

Wednesday, 29 July 2009

Attention Chris Evans  
Consents Manager, Natural Resources  
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PO Box 2454, Christchurch.

Dear Chris

## **Stockton Plateau Hydro: Review of resource Consent Application Documentation**

### **Introduction**

This letter sets out a summary of issues identified with respect to the Stockton Hydro Project. My assessment is based on review of the applicant's Resource Consent Application and Assessment of Effects on the Environment report and supporting documentation.

### **Qualifications**

I have been employed by Damwatch Services Ltd., as a water resources development specialist, for six years and have over 40 years professional experience internationally. My qualifications are BE Civil, Diploma of Hydraulic Engineering (Delft), CPEng, MIPENZ, MNZSOLD.

### **Documents Reviewed**

In conducting this assessment I have considered relevant sections of:

- Hydro Developments Ltd., Resource Consent Application and Assessment of Effects on the Environment (AEE);
- URS, February 2008, Ngakawau Restoration Project Preliminary Assessment of the Potential Effects of Dam Breach;
- URS, February 2008, Ngakawau Restoration Project Scheme Modelling Report;
- URS, March 2008, Ngakawau Restoration Project Hydrology and Water Quality Review;

- URS, March 2008, Ngakawau Restoration Project Weka Dam and Mt William Dam Concept Design Assessment;
- URS, September 2008, Stockton Plateau Hydro Project-Water Quality and Hydrological Modelling;
- Geotech Ground Engineering, June 2008, Stockton Plateau Hydro Project Concept Design and Geotechnical Assessments;
- Stockton Plateau Hydro Scheme – S92 request for Additional Information;
- Opus, July 2009, Proposed Stockton Plateau Hydro Project Technical Assessment of Dam Works;
- West Coast Regional and Buller District Council; July 2009, Joint S42A Planning Officer report Applications for Resource Consents Hydro Developments Ltd., RC08149/01-RC08149/42 and RC08/131(A-G)

### **Overview of the Stockton Hydro Project**

The Stockton Hydro Project aims to intercept runoff from the Stockton Plateau, which is polluted by coal mining activities, for hydro power production. It includes two dams which regulate the inflow and the intercepted flow is passed through two power stations arranged in series fed by two major tunnels each connecting a lake with the associated power station. Inflows to the scheme will be variable due to variation of rainfall and associated runoff over time.

The consent application documentation presents 13 scheme scenarios each with combinations of different dam size and power station installed capacity, and these vary widely. A consequence of this is that the proportion of polluted runoff that is intercepted varies significantly between scenarios. A smaller amount of polluted runoff is intercepted with smaller dams and smaller installed capacity (which requires less capital investment). The AEE states that the current proposal is for construction of two dams, Mt William dam 30 m high impounding around 7 million cubic metres and Weka dam 20 m high impounding around 3 million cubic metres. These dam capacities apply to Scenario 13 in the Scheme Modelling Report However the AEE also states that: *“The installed generation capacity of the Project will be dictated by the capacity and costs of the underground penstocks and tunnels connecting the dams.”* It is not clear whether HDL have settled on a preferred scheme scenario.

### **Hydrology**

The URS, March 2008, Hydrology and Water Quality Review notes the paucity of hydrological data available for hydrological analysis and explains that two approaches were adopted:

- (i) mean flow analysis and
- (ii) consideration of a full year of data (2006 dataset).

In my opinion, standard practice for a hydro project such as this would be to address inflow variability by utilising at least 10 to 20 years of good stream flow record or alternatively, utilising rainfall data if flow records are unavailable. It should be possible to extend the period of record using correlation with other nearby instrumented catchments which, whilst not as preferable to complete stream flow records, would overcome the problems with the limited hydrological assessment that supports the resource consent application.

Accordingly, the results of the hydrological analysis are imprecise, particularly relative to a hydrological assessment based on good quality long term data. Consequently, conclusions drawn from the hydrological assessment require cautious interpretation and the claimed generation and effects of the proposal cannot be properly ascertained.

The Resource Consent Application document explains:

*"capture of approximately 95% of tributaries of the Ngakawau River that are affected by acidic mine drainage (AMD)*

and also how

*"essentially the (Stockton Plateau Hydro) proposal creates a water barrier between the parts of the Ngakawau River catchment affected by mining activities and the pristine Ngakawau Ecological Area"*

This statement is not supported by the table below which is based on Appendix A of the URS Ngakawau Scheme Modelling Report (February 2008, Appendix I in the Assessment of Environmental Effects) which summarises the reservoir sizes, installed capacities and spills of the scenarios that were modelled and presented.

