Tonkin & Taylor

T&T Ref : 880063
04 April 2008

Gibbston Valley Station Ltd
C/- Construction Management Services
96 Atley Road
RD 1
Queenstown

Attention: Ken Gousmett

Dear Ken

Proposed Gibbston Valley Station Development
Gibbston Highway/SH6, Gibbston, Otago
Additional Geotechnical Assessment and Recommendations

1 Introduction

Tonkin and Taylor Limited (T&T) issued a preliminary geotechnical investigation and natural hazard assessment report for the proposed Gibbston Valley Station development on 03 March 2008 (T&T reference number 880063). Subsequent to the issue of this report T&T were asked to provide additional geotechnical recommendations regarding:

i) The proposed gully fills works.

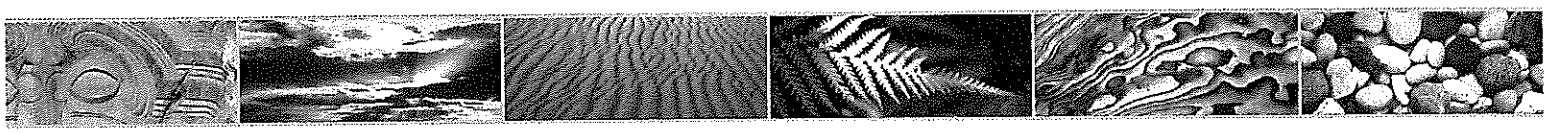
ii) The proposed potable water supply system, and;

iii) A proposal to construct cut earthworks near the toe of the Resta Road Slide to form a new accessway.

This letter presents preliminary geotechnical recommendations for the above works and should be read in conjunction with the previously issued preliminary geotechnical investigation and natural hazard assessment report (T&T reference number 880063, 4 April 2008).

2 Proposed Infilling of the Gullies East of Resta Road

Aerial Photograph 1, Appendix A, shows the approximate extent of the engineered fill which is to be placed in "Fill Gully A" and "Fill Gully B". These gullies are located on the terrace slopes that lie above the proposed area of building development. Resta Road traverses Fill Gully B at a lower level than the proposed fill area as it climbs to the elevation of the terrace surface from the Gibbston Valley. T&T understands the purpose of filling the gullies is to



dispose of excess cut material from the bulk earthworks construction and to create level areas that will be used for equestrian purposes.

Fill Gully A and Fill Gully B were the subject of a walkover inspection by T&T during the fieldwork for the preliminary geotechnical investigation and natural hazard assessment report, however, no sub-surface investigations were undertaken in the area. Both these gullies were assessed to be a degradational feature and the head of both gullies lie within the relatively flat gravel terrace surface.

No water flows were observed in either fill gully at the time of the T&T walkover inspection. Site observations indicate the water flows within the subject gullies are not regular and may only occur during periods of high intensity rainfall or during the 'wet' season. A tributary gully joins Fill Gully B down slope from the proposed area of fill. This tributary gully, which is shown as a series of blue arrows on attached Aerial Photograph A, drains a much larger area of land than the short piece of Fill Gully B which is to be infilled.

It is proposed to advance the fill down slope from the head of each gully. The gully fill material will be sourced from the bulk earthworks which are required to form other parts of the proposed Gibbston Valley Station development (pers. com. Steve Winter, Paterson Pitts Partners Ltd). The fill material is expected to comprise; for the most part; silty sandy gravels derived from alluvial and glacial deposits.

From a geotechnical perspective the proposed filling of Fill Gully A and Fill Gully B is considered technically feasible provided it is properly designed and constructed in accordance with the appropriate New Zealand Codes and Standards and detailed design of these works is completed by a suitably qualified and experienced engineer.

The following recommendations are made with respect to the proposed filling;

- All fill slopes which are greater than 3.0 metres high should have specific stability analysis and engineering design carried out by a suitably qualified geotechnical engineer or engineering geologist who is familiar with the on site materials and the contents of the preliminary geotechnical investigation and natural hazard assessment report dated 4 April 2008 (T&T reference number 880063).
- All fill should be placed and compacted in accordance with NZS4431:1989 and certified in accordance with Queenstown Lakes District Council standards.
- All topsoil, residual topsoil, organic matter, colluvial deposits and other unsuitable material should be removed from the fill footprints prior to the placement of fill in accordance with the recommendations provided in NZS 4431:1989.
- A subsoil drainage system should be provided beneath the proposed fill areas.
- Stormwater should be diverted away from the fill area during construction and a permanent storm water system provided to drain the terrace surface.
- The fill in Fill Gully B should not extend down slope of the point where the tributary gully joins Fill Gully B without appropriate design of a storm water collection and distribution system; and;
- All fill slopes should be periodically inspected during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist.

