IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of Resource Consent Applications for the Stockton Plateau Hydro Scheme being:

RC08/149 - West Coast Regional Council

and

RC08/131 - Buller District Council

STATEMENT OF EVIDENCE OF JOHN EASTHER

Project Manager, Hydro Developments Limited

PART 1.

Section 1 Introduction

1.1 Qualifications and Experience

My name is **John Montgomery Easther**. I am a Member of the Institute of Professional Engineers of New Zealand.

I hold the qualifications of Bachelor of Engineering (Agriculture), specialising in water resource development and catchment management, and an MA (Applied) in Environmental Studies specialising in economics, environment and development.

During my career, I have specialised in river engineering and in the management of high risk projects.

I am the Project Manager for Hydro Developments Limited, responsible for bringing together the specialist skills required to design the scheme, to plan the scheme, and to seek consents for the scheme.

I am also a Director of Hydro Developments Limited and hold 20% of shares in the company.

I provide risk management services and project management services through my company Riskworks Limited. Until very recently, I have been providing contract professional management services to Solid Energy Limited Stockton Mine.

Recent projects that I have been responsible for at Stockton mine include the concept design of the mining process for Ridgeline mining, which was the deconstruction of Mt Augustus; No 2 South Cutback, which is a mining block bordering the coal mining licence which requires concession application from the Department of Conservation in order for it to proceed; the Cypress mine, Waimangaroa Valley; and the Millerton mine which is currently seeking consents. For these projects I have been providing the project management services and have been responsible for the scope, feasibility design, investigations, employing the specialists who undertake the investigations, and for delivering recommendations to Solid Energy’s Board as to how these projects will proceed.

In this role I have extensive knowledge of mining on the Stockton Plateau, the physical environment of the Stockton Plateau, and of those matters which affect the external environment beyond the Plateau. I have a full understanding of matters associated with acid mine drainage and Solid Energy's current strategy to mitigate the effects of acid mine drainage.

As Project Manager for Hydro Developments Limited, I have been responsible for setting the scope of the design programme, designing the briefs that all our specialist teams have worked to, managing the outcomes of those processes and the quality of the outputs, and for determining the direction of final design.

I have been responsible for the quality and completeness of all the documents that support this current application.

Teams that I have employed for the purposes of the design of the Stockton Plateau Hydro Scheme (SPHS) include individuals and companies that I have worked for in a professional capacity directly or have employed them to work on projects under my control. The individuals concerned all have extensive knowledge of the Stockton Plateau through work for both Solid Energy and its suppliers. This team has brought to the Scheme years of knowledge and experience in undertaking physical operations and mining operations on the Stockton Plateau.

Other projects that I have been responsible for in the last 10 years that are relevant to this Scheme include the preparation of the Hutt River Floodplain Management Plan which I was responsible for in the early 1990s which led to the current major works to reduce risk of flooding to Hutt City; the Alexandra Future Solutions Strategy, which deal with flooding of Alexandra from the Clutha River. I have been responsible for managing the System Integrity Strategy for the National Grid for Transpower which looked at identifying those projects which were most critical for maintaining the lights on in New Zealand; and I have been responsible for the Waiwhetu project requiring the decontamination of New Zealand's most contaminated waterway.

All these projects are directly relevant to the various aspects of the SPHS which requires a full understanding of catchment management, the management of contaminated sites, and hydrological and hydraulic processes.

1.2 Hydro Developments Limited ("HDL")

HDL is a locally based company which has had an interest in the development of hydro projects on the West Coast for a number of years. The shareholders of the company are committed to development activities on the West Coast and include:

Anthony Black: Anthony Black will provide evidence shortly. Anthony is owner of Geotech Limited, a company based in Charleston employing 25-30 people engaged in ground engineering and tunnelling, principally on the West Coast. Geotech Limited is recognised as having New Zealand's leading capacity for small tunnel construction and the rehabilitation of tunnels. Geotech Limited has a turnover of approximately $8 million per annum and will be a major interest in the construction of the hydro scheme.

In addition to tunnelling, Geotech Limited is active in ground stabilisation and restoration of access areas for the Department of Conservation in the Banbury area as part of tourist development within the Conservation Estate. Geotech is also involved in a number of other development projects on the West Coast, including export of water from Fiordland. Geotech is active in leading community work both at Charleston and elsewhere on the Coast.

Chris Coll and Jan Coll: Chris and Jan have operated a survey company from Westport since 1981, currently employing 7 surveyors. Chris is Civil Defence Controller and leads Volunteer Surf Rescue. Jan has spent 18 years as a District Councillor on Westport Borough and Buller District Councils, 3 years on West Coast Regional Council, and from 2001 to 2007 was a trustee of Development West Coast. Jan is currently a trustee for Buller Electricity Power, Denniston and Rescue Helicopter Trusts.

Brian Kidson: Brian Kidson is owner of Kidson Construction in Nelson employing 40-50 in heavy engineering and civil construction in the South Island. Kidson Construction will be interested in being involved in the construction of the power stations and other civil works associated with this Scheme. Kidson Construction have built the new Solid Energy recreation centre at Westport and have previously constructed facilities for Solid Energy at Ngakawau and Stockton mine. Brian Kidson has also been involved in the development of the Onekaka power scheme which takes water from the Conservation Estate.

The shareholders of HDL in their own rights have the specialist skills and knowledge to be involved in the hydro development, the assessment of geotechnical effects, civil engineering, hydraulic, hydrological and catchment engineering, land survey and tunneling. They have brought this knowledge to this Scheme throughout the design process.

1.3 **Scope of Evidence**

My evidence is presented in two parts. The first part considers the design of the SPHS and provides evidence that supplements and draws from the information contained in the supporting documents.

Commissioners should be aware that the supporting documents have *not* been specifically prepared for this consent hearing, but are the documents that were prepared as part of the design process.

The documents track the development of the very first aspects of the design through to the final aspects of feasibility design that is described in the consent applications. For this reason, it is important to note the dates of the various documents and to follow through the sequential thinking that took place as the design evolved to the final design that we are now presenting and seeking consent for.

The second part of my evidence will deal with the actual engineering works.

My evidence is provided under the following sections:

Section 2: Overview of the Scheme

Section 3: Geology. I will break my evidence at section 3 to allow Anthony Black, who has been responsible for the geotechnical and geological assessment of the site, to provide his evidence.

Section 4 covers geochemistry and acid mine drainage.

Section 5 will cover the hydrology that provides input to the water quality and modelling inputs covered in section 6.

Section 7 covers hydraulic modelling which is essential for the assessment of hydro power output.

Section 8 provides the modelling results of both water quality and hydro modelling.

Section 9 will cover the near shore environment where the ocean outfall will be located.

Section 10 discusses the hydroelectric power modelling and the forecasts for renewable energy from this Scheme.

Section 11 will briefly cover the transmission capacity. It is our intention to embed all power from this scheme into Buller Electricity local network. I will break my evidence atthis point to allow Mine McSherry, CEO of BEL, to providence on the capacity of the BEL network.

Section 12 will briefly discuss sedimentation issues that have been raised in section 92 reports.

Section 13 will cover the dam break assessment which has led us to determine the nature of the design of the dams and also sets the impact category in terms of the New Zealand Society for Large Dam requirements for design.

Sections 14 to 24 will deal with the various components of the scheme as they are laid out in section 5.1 of the AEE.

Section 2: Overview of the Scheme

The SPHS collects water from the Stockton Plateau which occupies the South Western corner of the Ngakawau catchment. Figure 2.1 shows the location of the Stockton Plateau, particularly the principal activities on the plateau which are mining activities within the Stockton CML, and proposed mining activities in the Upper Waimangaroa Valley for the development of Cypress mine.

The outline of the scheme is provided in figure 2.2, showing the entire Ngakawau catchment and the four principal sub-catchments which are captured by the Scheme.

The principal catchments reporting to the SPHS are the Mangatini Stream, which will be captured by diversion and interception through the construction of the Weka reservoir; and the St Patrick's Stream, which will be captured by diversion and interception of the Mt William reservoir. We also seek consents for the diversion of Mine Creek which captures runoff from the historic Millerton workings and the future Millerton mine. The Scheme has made provision but does not include consents for the possible collection of AMD from Granity Stream and its tributary, Miller Creek, by possible drop shafts into the tunnels.

The catchments affected by the scheme, the existing areas and the reduced area of catchment downstream of our interceptions, and the corresponding changes in mean flows, are shown in the table in figure 2.2.

Figure 2.3 provides an overview of the whole scheme. Scheme major components are the two reservoirs - the Mt William reservoir to the west in the higher catchment, and the Weka reservoir to the north on a tributary of the Mangatini Stream.

The two reservoirs are connected by the Stockton tunnel which is approximately 150-170 metres below existing topography. The Granity tunnel connects Weka reservoir through to a powerhouse at Granity. The tunnel runs 300 metres below existing topography.

Near the exit portals of both the tunnels there will be an underground power station hewn into the granite basement rock, not dissimilar to the Manapouri power house.

The two power stations can be operated independently but in fact will be operated to maximise the aMt of power that can be generated from the site minimising the spill that will occur from the site.

In addition to the interception of runoff which occurs by building the reservoirs within the tributary valleys, a number of diversions have been added to divert water from other contaminated tributaries into the reservoirs. These tributaries include the Darcy diversion which discharges into Mt William reservoir, and the Mangatini and Mine Creek diversions which discharge into Weka reservoir.

Also in addition to the tributary diversions, there is the provision to build drop shafts from contaminated watercourses where they cross the line of the tunnels to discharge contaminated leachate into the tunnels. These drop shafts will be built if an integrated water management strategy is agreed with Solid Energy for the control of all acid mine drainage from Stockton mineto permit the avoidance of long term chemical water treatment and lime dosing.

Figure 2.3 shows that all the scheme components, with the exception of the Granity tunnel, are built on or under land that is between the Ngakawau Ecological Reserve boundary (which is shown in green on the plan) and Solid Energy land which defines the boundary of the current coal mining licence (shown in yellow on the plan).

The other blocks on the plan which are bounded in purple are known as the ancillary coal mining licence and provide for access into the coal mining licence for Solid Energy’s operations.

What is also evident from figure 2.3 is that the hydro scheme effectively forms a water barrier between the areas that are currently being mined, will be mined in future, or have been mined in the past. By capturing all runoff from this area, 95% of all acid mine drainage that can report to the Ngakawau River is captured and discharged to sea in a manner that causes no significant effects on the marine environment.

A schematic of the scheme is provided in figure 2.4. In the schematic the top half shows an elevation through the centre line of the tunnels and reservoirs and shows where the various watercourses are captured. Under each watercourse there is an indication of the total percentage of AMD from that watercourse that will be collected and an indication of the percentage of flood flows that will be captured. You will notice that most of the flood flows are captured, which is critical for hydro power, and nearly 100% of all AMD is captured, which is critical for improving water quality and restoring the amenity value of the Ngakawau River.

The schematic shows that both Weka and Granity power stations, are located underground. The lower part of the schematic shows the concept design for the power stations. The power stations are located at a position within the tunnel outlet portal close to a bulkhead that separates the high pressure section of the tunnel, contained by competent rock mass, from the low pressure outlet which is in broken rock which cannot contain pressure. The approximate location of the bulkhead will be determined by drilling but final location will be dictated by the ground conditions found during tunnelling.

The turbines will be located as close to the bulkheads as can reasonably be constructed. The purpose for locating the turbines close to the bulkhead is to minimise the length of penstock between the bulkhead and the turbine. The capacity of the penstock limits the hydraulic flow for power generation and water balancing between the reservoirs.

It is notable that the tunnels do not form a hydraulic constraint in the SPHS. The huge over-capacity of the tunnels that link the reservoirs and power stations provide HDL with great flexibility in managing storage levels in the two reservoirs and for avoiding spill, which is equivalent to lost power generation. This provides the company with huge capacity to control the nature and timing of its power output.

The lower part of the schematic also shows the diffuser design and the micro-tunnel which connects the Granity power station to the diffuser. The micro-tunnel is bored using a tunnelling machine from a jacking station near to the Granity escarpment.

Details of the power stations and components of the scheme will be discussed more detail in Part 2 of my evidence.

In addition to the core components of the Scheme shown in the scematic, there is the opportunity to extend the scheme to include the St Patrick's dam. St

Patrick's dam is located upstream of Mt William dam. If St Patrick's dam is connected to the scheme, water that currently flows down the Plover and Fly Creeks to the Mt William reservoir will be captured by St Patrick's dam and pass through a power station before it enters Mt William reservoir. This addition of St Patrick's dam does not increase the water available to the scheme, but it does allow an increase in power generation. This is not a significant quantity but may prove to be viable if power prices continue to rise.

The current consents do not cover the connection of St Patrick's dam to the scheme. Consents will be required in the future if it is decided to proceed with this addition.

Figure 2.5 shows the connections that will be required to include St Patrick's dam.

Figure 2.6 shows the current status of St Patrick's dam. This dam is due for refurbishment as part of the Cypress mine project, at which stage it will be refurbished and raised by 2 metres. The refurbishment is covered under the current conditions of consent held for Cypress mine by SENZ.