I have added to the table the percent spilled (derived from the volume lost divided by inflow of the respective catchments) and the comments columns.

Scenario	Reservoir vols (St Pat/Mt Will/Weka) (mill m3)	Threshold lvs (St Pat/Mt Will/Weka) (mill m3)	Maximum Power Generation* PS1/2/3 (MW)	Base Power Output (MW)	Annual Power Output (GWh) (2006)	Vol lost (Mt Will/Weka) (mill m3)	% spilled (Mt Will/Weka)	Comment
1	0.5/3.0/1.0	0.25/2.0/0.3	5/12/50	8.6	234	21/62	15/24	
2	0.5/3.0/1.0	0.25/2.0/0.3	10/25/100	8.6	284	3/36	2/14	Low spill with 135MW installed capacity
3	0.5/3.0/1.0	0.45/2.8/0.9	10/20/50	11.5	213	20/93	14/36	
4	0.5/5.0/1.0	0.45/4.5/0.9	10/20/50	14.8	228	10/87	7/34	
5	0.5/5.0/1.0	0.45/3.5/0.3	10/25/100	12.0	282	1.3/36	1/14	Low spill with 135MW installed capacity
6	0.5/5.0/1.0	0.45/4.5/0.9	10/25/100	14.8	265	7/48	5/19	
7	0.5/5.0/1.0	0.45/4.5/0.9	10/25/70	14.8	248	7/68	5/26	
8	0.5/7.0/1.0	0.45/6.3/0.9	10/25/80	18.3	266	3/53	2/21	
9	0.5/3.0/1.5	0.45/2.81/1.35	10/25/50	12.1	216	15/97	11/38	
10	0.5/5.0/1.5	0.45/4.5/1.35	10/25/70	15.4	251	7/66	5/26	
11	0.35/3.0/3.0	0.3/2.7/2.7	7/13/30	12.5	188	28/110	20/43	
12	0.35/5.0/3.0	0.3/4.5/2.7	7/13/30	14.5	216	21/96	15/37	Increasing size of Mt Williams reservoir with 50MW installed capacity
13	0.35/7.0/3.0	0.3/6.5/2.7	7/13/30	18.8	297	15/83	14/32	

The table shows that the lowest proportion of catchment inflow spilled is with large installed capacity and large reservoir storage. Large installed capacity and large reservoirs are expensive and are at risk of not being economic. The tabulated volumes lost are due to spills from the reservoirs caused by large rainfall events. The short duration and low precision, of particularly the high flow data on which the hydrologic modelling is based means that the spills tabulated are likely to be underestimated.

The claim that the project creates a water barrier is incorrect as all Scenarios spill a portion of Stockton Plateau catchment runoff which is polluted.

The impact of spill flow on the Ngakawau River ecology is unclear from the documentation supporting the consent application. It can be anticipated, however, that as spill will occur during periods of high rainfall and corresponding high rates of runoff from both the Stockton Plateau and the balance of the Ngakawau catchment, that there would be dilution of contaminants. Whether this dilution is sufficient for survival of aquatic life in the Ngakawau River is not clear.

Further, the conclusion contained in the Resource Consent Application and Assessment of Effects on the Environment report,

*“The installed generation of the Project will be dictated by the capacity and costs of the underground penstocks and tunnels connecting the dams. Increasing or reducing installed capacity (the effective “size” of the scheme) will not significantly alter any of the anticipated environmental effects”*

is not supported by the table above as the spills of polluted runoff are significantly different for different Scenarios.

The uncertainty inherent in the hydrology assessment means that the project annual energy output cannot be determined with any precision. The energy output appears to be overstated in the documentation. For example, the URS, February 2008, Scheme Modelling Report tabulates for Scenario 13 a base power output of 18.8 MW. This is with PS1, 2 and 3 and if 70% average efficiency is adopted (the outputs presented in the AEE appear to be with 100% efficiency which is unrealistic) reduces to 13.2 MW. The documentation indicates that PS3 may not be constructed which further reduces the output as presented in the documentation based on very limited hydrologic data. Accordingly, the 25 MW base power output quoted in the AEE document is optimistic and overstates the project power output that might be anticipated from the development described in that report.

