasture. The tables in **Exhibit CDJ13** provide a summary of the anticipated areas of vegetation removal relevant to the various construction activities.

6.2 The total area suitable for re-vegetation as shown in the tables referred to above is 8 ha (of the original up to 25 ha of clearance proposed). This re-vegetation would commonly occur on turbine pads where, once the construction phase of the project is complete, there is only a requirement for service vehicle access to the turbine. Re-vegetation would involve the spreading of topsoil over the pad and the planting of native grasses and other low lying species. This is addressed further in the evidence of Mr Shaw.

6.3 A variety of vegetation removal and management methods are available as outlined below. Preferred or most appropriate methods will be assessed on a site specific basis including:

- (a) Strip and stockpile topsoil and grass for later re-use;
- (b) Any ecologically and archaeologically sensitive areas within close proximity of proposed earthworks will be identified and/or fenced off;
- (c) Up-lift light scrub and secondary growth and mulch;
- (d) Uplift light scrub and bush and direct transfer to completed earthworks areas;

- (e) Uplift light scrub and bush to temporary storage areas for later re-use; and
- (f) Fell and remove trees with a trunk diameter over 0.2m. Push remaining vegetation and soils into a bund around the extent of earthworks to act as a natural silt fence.

6.4 Vegetation removal, management and re-instatement are dealt with in detail in the evidence of Mr Shaw.

7. LAND DISTURBANCE ACTIVITIES

7.1 The earthwork activities at the site include the following:

- (a) Formation of access roads;
- (b) Construction of foundations and formation of platform areas at turbine sites;
- (c) Formation of substation platforms and operations/maintenance facilities;
- (d) Disposal of excess excavated material within the Wind Farm area;
- (e) Trenching for underground cables within the Wind Farm area; and
- (f) Construction of foundations, and other land disturbance associated with overhead transmission lines.

7.2 Based on preliminary design, the total area of disturbance within the Turitea Reserve is 57 ha, consisting of 50 ha of new and upgraded roads, and the remainder associated with the turbine pads and batters.

7.3 As noted previously, during the construction phase, substantial earthworks are required to form the necessary access roads for the cranes and heavy haulage equipment used to transport and erect the wind turbines. These large cranes require 10 m wide roads, with a maximum vertical gradient of 17.6 %, and no super-elevation. Wide-radius bends are also required to accommodate the 45 m long turbine blades. Although the wind turbines are generally located adjacent to the existing South Range Road and the Water Catchment Access Road, these roads will require modifications, involving substantial earthworks, to comply with these requirements. Further earthworks would also be required for the wind turbine construction platforms, including a flat work area of

approximately 33 m x 25 m (excluding the turbine foundation area but including 5m for transport access) adjacent to each turbine site.

- 7.4 Concrete batching plants with attendant aggregate stockpiles and cement storage will be required, cement storage will also be within a sealed steel silo. These will be located so that any site run off can be managed and diverted away from the water supply catchment.

Formation of Access Roads

- 7.5 The table in **Exhibit CDJ14** summarises the earthworks required for the construction of the access roads and turbine platforms. Typical access road details are also provided in this Exhibit.
- 7.6 A total length of 57 km of accessway will be required for the site with approximately 33 km of new accessway created.
- 7.7 It is estimated that a total of 185,000 m³ of road and crane pad paving material will be required for the project based on a pavement depth of 0.25 m. At this stage it is expected that 25% of this material will be able to be won on-site, from rock excavated during construction. The suitability of this material for use as sub-base material will be confirmed when the full geotechnical investigation is carried out during the detailed design phase of the project.
- 7.8 Wherever possible, inside the Turitea Reserve the roads and pads have been designed on a cut to waste basis. This approach speeds up construction, minimises the earthworks footprint, reduces the area of disturbance and vegetation removal, and reduces the length of time earthworks are exposed.
- 7.9 Wherever possible a bund of existing ground and vegetation will be left on the outside edge of all roads and pads. This bund will have four functions:
- (a) Provide a safety barrier for vehicles using the road;
 - (b) Help conceal the roads and pads and reduce the visual impact of cuts;
 - (c) Control run-off and the point of discharge; and
 - (d) Provide wind shelter for re-vegetation.
- 7.10 Access road and crane pad construction will be undertaken in a number of areas simultaneously. Each area will be managed so that the area of exposed

earthworks is kept to a minimum. The re-spreading of topsoil and re-vegetation of completed sections will be undertaken in each area as soon as practical after the completion of the bulk earthworks in accordance with the methodology outlined by Mr Shaw.