3 Proposed Water Supply Pipeline

A fresh water intake and pump house structure is to be constructed within the Kawarau River adjacent to the north-western corner of the site. A new riser main will also be constructed to convey fresh water from the intake structure up to a new header tank that is to be located upslope from the Gibbston Valley winery site. This pipeline will run from the intake in a southerly direction for a distance of approximately 120 metres before turning and running in a south-easterly direction for a length of approximately 650 metres up to the proposed header tank. We understand the water from the header tank will be used for irrigation and potable water supply purposes.

No sub-surface geotechnical investigations have been undertaken specifically for the proposed fresh water intake/pump station, riser main or header tank, however, the proposed location of these works were the subject of a walkover inspection by T&T during the fieldwork for the preliminary geotechnical investigation and natural hazard assessment report.

The location of the proposed fresh water intake/pump station and riser main is immediately adjacent to or traverses the North-west Cardrona, Cardrona and Nevis Faults. The approximate location of these faults are shown on Figure 1c (Revision F) in Appendix A.

The Institute of Geological and Nuclear Sciences (GNS) website[1] lists the North-west Cardrona, Cardrona and Nevis Faults as having a return period for surface rupture of 5,000 to 10,000 years, which corresponds to a fault rupture recurrence interval class of IV. The date of the last known surface rupture is not known.

A review of the existing site information, in conjunction with the Ministry for the Environment (MfE) guideline 'Planning for Development of Land on or Close to Active Faults', indicates the North-west Cardrona, Cardrona and Nevis Fault system has a "Type B - Distributed" fault complexity and structures with a building importance category (BIC) of 1, 2a and 2b may be constructed over or in the immediate vicinity of the fault system.

Buildings that have a BIC of 1, 2a and 2b include structures that present a low degree of hazard to life and other property (BIC 1), single storey residential timber framed dwellings (BIC 2a) and other structures, such as cinemas, multi-occupancy buildings and dwellings outside the scope of NZS 3604 (BIC 2b), but does not include structures that may contain people in crowds or contents of high risk, and/or structures with special post disaster functions.

Based on the recommendations published by MfE, T&T considers the proposed location of the fresh water intake/pump station and riser main to be geotechnically acceptable, however, detailed design of the fresh water supply system should include provision for potential damage to due to rupture of the North-west Cardrona, Cardrona and/or Nevis Faults. Such provisions may include:

- The use of flexible HDPE piping.

[1] http://basilisk.gns.cri.nz/website/af/viewer.htm

- The installation of one way valves to prevent water loss from the header tanks in the event of pipeline rupture, and,

- The provision of a back-up system for the potable water supply.

The NW-Cardrona Fault scarp is listed in the New Zealand Geological Society (NZGS) preservation inventory as being of 'National significance', and 'vulnerable to modification by humans'. Explanatory text associated with the NZGS inventory states landowners are 'privileged if they have custody of an important part of this country's earth science heritage on their land' and land managers should, 'ensure the ongoing protection of important features such as fault scarp'.

We recommend the fresh water supply system, and all other aspects of the proposed Gibbston Station development, be designed so as to minimise modification of the North-west Cardrona Fault ground surface expression. The approximate location of the North-west Cardrona Fault is shown on Figure 1c (Revision F) in appendix A.

4 Proposed Development Near the Toe of the Resta Road Landslide

T&T have been provided with updated plans which indicate the location of the proposed residential units immediately west of Resta Road has been moved north to minimise the cuts which are required to form the proposed access roads. A copy of these amended plans, which are entitled 'Gibbston Valley Station, Central Development Area - Village Area" (by Patterson Pitts Ltd, 7 March 2008), is provided in Appendix A.

Cut excavations up to 3.5 metres deep are now required to form the proposed access roads. These cuts will be finished to a batter angle of 1:1 or flatter or structurally retained.

Investigation test pits indicate the sub-surface conditions in the subject area comprises:

- A surficial layer of topsoil, overlying,

- A 3.8m thick layer of fine grained sub-horizontally laminated lake sediments, overlying,

- Moderately dense to dense sandy gravel.

A low ridge of lake sediments, which is locally referred to as 'Rabbit Ridge', exists upslope (south) of the subject units. The glacial gravel outwash terrace face is located further south of Rabbit Ridge, and the proposed road cuts are located north of rabbit ridge, at the base of a moderately steep slope.

Topographic contours of the northern slope of Rabbit Ridge are shown on the attached PPL plans (refer to Appendix A), however, the glacial gravel outwash terrace face is located south of the area that is covered by this plan.

Figure 1c (Revision F) indicates the Resta Road landslide lies south of the subject area and encompasses a significant amount of land upslope of, and including, the glacial gravel outwash terrace face. The inferred locations of other smaller landslides are also shown on this plan.

No evidence was observed in the field which indicated the lake sediments or underlying gravel material had been deformed by movement of the Resta Road landslide, or any other landslide, in the revised location of the residential units.