There is also the possibility to add a connection between the Mangatini sump which has recently been commissioned by Solid Energy and the Stockton tunnel. This connection will not add additional water to the scheme, but will provide for additional power generation as the water will pass through the Weka power station rather than flowing down Mangatini Stream and being captured at the Mangatini diversion. This connection is shown in figure 2.7.

Section 3: Geology

At this point I will break my evidence to allow Anthony Black to present his evidence dealing with the hydrology and the geochemistry of the site. Figures 3.1 to 3.7 of my evidence are taken from Anthony Black's evidence and will support his evidence.

Section 4: Geochemistry and Acid Mine Drainage

The Brunner Coal Measures (BCM) which form the eroding surface of the Stockton Plateau in most areas other than where granite outcrops occur naturally weathers and in this process forms acidic rock drainage. The acidic rock drainage from each rock surface combines to forms an acidic leachate which depresses the acidity of water naturally flowing from these areas.

The process of open cast mining breaks the BCM into tiny fragments in order to remove the overburden to access the coal deposits. The process of open cast mining takes the waste material and places it back into waste dumps which are far more permeable to air and water than the original massive rock formations. The air and water increase the oxidisation within the waste dumps, leading to acid mine drainage. Acid mine drainage has the potential to substantially lower the pH of the streams draining these areas and leads to severely effects on the fresh water ecology.

Figure 4.1 shows the sources of acid mine drainage within the catchments of the SPHS. These are all within the Stockton Plateau and are historic, current and future areas of mining.

The areas in red are the areas that are outside the current coal mining licence and have been historically mined. Within these areas the coal resource has been mined by underground mining processes. The underground mining processes have led to the subsidence that Anthony Black has discussed in his evidence, increasing the oxidisation processes and leading to an extremely acid leachate from the underground mines which then drain into the watercourses of the plateau.

The areas in red to the north east towards Mt William include Mt William mine, Fly Creek mine, and New mine. The area above Millerton is referred to as the Old Dip mine. Mt William mine, New mine and Fly Creek mine are all areas which contain resources which could be open cast in the future if coal prices return to the levels that have been experienced in the last few years.

The areas shown in figure 4.1 in orange are those areas of the Stockton Plateau where previously underground worked resources are planned to be open cast. The main area is the Millerton mine which is due to commence open stripping later this year.

Total volumes of waste material that will be generated from Millerton pit are not dissimilar to the total volumes of waste that have been created through open cast activities at Stockton mine to date.

The area in yellow represents the current mining activities at Stockton mine. These are all open cast. Most of these areas report to the Mangatini Stream through water management systems that Solid Energy currently has in place, introduced over the last 3 to 5 years.

The areas in brown are areas of BCM which contain old workings which may, in the future, contain economic resources if coal prices increase.

All the areas shown in Fig 4-1 will contribute to future acid mine drainage. While only the area in yellow is currently actively being mined, the historic areas in orange, red and brown are all discharging elevated acid rock drainage and contributing to the very poor water quality in the tributaries of the Stockton Plateau.

There has been extensive investigations to understand the nature and quality of AMD on the Stockton Plateau. Figure 4.2 provides coverage of acid mine drainage surveys undertaken in 2002 by Golder on behalf of Solid Energy.

The results of the studies are shown in figure 4.3 and record the variation in water quality between those watercourses that are not affected by active mining, for instance, Charming Creek; and those watercourses that are severely affected by mining, such as the Mangatini and St Patrick's streams. Photographs of the Mangatini Stream shown in figure 4-4 were taken in 2006 before the benefits of the extensive works undertaken by Solid Energy to introduce improved water control really started to take effect.

The benefits of the active water treatment and lime dosing of the Mangatini are shown in figure 4.5, reported to the Stockton Community Consultative Group in November of last year. The figures show when limestone dosing commenced in 2007 and show the significant improvement in acidity in the lower Ngakawau River and in dissolved aluminium. It is relevant that turbidity and water clarity has not shown the same improvement through the chemical water treatment process. In order to achieve the benefits shown continuous lime dosing and/or chemical water treatment will be required for up to 100 years after miing has taken place. The intention of the SPHS is to avoid the need for chemical water treatment or lime dosing into the future.

Despite lime dosing and chemical water treatment, sedimentation and decolouration still remains a problem as is shown in figures 4.6 – 4.8 which contain photographs of low flows and storm flows over the Mangatini Falls in 2008 and 2009. Solid Energy is addressing the problem of high sediment loads by building substantial sumps in all of its working areas. The control of sediment load from active mine areas is a necessary activity that must continue after the construction of the SPHS. It will be problematic for Scheme operations for levels of sediment as shown in these photographs to be discharging into the Mt William or Weka reservoirs. Future strategies for water management integrated with the SPHS would see the focus on controlling sediment, not on correcting acidity.

Section 5: Hydrology

The SPHS has been designed to create a hydrological barrier between the upper catchments of the Stockton Plateau that are affected by mining, and the lower catchments that have not been affected by development.

The objective of the scheme is to capture all surface runoff from the upper catchments. This will prevent ongoing contamination of the Ngakawau River and will maximise water available for power production. At this stage of design Scheme modelling shows in the order of 20-30% of runoff reporting to the Weka reservoir will be spilt. HDL is confident that in final design this figure will be reduced to in the order of 5-10% spill lost from the system.

Figure 5.1 shows the catchments reporting to the SPHS. As mentioned previously, the main catchments are Mine Creek, Mangatini Stream, Fly Creek, T31 Stream, Darcy Stream, St Patrick's Stream and Plover Stream, AJ Stream and the Weka Creek tributary of Mangatini Stream.

Understanding the hydrology of these catchments, particularly the runoff hydrology, has been assisted by the location of recording stations established for recording and managing the effects of mining. These are shown in figure 5.2 along with the periods of record and the gaps in the records, which affect record quality.

While the period of record is not long in hydrological terms, the records at S14, and S16 used in the hydrological analysis are 15 minute runoff records which allow us to model continuous annual flows through both the hydro scheme and extrapolate this information over the sub-catchments. This extrapolation, referred to as donor, is summarised in figure 5.3 and lists those sub-catchments which have been derived from S14 records and those sub-catchments that have been derived from S16 records.

While no hydrological record is ever considered complete, we believe that the hydrological network established by SENZ for the purposes of mining provides an adequate basis for the design of the hydro scheme.

Figure 5.4 summarises the mean flows that the hyrological analysis indicates will be available from the catchment areas reporting to the hydro scheme. The approximate mean flow is in the order of 5.7 m^3/s from an area of 31.7 square kilometres. This is compared to the modelled base flow of 4.5 m^3/s through the Scheme's power stations.

In summary,

- The hydrology of the affected catchments downstream of the scheme is based on 15 minute water level recordings on St Patrick's Stream (site S16) and Mangatini Stream (site S14), with area and elevation corrections applied. These sites are just upstream of the diversions. While the period of record is short (2002-2007), the variability within the record is considered representative of variability that will determine effects on the ecology of the truncated catchments. Data recorded at five other sites on the plateau has been used as supporting data.

- Hydrological means for the upper catchment captured by the scheme are used for assessment of hydro power potential and assessment of water quality at the outfall. This is appropriate, given the detention effects of the reservoirs and the hydrological data that is available.

- The future ecology has been assessed by considering the frequency and variability of flows from the truncated catchments. The assessments have taken into account the final design objective to eliminate spills from the upper catchment, but have also taken account of the frequency of spills from the scheme to the downstream catchments predicted by the modelling of the scheme concept design in the event that total containment cannot be achieved.

- The current ecology of the streams has been marginalised by AMD and silt loads. It has been assessed that the future ecology of the streams will naturally evolve into a healthy, diversified ecology typical of the pre-mine Stockton Plateau that is in balance with improved water quality and modified flow regimes.

- HDL selected 2006 flow records for hydro power modelling as it was the most complete highest quality flow record. Subsequently, the 2006 series was replaced in the model with other years of flow recordings (2003-2005), with the finding that 2006 represented a wet year for hydro generation, as discussed in the scheme modelling report. The variability of flow within the 2006 series of 15 minute recordings, combined with the analysis of periods of drought in the 2002-2007 records at sites S16 and S14, are adequate to assess effects on the freshwater ecology.

- Climate change scenarios have been considered. The scenarios influenced the decisions to opt for tunnels with surplus hydraulic capacity and maximise storage at each reservoir site. The operating regime for the outfall has been designed to cope with extended periods of drought. Climate changes are expected to be sufficiently gradual for the ecology of the truncated catchments to adapt.

- The effects on ecology have been based on the expectation that the stream ecology will recover to a condition similar to adjoining catchments that have been unaffected by mining or diversions.

- During final design, a hydrological recording network will be established for the purposes of hydro scheme operation (the current network is set up for SENZ’s purposes of managing the effects of mining). This will improve the hydrological data available for scheme final design and operation. However, it is relevant that the use of tunnels with effectively unlimited hydraulic capacity means that the only hydro components that can be affected by uncertainty in the hydrological analyses are the spillway design and the selection of turbine sizes.

- Dams have been specified with the maximum storage volume that current investigations show can be reasonably constructed on the sites. Spillways are physically unconstrained and will be specified at upper levels of prediction. Feasibility design installed generation capacity provides an unusual level of duplication to allow machines to be taken out for service more regularly than normal due to the acidic environment and hence selection is not critical on the quality of hydrological analyses.

- The use of mean water quality for all inflows in the water quality model is a highly conservative approach predicting lower water quality at the outfall than is expected to occur most of the time. This approach has been taken because existing records are not suitable to determine a relationship between water quality and flow, although there is sufficient data to indicate that a strong relationship exists. Hence no account has been take of higher quality runoff into the reservoirs and dilution effects in the reservoirs. During final design, the hydrological network will be developed and field trials undertaken to establish the relationship between water quality and flow rates for the contributing catchments. It is expected that the concept design will be conservative and that actual water quality at the outfall will fall well within ANZECC guidelines. The reviewers support our understanding that the analyses are conservative.

- The deficiencies in the hydrological records will have no material effect on the assessment of ecological effects which can be adequately assessed from the variability demonstrated within the 6 years of 15 minute flow recordings. The deficiencies affect the assessment of water available for hydro generation and represent economic, not environmental risk to the Scheme opertaors.

- It is relevant that the Stockton Plateau is one of the most intensely monitored catchments in New Zealand. HDL has had full access to all hydrological records and analyses. SENZ staff have reviewed the hydrology, scheme modelling and water quality reports to ensure consistency with current work undertaken for Solid Energy. The hydrology that supports this application has supported previous consent applications by Solid Energy for diversion and hydraulic structures on the same tributaries, and has been found appropriate for the purpose. The hydrological methods applied by HDL are the same applied by Solid Energy, which is subject to international peer review under conditions of consent held by Solid Energy.

- A precautionary approach has been taken to the design and economic analysis, whereby when faced with uncertainty, the project team have selected inputs which lead to potentially greatest effects, not least effects. The result is that there are layers of conservatism built into the concept design as is appropriate for assessments of environmental effects at this stage of development.

Section 6: Water Quality Modelling Inputs

The hydrological modelling discussed in the previous section has been used to provide the inflow data for modelling of water quality. Water quality inputs have been based on extensive work undertaken by Solid Energy and others for the purposes of designing water treatment systems on Stockton Plateau. HDL has had full access to this information. The information used for these consents is consistent with information and data used in previous consent applications by Solid Energy.

Figure 6.1 summarises the water quality inputs from the various catchments into the scheme. The water quality inputs have been peer reviewed by Solid Energy staff responsible for the control of acid mine drainage at Stockton mine.

As part of the modelling, some attempt has been made to establish a relationship between mean flow water quality and the water quality that exists at lower flows and during peak events. This is a critical relationship as the nature of runoff from Stockton Plateau is that by far the bulk of total runoff occurs during high intensity events. The nature of rainfall over the Plateau is periods of drought followed by periods of intense rainfall.

Analysis undertaken of all available records has been unable to establish an empirical relationship between water quality and flow. This does not mean that a relationship does not exist, but that at this stage, the data does not support a relationship. This is principally due to the historic recording of data which has focused AMD leachate or low flows, and has been less concerned with the water quality at higher flows. The focus on low flows is driven by the compliance requirements defined in Solid Energy's consents.

The water quality from Stockton Plateau is required to comply with conditions of consent 90% of the time. The remaining 10% of the time is during high flows when compliance is not a requirement; hence, this has not been a focus for previous monitoring. Work that will be undertaken by HDL after consents are awarded will focus on describing this relationship. This will require extensive field sampling during high flow events.

The importance of the relationship can be illustrated by the graphs in figure 6.2. These graphs record the St Patrick's Stream's response to rainfall that occurred during one of the Scheme open days and shows that, as turbidity increases (measure of flow rate) the pH increased considerably. This relationship is very important as the high volumes of storm runoff in the Stockton Plateau Hydro Scheme will be captured and mixed with low flows which are more contaminated within the Mt William or Weka reservoirs. HDL is of the belief that more detailed information on the water quality of storm events will dramatically change the assessments of water quality in Weka reservoir and hence the water quality that is discharged through the ocean outfall will be more benign than is being predicted by our conservative water quality modelling.

Section 7: Hydraulic Modelling

In order to understand and model both volumes of water through the hydro scheme and the quality of water through the hydro scheme, a hydraulic model has been built. The model that is being used for both water quality and hydro scheme modelling is shown in the schematic figure 7.1. The schematic illustrates all components of a future, fully developed hydro scheme.