Turbine Platforms and Foundations

- 7.11 The size of the platform is primarily driven by the access requirements of the crane and the temporary storage of turbine components prior to erection. The crane pads will need to be approximately 33 metres by 20 metres wide (depending on final turbine selection) with an additional area of at least 5 metres for transport access. In addition to the prepared crane pad, an area of approximately 17 metres by 30 metres is required for the turbine foundations. Wherever possible the crane pads will be adjacent to and parallel with the access roads. This will allow onsite storage of turbine components such as towers, nacelles, hubs and blades. Where it is not possible to position the crane pad clear of the roads, due to restricted sites or excessive earthworks, it may be necessary to utilise the road as part of the crane pad. This would require “just in time” delivery of turbine components. All crane pads will be positioned and excavated to a level such that all foundations will be in cut. This methodology is preferred as it provides the most suitable foundation conditions for the turbines.
- 7.12 **Exhibit CDJ15** provides a typical indicative layout for the turbine platform. The table in the same Exhibit summarises the earthworks required for the construction of the access roads and turbine platforms.
- 7.13 The final turbine location for Zone 0048 within Browns Flat will be selected in conjunction with Mighty River Power’s ecological experts to make sure that no wetlands are disturbed by the construction of the turbine. All wetlands within a radius of 50 metres of the selected and agreed location will have temporary fencing erected around them to ensure that no construction equipment or construction activities impact on any wetlands.
- 7.14 As part of the mitigation works in this area, all well-established native plants or clumps of native plants within the limits of the earthworks will be carefully excavated and set aside. These plants will then be used as part of the re-vegetation of the area. This is dealt with in detail in the evidence of Mr Shaw.

- 7.15 If found to be suitable for all turbine sites, and based on preliminary designs, a spread foundation of between 400 to 450 m³ will be required for each turbine foundation. Foundations of this size will require a total of 50-60,000 m³ of concrete for up to 122 turbines.

Substation Platforms

- 7.16 The area requirements at Browns Flat and Plantation substations have both been assessed to be 160 m x 110 m (1.8 ha). Preliminary platform designs for the two substations have assumed that they will be predominately in fill using surplus material from other parts of the site and therefore above existing ground levels at each site. **Exhibit CDJ16** provides a summary of the earthworks required for the construction of the substation platforms.

33 kV Internal Reticulation

Underground

- 7.17 Excavators or chain diggers equipped for trenching rocky material will be used for cutting the trenches. One cable circuit (including fibre optic cable) is typically installed 800 to 1000 mm below the ground, in a trench 300 to 500 mm wide. Typically access tracks and existing roads are assumed to be 10 m wide, and it is estimated that up to four cable circuits could be buried within the access tracks and existing roads.
- 7.18 Assuming suitable material is identified, thermally-stable backfill will be prepared on site, or brought to site for installation around the cables. This material is required to achieve desirable cable ratings and reduce the risk of damage during installation, as it is generally free of large or sharp particles. It is anticipated that this material will be used to fill from the bottom of the trench to approximately 200 mm above the installed cable. However, the volume of this material may need to be increased if the thermal resistivity on site is found to be exceptionally poor during detailed geotechnical investigations. The remainder of the trench will be reinstated with excavated material and roading aggregate. Any material that is not reinstated will be taken to nearby disposal sites.
- 7.19 Indicative volumes have not been calculated for the underground reticulation for two reasons:

- (a) as much excavated material as possible will be returned as backfill once the cables have been installed, with any excess material disposed at fill sites; and
- (b) the exact length of trenching required will be determined during detailed design.

7.20 Further, as the cable laying process is a highly automated one, with the same machine cutting the trench, laying the cable, and backfilling the trench, the amount of exposed trench at any one time will be minimal, typically about 50-100 metres, and the amount of relocated material will also be minimised.

7.21 An indicative trench cross-section drawing showing the 33 kV power cable and fibre optic cable installation details is shown in **Exhibit CDJ17**.

Overhead

7.22 Any 33 kV overhead lines required will be supported by concrete or steel pole structures. Earthwork volumes for the overhead reticulation are not considered to be significant as the earthwork volumes per pole would be in the order of 1 – 2 m³.

7.23 **Exhibit CDJ18** includes details for indicative internal overhead reticulation structures.

Internal and External 220kV Transmission Lines

7.24 Internal 220 kV transmission line structure foundation footprints with access tracks to the structures would have a typical footprint of 12 m x 12 m. In addition to this area, laydown areas will be required at the structure locations for assembly and erection of the structures. The required laydown area will be dependent upon area available, but typically a total combined area of 15 m x 15 m will be required.

7.25 Sites within the upper valleys of the Turitea Reserve may be constructed with use of helicopters to minimise the need for roading in steep areas and will be constructed on small footprints to minimise the impact on vegetation and topography. This approach would also be considered if access by track proved difficult. A footprint area of approximately 15 m x 15 m would be cleared by hand and the tower constructed within this area. Materials, construction equipment and linesmen, in the very remote locations, would access the site

using helicopters. Large items of equipment/ materials would be broken down into small components for helicopter transportation to the site. Concrete would be supplied to the site in a number of helicopter lifts carrying approximately 0.7 m³ per lift.

