



Site Suitability Assessment

205 Lud Valley Road, Hira

Andrea Vincent

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1. Introduction

CGW Consulting Engineers (CGW) has been engaged by Andrea Vincent (the Client) to complete an evaluation of geotechnical conditions and water, wastewater and storm water servicing for a proposed housing development on a subdivided lot located at 205 Lud Valley Road, Hira. This report presents publicly available factual information, interpretation of field data and site specific geotechnical recommendations for the proposed development at the site.

This work was conducted in accordance with our proposal dated 18 July 2018. The purpose of this assessment is to provide supporting information to enable the preparation of a Resource Consent Application.

2. Proposed Development

It is proposed to subdivide the site into a northern and southern lot. A residential dwelling is proposed in the north western corner of the new southern lot, with area for parking to the south of the building. An access way/driveway is proposed for access to the house, with a shed/garage built at the top of the site on the western boundary. Drawing No. 18360/03 within Appendix B presents a generalised proposed site layout.

The residential dwelling is proposed to be a type of 'earth house', where it is built into the hill side. The shed is proposed to have a dirt or gravelled floor with a light weight construction.

Temporary accommodation is proposed for the client at the top of the centre ridgeline, also shown on the attached drawing.

3. Site Description

Address: 205 Lud Valley Road, Hira

Legal Description: Lot 1 DP 18871

The site comprises an irregular shaped parcel of land located approximately 10 km North East of Nelson. A site location plan is presented as Drawing No. 18360/01 within Appendix B of this report.

Topographically the site generally slopes moderately to steeply down towards the eastern boundary from the highest point of elevation in the south western corner. The western boundary is the top of a ridgeline which trends south to north through the area. The site measures approximately 320 m in length by 200 m in width.

An existing development is located in the northern half of the site, including a relocated timber house, garage and associated gardens. Access to this area is via a shared driveway off Lud Valley Road, entering the site in the centre of the western

boundary. It weaves steeply down the hill side to a large turning area next to the existing dwelling.

Historic aerials obtained from Top of the South Maps and Google Earth show the site as undeveloped hillside pasture until 1998 when an old timber house was relocated to the site. The southern half and north western edge of the site remain as farmland.

Surrounding the site the land to the west slopes steeply back down towards Lud Valley Road and the Lud River. To east the area slopes up to another higher elevated ridge. Rural residential properties surround the site.

A site features plan is presented as Drawing No. 18360/02 within Appendix B of this report.

4. Geological and Environmental Setting

4.1. Published Geology

According to GNS Geology mapping (Geology of Dun Mountain, 1981) the site is underlain by the Maitai Group Stephens Formation (ys) which is described as '*bedded green and grey sandstone, grey siltstone and mudstone with beds of red siltstone, lenses of conglomerate and impure, fossiliferous limestone*', as shown on Figure 1 below.

A branch of the Waimea Fault is located approximately 350 m to the west of the site, near the Lud River. The fault trends from the south to the north.

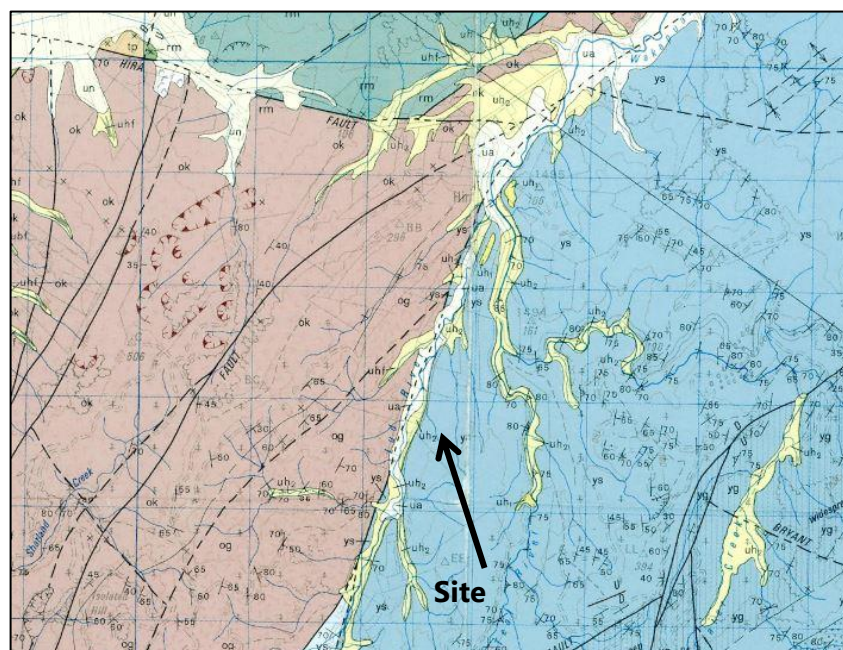


Figure 1: GNS Dun Mountain, 1981, Sheet 027AC – extract.

4.2. Hydrology and Flooding

An un-named stream is located at the bottom of the valley on the eastern boundary of the site. According to the NCC flood models for the year 2100 the stream is a flood hazard, as shown on Figure 2 below.