Section 5.6 of the Resource Consent Application and AEE report describes the diversion weir at the Mangatini Diversion, which can be shut to prevent flows entering the Weka Reservoir. This may be required for maintenance reasons or to prevent ingress of highly contaminated flows. There is a similar description in

Section 5.7 with respect to the Mine creek Diversion. Considering that no treatment is proposed these highly contaminated flows would be diverted into the downstream channel. The effects of this diversion are not clear.

### **Dam Safety and Design**

Both Mt Williams and Weka creek dams are proposed to be constructed using Roller Compacted Concrete (RCC). The Potential Impact Category (PIC) of these dams, that is the impact should one of these dams fail, is high. Accordingly, the highest standards for design, construction and operation of these dams is required. These criteria are set out in the New Zealand Society on Large Dams, New Zealand Dam Safety Guidelines.

There is limited discussion in the documentation on geology and geological hazards. RCC dams require competent hard rock foundations. There is insufficient information presented in the documentation to assess whether such suitable foundation exists at the proposed sites and whether Roller Compacted Concrete dams are feasible for the sites proposed. Whilst I appreciate that some matters will be left for the detailed design phase, it is unusual that more detailed geological investigations have not been undertaken prior to consent application being lodged.

The NZSOLD Dam Safety guidelines relate the design loads for the dam to the PIC. For example a High PIC requires design for the Probable Maximum Flood and the Maximum Credible Earthquake at the dam sites. While RCC dams can be designed for these loads, there is no assessment provided on what loads will be utilised in detailed design. In a resource consent application it would be expected that the applicant had assessed the hazards the dam would be designed for. In my opinion this is a significant failing of the application.

### **Tunnel Construction and Operation**

Major high head tunnels are proposed to convey flow from Mt Williams Dam reservoir to PS2 (4.1 km long) which then discharges into Weka Creek Dam reservoir and from Weka Creek Dam reservoir to PS2 (5.1km long) which then discharges into an ocean outfall tunnel. Construction and operation of these tunnels will have a significant impact on the ground water regime along the route.

Millerton and Granity are close to the route of Weka Reservoir to PS1 tunnel and springs used for water supply are likely to be impacted due to dewatering caused by tunnel construction.

During operation pressurised polluted water from the tunnel should be expected to enter the groundwater and may pollute the groundwater used in Millerton and Granity.

While the supporting documentation does not address these impacts arising from construction and operation of these two tunnels they are addressed in the request for additional information and HDL state that alternative water supply will be provided, however it is unclear what investigations HDL has done into the feasibility of doing this.

### **Sedimentation Management**

Significant operational effort would be required desilting interceptors or silt traps proposed at the reservoir inlets. Operation of these traps is not explained in the documentation.

An operational aspect which is also not addressed is that two shafts in the PS1 tunnel are proposed intercepting stream flow along the tunnel length. Gravels which enter the tunnel from these shaft intakes would require removal which in turn would require dewatering the tunnel. It is not normal practice to dewater pressure tunnels on a routine basis. Such a high head tunnel must be dewatered slowly to allow relieving of groundwater pressures and prevent excessive water pressures collapsing tunnel walls. Dewatering will in turn impact on the groundwater regime in the area. Further disposal of potentially contaminated sediment is not addressed in the documentation.

### **Conclusions**

In my opinion the Assessment of Environmental Effects and section 92 response fail to supply the level of detail required to adequately understand and assess the potential effects of the project from a generation or dam safety and design perspective. Furthermore, the potential environmental effects are unclear. It is concluded that:

- Reliance has been placed on limited hydrological data and conclusions drawn from the hydrology require cautious interpretation and conservative application;
- Economic factors are likely to limit the reservoir sizes and power station installed capacities, in turn reducing interception of polluted runoff and significantly reducing the environmental benefits;
- Concrete gravity dams are proposed, constructed using roller compacted concrete, for the Mt Williams and Weka Creek Dams which require competent rock foundations. The geological investigation presented in the supporting documentation is inadequate to establish feasibility of the dams proposed;
- Tunnel construction is likely to modify the groundwater regime which may compromise the water supply to Millerton and Granity;
- Removal of gravel from the power tunnels will cause lengthy outages during operation of the scheme as depressurising high pressure tunnels must be done slowly;

- Power output from the scheme cannot be precisely estimated due to paucity of hydrologic data and it appears that the scheme power output is overstated in the AEE report; and
- Sediment management will require significant operational effort, the feasibility of which is not explained in the documentation.

Yours sincerely

Nigel Connell  
**Water Resource Consultant**