- 7.26 The following points summarise the typical processes and site access that will be required to construct the transmission structures and string the conductors:
- (a) Site access will be required in the detailed design phase to carry out geotechnical investigations. For sites where vehicle access is not practical, portable drilling rigs and helicopter transport will be utilised;
 - (b) Set out structure locations using a light vehicle and survey equipment;
 - (c) Transmission construction access roads will be typically 4 m wide with a gradient of up to 25% (dependant on the terrain) and a minimum radius of 10 m (though this will be dictated by the specific plant). The access road surface will be metal and roadside drainage and silt control methods will be employed;
 - (d) The major plant required for the installation of the foundations will be a drilling rig and concrete trucks. Where access prohibits the use of concrete trucks, methods for concrete delivery will include pumps on helicopter;
 - (e) Structures will be erected by crane. Where crane access is not feasible, alternative methods will be employed, such as derrick erection or helicopter erection;
 - (f) To string the conductors a bond wire will first be pulled through the line using a helicopter. A winch and tensioner will be situated at one end of a section, (approximately 8 to 12 towers), and the conductor drums the other end. The conductors are then pulled through each of the towers under tension, (i.e. not along the ground) and clamped in place. For the cross valley link, the conductors would be strung by helicopter, removing the requirement for ground access between structures; and
 - (g) Following construction, where relevant, access tracks would generally be maintained suitable for 4WD access to allow for maintenance vehicles to and from the structure sites.

Site Laydown Areas

- 7.27 Laydown areas will be required throughout the site for the temporary storage of plant and turbine components. They will be located adjacent to the proposed substation sites, be approximately 150 m by 75 m and be of a uniform grade. Laydown areas will be metalled to provide all-weather access. These areas will be top-soiled and re-grassed, on completion of construction. Appropriate stormwater and silt control measures will be installed at each laydown area. These are likely to consist of cut-off drains, silt fences, grit traps and silt ponds.
- 7.28 In some areas it is proposed that Spoil Disposal Areas be constructed in such a way that they can be utilised as Laydown Areas.
- 7.29 Indicative Laydown Area locations are shown on the site plans in **Exhibit CDJ01**.

Placement of Excess Material – Disposal Sites

- 7.30 Based on preliminary designs, it has been calculated that approximately 740,000 m³ of material will require disposal and collectively cover approximately 33 ha. Final configurations for the soil disposal sites will be confirmed during the detailed design phase.
- 7.31 Disposal site locations have been located as close as possible to the areas of excess excavation, whilst being located outside the water supply catchment (with the exception of the areas discussed below). This design criteria not only minimises the haul length to and from disposal sites, thereby increasing plant efficiency, but also reduces the amount of wear on the roads and impact on the environment (e.g. from dust).
- 7.32 Two locations suitable for disposal sites have been identified inside the Turitea Reserve adjacent to the Water Catchment Access Road. The larger site is in the area of the Plantation Substation and is outside the water supply catchment. The smaller site is just inside the water supply catchment near turbine 0010. Both sites are in the area of the recently felled pine plantation.
- 7.33 A further five potential sites have been identified within the Browns Flat area of the Reserve. All five sites are at the upper reaches of the water supply catchment.

- 7.34 Wherever possible, and in compliance with the Proposed One Plan (Rule 12-5), disposal sites will be located within the road corridor, at least 10 m away from watercourses and with appropriate sediment control measures in place as defined by the Greater Wellington Regional Council Guidelines (2002). These guidelines have been accepted by Horizons as appropriate for the proposed works. In addition to these areas, other areas acceptable to individual landowners will also be utilised. Disposal sites will be shaped to a similar profile as the surrounding terrain and topsoiled and re-vegetated on completion. These works are discussed in greater detail by Mr Levy.
- 7.35 Potential spoil disposal area locations are indicated on the site plans in **Exhibit CDJ01**. Geotechnical, archaeological and environmental constraints will be taken into account in the final selection of disposal sites during the detailed design phase. Sites will be prepared and placement of fill will be controlled to eliminate future instability.
- 7.36 The following typical measures will be incorporated into the location, design and construction of the disposal sites:
- (a) A Construction Environment Management Plan (CEMP) for the Wind Farm will be prepared for submission to the relevant Councils as part of the detailed design phase for the project. Mr Levy outlines in detail what this should include in his evidence;
 - (b) Implement measures, as recommended by Mighty River Power's ecological experts, to clear valuable species of flora and fauna from the potential disposal site where avoidance is not possible;
 - (c) Strip topsoil from the ground surface and stockpile;
 - (d) Bench slopes as required to key in fill (see **Exhibit CDJ02** for typical road and disposal area cross sections);
 - (e) Install subsoil drainage in the base of gullies with branches to areas of observed seepage, or prepare surface drains within and on the peripheral of the site to prevent erosion and mitigate run-off as applicable;
 - (f) Compact the fill adequately to ensure sufficient strength and to minimise settlement;