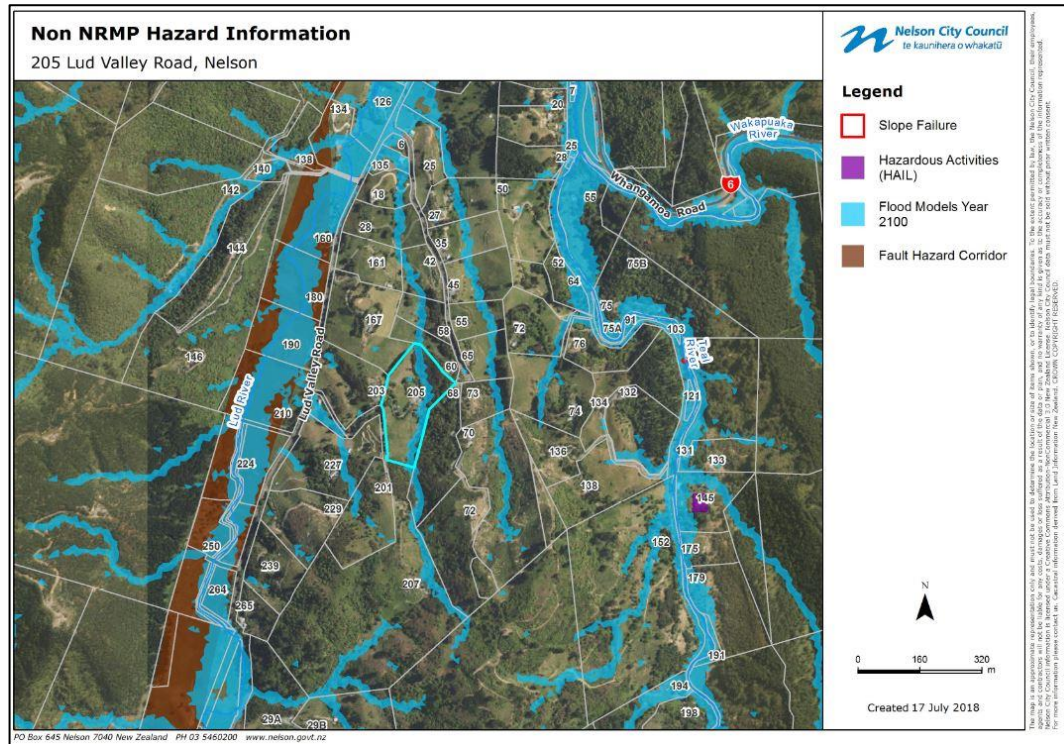


Figure 2: NRMPM Flooding Hazard Overlay – extract

The proposed house site is approximately 10-20m in elevation greater than the water level indicated in the 2100 flood model. Overland flow requires diversion around the proposed buildings however the effect of inundation from the gully on the proposed house site is considered insignificant.

CGW did not undertake inundation modelling as part of this work.

4.3. Contaminated Land (HAIL) Assessment

According to NCC the site does not register as a HAIL listed site. Aerial photography of the site back to the 1940's indicates the site remained as hillside farm land till it was lightly developed in 1998.

The closest HAIL site mapped by NCC is located approximately 700 m to the west, within the Teal Valley.

5. Property File Review

The property file for 250 Lud Valley Road includes the following:

- Property Conditions C1050 – Conditions of subdivision
- Resource Consent 975606 – Construct access track and proposed building site.

- Building Consent 971491 – Relocated villa to be renovated and extended
- Building Consent 010786 – Construct a garage

As part of the building consent for the relocation of the house an assessment for an effluent field and a structural assessment for the villa were undertaken by Worseldine and Wells (1994) Ltd in December 1997. The effluent report states that a soil category of 2 -3 (good to free draining) can be assigned to the site and that low pressure effluent distribution technology could be utilised for the effluent system at the northern end of the property.

As part of the resource consent the following conditions, stated within C1050 have been applied to this property and will most likely be similar for any new subdivision of the property.

- Foundations shall penetrate fill, topsoil and subsoil to bear in competent in-situ scree or bedrock. Foundations must be designed and constructed under the supervision of a chartered professional engineer.
- Cut faces adjacent to buildings shall be retained unless considered unnecessary by a chartered professional engineer. Faces over 1.50 m in height within 2.0 m of a dwelling shall be assessed by an experienced engineering geologist. The engineer shall also design and supervise the construction of any retaining walls.
- Structural fills shall be in accordance with NZS4431:1989 – Code of Practice for Earth Fill for Residential Development. Non-structural fills shall be placed in a competent manner with track rolling in thin incremental layers. All fill placements shall include adequate stripping, benching and under drainage.
- Allowance shall be made for potential differential settlement of all structures that are not founded in competent ground or straddle natural ground / fill interfaces.
- Stormwater from roofs, hard standing areas and access roads and effluent disposal to land shall be in a manner that does not induce slope instability.
- Effluent systems shall be designed and constructed by a chartered professional engineer.
- The property shall be maintained in a vegetation cover that prevents erosion.

6. CGW Investigation

CGW undertook a site walkover and site testing on 24 July 2018. Drawing No. 18360/02 presents the site features and investigation locations.

6.1. Site walkover

During the site walkover, in general the site was observed to be free of any ponding water or boggy areas within the paddocks.

An area at the proposed new entrance to the site was noted to have been historically filled to create an easier access; this is considered to be non-engineered fill material.

Two areas across the site showed signs of shallow soil creep and were generally steeper than other areas on the site. These included along the southern boundary and western boundary where the site is closest to the neighbour's house.

A farm track has been created in the centre of the site, which gives access to the vegetable garden on the eastern boundary. The cut for this track is approximately 0.50 m high and comprised weathered Maitai Group Siltstone. The excavated material for this track was most likely cast off to the side at the time of construction, but no evidence of this was seen on site.

The current access track to the site comprises cuts greater than 1.20 m high. Material within these cuts also included a slightly weathered siltstone. No instabilities were observed on the access way. An open drain was located on the outside of the track which was observed to have had large amounts of water flowing through it during storm events. The track is currently gravelled.

The stream on the eastern boundary was observed to have light flow during the site visit. Evidence of it rising considerably during a storm event was not noted, and according to the owner the stream level did not increase much during rain events. Siltstone was again noted in the base of the stream.

Site photographs are presented within Appendix D of this report.