Elements of the schematic shown in black are the core components of the scheme that are covered by the current consent applications and comprise the

Mt William dam and reservoir, which intercepts flows from St Patrick's, Fly, Plover and T31 streams; the tunnel which connects Mt William reservoir through power station 2 (Weka PS) which acts as a hydraulic throttle and discharges into Weka dam and reservoir; capture of Weka and Sandy Creeks through interception (they report directly to the Weka dam and reservoir); and capture of Mangatini and AJ Streams via the Mangatini weir. Water from the Weka dam and reservoir then discharges via power station 1 (Granity PS) through the Granity tunnel and thence through an outfall to the sea.

Both power station 2 and power station 1 act as hydraulic controls in the water modelling. The other controls in the water modelling are operating thresholds set to ensure the reservoirs do not empty during periods of drought. This is based on low flows and periods of drought taken from the 5 year period of continuous recording.

The red components illustrated in figure 7.1 are optional components covered by the current consent applications. They include the upper Darcy Stream diversion which is via the Darcy tunnel into Mt William reservoir; parts of the T35 Stream, the Mangatini sump which can be captured via drop shafts into the Stockton tunnel, and the Upper Mine Creek weir diversion which will be captured by a tunnel and channel through into Sandy Creek which will then report directly to the Weka dam and reservoir. In addition, parts of Miller and Granity Streams can be collected by drop shafts if that is deemed desirable.

Components of the diagram which are not covered by the current consents are power station 3 and use of the St Patrick's dam and reservoir. In order for the St Patrick's dam and reservoir to be useful for hydro generation, the flows from Fly Creek and Plover Stream must be diverted to the reservoir by canal. Flows reporting naturally to St Patrick's dam are not sufficient, and the storage behind St Patrick's dam is too small, to justify the construction of a penstock and power station. Hence, the decision to add the St Patrick's dam and reservoir and power station 3 to the scheme would be dependent on the economics and environmental effects of a canal which would divert Fly Creek and Plover to St Patrick's dam. These elements are not part of this current consent application because the use of St Patrick's dam is currently covered by a prior consent to manage mine water from Cypress Mine.

All the hydraulic components downstream of Mt William reservoir have been designed to cope with the future addition of St Patrick's dam should it occur once mining in the Waimangaroa is completed, possibly in 20 years' time.

Figure 7.2 illustrates the stage storage curve at Mt William reservoir. It shows the lower operating threshold and that the range of water levels within the reservoir will be in the order of 22 metres if the full range is used. This range will be determined in final design with a greater degree of accuracy and will be subject to the level of risk HDL is prepared to accept through lower quality water which is stratified at the base of the reservoir entering the intakes. Hydro modelling predicts that the water levels will remain within the top 5 m of this range most of the time.

Figure 7.3 shows the stage storage curve for Weka reservoir. For Weka reservoir the likely range will be in the order of 10 metres with water levels remaining within the top 5 m of this range most of the time.

Section 8: Results of Modelling

Scheme modelling predicts the changes in the hydrology of the tributaries that are truncated by the SPHS. This is measured in terms of the flow that corresponds to a given percentage of time exceeded. This analysis is based on the 5 year period of 15 minute interval recordings.

Figure 8.1 shows the effects on the tributaries of the truncated scheme. The tables contain a column called On and Off; “On” means that all components of the scheme, including the Darcy diversion and Mine Creek diversion, are part of the model, and are assessed as part of the prediction of changes in flow exceedence. “Off” means that these components are not included in the analysis.

The results show that the flows within the St Patrick’s Stream are reduced by up to 50% at low flows, but in the order of 40% in high flows. This trend for reducing effects in high flows is consistent for all tributaries and is highly dependant on the assumed distribution of rain fall over the Plateau. It represents average conditions.

Greatest effect on Mangatini Stream is not surprising as the Mangatini is the most degraded watercourse on the Stockton Plateau and has the greatest area of contaminated catchment contributing to the SPHS.

The effects of flow changes in scheme water quality are modelled in figure 8.2. This table summarises a highly complex analysis which assesses water qualities from all the various contributing sub-catchments, routes those through reservoirs and then calculates the water quality in the various reservoirs. The columns that are important for the Scheme are the water quality at the point of discharge from the Scheme. In terms of Scheme operations this is water quality within Weka reservoir.

Figure 8.2 records that water quality predicted at the Weka outfall increases from a pH of around about 3.6 through to a pH of 4.5 from, low, medium and high flows. Remembering that pH is a logarithmic scale, this represents a very significant improvement in the water quality as flow increases. Referring back to figure 6.1, the results show increases in pH from as low as 3.0, 3.1, 2.8 in the upper, most contaminated headwater catchments. This is a substantial improvement in water quality.

HDL expects the predicted improvements in water quality to be exceeded as the analysis uses mean input water quality figures. All parties who have reviewed the analysis agree that use of mean water quality is highly conservative. Additional water quality modelling to establish a relationship between flow and water quality will be the focus for final design activities once consents are awarded.

Figure 8.3 is also of interest as it shows what can happen in terms of water quality reporting to our Scheme when things don't perform as expected within the mining areas. As has been discussed the Stockton Plateau is increasingly being converted from underground mining into open cast mining as the underground mines are open cast to recover the remaining coal. The effect is that the waste from the open cast mining process is stockpiled in waste dumps which, subject to the quality of their construction, can create long term acid load liabilities.

Solid Energy has now developed waste dump designs which are a substantial improvement on the waste dump designs used prior to 2005. All historic waste dumps are gradually being reworked so that they have a capping layer which excludes air and reduces the potential for acid mine drainage from the waste dumps. All new waste dumps will be built in a manner where air is excluded from the waste dump. However, the containment of the acid mine drainage potential, and effectively the environmental liability associated with that, is only as good as the quality of the waste dump construction and the quality of the capping layers that sit over the waste dumps and exclude air and water inflows.

In designing the Stockton Plateau hydro scheme, HDL has considered worse case water quality that the Scheme may have to deal with in the future. A number of scenarios have been considered, including massive earthquake leading to landslides and breaches of the capping layers on the waste dumps through to landslides which may create very large sediment loads.

Figure 8.3 reports on water quality that could be expected at the Weka reservoir and outfall following a major failure of capping layers. The table shows that pH could drop from 4.5 to 2.9; for Scheme operators a dramatic change. Figure 8.3 also shows turbidity that could result based of TSS recorded in the Ngakawau River prior to current efforts to contain the effects of mining through use of sumps and other sediment traps.

The graph listed as figure 5.3 within figure 8.3 shows the potential for the Scheme to reduce high levels of turbidity. HDL believes that this is a very significant environmental benefit. The Stockton Plateau hydro scheme will provide a failsafe buffer to the receiving environments from any calamity that might occur within the mining areas.

The current approach taken by HDL is to build, wherever possible in the system, sediment traps to contain the high sediment loads that could occur through either environmental or mining mishaps. In terms of containing adverse pH that results from such events, HDL has proposed a number of ways in which pH could be corrected, either through correction at Weka reservoir by lime dosing or through community acceptance that high level of acidity deposited for a short period through the ocean outfall is unlikely to have permanent effects on the marine environment.

An alternative protection measure which has been built into the Scheme is the capacity to shut off the Mangatini and Mine Creek diversions. These are the diversions most likely to be contaminated in the event of a disaster, in which case the contaminated water would continue down its current path into the Ngakawau River.

Water modelling undertaken as part of the design shows that water quality at the outfall will comply with ANZECC water quality standards for discharge into marine environment, after reasonable mixing,. This is shown in figure 8.4 and in 8.5, and is supported by Cawthron and in the independent reviewers of our consent applications.

Of importance in terms of amenity value is the clarity of the Ngakawau River as this affects its enjoyment by the community. Figures 8.6 and 8.7 provide the results of water quality modelling that report on the clarity that we could expect to see in the Ngakawau River after the scheme is built. These show substantial and very significant improvements in the water quality with water quality reverting to pre-mining water quality. HDL believes this is a major benefit from construction of the Scheme which cannot be achieved by other processes of treatment.

Concern has been raised about reduction in flows over the Mangatini Falls. Figure 4.6 – 4.8 referred to earlier show photographs of the Mangatini Falls and the Ngakawau River.

Figure 8.8 has been prepared to show the tradeoff between reductions in flows over the falls and improvements in water quality. The Mangatini catchment is shown broken into three areas; the northern area will provide the low flows that in future will be seen over the Mangatini Falls. This water will be pristine and will allow the waterways between the AJ Stream confluence and the Mangatini Falls, to revert back to pristine conditions.

The central catchment in the figure is mostly diverted through into the Weka reservoir via the Mangatini Stream diversion. However, during high flows water will discharge over the weir and will contribute to the flows in the Mangatini Falls. The the southern-most portion of the Mangatini catchment is highly affected by mining. It is our intention to attempt to capture and divert the storm water originating from this area through the scheme under all flow conditions.

The trade-off is that while there will be reduced flow over the Mangatini Falls, water quality will revert to that of a pristine tributary to the Ngakawau River, not a tributary that is currently stained with lime deposits and other chemical deposits resulting from the water treatment process.

A further benefit of the scheme is the reduction in flood frequency in the Ngakawau River. Figure 8.9 has been prepared to show the possible effects of flood risk reduction. When storms occur over the catchments that report to the Stockton Plateau hydro scheme, we can expect to see substantial reductions in flood flows in the Ngakawau River. However, if the storm tracks an alternative route and missed entirely the catchments that report to the Scheme, there would be little or no benefit gained in reduction in flood flow.

Figure 8.10 provides an indication of what is likely to be the reduction in flood flows in the St Patrick's Stream and the Ngakawau River as a result of the construction of the scheme when a storm is evenly distributed over the Ngakawau catchment. The upper graph shows that a 100 year flood at the recording station at the St Patrick's Stream would reduce from 600 m^3/s to 300 m^3/s. The effects of a 100 year flood will be reduced substantially. The reductions in flood frequency are substantial on the St Patrick's Stream because a large proportion of the catchment is controlled by the SPHS.

The lower part of figure 8.10 shows flood frequency changes on the Ngakawau River. In this case we see that after the scheme is constructed, the 100 year flood will be equivalent to around about 820-830 m^3/s. The 100 year flood is now currently in the order of 1100 m^3/s. Construction of the scheme will therefore lead to a significant reduction in the risk of flooding at Hector.

Section 9: Near Shore Environment

Work undertaken for Solid Energy and others looking at both wharfs and possible ocean outfalls in the Granity area has concluded that this section of coast is ideally suited for ocean outfalls due to the bathymetry of the area. Figure 9.1 shows the bathymetric contours off the West Coast between Westport and Granity. They show a gradually deepening bed resulting in water levels at the point of diffusion 600 metres offshore approximately 6-7 metres deep. The construction of the diffuser at the point of diffusion is a relatively straightforward and achievable process in this depth of water.

Figures 9.2 to 9.4 show the coastal marine area at the outfall location showing an active near shore area with a coarse shingle bed. Any deposition of iron or aluminium within this area is not considered to be an issue and will not lead to smothering or other effects that can be significant on the marine ecology.

Figure 9.5 shows the preliminary results of modelling undertaken by Cawthron which supports HDL's assertion that dilution for pHs at flows of around 4.5 m^3/s can be discharged to the near shore environment with minimum effect.

Some form of surface expression of the outfall can be expected from certain vantage points such as a plane flying over the outfall. This may be represented by areas of greater clarity or decreased clarity. It may also be represented by surface disturbances during exceptionally calm periods. Figure 9.6 shows the plume where fresh water from the Manapouri outlet tunnels discharge into the sea into the. This type of surface expression is expected to be noticed at the ocean outfall during calm conditions. However, it is noted that the more normal conditions experienced at Granity are active conditions as represented in the previous figures.

Section 10: Hydro Electric Power Modelling

Using the hydrological and hydraulic modelling described, HDL has run a number of theoretical configurations for the SPHS. Scenarios that have been considered include a range of reservoir volumes at St Patrick's, Mt William and Weka reservoirs and a range of power generation thresholds which represent installed capacity at the power stations and the way in which the throttles formed by the power station are likely to operate.

Figure 10.1 shows the output of HDL's power modelling which reports on 13 different scheme configurations. What can be concluded from the range of configurations is that annual power output in gigawatt hours available for power generation prior to generation losses is in the order of 180 to 300 GWh per year. Base power output may range from 8 to 19 GWh per year.

HDL has focused on maximising the base power output in order to provide security of supply to potential contracted customers within a maximised annual power output. The final scenario that has been consented is a slight variation on scenario 13. The figures recorded for scenario 13 are regarded as conservative as there is still a substantial volume of water lost through the Weka reservoir (83 million m^3). In an operating environment, the flow through the reservoirs would be regulated by transfer of water between the Mt William dam and the Weka dam, and by more sophisticated variation of flows through the turbines than has been modelled.

Figure 10.3 illustrates the output from the model in terms of power generation. The parts of the graph that are shown in the top right of the figure are a close up of a section of the lower graph which represents a full year's annual production based on 2006 rainfall. 2006 rainfall is generally regarded as a wet year, but may be representative of the 20%-odd increase in rainfall expected over these catchments as a result of climate change. HDL believes that scenario 13 using 2006 data is a reasonable estimate of the potential of this scheme.