- (g) Select an appropriate fill profile for stability by considering the nature of the material and proposed fill height;
- (h) The surface of the fill will be formed to an even surface, with adequate fall to provide surface drainage and to minimise drainage. Where necessary, surface collector drains will be provided with controlled outlets, in stable locations that are clear of the fill and any areas of instability;
- (i) Spoil areas will be shaped and track rolled each day to divert any stormwater runoff into appropriate silt control measures. A bund will be maintained around the outside edge of flat areas to prevent the discharge of run-off down the face of batters;
- (j) The final surface landscaping will be confirmed in accordance with Council requirements; and
- (k) The surface of the fill will be covered in the previously stockpiled topsoil and re-vegetated with suitable ground cover.

7.37 Measures will be provided for erosion and sediment control during construction and until ground cover is established. Disposal areas will be included in the CEMP.

7.38 Sediment control measures will be provided for potential silt run-off during construction and until ground cover is established. These issues are discussed in detail in the evidence of Mr Levy.

Structures within Waterways

7.39 The Wind Farm access road layout indicates some new watercourse crossings will be required. However, the location of the turbines and the fact that the majority of the access roads will be located along or close to ridgelines minimises the need to cross watercourses.

7.40 The majority of the in-stream works will be culvert crossings of ephemeral (or temporary) watercourses at the extreme headwaters of relatively small catchments (i.e. towards the top of gullies).

- 7.41 The largest catchment area investigated is approximately 65 ha. Culvert design solutions have been based on the catchment areas described in the first table of **Exhibit CDJ19** and on a 50 year return period flow.
- 7.42 The size of the 50 year return period flow is dependent on the catchment area, amongst other variables.
- 7.43 The culvert sizes required for each of the catchment types are shown in the second table in **Exhibit CDJ19**. There are three proposed arrangements for the culvert structures given in this table. The single and double barrel culvert arrangements will be used. The majority of watercourses in which these culverts will be located are ephemeral. The table also estimates culvert diameters for catchments from 2 ha to 90 ha. For catchments of less than 2 ha, a 1 x 525mmØ culvert solution can be installed. It is expected that a number of small ephemeral gullies may cross the access tracks at additional locations not identified in the LINZ topographical maps nor easily discerned from aerial photos.
- 7.44 Indicative culvert designs are also presented in **Exhibit CDJ10**.

8. DISCHARGES

Concrete Batching Plants

- 8.1 The maximum preferred travel time for transporting concrete between the batching plant and pour site is 30-40 minutes. Concrete batching facilities will therefore need to be constructed on site. Potential locations for the concrete batching plants are shown on the plans in **Exhibit CDJ01**.
- 8.2 For each of the batching plant locations the following will be required:
- (a) A water supply – tanks for water storage from external water supply;
 - (b) Stormwater discharge facilities;
 - (c) Material storage facilities;
 - (d) Control of dust emissions; and
 - (e) A wash down area.

- 8.3 Concrete truck washing operations may use in the order of 20 cubic metres of water per day. Process and wash water will be recycled through a series of lined settlement ponds for re-use.
- 8.4 A number of small temporary Portacom style support buildings for staff, equipment maintenance and storage will be required.
- 8.5 The area required for the plant and supporting structures is expected to be in the order of 50 m x 70 m.
- 8.6 Concrete batching plants are only on site for a relatively short period during the wind turbine foundation construction phase of the project, which is currently expected to take 12-15 months.
- 8.7 The photograph in **Exhibit CDJ20** shows a typical Batching Plant.

Crushing Plants

- 8.8 A portable crushing plant will be required to break down suitable on-site rock for road pavements. The unit will incorporate mist spray equipment to control dust. The exact size and specification of the crushing plant cannot be confirmed until a contractor has been selected and the hardness of the rock determined by a full geotechnical investigation. This plant will move to different locations within the site as required as the staged construction progresses.
- 8.9 The photograph in **Exhibit CDJ21** shows a typical Crushing Plant.

Waste Management

- 8.10 All waste will be collected and removed from site and disposed of at an appropriately licensed facility outside of the catchment. All domestic waste water will be collected during construction and will be removed from site for disposal at a licensed treatment plant. There will be no domestic waste water discharged to ground or water within the water supply catchment.

Storage and Use of Hazardous Substances

- 8.11 The hazardous substances potentially required during the construction of the Wind Farm and associated works have been outlined in detail in the Construction Effects Report.