6.2. Subsurface Investigations

Three test pits (TP1 – TP3, inclusive) were completed across the southern end of the site for the purpose of determining the ground conditions beneath the different landforms. Test pits were terminated between 0.50 m and 2.75 m below ground level (bgl).

Soil logging was undertaken in accordance with the NZGS Field Description of Rock and Soil Guidelines, dated 2005.

Scala penetrometer testing was undertaken next to TP1 and TP2, where refusal was reached between 0.90 m and 2.80 bgl.

Test pit logs and photographs are presented within Appendix C of this report.

7. Ground Conditions

A summary of the ground conditions at the southern end of the site is presented below in Table 1.

7.1. Strata Properties

Table 1 – Summary of sub surface strata at southern end of the site			
Strata	Depth to top of strata (m bgl)	Strata Thickness (m)	Strata Description
Topsoil	0.00	0.30 – 0.40	Topsoil comprising silt with minor organics was generally found across the site. It is described as dark brown, wet and with low plasticity.
Stephens Formation – Residual Soil	0.30 – 0.40	0.30 – 2.30	<p>Weathered Stephens Formation was encountered below the topsoil across the site. Where test pits were completed on ridges this unit was relatively thin, compared to test pits completed within the gullies.</p> <p>The residual soil comprises clay silt with minor to some gravel. It is described as yellow – brown, moist and low plasticity. The gravels are described as completely to moderately weathered, angular and comprise sandstone and mudstone.</p>
Stephens Formation	0.70 – 2.70	Base Not Encountered	Less weathered and more competent Stephens Formation was encountered below the residual soils and comprised silty fine to coarse gravel within TP1 and moderately to slightly weathered sandstone with TP2, at depth.

7.2. Strata Properties

Scala penetrometer testing from the surface next to TP1 and TP2 indicate the residual soils are firm to stiff, whereas scala refusal occurred in the more competent Stephen Formation.

Rock encountered within TP1 is described as extremely weak and within TP2 is described as weak in accordance with NZGS logging guidelines.

7.3. Groundwater

No groundwater was encountered as part of this investigation. Groundwater levels across the site may vary in response to weather and seasonal variation.

8. Geotechnical Recommendations

Recommendations contained in this report are based on the field results obtained during the site investigation. The nature on continuity of the material identified is inferred between test locations and it should be appreciated that actual ground conditions may vary from the assumed site model.

8.1. Ground/Slope Stability

The site was measured to be sloping at angles between 20° and 35°. With the proposed development it is envisaged that cut earthworks to excavate part of the hillside out will be completed. As per the properties current conditions retaining structures will most likely be required for the excavations over 1.00 m high.

CGW recommends slope stability analysis is undertaken on sections through the proposed build areas prior to building consent being issued.

8.2. Liquefaction Potential

No liquefiable soils were identified at the site within the investigated depths. Therefore it is considered there is a low risk of liquefaction beneath the proposed building platform in the event of an earthquake. A detailed liquefaction assessment was not part of this scope of works.

8.3. Flood Hazard

CGW did not undertake an inundation assessment as part of this assessment. The proposed building areas are deemed to be well above any potential flood hazard areas associated with the un-named stream on the eastern boundary of the site.

8.4. Building Locations

It is recommended that buildings proposed on the site be placed in areas where the competent rock is predicted to be shallow. Therefore building within the gully area on the southern boundary is not recommended, due to the depth to rock and the shallow strata having been affected by groundwater weathering.

It is recommended that buildings for the proposed development not be located in areas shown in red on Drawing No. 18360/03 within Appendix B of this report.

8.5. Accessway/Driveway

The proposed access is anticipated to enter the site on the western boundary at the top of the prominent ridge through the site. This area has historically been filled with non-engineered fill.

Major earthworks will be required for the access to be built, including a potential retaining wall to support the fill required for the driveway width on the slope. An accurate survey of the site is suggested so that detail design for the access can be undertaken.

8.6. Foundations

Foundations for the buildings at the site will be dependent on the type of building platforms utilised. For the proposed house a concrete floor is desired and with the ground conditions anticipated within this area, shallow foundations are recommended.

Specific design of the foundations should be completed after a site specific slope stability analysis has been completed by a geo-professional. A more in depth ground investigation is recommended to gain accurate ground parameters for design at the site.

8.7. Earthworks

Any earthworks at the site should be undertaken within accordance with NZS 4431:1989 *Earth Fill for Residential Development* and NZS 4404:2010 *Land Development and Subdivision Infrastructure*.

It is recommended that excavated material from the site is secured behind retaining structures where the thickness is more than 0.50 m.

9. Wastewater Disposal Recommendations

9.1. Regulatory Context

The site is located within the Nelson City Council (NCC) area in land zoned Rural (lower density small holding). In accordance with RUr.78.4, effluent discharge must comply with Freshwater Rule FWr.29. In accordance with FWr.29, on-site effluent discharge is a discretionary activity for single residential units on lot sizes smaller than 15 ha. The proposed lot size is approximately 1.4 ha. Assessment criteria includes the extent to which the proposed system complies with AS/NZS1547:2012, the capacity and level of treatment and the size of the land application area and alternative disposal areas.

9.2. Site and Soil Evaluation

A site and soil evaluation was conducted on the 24th of July 2018 in accordance with AS/NZS1547:2012. The proposed location of the house site and wastewater disposal field was identified on site with the owner and CGW. The site evaluation findings are as follows

- The proposed disposal area is on a waning slope with several undulations which would concentrate stormwater during prolonged rainfall events.
- The slope angle was measured on site and varies from 30-40% within the proposed disposal field. A slope angle of 35% was exceeded in some localised areas due to uneven ground surface. On average, the slope within the proposed disposal field is estimated at 35%. This exceeds the maximum slope angle of 30% before specific design is required, in accordance with AS/NZS 1547:2012.
- The slope in the proposed disposal area did not exhibit evidence of shallow instability, therefore the risk associated with disposal is primarily the risk of effluent 'daylighting', leading to overland flow rather than presenting a risk to site stability. The slope angle is considered suitable for onsite effluent disposal provided it is undertaken at a very low rate, as discussed subsequently.
- The closest watercourse to the proposed disposal field is a gully which flows into the Lud River. CGW understand that this gully is spring fed and does flow throughout the year under typical conditions. A 20m offset from any disposal field to this gully should be observed.