The scheme configuration has been limited by generating output which is shown in the red boxes as 30 MW at maximum output at Weka Creek and in the order of 13 at Mt William. The data in figure 10.3 predicts a theoretical base output of around 20 MW which, after losses, converts to a power output distributed into the Buller Electricity network of 16 MW, well within the capacity of the existing network. Annual power output will be around 240 GWh per year. Under this scenario, the volume lost from the scheme at Weka Creek is in the order of 26% of total rainfall and at Mt William around about 11% of total rainfall, so there is potential to optimise beyond this level. HDL believes that after inclusion of the Mangitini sump and various other sumps that are available within the upstream areas, power output will increase above that shown under this scenario. Hence in our AEE and supporting documents, we are confident that we will produce a base load in the order of 25 MW after optimisation has been undertaken.

Section 11: Transmission

The SPHS has been designed to be embedded within the Buller Electricity distribution network.

While at this stage it is not anticipated to be necessary, the SPHS has provision in 2016-2017 to make a contribution towards upgrades of transmission capacity from the area. Provision has been made to contribute to upgrading in the area, although at this stage Buller Electricity are unable to determine what the optimum transmission upgrade might be, due to a number of other changes taking place and opportunities for upgrading that they are considering, both within their network and their connection to the national grid.

At this stage I will break my evidence to allow Mike McSherry, the CEO of Buller Electricity, to provide evidence on the capacity of the local network to embed the SPHS.

Section 12: Sedimentation

Some concern has been expressed in section 92 requests about the movement of sediment through the Scheme and our ability to control it.

Management of sediment on the Stockton Plateau has been the subject of extensive investigations by Solid Energy over the last 10 years. Conclusions from this work are that background levels of sediment movement both from waste dumps and from undisturbed country are very low. Sediment movement is almost exclusively attributed to mining operations or other forms of active land disturbance. Once land has been disturbed and rehabilitated, the high degree of permeability of the sandstone BCM used in the rehabilitation results in fines within the surface being drawn back down into the landfill rather than appearing as high sediment loads in stream flows. It is not the case when machinery is working in water and other activities are occurring which lead to sediment entrainment.

Sediment movement is a concern to the Scheme during the remaining life of Stockton mine which is expected to be in the order of 20 years. During this period high sediment loads can be expected from those parts of the mine which are being actively worked. Solid Energy has a programme of creating sumps and other physical sediment traps on all new worked areas. The future mines for Solid Energy which will provide the bulk of their production from 2012 onwards are the Millerton pit and the Cypress pit. For both these pits there is no gravitational flow from the pits. All sediment laden water within the pits will be pumped through sediment ponds before being discharged through to natural water. Hence the risk of high sediment loads which has been characteristic of previous mining operations at Stockton will be reduced.

The commissioning of the SPHS will is expected to coincide with the commencement of mining of Cypress pit and the development of Millerton pit. Hence the period between now and the commissioning of the scheme, when sediment loads are likely to remain problematic, will be prior to the commissioning of the scheme. Post-commissioning of the scheme, sediment loads are expected to be controlled to a far higher degree than they are at the moment.

This said, HDL has designed sediment traps in all inflows to the hydro scheme. These sediment traps have been located at every point inflow to reservoirs and at every point inflow to drop structures and outlets to diversions. The volumes used in the design of the sediment traps is considered excessively conservative by SENZ and not reflective of their current initiatives to control silt movement.

Figure 12.1 shows a typical cross-section of the silt traps that will be located in all locations. These comprise a permeable rock barrier with a filter zone on the upstream face. Silt will be trapped within the upper reservoir area at the coarser gradings. The finer gradings will be deposited within the reservoir itself. Most of the coarser material which will provide the bulk of the sediment will occur in areas which can be excavated without disturbing water within the main reservoir.

In addition, and as discussed previously, HDL has incorporated sediment control gates at the diversions which take water from the areas of active mining, so that in the event of loss of control or major disturbances within the mining area, that is not reporting adequately to a sediment removal process before it reports from the CML, HDL has the option to close off these diversions. In this event sediment-laden water will report to the Mangatini River as it does at present. While this is a highly undesirable outcome, it is a provision that has been made to protect Hydro Development's facilities.

In terms of silt that is transported into the tunnels, silt that is fine enough to remain in suspension will pass through the turbines. Silt that is not fine enough to remain in suspension will roll along the tunnel floor and will end up in the scour on the pressure side of the bulkheads. The probability of sediment remaining entrained within the tunnels is reduced due to the low grade of the tunnels and the relatively large cross-sectional area which will see velocities in the tunnels operating most of the time below 0.5 metre per second.

The scour valves at the base of the bulkhead will be operated as part of regular maintenance during draining the tunnel after the intakes within the reservoirs have been closed. The scour will report to the outlet in the scour channel built into the base of the tunnel portal which will report either into the sediment trap at the top end of Weka reservoir or be diverted through the Granity tunnel emergency outflow to the sediment trap located alongside Granity Stream.

Figure 12.2 is a photograph showing deposits at St Patrick's dam site resulting from the bedload in the Plover and Fly Streams which drain the active mining areas in the southern part of the coal mining licence area. The photograph shows that sediment loads that are deposited will comprise coarse sandstone deposit mixed with coal fines. While this is the current evidence of mining activity, it must be noted that Solid Energy is investing significant sums in facilities within the coal mining licence to prevent depositions of this nature occurring in the future.

HDL is confident that adequate controls will be in place to control sediment discharges from the Stockton Plateau mining areas by the time the scheme is commissioned.

Section 13: Dam Break

At the commencement of the design of the SPHS HDL sought to determine the best locations for reservoirs, the type of construction that was best suited to these locations, and the potential risk that these reservoirs could impose on both the physical receiving environment and the Hector and Ngakawau communities.

The two most likely sites that were identified were the Weka reservoir site and the Mt William dam site.

HDL undertook dam break modelling to reflect the breach of reservoirs that would be located in either of these locations. This dam break modelling looked at the full range of reservoir sizes that at that time was thought to be likely in those locations, and wished to understand the mitigation effect that would occur as a breach originating from a reservoir passed down the stream channels, through the Ngakawau River gorge and then out to sea at Ngakawau. In order to understand the effects of mitigation as the flood wave passed through the river systems, HDL specified generic dam break mechanisms that were considered to be catastrophic to so establish the outer envelope of risk that this Scheme could impose on the community.

Figure 13.1 shows the dam break modelling and the cross-sections used in the modelling. They show the route that a flood wave would take if the Weka main dam breached, if the Weka western reservoir shoulder dam breached, or if a dam located somewhere in the vicinity of the Mt William dam breached. In all cases, the dam was modelled as an earth dam that could rapidly erode so that the entire cross-section of a valley at the location of the dam site would be available for outflow from the reservoir over a very short period of time.

Figure 13.2 shows the extreme breach sections that were assessed. The breach analysis allowed for the entire dams to either rapidly or slowly erode so they would allow full outflow from the reservoirs. This can only occur in practice if either the dam completely fails as may occur in a thin concrete arch dam, or where an earth dam rapidly erodes due to the erodible nature of the dam material itself.

As a result of this analysis, flood flows at Ngakawau were modelled that for the Weka reservoir were within normal expectations of flood flows in the Ngakawau River, but for Mt William dam were considerably in excess of what would be considered to be a large flood in the Ngakawau River. These results are shown in figure 13.3.

In addition, HDL modelled the depth of flow that was likely to occur in the Ngakawau Gorge, particularly in those sections where the Charming Creek walkway exists and users of the walkway could be threatened by a sudden wave moving down the flood channel. Figure 13.3 shows the expected levels of inundation of the Charming Creek walkway at various locations .There are at least three locations where the depth of inundation for very fast breaches of the Mt William dam would be considered to be extremely hazardous and could lead to drowning.

Figure 13.4 shows the flow hydrographs that would leave a breach from the Mt William dam under these conditions, and these are extreme in any measure. The jagged lines that you see on the output shows that the hydraulic modelling, which uses DHI 2D dam break modelling package (considered to be best practice for dam breach modelling) have become unstable and hence the results are not particularly reliable other than to know that they are extreme.

After consideration of these results, HDL made a design choice not to build erodible structures that could breach in the way that has been modelled and lead to a sudden outburst from the dam sites. Our decision has been to invest considerable sums in the construction of rolled compacted concrete structures and to remove all ancillary works that could place those structures at risk from the dams.Spillways and inlet towers have been removed moved or located over the higher section of dam foundation where failure could not lead to emptying of the dams.

HDL has concluded that flooding at Hector and Ngakawau is unlikely to lead to fatalities or to serious loss within these communities, as can be seen by the figures 13.5. The upper figure represents natural levels of flooding within the Ngakawau River and the lower level represents the most extreme levels of flooding that could be expected if Mt William breached rapidly.

However a breach could endanger people on the Charming Creek walkway. As there is a possibility of a fatality in this instance, the NZSOLD high potential impact category has been selected as the appropriate category to build the two dams to. This means that all aspects of the dam design, supervision, construction and subsequent monitoring will be at the highest level possible for structures of these types.

HDL is confident that the level of risk imposed by the dams will be reduced to below an acceptable level and is comfortable proposing the dams at the locations proposed.

Construction of dams requires further consenting and the current consent applications do not give us the authority to build the dams. HDL has proposed conditions of consent that require HDL to involve independent parties in the peer review of the dams. Final design will be forwarded to the Otago Regional Council for dam specialists to assess the design and confirm that the level of risk imposed by the final design is insignificant.

HDL does not believe that any further purpose will be served by undertaking dam break analysis on theoretical rolled compacted concrete structures. We do not believe that the results of undertaking theoretical analysis will be any more significant or more extreme than the modelling undertaken with rapid collapse of earth embankments. We believe the appropriate time to consider further dam break analyses is once the dams themselves are at final stages of design or in the final design process. At this stage we will also consider the other hazards in the risk analysis to put the entire dam break risk into context.

PART 2: SCHEME DESCRIPTION

In this part of my evidence I will describe the civil engineering works required for the SPHS. This part will follow the outline contained within section 5 of the AEE. The part is broken into the following sections:

14 Darcy Diversion

15 Mt William Reservoir

16 Stockton Tunnel

17 Weka Power Station and Transmission Line

18 Mangatini Diversion

19 Weka Reservoir

20 Granity Tunnel

21 Granity Portal and Construction Site

22 Ocean Outfall

23 Land Ownership and Access Agreements

24 Scheduling and Economics

In presentation of this evidence I will refer to attachment 2 containing the figures for sections 14 to 24.

Conditions of Consent

HDL has proposed draft conditions of consent that will cover the construction of all aspects of the Scheme. The conditions of consent define noise management, water management, control of silt, and all other aspects associated with vibration and other construction activities. The conditions of consent have been developed in consultation with the consent authorities, and we believe are both workable and have been proven on similar projects both on the Stockton Plateau and elsewhere in New Zealand. There is general precedent for the conditions of consent that we propose.

In describing the components of the SPHS, the conditions of consent are assumed to be applied.

Section 14 Darcy Diversion

The Darcy diversion is the most elevated section of the SPHS, collecting mine leachate from the Mt William mine. I refer you to figure 14.1. Mt William mine is located above the Mt William reservoir in the Mt William range. In figure 14.1 the mine can be seen on the left lower part of the photograph with access tracks running through to the mine.

On the eastern side of Mt William mine are waste dumps and tailings associated with the underground workings at Mt William mine.

Leachate from these workings drains down into the tributaries of the Darcy Stream and further north to a tributary of St Patrick's Stream.

The Darcy diversion will be driven beneath these watercourses in order to intercept the leachate flow and runoff that can be achieved with simple stream bed intakes.

The Darcy diversion will be driven from within the footprint of the Mt William reservoir which is shown at the top left hand corner of figure 14.1. The tunnel has got to be on a relatively flat grade in order to achieve pickup at the Darcy Stream diversions due to the relative elevations of the Mt William reservoir and Darcy Stream.

In order to construct the tunnel a portal will be established at Mt William reservoir and the tunnel will be driven from the reservoir back beneath Mt William and beneath the points of intake of the Darcy and St Patrick's Stream tributaries.

As for all tunnels in the SPHS, the dimensions of the tunnel will be determined by the minimum size required for tunnelling purposes. Tunnelling processes have been described previously in the evidence by Anthony Black.

The anticipated sequence of construction is described below:

- An access track will be formed through the reservoir site to the tunnel portal site.
- Just downstream from the tunnel portal site the silt trap will be formed. Initially this will comply with the requirements of Auckland Regional Council TP90 recommendations for the control of silt in earthworks, but upstream of the TP90 control a permanent silt trap will be developed as

shown in figure 14.1. This silt trap will also form the platform from which the tunnel portal is established.

- The tunnel portal will be formed using similar methods to those used at the other portals of the SPHS. This will involve stabilisation of the outer face of the hillside through methods of spilling.

- The first section of tunnel will be through slope debris, in this case expected to be in the order of 20 metres thick.

- Once the portal is established, tunnel driving will take place from the tunnel face using drill and blast methods.

- In order to accommodate the equipment required for drill and blast, the tunnel dimensions will be approximately 2.5 x 3.5 sm in diameter.