- 8.12 These substances include explosives, which might be required in some areas during track and pad construction where rock cannot be removed by normal mechanical means. These areas will be identified during geotechnical investigations at the detailed design stage, and blasting will be small scale and subject to strict controls.
- 8.13 During construction, diesel fuel will be stored on site in a tank with approximately 10,000 litre capacity. Storage tanks of this type are protected by an appropriately sized bund to prevent spillage of fuel during normal use or by accidental rupture. This bunding will provide a minimum storage capacity of 110% of the tank's contents. A mobile fuel bowser can then be used to transfer smaller quantities of fuel to plant employed around the site. All temporary fuel storage facilities will be constructed outside of the Turitea water supply catchment.
- 8.14 Each of the electrical substations will incorporate power transformers for insulation and cooling. The oil capacity for each of the transformers is as follows:
- (a) Browns Flat – 2 x 60,000 litre capacity;
 - (b) Pine Plantation – 2 x 100,000 litre capacity.
- 8.15 Industry best-practice requires the use of bunds and oil catch tanks to prevent leakage of the oil in the worst-case event of a rupture and/or fire. A plate separator is typically deployed to ensure that rainwater falling within the bunded areas complies with consent requirements upon discharge. At both substation sites, this rainwater will be discharged outside of the water supply catchment area. The potential effects of these discharges on aquatic ecology are assessed by Dr Coffey.

9. OTHER CONSTRUCTION CONSIDERATIONS

Construction Traffic and Noise

- 9.1 Construction traffic and noise issues are addressed in detail in the evidence of Mr Galloway and Mr Hegley respectively.

Lighting

- 9.2 During the majority of the construction period, it is unlikely to be necessary to continue construction work after sunset. However, there may be occasions when particular construction activities require work during darkness and artificial lighting may be required. Possible examples may include during large foundation concrete pours and turbine installation.
- 9.3 Where works after sunset are necessary and appropriate, portable lighting rigs powered by generators will be employed. Given the remote location of the site, it is unlikely that lighting or night works will be prominent or significantly noticeable beyond the site boundary, and locations sensitive to light spill, for example, neighbouring dwellings, will be avoided. Further, the lighting will be directed away from roadways to avoid the possibility of driver distraction.
- 9.4 Any use of artificial lighting during construction will only be for short periods of time and will comply with the requirements regarding light levels at residential dwellings adjacent to the site within the applicable District Plan.

10. KEY EROSION AND SEDIMENT CONTROL MEASURES TO BE ADOPTED

- 10.1 Construction of the turbines, transmission lines and supporting infrastructure has the potential to generate sediment which could have adverse environmental effects. Land disturbing activities need to be well planned to ensure that the risks of erosion and the resultant sedimentation is managed and appropriately mitigated. For the Turitea project, this is to be achieved through a series of management plans, as outlined in detail by Mr Levy.
- 10.2 In particular, erosion and sediment control planning and implementation will be undertaken throughout the duration of the construction, consistent with the Greater Wellington Regional Council's guidelines. The guidelines state that erosion and sediment controls should be in place before bulk earthworks commence and should be removed only after the site has been appropriately stabilised to protect it from erosion.
- 10.3 The Wind Farm is situated in a number of areas exhibiting different characteristics. As outlined by Mr Levy, the approaches to erosion and sediment control in the different areas will vary because of this. However, I outline the key specific erosion and sediment control measures and principles to be adopted for the project below.

Specific Erosion and Sediment Controls for Land Disturbing Activities

Access Roads

- 10.4 Existing controls (e.g. grass swales and grit traps) will be utilised for the upgrading/ widening of access roads where practicable. Turn out areas and grit traps will be the main source of sediment control, with silt fences used where possible. Grit traps will be installed as required, as works on the access roads progress. Side drains will capture any flows and direct them to the 'turn out' areas and the associated grit traps. Material excavated will be removed from the site and deposited in designated fill disposal areas. Vegetation that is cleared for new access roads will be used to form 'vegetation borders', which will help catch debris (as further discussed in the evidence of Mr Shaw).
- 10.5 Wherever possible, run-off will be discharged away from the Turitea catchment along the Water Catchment Access Road.
- 10.6 Cuts will be progressively stabilised by hydroseeding. If site conditions do not allow this, geotextile may be required to temporarily stabilise the cut at the end of each working day or when adverse weather is forecast. Where practicable fill batters will have silt fences installed along their toe and hydroseeded. Once the fill has been permanently stabilised by the establishment of vegetation the silt fences may be removed. Roads will be metalled as soon as the subgrade is complete.

Wind Turbine Platform Areas

- 10.7 The platforms and crane pads will be constructed in such a way that the water is contained within the working footprint and directed to a treatment device, either a silt fence or a grit trap, whichever is the most appropriate to the site. Diversion bunds and channels will be installed to direct flows to the silt fences and/ or grit traps for treatment and to direct flows away from access tracks. Wherever possible, stormwater runoff will be directed away from the water supply catchment. Earth bunds will be used in the Browns Flat area to isolate the work areas from the rest of the site.