- Significant earthworks will be undertaken as part of the development of this site. This will include a driveway, formation of pads for buildings and possible terracing of the land.
- The site is east facing and wind exposed

A soil evaluation was conducted in accordance with AS/NZS1547:2012. The inspection coincided with the site geotechnical excavations, therefore test pits were mechanically excavated rather than hand augured. Indicative test pit locations are on Drawing No. 18360/02 within Appendix B of this report. Soil investigations are summarised within Section 6 of this report, with logs presented within Appendix C.

Some variation in soil conditions was observed across the 3 test pits. 150-400mm of top soil was present in all test pits, being the thickest within TP1. Conditions in TP1 and TP3 were similar from a wastewater disposal perspective, with coarser gravels and more frequent gravel deposits observed in TP1.

Typical soil conditions are shown in Figure 3 below. This investigation concluded that the site should be assessed as moderately well-structured sandy clay, Category 5, for the purposes of onsite wastewater disposal.



Figure 3: TP2 Typical shallow soil conditions

9.3. Wastewater Treatment

CGW understand that the plans for the proposed development are yet to be finalised. It is likely that the total load for onsite wastewater disposal will be equivalent to up to a 4 bedroom house. It is the Clients preference that water for the proposed development is supplied from the local community reticulated water scheme. If connection is not available, water demand will be met through onsite rainwater tanks. From discussions with the Client, CGW understand that water saving appliances will be installed, in accordance with AS/NZS 1547:2012. As a worst case, wastewater load has been calculated assuming a reticulated supply, with 8 occupants in the proposed 4 bedroom house. On this basis, a total capacity of 1320L/day is required.

Subsurface drip irrigation is considered the most appropriate means of effluent disposal at this site due to the soil type and the relatively steep nature of the site. The irrigation rate for drip irrigation in Class 5 soils is 3mm/day (in accordance with Table M1). This is reduced by 50% for a 20-30% slope (Table M2) giving a design irrigation rate of 1.5mm per day. It is noted that for slopes greater than 30%, AS/NZS1547:2012 states that the advice of a suitably qualified and experience person should be sought to confirm site suitability. The slope in the proposed disposal area is approximately 35%. Due to the conservative design basis, assuming a fully occupied 4 bedroom house, the proposed irrigation rate is considered to present a low risk of environmental impact. A total disposal area of 880m² is required.

Under typical conditions, with an average Tasman/Nelson occupancy of 2.4 persons per dwelling, the typical loading rate is unlikely to exceed 0.5mm/day.

The site is not considered suitable for disposal with a bed or trenches. Due to the specification of drip irrigation, a packaged treatment plant capable of treating effluent to secondary treatment standards in accordance with AS/NZS1547:2012 is required. The system should consist of a packaged secondary treatment system which is pumped to the disposal field.

9.4. Disposal field

FWr.29 requires a minimum separation distance between an effluent disposal field and a waterway of 20m. This is considered appropriate for this site and the nominated field location includes this allowance.

It is recognised that for a Permitted Activity, FWr.29 requires a minimum separation distance between an effluent disposal field and a boundary of 20m. This is considered excessive due to the low rate of disposal and the fact that the proposed disposal field location is downslope from property boundaries. AS/NZS1547:2012 Table R1 notes that a minimum setback of 0.5m can be applied between a dripline system and an upslope boundary where the slope is greater than 5%. It is

recommended that a minimum of 3m set back to the western boundary is implemented and the disposal field is located as far upslope as possible from the waterway. Slopes greater than 35% should be avoided for the purposes of wastewater disposal.

An indicative location for the proposed disposal field location is shown on Drawing No. 18360/03 within Appendix B.

It is likely that the driveway will pass close to or through part of the area nominated for effluent disposal. The exact location of the disposal field should be confirmed following completion of site and landscaping plans. This evaluation has concluded that provided effluent disposal field is given due consideration when the site layout is finalised, the site is suitable for effluent disposal in compliance with AS/NZS1547:2012.

It is proposed that sub-surface pressure compensating drip line is used to distribute treated effluent, installed at 1m intervals perpendicular to the slope. Drip line should be installed approximately 100-150mm below ground surface.

All elements of the proposed onsite wastewater management system require detailed design once the site layout is confirmed.

10. Stormwater Recommendations

No NCC owned stormwater network services the proposed development area. A gully leading to the Lud River flows York Stream is accessible from the site. In accordance with the NCC Land Development Manual (LDM) Section 5.5.3.3, stormwater discharge into a stream or watercourse is a permitted activity provided the discharge complies with the conditions specified in the LDM. This includes ensuring there is no erosion resulting from the discharge and there are no obstructions placed in the stream.

The area occupied by impervious surfaces has not been finalised but will include a house area (assumed to cover up to 250m²) and a shed (100m²). An allowance of 350m² has been made for a gravel driveway. The increase in impervious surfaces will increase the rate of runoff post development.

To mitigate the effect of the discharge on the receiving environment, CGW recommend attenuating stormwater runoff by diverting roof runoff to a rain tank with a restricted outlet in general accordance with the NCC Land Development Manual, drawing SD 526. The use of a rain garden is not recommended for this site due to the steep topography and low soakage soils. The outlet from the rainwater tank should be piped the entire distance to the gully and diverted to existing rocks on the stream bed. The likelihood of the discharge causing erosion in the gully will be mitigated by the low restricted rate of discharge.