- The tunnel will be driven progressively from the outlet portal through to the first pickup shaft above the tributary of the south branch of the St Patrick's Stream. It will then continue beyond this point through to pick up the Darcy Stream first tributary and the Darcy Stream second tributary as shown in figure 14.1.

- Where the tunnel passes beneath the stream, a vertical shaft will be bored from within the tunnel through to the surface.

- Before the raise shafts are bored, an exploration drill rig will be flown in to the location of the intake and through the bed of the tributaries a bore hole will be driven into the tunnel. This bore hole will be used to direct the vertical raise boring to create the intake point.

- This process will be repeated on each intake.

- At each intake the stream will be diverted around the intake position to ensure water does not flow down into the raised bore as it is being formed. Once the bore hole has been completed, a pre-cast intake structure will be flown to site and located over the bore hole. This intake structure will have a slotted grille on it; the intake is designed to capture leachate and as much of the higher level flows as can be achieved without forming a permanent weir in the watercourse. The purpose of these intakes is not to collect water for hydro generation, but to collect the most contaminated leachate from the site. During higher flows the leachate is of a higher quality and is not such a concern in terms of pollution of St Patrick's Stream.

- The exact location of the intake structures and the Darcy tunnel will be determined by geotechnical drilling prior to construction of the tunnel. Geotechnical drilling will be undertaken using exploration rigs that are flown to site by helicopter. Exploration drilling in this way has minor impact on the stream beds.

Section 15 Mt William Reservoir

Mt William reservoir is formed across the St Patrick's Stream immediately downstream of the Ngakawau and St Patrick's Stream junction but upstream of the junction of T35 Stream and St Patrick's Stream. In this area T35 Stream defines the boundary of the Ngakawau Ecological Reserve.

One of the objectives of the SPHS has been to avoid any disturbance of the Ngakawau Ecological Reserve. Figure 15.1 provides a plan of the dam and impoundment area. The dam comprises a rolled compacted concrete mass structure which extends from the eastern abutment across St Patrick's Stream and then follows high ground contour through to the western abutment beside the escarpment forming the eastern boundary of the old Fly Creek underground workings. With the exception of a scour that is formed in the bed of St Patrick's Stream to control stream flows during construction, there will be no other apertures in the dam. All services will be provided separate to the dam. The intake tower will be a separate structure as is shown in figure 15.1. In this way HDL have removed all risk from the dam structure. In addition the spillway is formed in a low part of the shoulder dam and is directed over original ground through to T35 Stream. In event of spillway failure the dam could only be eroded a matter of five to seven metres preventing full release from the reservoir.

All flows into the reservoir pass through permeable silt traps as shown on plan 15.1. This allows the silt traps to contain the larger particles within an area that can be easily accessible for maintenance. Finer particles that pass through the silt traps will remain in suspension and will tend to pass through the outlet tunnel. The outlet tunnel will be surrounded by yet a further silt trap to prevent scouring of the very fine deposits or any deposits which do occur within the reservoir from entering the intake tunnel. At the southern end of the reservoir there is some higher ground. That area will be retained for the purposed of temporarily storing silt which is removed from the silt traps.

During the operation of Stockton mine or any other active mining activities upstream of Mt William reservoir any silt that is released from the mining activities will be recovered from these silt traps and returned to the mine operations.

All operations required for the construction of the Mt William dam, the intake tower, silt traps and the Darcy diversion will take place within the inundation area of the reservoir. Figure 15.1 identifies a number of features within the footprint of the reservoir. These features are located indicatively on the plan, their final location to be determined through geotech and geological investigations. These features include:

- An excavation around the intake tower that will connect the St Patrick's Stream to the intake location to provide the lowest point of the reservoir. This excavation will provide the granite aggregate required for the construction of the reservoir.

  A concrete batching plant will be formed above the St Patrick's Stream to form the concrete for both the dam aggregate and the concrete required for the ancillary works.

- All access construction through the reservoir will be by construction tracks which will generally follow those tracks which are already established on site.

- The dam footprint will provide a source of plant materials that will be useful for rehabilitation both within with the SPHS footprint area and also for Stockton mine or for Department of Conservation activities.

- It is not HDL's intention to strip any land that is not required for construction purposes. However HDL will make any part of the reservoir footprint that will be lost to inundation and contain valuable plant materials available to any party who wishes to recover this material.

- Logs and other debris which are within the site which are likely to cause problems at the intake structure will be recovered and disposed of.

Figure 15.2 provides a computer generates three dimensional image of the Mt William reservoir for a upper water level of 570 metres. Final water level will be determined in the design process but is likely to be in this order plus or minus five metres. Figure 15.2 shows the very low shoulder dams that form the bulk of the length of the reservoir dam and the higher section of the dam that is located above St Patrick's Stream. Through the centre of the illustration can be seen the existing access road through to Mt William mine.

Figure 15.3 provides a panorama from Mt William. This shows the reservoir barrier across the northern part of the confluence of the St Patrick's and T35 Stream flooding back to the confluence of Plover and St Patrick's Stream.

Figure 15.4 provides another perspective of the reservoir taken from above St Patrick's Stream looking north. Again the main dam can be seen in the bed of the St Patrick's Stream with the low shoulder dam running to the northwest. The red dotted line indicates the maximum level of flooding.

Figure 15.5 provides a schematic of the dam taken from just above the low water mark showing the upper level of water inundation and by the dotted line the lower operating level. The intake is shown as a tower on the left hand side of the figure. A trench will be excavated from the tower through to the bed of the St Patrick's Stream so that the lowest point of the reservoir is at the tower. For the purposes of future operation and inspection of the dam the watering of the reservoir site will take place through the tower not through the sluice that is built under the dam within St Patrick's Stream. It is our current intention to permanently seal the sluice within St Patrick's Stream on completion of construction and before filling of the reservoir commences.

Figure 15.6 provides a simulation of the main section of dam where it crosses St Patrick's Stream.

A geological map of the Mt William dam site is provided in figure 15.7. The red speckled areas on the map indicate granite showing that the proposed dam site and shoulder dams are located mainly in granite. Along the route of the shoulder of the dam there is BCM sitting over the granite foundation. During construction, the BCM will be stripped through to the granite foundation and both the shoulder dams and the main dams will be located on granite.

Figure 15.7 also shows the location of the Mt William fault and the Mangatini faults both of which have very low return periods of rupture, as discussed in Appendix B.

The foundation of the dam where it passes at its highest point over St Patrick's Stream is shown in figure 15.8. Massive granite is shown right across the crossing at this location.

The general layout of a rolled compacted concrete structure is shown in figure 15.9. The detail of this figure is discussed in Appendix B. It is noted that since these plans were developed, HDL has taken a number of measures to eliminate risk of dam breach, one being to remove all apertures and all services through the actual dam structure itself as previously discussed. The spillway as shown in this figure on the dam face and the spillway apron will not be required as the spillway will be located in natural ground.

The heights of the dams both in the central portion above St Patrick's Stream and in the saddle section that runs from St Patrick's Stream through to the western abutment is shown in figure 15.10. Over most sections of the saddle dam the height of dam above existing ground is in the order of 5 to 10 metres. Greatest height of dam is at St Patrick's Stream and is in the order 40 metres high. In terms of dam breach risk for rolled compacted concrete dam structures, dislocation of major blocks of the dam is the most likely failure scenario associated with massive earthquake movement. As can be seen from figure 15.10, massive dislocation of the shoulder dams could not lead to emptying of the reservoir and the dam break extreme flood predictions discussed in part 1 of my evidence. Dislocation of the dam would need to take place at the central portion above St Patrick's Stream in order for a major outflow to occur from the structure.

I describe below the anticipated sequence of construction of the Mt William reservoir and refer back to Fig 15.1:

- Within the reservoir footprint the areas that are to be disturbed to construct the intake channel, concrete batching plant and dam filled batching plant will be stripped of vegetation. Strippings will be used to rehabilitate the Scheme site. Any areas that are not used for this purpose will be made available to Stockton mine or to the Department of Conservation for the purposes of rehabilitation elsewhere on the Stockton Plateau.

- Silt controls will be established around all work areas. Silt controls will be built in accordance with Auckland Regional Council TP90 guidelines for the management of silt and earthworks which is within New Zealand a de facto standard for controlling silt on greenfields earthworks development sites.

- The intake structure will be excavated and will produce the aggregate required for dam construction. The excavations will augment the aggregate produced from the Stockton tunnel and the Darcy tunnel. Excavations will also be used for road sheeting.

- A concrete batching plant for dam ancillary structures will be set up. This concrete batching plant will also be used at Weka reservoir and will be relocated for those stages of construction when ancillary works are being built.

- A batching plant to create the aggregate for the rolled compacted concrete dam fill will be set up. This will be a larger batching plant than would normally be associated with concrete pre-cast works recognising the larger volumes involved in producing aggregate.

- By this stage the dam foundations will have been stripped to competent rock. As will be discussed later in my evidence it is HDL's intention to de-risk this Scheme by stripping dam foundations as a very first activity prior to the full implementation of the construction contracts.

- Any defects that are identified in the dam foundation will be repaired. A grout curtain maybe installed but this is not considered likely at this stage of investigations. Over most of the length of the shoulder dams it is our intention to excavate through the BCM into competent granite. Grouting will only occur where defects in the underlying granite are detected.

- A sluice will be formed to one side of St Patrick's Stream. As mentioned earlier, this will be a temporary sluice to divert waters through the dam site until such time as the dam is completed. At that time the sluice will no longer be required as the lowest point of the reservoir will be at the intake tower.

- St Patrick's Stream will be diverted through the sluice.

- Dam construction will commence including the installation of permanent monitoring galleries within the dam structure. It is noted that construction of rolled compacted concrete structures are very resistant to erosion during the construction process. If at any stage during construction a flood occurs St Patrick's Stream that is greater than the capacity of the sluice and leads to overtopping of the dam only minor re-scarification of the concrete surface of the highest lift of the dam needs to be re-worked. A rolled compacted concrete structure is not exposed to pre-completion scour failure as is the case for dams built of erode-able materials.

- The outlet tunnel will be constructed at the location of a drop-shaft which will be bored up from Stockton tunnel. Other options for forming the drop-shaft will also be considered other than a raised bore. At this stage HDL is also looking at excavating the raised bore from the surface. Both methods have their advantages and disadvantages and a decision on which method that will be used will be a matter for final design.

- Permanent settlement traps will be constructed across the Plover and Fly creeks intersection and across St Patrick's Stream at the head of the reservoir.
- A permanent access road to the Darcy Stream diversion will be constructed across the dam crest and above the eastern perimeter of the reservoir. The road will also service the settlement traps.
- On completion of the dam the sluice will be sealed. All construction plant equipment and materials will be removed from the reservoir footprint and controlled filling of the dam will take place. Full monitoring of the dam will take place as the dam is filled for the first time as required by NZSOLD's (New Zealand Society of Large Dams) requirements for the operation of large dams.

Extensive geotechnical drilling of the dam site will be required before the final design layout can be completed. As a result of this investigation the exact location of the main dam and saddle dams including the spillway and outlet structure will be selected. The final design is likely to lead to changes to the depths, elevations and layout of the dam and reservoir but these are expected to remain within the reservoir footprint generally as shown in figure 15.1.

Construction of the Mt William dam and the works described is expected to take 18 months. It is HDL's intention for geotechnical investigations to commence as soon as consents are granted. These will focus on proving the foundations of the dam and the intake tower in order to de-risk the Scheme for institutional investors.

Construction of the dam will run in parallel with driving Stockton tunnel. The tunnel must be completed before the dam outlet tower can be built in order to ensure the location of the tower is correct. The sealing of the sluice and flooding of the dam will not commence until the Stockton tunnel is completed and all aspects of the diversions downstream of the Stockton tunnel are also completed.

Section 16 Stockton Tunnel

Water from the Mt William reservoir will exit through the outlet tower into Stockton tunnel. Stockton tunnel will be approximately 3850 metres long and will connect the Mt William dam to the Weka power station which will be located within the outlet portal of the Stockton tunnel.

The Stockton tunnel route and profile is shown in figure 16.1. The tunnel profile shown in figure 16.1 is the minimum required to contain pressures within the tunnel. In final design, we expect the grade of the tunnel to be reduced to approximately 3% to facilitate the use of rail-mounted tunnelling equipment. This will have the effect of increasing the drop shaft underneath the Mt William intake to approximately 60 metres deep.

The Stockton tunnel will function as a pressurised penstock with pressure rising from approximately 90-100 metres at the intake to approximately 175 metres at the Weka power station.

The tunnel will be unlined except where defects in the rock mass need to be sealed. Provision has been made to include several drop shafts to collect acid mine drainage leachate from the streams that pass over the top of the tunnel and for managing surge.

At this stage of design the drop shafts would not be constructed purely for ventilation purposes as the costs of the drop shafts are deemed to be greater than the costs of providing forced ventilation from the intake portals.

A schematic of the termination of the Stockton tunnel is shown in figure 17.1. It is relevant that the same arrangement is used for the Granity tunnel termination which will be discussed later.

As shown in figure 17.1, there will be a bulkhead within the tunnel approximately 150 metres from the outlet where the pressurised section of the tunnel will end. The intake manifold to the power station will connect to the bulkhead. The location of the bulkhead will be where the rock mass is deemed competent to contain the pressure within the penstock within the high pressure side of the tunnel.