Substation Platforms

- 10.8 The substation platforms will be constructed in such a way that the water is contained within the working footprint and directed to an appropriate treatment device. Stormwater runoff will be directed away from the water supply

catchment at both sites. Earth bunds will be used in the Browns Flat area to isolate the work area from the rest of the site.

Fill Disposal Sites

- 10.9 Any sediment-laden flows originating from fill disposal areas will be treated in a sediment retention pond. Run off diversions will prevent 'clean' flows coming into the fill disposal area and also direct sediment-laden flows from the fill disposal site to the retention pond (e.g. a bund/ channel arrangement). A silt fence will be installed below where the sediment retention pond will be situated prior to its construction to treat any sediment generated from this.

Trenching Works for Cable Reticulation

- 10.10 Trenches will be cut within the new and existing access roads for cables. Once cables have been installed and the cable laid as much excess material will be returned as backfill as possible. This approach minimises the area disturbed at any one time. Any sediment generated from this operation will be controlled by sediment controls that are in place for the access road works, as previously described.

Overhead Transmission Lines Foundations

- 10.11 Minimal earthworks are required for the construction of the overhead transmission line foundations. Most of the vegetation that will need to be cleared can be removed just above ground level for the lattice tower structures, so that the earth is not disturbed, which will reduce sediment generation potential. Areas that are to be excavated (four posts per transmission tower equalling an earthworks footprint of approximately 15 m²) will have a silt fence placed around the perimeter to treat any sediment-laden flows originating from this excavation.
- 10.12 The larger monopole structures will require a larger working footprint, but are located outside the Reserve. Silt and sediment control measures similar to those for lattice towers will be used.

Specific Management for Activities Affecting Waterways

- 10.13 Construction for all works within watercourses will be undertaken based on the following principles:

- (a) Wherever possible culverts will be constructed during summer months;
- (b) Install suitable runoff controls including diverting runoff from disturbed areas to minimise discharge of sediment and construction materials into the stream;
- (c) Minimise area of disturbance at any given time;
- (d) Stage works to minimise work in the stream bed;
- (e) Undertake works, as much as practical, when it is dry;
- (f) Allow “offline” crossing construction by temporarily diverting the stream to minimise the generation of sediments and the possibility of construction materials entering the watercourse;
- (g) Select material (such as pre-cast headwall and culverts etc) to minimise time of the works in the stream;
- (h) Remove all construction materials on completion of works;
- (i) Stabilise all exposed areas of soil against erosion by re-vegetating or other methods;
- (j) Storage of fuel or refuel machinery in locations where the potential risks from spillages are minimised;
- (k) Undertake site-specific measures (such as separation of fuelling areas) so that construction materials such as oil, hydraulic fluids, petrol, diesel, other fuels or paint will not enter the water at any time;
- (l) Conduct regular inspections to ensure construction materials handling and sediment mitigation measures are being adhered to; and
- (m) Co-ordinate construction methodologies with council officers to ensure appropriate construction methods are used to avoid, remedy and mitigate environmental effects through the implementation of an effective CEMP.

Specific Management for Discharges

10.14 At each of the concrete batching plant locations there will be an interceptor system in place that will control the discharge of contaminants. The interceptor

will take the form of a concrete lined pit that will provide a watertight area where the concrete trucks will be washed down. The pit will be fitted with a weir. The wash-down water will flow over the weir into a second pit where the remaining cement contaminants will be allowed to settle out naturally. The resulting water will be recycled for use in truck washing and concrete production. Sludge from the ponds will be regularly cleared and allowed to dry on site. Any waste concrete will be poured into forms and made into large blocks which will ultimately be removed from site once construction is complete.

- 10.15 At the mobile crushing plant mist spray control will be used to control any dust emissions.

Water Quality Monitoring

- 10.16 A Water Quality Monitoring Plan (WQMP) has been developed for the Turitea water supply catchment and is included in the Construction Effects Report prepared by Beca (July 2008) as Appendix G.

- 10.17 The approach to water quality monitoring within the Turitea water supply catchment is:

- (a) Obtain a baseline set of data against which any suspected changes in water can be measured;
- (b) Develop a risk matrix of potential contamination issues;
- (c) Design all phases of the Project to avoid or mitigate the risk of potential water quality impacts;
- (d) Require contractors and operators to develop environmental management plans that specifically address the potential water quality impacts;
- (e) Monitor the Project to identify impacts on the environment; and
- (f) Have response plans in place in the event of non-compliance.

- 10.18 The WQMP will confirm the key project outcomes envisaged, as a result of implementing an environmental management regime. Outcomes sought include that:

- (a) There will be no measurable increase in sediment discharge to the water supply dams as a result of the Project;
- (b) There will be no impact on the Turitea Water Treatment Plant as a result of the Project;
- (c) Other contaminants will not enter the Turitea water supply as a result of the Project, and risks associated with contaminants will be actively managed;
- (d) The stability of valley sides will not be compromised by the Project; and
- (e) The existing natural streams will be retained as far as practicable.