To determine the effect of the proposed discharge, CGW have assessed pre and post-development flows with and without attenuation for 10%, 6.67% and 2% Annual Exceedance Probability (AEP) rain events.

CGW have calculated the rate of discharge assuming the house and shed areas outlined above and runoff coefficients and rainfall intensities in accordance with the LDM. A minimum 10 minute time of concentration has been assumed in accordance with the Building Code. To ensure a conservative assessment, it is assumed that guttering and pipe sizes leading to the tank are only sized for a 10 min 10% AEP in accordance with the Building Code. The discharge rate has been calculated assuming a 25mm pipe is used to restrict outflow from a 2.6m high tank. The results of this assessment are presented in Table 2 below

Event (AEP)	Pre Development Runoff (L/s)	Post Development Runoff (L/s)	Detained Post Development Runoff Rate (L/s)
10%	139	143	137
6.67%	157	161	156
2%	223	229	224

From this assessment it is considered possibly to fully compensate to additional runoff from the proposed development using a rain tank with a restricted orifice for 10% and 6.67% AEP events. Post development runoff will exceed pre development runoff by approximately 0.4L/s during a 2% AEP event. A total of approximately 4,000L will be stored during this event. This is considered insignificant in the context of the wider Lud Valley catchment however in practice it is very likely that the capacity of guttering will exceed the minimum 10% AEP event stipulated by the Building Code therefore it is likely that hydraulic neutrality will be achieved during a 2% AEP event. It is recommended that 5,000L of tank capacity is dedicated to stormwater attenuation. All elements of the proposed stormwater management system require detailed design once the site layout is confirmed.

11. Conclusions

CGW recommend the site is suitable for the building of the proposed development, provided the recommendations for building location, retaining and earthworks are undertaken. Site specific slope analysis should be completed prior to detailed design.

CGW have undertaken a site assessment for onsite wastewater disposal in accordance with AS/NZS1547:2012. The site is considered suitable for effluent disposal using subsurface drip irrigation at a maximum rate of 1.5mm/day. Assuming a 4 bedroom dwelling is constructed, it is recommended that a total of

880m² of disposal field is constructed. A minimum setback to the western boundary of 3m is recommended.

Stormwater management for the proposed development has been investigated by CGW. CGW recommend all runoff from the dwelling and shed is directed to a water tank with a restricted outlet, piped to the gully. The location of discharge should be specified to minimise the risk of erosion, ie discharging onto existing rocks. It is considered possible to attenuate stormwater to not exceed pre development runoff during 10%, 6.67% and 2% rainfall events.

All elements of the proposed building, wastewater and stormwater management systems require detailed design once the site layout is finalised.

12. References

- NZ Geotechnical Society, December 2005; Field Description of Soil and Rock – Guideline for the field classification and description of soil and rock for engineering purposes.
- Johnston M.R. 1981; Geological Map of New Zealand – Dun Mountain, Sheet O27AC. New Zealand Department of Scientific and Industrial Research, Wellington.
- Standards New Zealand, 2012; Australian / New Zealand Standard – Onsite Domestic Wastewater Management AS/NZS 1547:2012.

Appendix A: Limitations

The professional services and this document provided by CGW Consulting Engineers ("CGW") are subject to the following limitations:

Reliance: This document has been prepared solely for the benefit of our client, as per our brief and an agreed consultancy agreement. The document is confidential and reliance by any other parties on the information or opinions contained in this document shall, without our prior agreement in writing, be at such parties' sole risk. CGW accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this document.

Our Brief: This document has been prepared solely to address the issues raised in our brief, and shall not be relied on for any other purpose. The scope and the period of CGW's services are as described in CGW's proposal, and are subject to restrictions and limitations. CGW did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by CGW in regards to it.

Unforeseen Ground Conditions: The conclusions and recommendations contained within this document are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this document based on accepted normal methods of site investigation. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this document does not purport to completely describe all the site characteristics and properties. The nature and continuity of ground and groundwater conditions are inferred using experience and judgement and it must be appreciated that actual conditions could vary considerably from the assumed model. Defects and unforeseen ground conditions may remain undetected which might adversely affect the stability of the site and the recommendations made herein.

Third Party Data: In the event that external third party investigation data has been utilised or provided to us, the client acknowledges that we have placed reliance on this information to produce our document and CGW will accept no liability resulting from any errors or defect in the external third party data.

Ground Investigation Data: The Client grants permission to CGW to upload any factual data collected during the works to the National

Warranty: Any assessments made in this document are based on the conditions indicated from published sources and the investigations described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this document.

Time: In addition, it is recognised that the passage of time affects the information and assessment provided in this document. CGW's opinions are based upon information that existed at the time of the production of the document. It is understood that the services provided allowed CGW to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality or features of the site, or its surroundings, or any laws or guidance or regulations.

Construction Issues: It is common that not all site issues will necessarily be dealt with at site assessment stage. As the project progresses through design towards construction, if issues arise, allow CGW to develop alternative solutions to problems, that will be of benefit both in time and cost. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. Contractors should perform any additional tests as necessary for their own purposes.

Geoenvironmental: Unless specifically stated the document will not relate any findings, conclusions or recommendations about the potential for hazardous or contaminated materials existing at the site. Specialist equipment, techniques, laboratory testing and personnel are required to perform geoenvironmental (ie. HAIL) assessments.

Sub-Contractors and Staff: CGW may have retained sub-consultants or sub-contractors to provide services for the benefit of CGW. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, CGW's sub-consultant or sub-contractor companies, and CGW's employees, officers and directors.