The excavation for the powerhouse will be located immediately downstream of the bulkhead. Downstream of the bulkhead the tunnel will not be under pressure. The excavation for the powerhouse will be on the competent rock side of the fault and the slip planes that exist at the portals of both the Stockton and Granity tunnels, as shown in figure 17.1.

The purpose for locating the powerhouse underground at this point is so that in the event of movement of the Millerton Fault (or the slip faces above Granity) the only disruption to the scheme will be loss of the portal and will not lead to uncontrolled release of high pressure water from the tunnels. Fault movement should also not lead to damage of the powerhouse or its installation where it has been formed within the competent granite materials.

The bulkhead also contains a scour outlet which allows for the removal of rock that fritters from the unlined sections of the tunnel or for any buildup of debris that can otherwise enter the tunnel. Operation of the scour will require that the intake tower is closed and that the Stockton tunnel is drained through the scour.

An outlet channel is formed in the base of the outlet portal and will scour to either the Weka reservoir or, in the case of the Granity tunnel, to the emergency spillway and into Granity Stream.

The turbines and generators will be contained underground within the powerhouse along with any high voltage switching gear required to connect through to the Buller Electricity transmission network.

Figure 17.2 shows a typical Pelton power station installation which will be similar to those installed in both the Weka and Granity powerhouses.

The anticipated sequence of construction of the Stockton tunnel will be broken into two phases. The first phase will establish the portal and determine the location of the interface between the fault-affected rock at the Millerton fault and the underlying competent granite. This work will precede the other construction works on the site and will be a part of de-risking the Scheme.

Construction of the portal will involve careful spilling through the slope debris and fault zone. An access track will be formed from the 25 haul road through the Weka reservoir footprint to the site of the portal. At this point silt traps will be formed below the construction site to control any water associated with the portal formation and a working platform will be created. The portal will be formed by stabilising the rock around the portal using spilling techniques and a fully reinforced concrete portal will progress into competent basement material.

The second phase of tunnel construction will follow establishment of the portal and the installation of the electrical and ventilation equipment required for full scale tunnelling. The tunnelling will then commence and is expected to take in the order of 3 years from the Weka reservoir through to Mt William reservoir.

The use of ventilation shafts will be dictated by economics and by the interest of other stakeholders in collecting leachate from the streams that pass directly over the tunnels. If there is interest and funding, then drop shafts will be located to provide both ventilation and collection of leachate.

If drop shafts are to be included, the drop shafts will be guided by pilot holes drilled from the surface. Drilling of the pilot holes will take place using exploration rigs which will be flown to the location or will access the sites from the Mt William access road. The exploration bore holes will guide the raised bore equipment to raise the drop shafts from within the Stockton tunnel.

As for the Darcy tunnel, all operations associated with the construction of the Stockton tunnel will take place from within the footprint of the Weka reservoir. No land outside the upper inundation levels of the Weka reservoir will be disturbed as part of the construction of the Stockton tunnel.

Section 17: Weka Power Station and Transmission Line

As discussed, the Weka power station will be built in a chamber within the Stockton tunnel portal. The power from the power station will be distributed by a spur line from the portal outlet through to the existing 33 KV line owned by Solid Energy. The connection to Solid Energy's 33 KV line is expected to be close to the disused No 4 aerial ropeway station. The spur line connection is shown in figure 17.3.

Figure 17.3 also shows the proposed Meridian 110 KV Mohikinui power scheme transmission line which passes directly over the Weka reservoir.

Some concern has been expressed by Meridian and Council staff regarding the cumulative effects of the Weka power station spur line and the proposed Meridian line and/or the existing Solid Energy lines. Figure 17.3 shows quite clearly that cumulative effects will be minor and will dominated by the combination of the Meridian line and the existing Solid Energy 33 KV line.

Figure 17.4 shows the effect of two major transmission lines running in parallel that are already existing on the Plateau. In figure 17.4 the Datacom lines that have been strung along the old aerial ropeway towers dominate the landscape. To the right of the aerial route can be seen Solid Energy's 33 KV line which feeds Stockton mine from Ngakawau. The SPHS will be similar to Solid Energy's 33 KV line as shown in figure 17.4. We believe that cumulative effects are insignificant.

Some concern has also been raised that the spur line will be visible from Millerton. Figure 17.5 provides a photograph from Millerton looking in the direction of station 4 which is the red building in the centre of the photograph. Above station 4 is a dotted line which shows the route of the spur line from Weka reservoir to connect with Solid Energy's existing line as it will be visible from Millerton. It will require extremely good eyesight to detect the spur line within the existing environment.

The AEE and HDL plan C005 also refer to the possibility of locating the Weka power station external to the Stockton tunnel. This is not HDL's intention and will only need to be considered if conditions in the Millerton fault at the portal to the Stockton tunnel prove more difficult than is anticipated and make it more practical for the power station to be located external to the tunnel. In this eventuality a high pressure penstock will extend from the bulkhead out to a location to the west of Weka Creek as indicated in plan C005.

Section 18: Mangatini Diversion

The Mangatini diversion comprises a tunnel which extends from the Mangatini Stream in to the inundation area of the Weka reservoir as shown on plan C005. Figure 18.1 shows the route of the tunnel above ground. The AEE refers to the possibility that the tunnel may in part be open channel. This will be required if the diversion route through the Mangatini fault line which is in the middle distance requires an open channel for construction purposes. Construction purposes will be dictated by economics and the costs of bolting the roof of the tunnel exceeding the costs of open excavation.

The location of the Mangatini diversion weir is just downstream of the confluence of the AJ Stream as shown in figure 18.2.

The diversion weir consists of a low concrete dam built across the stream which diverts the stream flows through a tunnel portal in the direction of Weka reservoir as shown in Fig 18.3. The tunnel portal will be fitted with a gate which can be dropped in the event that maintenance is required on the diversion tunnel or water flows within the Mangatini Stream are highly turbid, in which case we would not want that water flowing down into the Weka reservoir. In order to construct the diversion weir, a sluice is required to be built first within the Mangatini Stream to take the Mangatini flows during construction. This sluice will be permanently blocked on completion of the structure.

A schematic of the diversion weir and tunnel is shown in figure 18.4. Final design of the weir will divert all flows and bedload to the Weka reservoir. There will remain extreme flood events which will exceed the capacity of the diversion tunnel and these will continue to pass down the Mangatini Stream over the weir.

The Mangatini diversion discharges into the southern upper levels of the Weka reservoir. Water diverted through the diversion and any bedload carried will pass through a silt trap before entering the reservoir, as shown in figure 19.1. Access to both the intake and the outlet will be via the access road to the Weka power station and Stockton tunnel portal. Machinery access to the Mangatini diversion weir will be via the diversion channel and tunnel. A foot access will be formed to the intake weir for the purposes of maintenance and monitoring.

The Mine Creek diversion weir and intake tunnel is a mirror version of the intake to be built on the Mangatini shown in figure 18.4. The location of the diversion is shown in the schematic in figure 19.2. The Mine Creek diversion discharges into Sandy Creek and thence into Weka reservoir, as shown in the figure.

Section 19: Weka Reservoir

The Weka reservoir is located in the area of the historic Tin Town located on the Tin Town Bend of the 25 haul road. A plan view of the reservoir and a schematic are shown in figures 19.1 and 19.2.

The general extent of inundation and location of both the main dam, shoulder dams and intake tower is shown in figure 19.3. As for the Mt William reservoir, the intake tower will be formed in a depression directly above the Granity outlet tunnel. All other aspects of the construction of the Weka reservoir are as for the Mt William reservoir. Figure 19.3 indicates both the upper and lower levels of inundation.

A computer simulation of the inundation and dams for Weka reservoir is shown in figure 19.4. The Weka reservoir shows the main dam in the Weka Gorge, the shoulder dam that follows out to the southeast, and the shoulder dam that forms across the existing route of the haul road to the west. The simulation is for a water level at RL 384 metres, the consented application is for 390 metres. The simulation shows the haul road disappearing into the reservoir and then beneath the shoulder dam to the west.

As for the Mt William dam, the main dam structure for Weka reservoir will be formed in granite as shown in the geological map in figure 19.5. Both the shoulder dams for Weka reservoir are expected also to be founded on granite in trenches cut through the BCM, although the exact location and depth of foundation will not be determined until geotechnical drilling is completed along both these routes.

The construction of the Weka dam will be rolled compacted concrete as for the Mt William reservoir dam and is shown schematically in figure 19.6. Again as for the Mt William dam, it is not our intention to incorporate the spillway or any outlet structures within the dam, but for these to be freestanding structures separated from the main dam. This is to reduce the risk of dam breach.

The spillway for Weka dam will be cut in natural ground in the right abutment of the Weka dam and will discharge into Weka Creek.

To provide sufficient capacity within Weka reservoir, the levels of inundation flood the existing 2-5 haul road. They also flood the formation of the electric loco which is considered to have some historical importance. The relocation of the haul road is shown in figure 19.7. The electric loco follows just above the haul road over the lengths shown in figure 19.7 and then continues for a further 4 km through to Mt William reservoir.

Some concern has been expressed that construction of the Weka reservoir will create landscape effects that will be adverse to the residents of Millerton. The zoom view of the location of the Weka shoulder dam, which is all that can be seen from Millerton, is provided in figure 19.8. The western shoulder dam for Weka reservoir will be just visible through the existing cutting for the 2 - 5 haul road as shown in the photograph. HDL does not believe that this creates a significant landscape effect.

Concern has also been expressed about public access through the Weka reservoir site through to the Repo Basin during the construction phase. HDL has undertaken to maintain access through the site for the duration of construction and thereafter. Figure 19.9 shows the access routes that will be available after construction and during construction. Normal requirements to protect the safety of users through a construction site will be enforced, but access will not be otherwise restricted.

Figure 19.9 also shows the location of the silt storage area at Weka reservoir. Silt from the silt traps that are formed both at the outlet to the Mangatini and Mine Creek diversions will be relocated to this area for subsequent disposal within the mine workings at Stockton mine whilst mining continues at Stockton mine. Post-closure of Stockton mine, sediment load is expected to return to background levels which is very low, in which case sediment will be contained within this site and along the route of the old haul road.

Concern has also been expressed on the effects of inundation of the formation of the historic electric loco that used to pass through the reservoir site. The way points that have been identified by the archaeologist are shown in figure 19.10. HDL believes that the inundation of the formation is unavoidable. The formation through this area is at a level of approximately 380 metres. A maximum level of 380 metres would provide very little operating storage and is not viable as a hydro reservoir in this location. For this reason, all dam options considered for this site are above 380 metres RL.

Reference to Appendix 1 of the scheme modelling report, Appendices A and B, provides graphs showing the predicted variations in Weka reservoir surface levels for the rainfalls which occurred in 2003 and 2006 as representative years. It is evident from the graphs that in wetter years (2006) water levels remain above 1,000,000 m^3 most of the time, meaning that the formation will be submerged most of the time, given that storage must drop below around 650,000 m^3 to expose the electric loco formation. In dryer years, such as 2003, the formation will be exposed more often but still infrequently.

At the very first stages of design HDL considered ways of avoiding inundation of both the haul road and the loco formation by running a dam along the side of the haul road to prevent flooding of the haul road. This was discounted as not feasible, due to both cost and issues of saturating the haul road foundation. The full length of the haul road would have had to have been rebuilt at a higher level.

Unfortunately it is not possible to build a hydro reservoir at the proposed location without flooding the haul road and loco formation. A reservoir at this location is required to control contaminated water flows from the Mangatini and Mine Creek catchments. It is notable that all future mining within the coal mining licence area will take place within these catchments. HDL has proposed mitigation for the loss of the section of loco formation that is within Weka reservoir, being the upgrading and protection of the remaining sections of loco line which run from this point right through to Mt William reservoir. HDL believes that this mitigation is both practical, feasible and will have the support of Solid Energy and Department of Conservation as future land owner.

Concern has also been raised about the effects of frequent changes in water levels within both the Mt William and Weka reservoirs. HDL's expectation is that a beach form will develop around both reservoirs between the upper water level and the regular operating water level. That will comprise largely the fine sands that are derived from the BCM which are the principal material that will be transported through the reservoir systems.

Two photographs are attached in figures 19.11 and 19.12 which show the effects of hydro operation at Lake Manapouri. A similar beach form is expected to result over time and it is expected that vegetation around the reservoirs will extend to the high water mark as is the case for this hydro lake. The major difference is that the water level variation at Manapouri is controlled to approximately 2 metres whereas the regular variation in both our reservoirs will be in the order of 4-5 metres.

Section 20: Granity Tunnel

The Granity tunnel connects the Weka reservoir through to the Granity power station located just above the village of Granity. The plan of the tunnel and the profile of the tunnel is shown in figure 20.1.

As for the Stockton tunnel, the grade of the tunnel will be reduced below that shown as minimum requirement in figure 20.1 to around 3%.

A flatter grade will allow the use of steel-wheeled tunnelling equipment which reduces tunnelling costs. Hence the profile shown in figure 20.1 will be modified to show longer drop shafts both at intermediate points and beneath the Weka reservoir.