10.19 The approach to water quality monitoring is discussed in further detail in the evidence of Mr Coffey.

11. COMMENTS ON SUBMISSIONS

- 11.1 Submitters 345, 9, 184, 272, 10, 227, 501, 503, 44, 80, 618, 194, 383, 590, 663, 657, 640, 659, 691686, and 711 were all concerned in general with the effects that could arise from the earthworks associated with the Turitea Wind Farm.
- 11.2 As I have stated throughout my evidence, the Construction Effects Report has been developed to manage the potential for adverse environmental effects that could result from earthworks. This report includes Erosion and Sediment Control principles which are dealt with in detail in the evidence of Mr Levy. I consider these measures will provide more than adequate erosion and sediment control measures. These principles will be implemented through Erosion and Sediment Control Plans, and are further explained in the evidence of Mr Levy.
- 11.3 Submitters 8, 9, 375, 23, 384, 189, 135, 478, 216, 175, 483, 365, 37, 179, 497, 232, 135, 80, 52, 598, 618, 587, 517, 194, 353, 188, 590, 293, 644, 640, 667, 659, 15, 74, 48, 691 and 682 have all raised concerns associated with sediment resulting from the earthworks. Considerable effort has been made to minimise the sediment that will result from the earthworks as far as possible. As discussed in the Construction Effects report, and my evidence, management plans will be developed to specifically address this issue and appropriately manage the risks associated with it.

- 11.4 Submitters 144, 669, 267, 278, 135, 607, 293, 15 and 66 have raised concerns with regards to dust. Submitter 403 is specifically concerned with dust from concrete batching and crushing blowing into neighbouring properties and contaminating potable water supplies. Submitter 590 is concerned with the discharge of contaminants to air during construction.
- 11.5 The temporary concrete batching plants that will be used for this project utilise a sealed storage and transfer system for cement which will minimise the risk of the discharge of cement into the environment. Both of the proposed batching plant sites are over 1.5km from either the PNCC water storage dams or the nearest residence.
- 11.6 Similarly, the proposed mobile crushing equipment will be over 1.5km from any residence. Dust emissions from this equipment will be controlled by a sprinkler system.
- 11.7 Submitters 298, 640 and 659 are concerned with the discharge of stormwater and cleanfill resulting from the earthworks. The control of stormwater runoff and the handling of fill material are both covered by the proposed CEMP.
- 11.8 Submitter 558 is concerned with disposal sites of excavated material within the Turitea Reserve. As I have previously stated in my evidence, spoil disposal site locations have been selected outside of the Turitea water supply catchment wherever possible, and will be designed in such a way that the finished surfaces remain productive for the landowner. The disposal sites chosen within the Reserve are currently either covered with exotic pines or have recently had the pine trees removed. These sites will be landscaped to a standard that is more in keeping with the Turitea Reserve on completion.
- 11.9 The disposal sites that have been nominated inside the Turitea Reserve are in the area of the old pine plantations and on the upper slopes of Browns Flat. One of the Pine Plantation sites is outside of the water catchment area, the other is on the more gentle slopes adjacent to the Water Catchment Access Road. All sites will be subject to the CEMP, thereby providing more than adequate safeguards.
- 11.10 Submitter 682 is concerned with the spoil disposal site opposite to WTG 88, as if a slip were to occur, their property could be affected.

- 11.11 As stated in my evidence, geotechnical investigations will be carried out at each proposed site during detailed design and each site will be designed with best practice factors of safety. If this site cannot be designed and constructed to these standards it will not be used.
- 11.12 Submitters 298, 640 and 659 are concerned with potential land slips resulting from earthworks, and submitter 700 is concerned with the possibility of land slip causing accident or disaster.
- 11.13 Section 10 of this evidence has set out mitigation measures and management of the construction effects (including those that could potentially arise from earthworks). The CEMP will appropriately manage the environmental risks associated with the project through the application of best design and environmental management practices. In my opinion, slips are unlikely to be caused by the proposed earthworks.
- 11.14 Submitter 48 raised the issue of increased runoff from vegetation clearance. Most of the earthworks associated with this project are located along ridgelines and the associated vegetation clearance consists of a narrow strip on each side of the roads and crane pads. It is not anticipated that the runoff will increase significantly. This issue is discussed by Mr Levy in his evidence.
- 11.15 Submitter 686 is concerned with the negative effects on topsoils from earthworks. All topsoil within the footprint of the earthworks will be stripped and stockpiled for subsequent re-spreading over spoil sites and earthworks batters. It is not anticipated that topsoil will be stockpiled for periods greater than 12 months. This will have no detrimental effect on the soil.
- 11.16 Submitter 685 questions if Mighty River Power has factored in recent heavy rain fall weather trends when designing sedimentation mitigation plans. As described by Mr Levy, all stormwater and silt/sediment control measures will be designed in accordance with the Horizons One Plan and the Greater Wellington Regional Guidelines.
- 11.17 A number of submitters have expressed concerns with regard to the effects of construction on water supplies. Specifically, submitters 302, 190, 140, 85, 384, 216, 465, 93, 95, 37, 398, 226, 491, 102, 500, 227,106, 497, 163, 128, 582, 596, 299, 618, 587, 298, 558, 194, 353, 188, 590, 293, 647, 644, 640, 677, 74, 704 and 691 are concerned with the potential contamination of the water supply within the Turitea Reserve that could result from construction.