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Intellectual Property Rights: All intellectual property (IP), designs and documents created or provided by CGW in the provision of the services shall remain the property of CGW. Subject to the Client complying with its obligations under the agreed consultancy agreement, the Client shall upon payment own all deliverables provided to it in the provision of the Services, and CGW grants to the Client a nonexclusive, non-transferable license to use the IP for the purposes described in the Proposal. The Client shall not use, or make copies of, the deliverables in connection with any work not included in the Proposal without prior written consent from CGW. If the Client is in breach of any obligation to make a payment to CGW, then CGW may revoke the license to use the IP and the Client shall return to CGW all originals of deliverables provided under the services and any copies thereof.

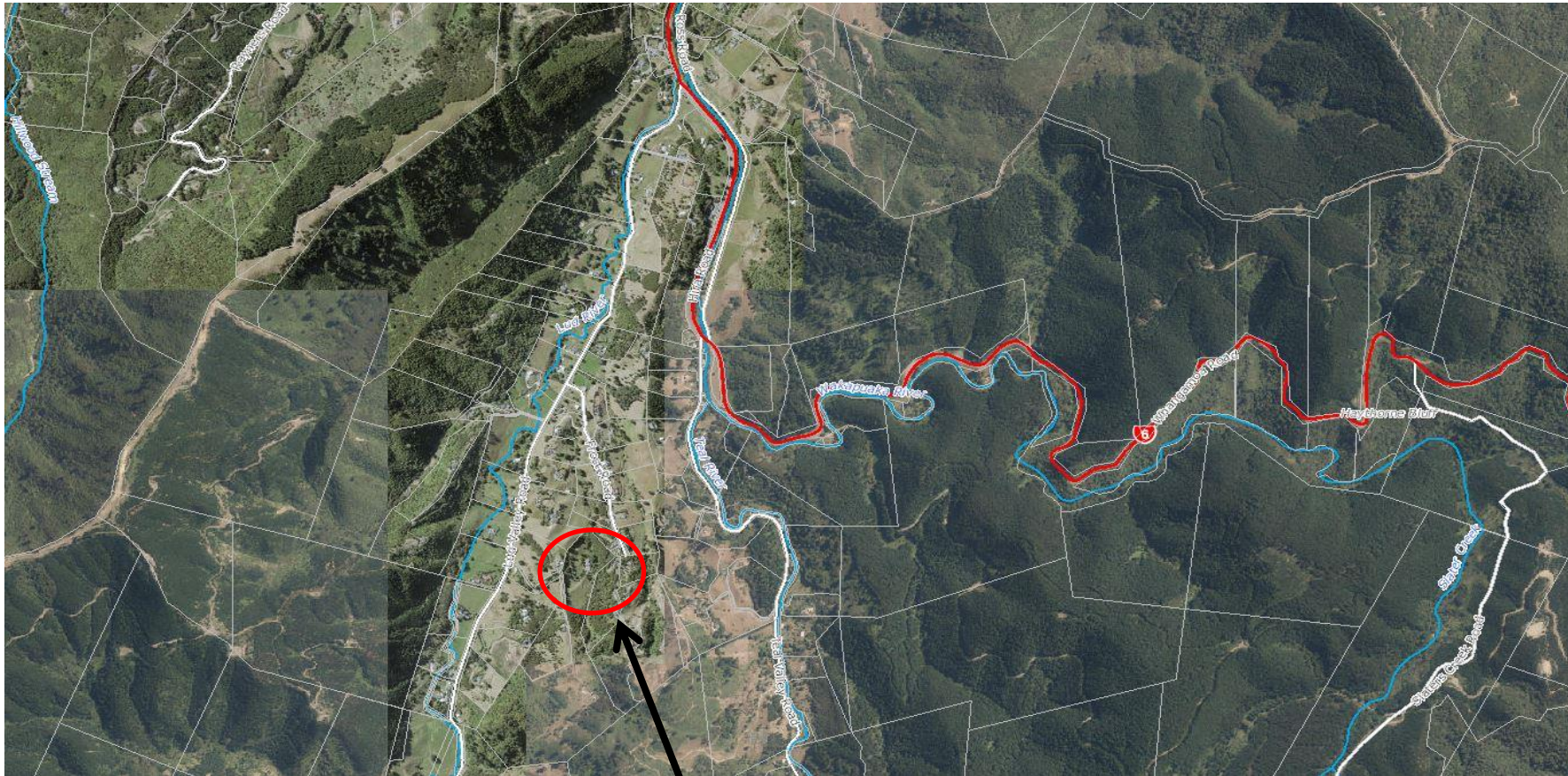
Assignment: Neither party and their respective successors may assign, transfer, or sublet any obligation under this Agreement without the prior written consent of the other party. Unless stated in writing to the contrary, no assignment, transfer, novation or sublet shall release the assignor from any obligation under this Agreement.

Standard Terms: These Limitations should be read in conjunction with the IPENZ/ACENZ Standard Terms of Engagement as per our proposal and agreed consultancy agreement.

Appendix B: Drawings



Approximate
True North



The Site

Legend:

Notes:

- 1. Source: Top Of The South Maps
- 2. Original plan size A4.