The entire length of the Granity tunnel will be driven through competent granite as was discussed previously in Anthony Black's evidence. The same tunnelling processes using drill and blast processes will take place as will be used for the other tunnels on this Scheme.

All tunnelling materials will be removed from the tunnel via the Granity portal and all construction materials required for tunnel lining and other temporary works required for tunnelling will also enter the tunnel via the Granity portal.

The alignment of the Granity tunnel has been selected to ensure that there is competent rock above the tunnel to contain the very high pressures within the tunnel which will exceed 370 metres pressure. The alignment has also been selected so that it crosses the faults at the steepest possible angle as is practical. In choosing this alignment the opportunity is available for drop shafts to be located where the Miller and Granity tributaries flow so that leachate within these streams can be captured at the drop shaft locations and discharged into the Granity tunnel. The location and need for drop shafts will be dictated by agreements on whether or not AMD from these catchments is to be captured.

As for the Stockton tunnel, the bulkhead will be located some distance in from the outlet portal at that point where ground pressure is adequate to contain the pressure within the tunnel. The same arrangements as are shown in figures 17.1 and 17.2 for the Weka power station and tunnel portal will be built at Granity.

The Granity tunnel will be approximately 4.8 km long. The final alignment of the tunnel will be dictated by conditions met during tunnelling but is not expected to deviate far from that shown in plans. Tunnelling is expected to take 3 years to complete.

Section 21: Granity Portal and Construction Site

The exit portal to the Granity tunnel is located immediately to the east of Granity village on the boundary of land held by Solid Energy for mining purposes and the Conservation Estate. Access to the tunnel portal is provided off the state highway, across the railway line and by an inclined ramp through to the portal. Figure 21.1 shows the layout of the construction site and its proximity to the village. About 40% of the construction site is on railway reserve while the remaining 60% is on land held by Solid Energy.

This entire area has been subject to development for over 100 years, most recently being an abandoned coal bin area which was levelled by local residents in an effort to tidy up the area. The coal museum is also located in this area and is an attraction for tourists.

Discharge from the Granity power station passes down a channel in the base of the tunnel through a surge chamber which feeds into an outlet tunnel and thence to a diffuser some 600 metres offshore. The entire outlet tunnel from the Granity tunnel portal through to the diffuser is buried underground. The section of pipeline from the portal through to the commencement of the micro-tunnel out to sea will be formed through surface excavation. The micro-tunnel to the diffuser offshore will be constructed through micro-tunnelling techniques whereby the tunnel will be bored from a jacking station located immediately below the tunnel portal.

All construction works required for the ocean outfall micro-tunnel, the ancillary works around the Granity tunnel portal, the construction of the Granity tunnel, and the construction of the underground powerhouse will all take place from within the construction site shown on figure 21.1.

Access to the construction site will principally be directly from the state highway via a redeveloped existing access across the railway as shown in figure 21.2. This access will enter a construction site which will be contained by an earth bund and fence as shown in the figure. Figure 21.2 also shows the approximate location of the tunnel portal with the dashed line showing the approximate grade of the ramp up to the tunnel portal from within the construction site. To the right of figure 21.2 is the coal museum, the railway can be seen in the middle foreground.

Figure 21.3 provides a different view of the same site. Figure 21.3 also shows the Buller Electricity Limited transmission line that passes through the site very close to the tunnel portal. Transmission from the Granity power station will be via a short spur connected from the tunnel portal through to this transmission line.

The jacking station required for the construction of the micro-tunnel and ocean outfall will be located behind the hatched box which represents a soundproof mound that will be built around the site. Construction of the micro-tunnel, which is the closest construction works to residents of Granity, will not take place until the third or fourth year of construction, by which stage sufficient materials from the tunnelling operation will have been produced to form a sound-deflecting bund around the Granity site. The only party affected directly by construction activities will be the Granity Museum. HDL has undertaken to schedule works around activities at the museum and to take due care to minimise effects on the museum.

Figure 21.4 contains a generic table of noise likely to be created by a full range of construction equipment that may be used by HDL. This table is taken fron evidence provided at the Mokihinui hearings. The table provides distances to achieve given noise levels assuming open terrain. The figures includes a scale to assist in the assessment of noise effects at Granity from the from (1) the portal and (2) the jacking station within the Granity construction site. The figure shows there are no affected parties within the expected distances to achieve the noise requirements emanating from the Stockton portal.

For the noise emanating from the jacking station, the figure shows that in the absence of a noise bund and use of silenced gear, there would be a number of properties affected by noise. However, these will not be affected as shown after HDL has taken the noise suppression steps proposed in the conditions of consent. HDL is confident that the construction of a noise bund along the western side of the construction site will allow it to meet the requirements of our proposed conditions of consent for containing noise.

Figure 21.4 also shows the location of the state highway and the railway line in respect of both our construction site and the residents of Granity. Concern has been expressed about both noise and vibration caused by the construction of the SPHS. HDL believes it is relevant that the state highway has traffic loads of between 200 to 600 vehicle movements per day to Stockton mine alone. In addition to this, there are the traffic movements through to the Ngakawau coal handling station and further north to Karamea. HDL is likely to add to this daily traffic load by around 10 heavy vehicles a day, plus workforce and periodic delivery vehicles. We believe that our traffic effects are insignificant.

Vibration caused by activities at the construction site need to be considered in the context of the location of the tunnel and also the location of the railway line. KiwiRail's Ngakawau line has between 8 - 20 1000 tonne coal train movements per day. In total, 3000 to 4000 coal train movements occur every year, and with each coal train movement, the ground alongside the railway line is vibrated to the extent that it can be felt at some distance. Heavy transport movements along the highway also create the same vibration effects. The properties within the Granity area close to the construction site are continually subjected to vibration.

Experience at other micro-tunnel construction sites has shown that vibration has not been a problem when this occurs in residential suburbs which are not subjected to either a railway line or a state highway with high vehicle movements. HDL is confident that it can work within both the noise and vibration standards that we have proposed as the conditions of consent for this Scheme.

Access to the Granity tunnel portal will require the construction of an access ramp through the existing vegetation. Figure 21.5 shows a schematic of where the ramp would incline up through existing vegetation. At the point of the photograph the Millerton Track is present as is the power line that delivers power through to the Millerton community. The effect of forming this ramp will be to interrupt this track and HDL has allowed to form an access to provide continuous access through the site and across the access ramp through to the Millerton Track.

On completion of the SPHS, there will be a permanent access ramp formed to the tunnel which will be very similar to that shown in figure 21.6 which is the access ramp to the Manapouri tunnel portal. HDL does not believe that this track will be visible from Granity once the vegetation is re-established. Every effort will be made to retain the vegetation along the Granity Village side of the ramp.

Figure 21.7 is a photograph of the Manapouri tunnel portal. This will be very similar to the Granity portal though at a slightly larger scale. The Granity tunnel portal will be enclosed for public security reasons, as in fact is the Manapouri tunnel portal but the gates are not shown as closed in this photograph.

Section 22: Ocean Outfall

The ocean outfall is to be formed using micro-tunnelling techniques whereby the tunnel is bored from the base of a jacking pit and as the tunnel is bored, sequential sections of pipeline are installed and are used to jack the tunnelling machine out to sea. The tunnelling machine is not dissimilar to any other drilling operation being fed using drilling muds which are recirculated at the jacking station. The tunnelling machine can be steered accurately out to the diffuser point located offshore.

Figure 22.1 shows a jacking station used for the Christchurch ocean outfall that has recently been completed. Of relevance is the noise bund built around the jacking station to contain noise from the immediate vicinity of the residential properties which can be seen in the background. In this area vibration was measured in the local area as was any settlement on the roads. There was no significant vibration or settlement detected during the construction.

Figure 22.1 shows the jacking station in the foreground, a crane which is used for lowering both the tunnelling machine and the sections of outfall pipe into the jacking hole, and the other silenced equipment used for maintaining the equipment as it is tunnelling. Jacking is a 24 hour a day operation and is suitably equipped to work within noise sensitive areas.

Figure 22.2 shows a typical cross section of an outfall pipe that is used in the jacking operation. The outfall pipe is reinforced concrete with a PE liner.

The micro-tunnel is jacked out to an outfall caisson which is pre-sunk into the ocean bed at the point of diffuser. Figure 22.3 shows a schematic of the ocean outfall terminal diffuser which in our case will consist of a concrete chamber approximately 12 x 6 metres sunk approximately 7 metres below seabed and standing approximately 1.5 metres proud of seabed. The caisson is located in such a way that the micro-tunnel can drive into the caisson which will allow the tunnelling machine to be recovered from the caisson by a barge sitting above the caisson. The caisson after the recovering of the tunnelling machine is then capped with a diffuser cap which provides the principal point of diffusion of water that is discharging through the ocean outfall.

Figure 22.3 shows a secondary diffuser which will be a permeable pipeline laid on the seabed on the line of the ocean outfall extending further out to sea. At this stage the requirement for a secondary diffuser is doubtful but will be determined through further water quality field trials and modelling.

The addition of the secondary diffuser is a relatively simple process which can occur either at the time the primary diffuser is installed, or at some subsequent date where further diffusion is required as a result of the performance of the primary diffuser. The purpose of the second diffuser is to extend the dilution zone so that the water flow past the point of diffusion achieves the required levels of dilution to meet ANZECC water quality guidelines. HDL does not believe that there is any obstacle to achieving the ANZECC guidelines either at the primary diffuser or with the addition of secondary diffusers.

All operations for the construction of the outfall caisson will be undertaken by barge which will be serviced out of Westport. No works are anticipated from the foreshore at Granity other than possible landing of dinghies associated with staff working on the barge.

Section 23: Land Ownership and Access Agreements

Land ownership for the SPHP is detailed in scheme plans C-008a and C-008b.

Occupation of Conservation Estate

The Scheme is located on the Conservation Estate between Stockton mine and the Ngakawau Ecological Reserve. Figure 23.1 shows land ownership as it currently exists.

The consented plans have been submitted to the Department of Conservation in support of an application for land exchange to mitigate the effects of the occupation of the Conservation estate by the Scheme. Figure 23.3 shows the Fairdown Block being the lowland forest in the middle distance. The Fairdown Block is a remnant of coastal forest that is highly valued. Valuations have shown that the value of the Fairdown Block exceeds the value of land that will be occupied on the Stockton Plateau.

The land exchange will incorporate an access agreement. HDL understands that DoC see no obstacles for completing the land exchange that cannot be resolved in final negotiation. DoC has withdrawn from this hearing for this reason.

Access to SENZ Land and Licence Areas

A large part of the Stockton Plateau is currently occupied by SENZ who hold freehold title to the land and / or occupy licences issued to Coal Corporation under the Coal Mines Act for mining purposes. HDL has worked with Stockton Mine staff to ensure that access through the mine, undertaken in accordance with the mine's transport management plan, will not disrupt mining activities. In July 2008 HDL requested agreement in principle for the access described below. Agreement is waiting completion of consenting and land exchange with DoC.

Access between the Mine gates and Mt William access road via the 2 – 5 Haul Road

Construction access and access for operation of the Scheme is required from Stockton Road (public road) to the Weka and Mt William reservoirs along the 2-5 haul road. The haul road is built and operated by SENZ on DoC land under the provisions of the Ancillary Coal Mining Licence (ACML) issued to Coal Corporation under the Coal Mines Act. The 2-5 haul road is used to cart coal from the ROM facility at Station 2 to the head of the Ngakawau aerial ropeway at Station 5. In addition to coal truck movements the 2-5 haul road is the main access road into the mine. There are in the order of 1000 vehicle movements per day. HDL will add up to 30 vehicle movement a day.

Access to Granity Tunnel Drop Shaft Intakes via the CML through Millerton Pit

If agreement is reached with SENZ to discharge AMD leachate from the tributaries of Granity Stream via drop shafts into the Granity tunnel, access will be required across the CML via existing access roads that are established for the purposes of mining the Millerton coal resource. Access is required to drill pilot holes and to service the drop shaft intakes. Construction of the drop shafts will be from within the Granity Tunnel.

Access through SENZ land at Granity

Access is required for the construction and operation of the Granity tunnel outlet portal, power station, and ocean outfall as shown in plan C006. The land was previously used for coal bins and coal processing servicing the Millerton Incline. This land is no longer used for mining purposes. The old mine buildings house the Granity Museum. The land is located between the Conservation Estate, where the Granity tunnel outlet portal is to be located, and railway land.

Access to SENZ Mining Permit 41515

Inundation by the Mt William reservoir area extends into MP 41515 (refer to figure 23-2). No coal resources or access to coal resources will be quarantined by this inundation.

Access beneath the ACML for Stockton Tunnel

The Stockton tunnel runs approximately 90M beneath a corner of the ACML as shown in plan C001. No occupation of the surface in this area will be required other than for the possible drilling of a geotechnical exploration hole on the line of the tunnel. There is no economic coal resource or planned mining in this area.

Access across the ACML and CML for the Weka Power Station Spur Line

The spur line runs runs across DoC land including the ACML and the CML from the Weka power station to SENZ’s 33kV transmission line in the vicinity of No 4 Station. There is no economic coal resource or planned mining along the route of the spur line.