The proposed building platform earthworks are not expected to have a detrimental effect on the Resta Road landslide provided the following recommendations, which were outlined in the preliminary geotechnical investigation and natural hazard assessment report, are followed:

i) All permanent cut slopes in moderately dense lake sediments and/or gravels should be finished to a maximum batter angle of 2.0H:1.0V or structurally retained. A steeper batter slope of 1.0H:1.0V may be formed if the results of additional geotechnical investigations and detailed design are favourable, and,

ii) All retaining walls should be designed by a suitably qualified and experienced Chartered Professional Engineer in accordance with the appropriate New Zealand codes and standards.

5 Applicability

This letter has been prepared for the benefit of Gibbston Valley Station Ltd with respect to the particular brief given to us and it may not be relied upon in any other context or for any other purpose without our prior review and written agreement.

TONKIN AND TAYLOR LTD

Environmental and Engineering Consultants

Letter prepared by:

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Shamus Wallace

Engineering Geologist

Authorised for Tonkin & Taylor by:

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Anthony Fairclough

Senior Geotechnical Engineer

4-Apr-08
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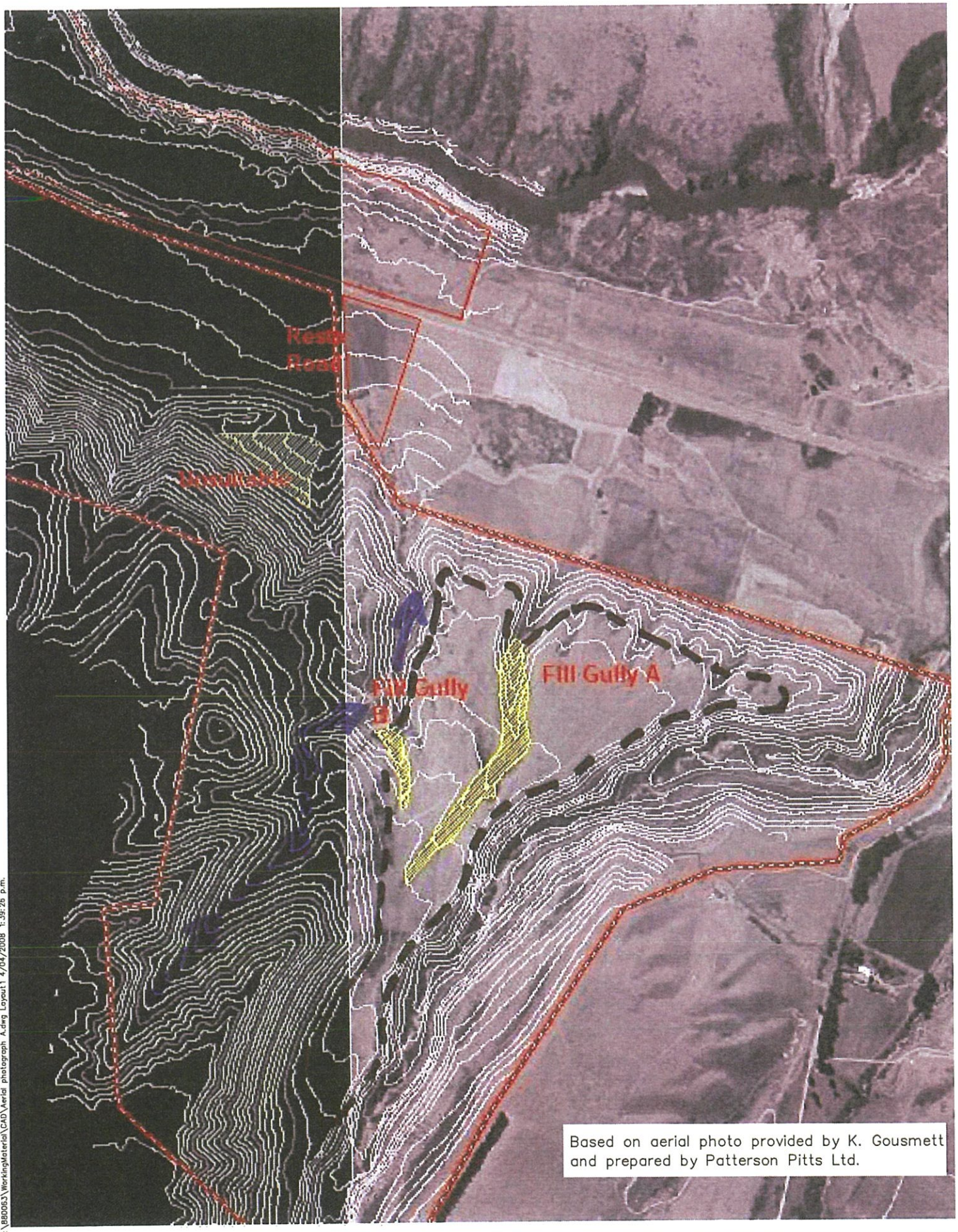
Appendix A: Figures