Civil Structural Environmental
Geotechnical

Nelson Ph: 548 - 8259
Christchurch Ph: 348 - 1000

DATE: August 2018

DRAWN: KJ

SCALE: NTS

Site Location Plan

205 Lud Valley Road

Hira

DRAWING NO:

18360/01

SHEET 1 OF 3



Approximate
True North

Existing Development



Legend:



CGW Excavated Test



Water Pathway

Notes:

1. Top of the South Maps
2. Original plan size A4.



Civil Structural Environmental
Geotechnical

Nelson Ph: 548 - 8259
Christchurch Ph: 348 - 1000

DATE: August 2018

DRAWN: KJ

SCALE: NTS

Site Features and Investigation Location Plan

**205 Lud Valley Road
Hira**

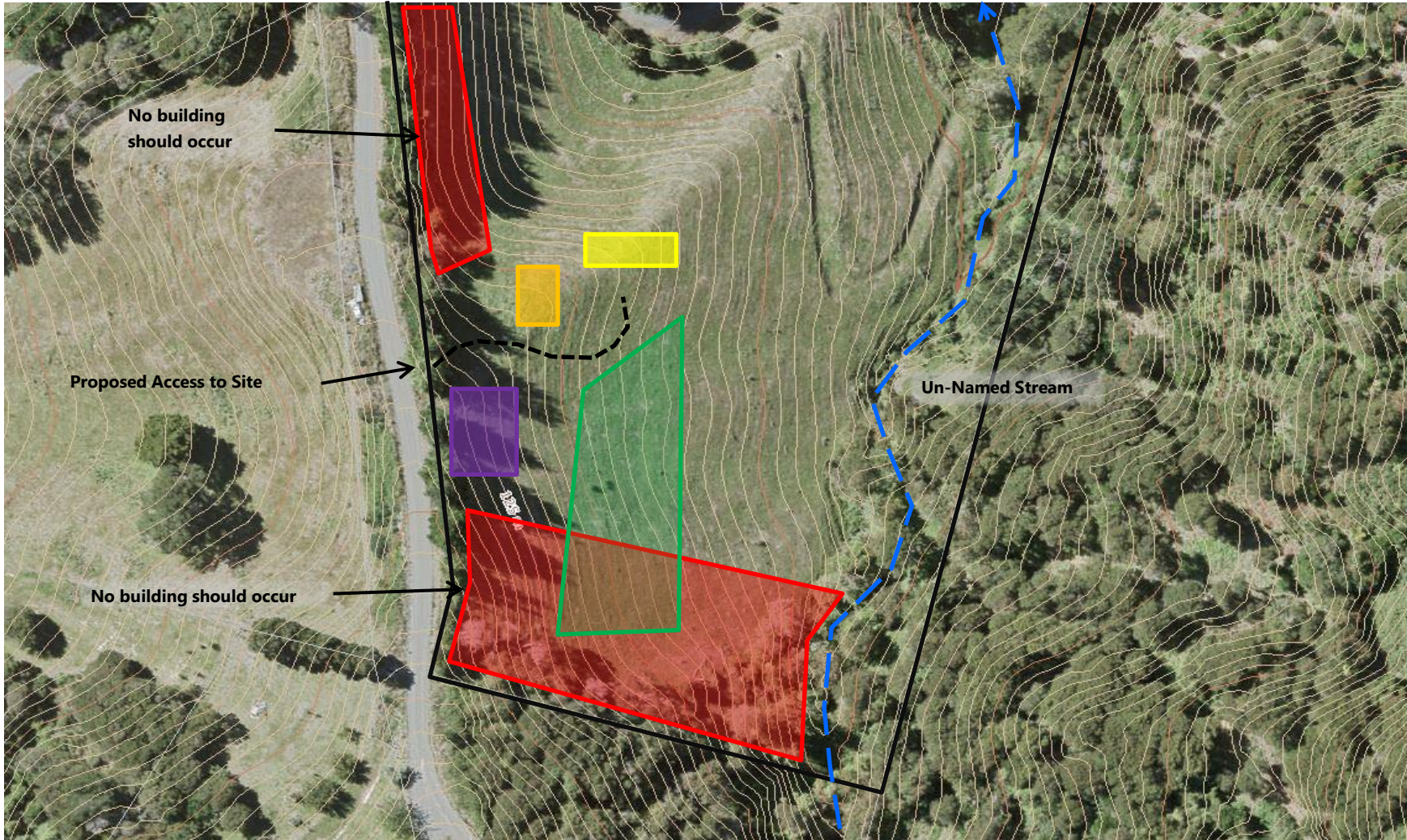
DRAWING NO:

18360/02

SHEET 2 OF 3



Approximate
True North



Legend:

- Areas where no building is recommended
- Area proposed for dwelling
- Area proposed for shed
- Area proposed for temp accomocation during build
- Proposed driveway
- Area proposed for wastewater field

Notes:

1. Top of the South Maps
2. Original plan size A4.



Civil Structural Environmental
Geotechnical

Nelson Ph: 548 - 8259
Christchurch Ph: 348 - 1000

DATE: October 2018

DRAWN: KJ

SCALE: NTS

Proposed Conceptual Site Plan

205 Lud Valley Road


Hira

DRAWING NO:

18360/03

SHEET 3 OF 3

Appendix C: Investigation Logs

Job No: 18360	Test Pit (TP): TP1			 CGW Consulting Engineers Civil Structural Environmental Geotechnical Nelson Christchurch PH: 548 - 8259 PH: 348 - 1000		
Job Name: 205 Lud Valley Road, Hira						
Surface Conditions: Grassed	Shear Vane kPa	Scala Blows /50mm				
Easting: 1632833 Northing: 5435086	< 12 Very Soft 12 - 25 Soft 25 - 50 Firm 50 - 100 Stiff 100 - 200 Very Stiff 200 - 500 Hard	0 - 2 Very Loose 1 - 3 Loose 3 - 7 Med Dense 7 - 17 Dense >17 Very Dense	Depth (m) Sample Type Groundwater			

Date: 24-07-18	Site Sketch (TP Location)	Site Observations:
Logged by: KJ		
Machinery Used: 3 tonne Excavator		
Shear Vane No: N/A		
Geologic Unit Depth (m) Eg. Silty fine to coarse GRAVEL with minor sand, light grayish brown. Tightly packed, dry to moist, sub rounded to rounded, sand, fine to medium (FILL). Or SILT, trace to minor fine sand, light brown, mottled orange. Medium dense to dense or "stiff", dry to moist, non-plastic (LOESS).	Unfactored Vane Reading (calibrated)	Scala Penetrometer Results
	Peak	