Access beneath the CML for the Granity Tunnel

The Granity tunnel runs some 200 - 300m below ground where it passes beneath the part of the CML referred to as the MAPPS area. No activities on the surface are required. The tunnel is sufficiently deep not to be affected by opencast mining of the coal resource up to 50 m below the surface. SENZ has agreed not to mine this area (by MAPPS agreement between SENZ, DoC and the Millerton community).

Realignment of the 2-5 Haul Road at Tin Town Corner

Agreement is required to relocate the haul road as shown in plan C004 to optimise the design of the Weka reservoir. The new haul road alignment will be partly on SENZ land and partly on HDL land obtained through land exchange with DoC. The HDL land will be transferred to SENZ. The realignment will remove the hazardous Tin Town bend. There will be no disruption to SENZ access as the new section of road wil be completd before the old section of road is decommissioned.

Access to CML to Dump Silt in SENZ Waste Dumps

Silt from mining activities that is not contained within the CML is captured in the silt traps at Weka and Mt William reservoir will be dumped in waste dumps within the CML that are open at the.

Access Through Private Land and other Public Land

Figure 23.4 shows the land ownership requirements at Granity for the hydro scheme. Land ownership issues and access agreements at Granity that have been agreed in principle include:

- The Northern Buller Communities Society: to drive the micro-tunnel beneath bare land to the north of the Lyric Theatre.
- Kiwi Rail: to drive the micro-tunnel beneath their land which includes the reserve where the library is built.
- Kiwi Rail: to allow the construction of a temporary railway crossing to the construction site, and to use the railway reserve for construction access and for permanent access through to the portal.
- Buller District Council: to drive the micro-tunnel beneath a strip of road reserve that exists to the seaward side of the Lyric Theatre.
- New Zealand Land Transport Authority: a deed of grant to drive the micro-tunnel beneath the state highway.

Access to Coal Resources

Previous mention has been made to the coal resources of the Stockton Plateau with respect to acid mine drainage. The SPHP will not prevent access to or otherwise quarantine any of these remaining resources. The SPHP will facilitate the development of these resources by providing water management infrastructure which would otherwise make the recovery of the resources difficult or prohibitively costly.

L & M Ltd holds the exploration permits for the land outside the CML boundary, on which the SPHP is to be built. L & M Ltd has not made a submission on the SPHP.

SENZ holds Coal Mining Licences and Mining Permits for the headwater catchments of the SPHP. SENZ's submission states:

> The reasons for Solid Energy's submission are as follows:
>
> The proposed scheme comprises elements that are intended to be located on land owned and occupied by Solid Energy and which would also require Solid Energy to alter its current mining operations at significant cost.
>
> While the parties have held informal discussions concerning these elements no agreement has been reached between the parties.
>
> Solid Energy does not wish to be heard in support of its submission.

HDL is of the view that construction of the SPHP will offer Solid Energy the opportunity to alter its current mining operations to obviate the need for chemical water treatment and to focus on the silt control. However, this will not result in significant costs to SENZ.

All costs associated with provision of access, as referred to earlier, will be funded by HDL. Access can be provided without disruption to SENZ's mining operations. HDL has assessed that the operation of the SPHP has the potential to remove million of dollars of costs from SENZ future mining operations by avoiding the need to construct and operate treatment plants or allowing the early decommissioning of treatment plants that are constructed before the SPHP is commissioned.

The total NPV of benefits accruing from building the SPHP so that chemical treatment of AMD from all sources of AMD is avoided (current and historic both from within and outside the CML as shown in Fig 4-1) has been assessed to be approximately $70M (refer to Fig 24-3). The assessment is based on the costs to neutralise acid tonne loads from each catchment plus rough order of costs for capex required to undertake neutralisation. This method of assessment is consistent with methods used for valuing historic AMD. The input figures have been checked by SENZ. SENZ has noted that some of the capex will not be avoided if the lime dosing facilities and treatment plants are constructed prior to commissioning the SPHP.

Water Treatment Contributions (REAL)		
Avoided acid treatment	***Acid tpa***	***$/tpa***
Darcy Stream	100	240
Fly Creek	1,500	240
Plover Stream	1,500	240
St Pats Stream	1,500	240
Mangatini Stream	5,100	240
Granity Stream	500	240
Miller Stream	1,500	240
Mine Creek	2,800	240
Annual decay in acid load	1.00%	
Total avoided acid treatment costs		
Avoided Investment in acid treatment P&E		***P&E***
Capital Expenditure incurred in year		2011
Darcy Stream		1,500,000
Fly Creek		2,500,000
Plover Stream		1,500,000
St Pats Stream		1,500,000
Mangatini Stream		1,500,000
Granity Stream		1,500,000
Miller Stream		1,500,000
Mine Creek		8,000,000
Lifecycle maintenance % of P&E		5.00%
Annual decay in annual costs		0.00%
Total avoided investment in acid treatment P&E		
Tax depreciation on water treatment plant (diminishing valu		8.00%

Section 24: Scheduling and Economics

It is HDL's intention to schedule the construction of the SPHS in four tranches. These tranches are outlined in figure 24.1.

The first tranche, which will be undertaken as soon as consents are awarded and initial funding is obtained, will be to undertake the high risk components of the scheme which will de-risk the Scheme in the eyes of institutional investors who will be required to fund the bulk of the Scheme. This will involve expenditure of between $5-$10 million over the next 12 months.

The second tranche of funding will be for the major implementation of the scheme and will take place in the 2-3 years immediately following the de-risking of the Scheme. This phase will cover the driving of the tunnels, building of the dams, the ocean outfall and the power station fitout. This aspect of the Scheme is seen to be low risk and is expected to attract institutional and green investors and those parties with a vested interest in the outcomes of the Scheme.

It is important to note that the Scheme can be configured in one of two configurations. The less desirable configuration is for the scheme to be built to generate hydro electricity and to divert the untreated waters from sources of acid mine drainage that are outside the current coal mining licence area. In this configuration Solid Energy would continue to treat water through active treatment processes such as lime dosing and active chemical water treatment. This would be an undesirable outcome but financially viable.

The optimal configuration is for the scheme to be configured to take acid mine drainage to obviate the need for continued water treatment and lime dosing and the attendant side effects of this process. The physical difference in configuration is not major. Additional costs for configuring the scheme to take acid mine drainage and to obviate the need for active chemical water treatment or lime dosing are also not major but still involve a significant investment. This can be undertaken either at the initial stage of the Scheme or can be through retrofitting.

The changes required to achieve the upside outcome of water treatment in addition to power generation include additional gensets within the power stations to allow one genset to always be in service due to the more acidic environment that the genset would be operating within, probable extension of the diffuser by the addition of a secondary diffuser pipe which is extremely unlikely under the downside scenario, and other issues associated with collection of water from, for instance, the Mine Creek diversion, Miller Stream, Granity Stream and other planned collection points that will allow full and maximum benefit to be obtained from this Scheme.

At this stage HDL does not have agreements to develop an integrated water management strategy, and hence at this stage HDL is not in a position to plan funding for the upside scenario of full water treatment. For this reason, figure 24.1 shows a third tranche of funding which would be to spend an additional $40 million over the period financial years 2012 or 2013 to configure the scheme for handling untreated acid mine drainage.

Finally, a fourth tranche of funding is anticipated to allow for a transmission upgrade post-implementation of the scheme in years 2016 to 2017. This transmission upgrade would only be considered if full optimisation of the Scheme hydro modelling resulted in peak distribution beyond the capacity of the existing Buller Electricity Limited network. The decision to proceed with this will relate to a number of matters including nodal prices at the national grid which would have to be sufficient to warrant upgrading the transmission network to sell peaks into the transmission grid. HDL's current approach to modelling of hydro power output has been to maximise the base load and minimise peaks.

The decision to proceed with tranche 4 is a zero risk decision; it will only proceed if there are significant upsides.

In addition to the economic benefits of the scheme, there are a number of stakeholders whose policy objectives will be achieved through construction of the Scheme. Figure 24.2 identifies those parties who stand most to gain from this Scheme, but in ways that are less tangible. Most notable is the treatment of historic acid mine drainage and the treatment of current and future acid mine drainage.

Value to the West Coast of restoring the Ngakawau River estuary and restoring the Ngakawau River water quality is difficult to quantify but is a real benefit of this Scheme. Similarly, and possibly easier to quantify, could be the security of supply to the region and the economic developments or surety that will result from this.

An independent financial viability assessment has been undertaken for HDL by Deloitte. The conclusions from their analysis are shown in figure 24.3. This table outlines the base case configuration where power is the only revenue stream, and the upside configuration where power and acid mine drainage are the revenue streams as discussed. Figure 24.3 shows the substantial NPV that is achievable through the upside configuration and the less modest NPV that the base configuration will provide but which is still substantially viable. Figure 24.3 shows those uncertainties which have most effect on the financial viability of the Scheme which are, in order of importance, the volume of electricity that the scheme is likely to produce, the weighted average cost of capital that the company will face in funding the scheme, and, as always, the actual construction cost or the capex required to implement the scheme.

Deloittes' conclusion from this work is that the scheme is sufficiently favourable to continue the development but that the priority is to firm up on the critical assumptions and upsides available through the scheme. This is the approach that HDL is taking.

The SPHS is quite unique in a number of aspects, most principally because it is owned locally and is being structured to maximise local involvement in the Scheme. Figure 24.4 outlines in summary form that over 75% of the total spend on this Scheme will be within the local economy. This is exceptional for any infrastructure project in New Zealand and should be the basis for receiving strong support from the local community. This is particularly important during a time of recession and during a time where international production and demand in coal is reducing production from Stockton mine by a substantial percentage.

The possible loss of Holcim from the district is also significant in winning support for the Scheme.

The first stages of construction are outlined in figure 24.5 and are expected to include:

- Geophysical and geotechnical proving of the micro-tunnel and tunnel routes. This will include geophysical work along the micro-tunnel route to identify any floaters or massive rocks that, in the past, have fallen from the escarpment and ended up buried within the historic and current beaches. Along the route of the Granity and Stockton tunnels, a number of geotechnical holes will be drilled to confirm the location of faults and the depth and inclination of those faults. Drilling will also be required around the portals to determine the depth of slip debris and fault zone debris that sits above the competent granite basement rock.

- Water quality field trials and advanced water quality modelling to determine the length of the ocean outfall diffuser. Water quality modelling that has been completed to date has been unable to establish from information that has been collected to date the relationship between water quality and flow. While this relationship is not important if the principal focus is the treatment of leachate, the relationship becomes important when the principal purpose of the design is to detain waters both from high flow events and low flow events.

  The effect of current assumptions that a relationship between water quality and flow cannot be applied is that mean water quality has formed the basis for the water quality modelling and hence is providing a conservative assessment of water quality at the ocean outfall. This has led to extremely depressed levels of pH, possibly in Weka reservoir under certain circumstances, which has a direct bearing on the design of the diffuser. Immediately following consents, HDL will commence water quality field trials that will be focused at determining that high flow water quality relationship and obtaining empirical evidence that will support with more certainty the water qualities that are expected in Weka reservoir.

- The dam sites will be stripped to prove the dam foundations and to complete the final design of the dams. This is a reasonably straightforward process as the dam sites already have competent granite exposed. The purpose will be to determine the extent of trenching required along the shoulder dams and to help resolve the decision as to whether or not to extend the shoulder dam foundations to granite or to use some other process for sealing or managing the interface between the Brunner coal measure overlying material and the granite foundation.

- Advanced power generation modelling will be undertaken to determine the optimum storage capacity. This will also be used to secure off take agreements. The current modelling that has been used to determine the likely output from the scheme is sophisticated for the purpose but does not contain the normal feedback mechanisms in response to weather patterns that is used in an operating model. The effect of using a more sophisticated modelling approach will be to determine ways to reduce the overall volumes of spill and operating regimes that will reduce the volumes of spill, particularly at Weka reservoir. Currently the scheme modelling is showing 20-30% of total water volume available for hydro power generation is being spilled. HDL believes this can be reduced.

- The highest cost risk construction component for the Scheme is the establishment of portals at the Granity and Stockton tunnels and also to a lesser degree at the Darcy diversion and the Mangatini and Mine Creek diversions. HDL intends to construct these portals as advanced works so that the high risk spilling and establishment phase is completed before funding is sought from institutional investors. The completion of those portals will allow also the first section of tunnel to be driven which will also establish the tunnelling productivities that will apply for the remaining part of the Scheme which are the highest cost items for the Scheme.

- Finally, advanced works covered by the first tranche and immediately following the award of consents will be to promote the Scheme as a low risk project to institutional investors. It is important to establish the relationships with equity partners and Government entities to resolve access issues such as with Solid Energy and locals at Granity, and to complete the land exchange with the Department of Conservation. This will require some considerable effort that has been deferred by all parties involved until such time as the consents are awarded.

In closing, and before I hand over to Rebecca Inward to describe the assessment of the effects and the consents required for the Scheme, I wish to make some observations on the process that we have followed to date.

Two section 92 requests have been made and to a greater extent, the information sought under those requests has been provided by reference to the documents and the plans provided in support of the application. The general conclusion from most parties who have had the opportunity to look at the proposal in detail is that it is, to quote one, “a cunning plan” that achieves a huge number of benefits both for the community and the environment.

I trust that you will consider this scheme in the context with which it is presented and determine the materiality of the outstanding items contained in the Council officers’ reports.