- **Aerial Photograph A:** Proposed fill Gully Locations
- **Figure 1c (Revision F):** Engineering Geological Site Plan
- **Patterson Pitts Ltd Plan:** Gibbston Valley Station, Central Development Area – Village Area, 7 March 2008 (showing topographic contours)
- **Patterson Pitts Ltd Plan:** Gibbston Valley Station, Central Development Area – Village Area, 7 March 2008 (showing adjusted location of the proposed residential units)



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APPROVED		
CADFILE : \\Aerial photograph A.dwg		
SCALES (AT A4 SIZE) NOT TO SCALE		
PROJECT No. PROJECT		

Tonkin & Taylor
Environmental & Engineering Consultants
Christchurch
Auckland Hamilton
Nelson Wellington Whangarei

GIBBSTON VALLY STATION Ltd

GIBBSTON VALLY STATION DEVELOPMENT
GIBBSTON VALLY
Proposed Fill Areas

FIG. No. Aerial photograph A

REV. 0

ZONE OF FAULTS AND DEFECTS ASSOCIATED WITH THE NEVIS CARDRONA FAULT SYSTEM

KAWARAU RIVER GORGE

NW CARDRONA FAULT

CARDRONA FAULT

NEVIS FAULT

RESTA ROAD SLIDE

EXPOSED BEDROCK

TERRACE FACE

OUTWASH GRAVEL SURFACE

OUTWASH GRAVEL TERRACE FACE

AL. FAN

COLL

FILL

ALLUVIAL/RIVER GRAVEL OVERLYING SCHIST BEDROCK NEAR SURFACE

RIVER GRAVELS

POND

SCHIST BOULDERS

LAKE SEDIMENTS

TP1 TP2 TP3 TP4 TP5 TP6 TP7 TP8 TP9 TP10 TP11 TP12 TP13 TP14 TP15 TP16 TP17 TP18 TP19 TP20 TP21 TP22 TP23 TP24 TP25 TP26 TP27 TP29 TP30 TP31

① ② ③

LEGEND:

- FAULT – ACTIVE FAULT, TRACE POSITION INFERRED FROM GNS DATABASE – NO SURFACE TRACE
- FAULT – SURFACE TRACE
- FAULT – OBSERVED ZONE OF SHEARED AND/OR CRUSHED ROCK – MINISTRY OF WORKS REPORT 1982
- LANDSLIDE
- MINE TAILINGS
- SWAMPY AREA
- POSSIBLE LANDSLIDE
- EROSION/MINOR SLIPS
- 62° STRIKE AND DIP OF BEDROCK
- →–WR→– WATER RACE (FLOWING)
- – –WR– – WATER RACE (DRY)
- ⤳ STREAM (FLOWING)
- COLL COLLUVIUM
- AL. FAN ALLUVIAL DEPOSIT
- PROPOSED DEVELOPMENT
- ① GIBBSTON VALLEY WINERY
- ② FARM HOMESTEAD
- ③ UN–NAMED WINERY/VINEYARD

SCALE 1: 7500

0 100 200 300 400 500 (m)

Tonkin & Taylor
Environmental & Engineering Consultants
Auckland Dunedin Christchurch Hamilton Nelson Wellington Tauranga

DRAWN	EJD	Mar 08
DRAFTING CHECKED		
APPROVED		
CADFILE :	\\Geological Site Investigation Plan – Rev F.dwg	
SCALES (AT A3 SIZE)	1: 7500	
PROJECT No.	880063	

GIBBSTON VALLEY STATION LTD.

GIBBSTON VALLEY STATION DEVELOPMENT

GIBBSTON VALLEY

Engineering Geological Site Plan

FIG. No. Figure 1c

REV. F

Gibbston Highway

Resta Road

Hut Site F41/243

Hut Site F41/270

Section 10C

Section 5A

Gibbston Valley Station, Central Development Area - Village Area, 7th Mar. 2008

PATERSON PITTS LTD
Wanaka Cromwell Queenstown Alexandra Dunedin
Surveying • Land Planning • Land Development • Resource Management
Wanaka ph 03 443 0110 fax 03 443 1330

Notes
Areas & dimensions subject to final survey
Levels in terms of Mean Sea Level

Scale	1:750 @ A1
Drawn By	JSH
Date	07/03/2008
Job No.	2588
Sheet No.	3 of 4

Gibbston Highway

Resta Road

Hut Site F41/243

Hut Site F41/270

Section 10C

Section 5A

Gibbston Valley Station, Central Development Area - Village Area, 7th Mar. 2008

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