TOPSOIL	0.00 - 0.25m: SILT, minor fibrous organics; brown; wet, low plasticity.	0	BULK			50mm	100mm
	0.25 - 0.40m: Organic SILT; black; moist, low plasticity. Organics: fibrous and amorphous.					2	2
Stephens Formation	0.40 - 0.70m: Stiff to very stiff, clayey SILT, some fine to coarse gravel; brown; moist, low plasticity. Gravel: completely to moderately weathered, angular sandstone and mudstone.	1	BULK			3	3
	0.70 - 1.70m: Dense to very dense, silty fine to coarse GRAVEL, trace cobble; yellow brown; moist, poorly graded. Gravel/cobbles: completely to slightly weathered, angular, sandstone and mudstone. (Extremely weak SANDSTONE/MUDSTONE)					2	2
						6	6
						12	25
	EOH: 1.70 m bgl No Groundwater Encountered.	2					
		3					
		4					
		5					


Reason for termination: Ground too hard.



TP1 Photographs



TP2 Photographs

Job No: 18360		Test Pit (TP): TP3			 CGW Consulting Engineers Civil Structural Environmental Geotechnical Nelson Christchurch PH: 548-8259 PH: 348-1000				
Job Name: 205 Lud Valley Road, Hira									
Surface Conditions: Grassed		Shear Vane kPa	Scala Blows /50mm	Depth (m)				Sample Type	Groundwater
Easting: 1632803		< 12 Very Soft	0 - 2 Very Loose						
Northing: 5435069		12 - 25 Soft	1 - 3 Loose						
		25 - 50 Firm	3 - 7 Med Dense						
		50 - 100 Stiff	7 - 17 Dense						
		100 - 200 Very Stiff	>17 Very Dense						
		200 - 500 Hard							

Date: 24-07-18		Site Sketch (TP Location)	Site Observations:	
Logged by: KJ				
Machinery Used: 3 tonne Excavator				
Shear Vane No: N/A				
Geologic Unit	Depth (m)	Eg. Silty fine to coarse GRAVEL with minor sand, light greyish brown. Tightly packed, dry to moist, sub rounded to rounded, sand, fine to medium (FILL). Or SILT, trace to minor fine sand, light brown, mottled orange. Medium dense to dense or "stiff", dry to moist, non-plastic (LOESS).		
		Unfactored Vane Reading (calibrated)		Scala Penetrometer Results
		Peak	Remoulded	50mm 100mm

TOPSOIL	0	0.00 - 0.30m: SILT, minor fibrous organics; brown; wet, low plasticity.	0					
	SF	0.30 - 0.50m: Clayey SILT, some gravel; yellow - brown; moist, low plasticity. Gravel: completely to moderately weathered, angular, sandstone and mudstone.						
		EOH: 0.50 m bgl No Groundwater Encountered						
	1		1					
	2		2					
	3		3					
	4		4					
	5		5					

Reason for termination: Target Depth



TP3 Photographs

Appendix D: Site Photographs



Photograph 1: View up the ridge line from the north east.



Photograph 2: View looking north across the southern end of the site.



Photograph 3: View looking north west, towards the access gate.



Photograph 4: Looking south across the site



Photograph 5: Looking north east, soil creep at the top of the slope.



Photograph 6: Un-named stream on western boundary.



Photograph 7: View looking down the ridgeline, view north east.

Appendix E: Property Conditions

DATE: 31-Jul-02 CONDITION No: 1050

STREET ADDRESS: No's 161,167,195,199,201 Lud Valley Road

DIAGRAM: No

LEGAL DESCRIPTION Lots 4,5,6 DP 17797, Lots 1,2,3 DP18871, Lot 1 DP19894

PROPERTY OWNER
or SUBDIVIDER: Various

SCHEME PLAN No:

NCC PLAN No:

AUTHORITY: Mike Johnston

REASON FOR CONDITION:
(Abbreviated) As a result of subdivision

CONDITION:

- 1) Foundations shall penetrate fill, topsoil and subsoil to bear in competent *in situ* scree or bedrock. Foundations shall be designed and constructed under the supervision of a chartered professional engineer experienced in foundations.
- 2) Cut faces adjacent to buildings shall be retained unless considered unnecessary by a chartered professional engineer experienced in retaining wall construction. Faces over 1.5 m in height within 2 m of a dwelling shall be assessed by an experienced engineering geologist. The engineer shall also design and supervise the construction of any retaining walls that may be required.
- 3) Structural fills shall be in accordance with NZS 4431: 1989 – *Code of Practice for Earthfill for Residential Development*. New non-structural fills shall be placed in a competent manner with track rolling in thin incremental layers. All fill placements shall include adequate stripping, benching and under drainage of the underlying materials.
- 4) Allowance shall be made for potential differential settlement of all structures that are not founded in competent ground or straddle natural ground/fill interfaces.

- 5) Stormwater from roofs, hard standing areas and access roads and effluent disposal to land shall be in a manner that does not induce slope instability.
- 6) Effluent systems shall be designed and constructed by a chartered professional engineer experienced in effluent disposal systems.
- 7) The property shall be maintained in a vegetation cover that prevents erosion.

If excavations as part of development of the building site, access to the site or for the foundations reveal ground conditions that are not as anticipated, such as the presence of soft and/or water saturated ground, or layers of plastic clay, the immediate services of an experienced engineering geologist or a chartered professional engineer practising in geotechnical engineering shall be obtained.

Date Entered: 27-Aug-02