Submitters 385 and 626 are concerned with how water monitoring is to occur. Submitter 476 is concerned with the potential flooding of the Turitea Stream. Submitters 369 and 596 are concerned with the 68,000 truckloads of soil affecting the water supply. Submitters 640 and 659 have requested water monitoring south of the Turitea Dam. I consider that these concerns are addressed in my evidence under paragraph 10.16, the Water Quality Management Plan, which is included as part of the Construction Effects Report.

- 11.18 Water quality monitoring issues are dealt with in the evidence of Dr Coffey and Mr Levy.
- 11.19 Submitter 367 is concerned with the effect on streams from the construction. Submitters 640, 659 and 692 are concerned that downstream tributaries will be contaminated during construction. Dr Coffey addresses these concerns in his evidence.
- 11.20 Submitters 257, 401, 479, 154, 482, 95,179, 491, 102, 227, 496, 163, 503, 495, 232, 128, 278, 135, 582, 52, 596, 598, 587, 517, 558, 194, 383 and 691 are concerned with the removal of native vegetation. Submitters 154 and 590 are concerned with the potential effect of construction on native habitats. Submitter 367 states that the removal of native vegetation from construction in the centre of the Reserve will cause fragmentation to the ecosystem. These effects are addressed in the evidence of Mr Shaw.
- 11.21 Submitter 669 is concerned with the increase in stormwater that would result from the substations. The substation sites will typically be unpaved. The vast majority of the area of each site will be gravel. The stormwater runoff from these sites will not increase significantly. All stormwater from the substations will be collected and disposed of outside of the water supply catchment.
- 11.22 Submitter 667 is concerned with the contamination of water supply from human waste during the construction phase from additional people being on site in the Reserve. No human waste will be disposed of inside the Turitea Reserve. During construction, all domestic waste water will be collected in porta-loo type facilities or holding tanks and then transported off site for disposal.
- 11.23 Submitter 667 is concerned with the potential fire risk in the Reserve and subsequent contamination of the water supply. Subject to further discussions with the relevant fire authorities, Mighty River Power will provide appropriate

on-site facilities to house suitable fire fighting equipment including monsoon buckets. These facilities would likely be in the vicinity of the two substation sites. In addition, a fire fighting water supply will be provided on site during construction in the form of one or more storage ponds.

- 11.24 Submitter 384 raised concerns that construction would affect the public walking tracks in the Turitea Reserve. No construction will be taking place in that part of Turitea Reserve that the public currently has access to (Hardings Park).
- 11.25 Submitters 479 and 606 are concerned with PCB contamination from the substations. Industry requirements dictate that PCBs are no longer used in transformer oil, thereby eliminating this risk.
- 11.26 Submitter 669 opposes the storage of diesel in bunded areas outside the Turitea water supply catchment area. It is considered that the storage of diesel near the site is necessary for construction equipment, and would assist in minimising traffic and vehicle movements to and from the site. The storage of diesel will be appropriately managed as I have discussed in my evidence.
- 11.27 Submitter 135 asks if Mighty River Power intends to replant spoil sites with native trees. Spoil sites on private land will be topsoiled and returned to an acceptable state, as agreed to with the owner. The final treatment of spoil sites inside the Turitea Reserve is covered in the evidence of Mr Shaw.

12. SUMMARY

- 12.1 In my evidence, I have outlined the key construction works and activities for the proposed Turitea Wind Farm. From the extensive preliminary civil design work undertaken to date it is my opinion that the design philosophy and conditions proposed by Mighty River Power will enable this project to be built in a manner that best protects the Turitea Reserve and the neighbouring environment.
- 12.2 This will be achieved by
- (a) minimising earthworks;
 - (b) minimising vegetation clearance;
 - (c) adopting a collaborative approach for the selection and treatment of spoil sites involving the landowner, ecologists, archaeologists and the local authorities;

- (d) imposing strict controls on where the contractor can operate; and
- (e) adopting stringent design, construction and monitoring procedures via the proposed CEMP and other management processes proposed for this project.

12.3 The overriding philosophy adopted by Mighty River Power in developing this project has been to minimise earthworks and vegetation clearance as far as possible in order to protect the environment.

C D James

1 May 2009