MEYER CRUDEN ENGINEERING LTD

PRELIMINARY GEOTECHNICAL AND INFRASTRUCTURE ASSESSMENT REPORT

SILVERLIGHT STUDIOS, CORBRIDGE ESTATE

REPORT VERSION CONTROL

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PREPARED BY	Mark Cruden		
AUTHOR SIGNATURE			
QUALIFICATIONS	BEng (Hons), CPEng		

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1. INTRODUCTION

Meyer Cruden Engineering Limited has been engaged by Silverlight Studios to complete a preliminary geotechnical and infrastructure assessment in relation to a proposed film studio development at Corbridge Estates near Wanaka. The site location is shown in Figure 1 below. This report has been undertaken as a desktop study and will form part of an application for referral for fast tracked consenting under the Covid Recovery Act. This report provides comment on the following matters: -

- Preliminary geotechnical assessment of the site, including natural hazards, in relation to the proposed development;
- Preliminary assessment of infrastructure requirements and servicing options for the site (water supply, stormwater and wastewater) including any potential constraints on serviceability.

Figure 1: Location Plan

1.1 PROPOSED DEVELOPMENT

The proposed development, which is currently at concept stage involves the creation of a film studios and associated facilities. A scheme plan for the proposed development is included in Appendix A. The scheme plan shows the proposed development which includes the construction of four sound stages, production offices and other facilities including a film school, tourist facilities and cafes and restaurants to service tourists, cast and crew. The facilities would be located around an existing man made reservoir/lake, proposed to be enlarged as part of this development.

1.2 PROJECT OVERVIEW

In preparing this report we have undertaken a desktop study of the:

- Otago Regional Council (ORC) Hazard Mapping System and associated hazard reports (1);
- QLDC Property, Services and Natural Hazard & HAIL GIS Mapping Systems and associated reports (2);
- NZ Geological Map Series (3);
- Tonkin & Taylor Geotechnical Investigation Report rp892491, dated March 2012, supplied by Silverlight (T&T report) (4)
- Horrell Contracting Report ref HCL 11088, Development of Corbridge Downs Estate, Reservoir/Pond lining investigation, supplied by Silverlight (HCL report) (5);

2. LEGAL DESCRIPTION

The development site encompasses several legal blocks:

- Section 1 Block II Lower Wanaka SD 205a,
- Section 65 Block IV Lower Wanaka SD, Part Section 64 Block IV Lower Wanaka SD,
- Section 66 Block IV Lower Wanaka SD,
- Section 67 Block IV Lower Wanaka SD,
- Part Section 64 Block IV Lower Wanaka SD.

3. SITE DESCRIPTION

The development site is located 7km east of Wanaka Town Centre and 1km west of Wanaka Airport. The site is bordered to the south by State Highway 6 and to the north by the Clutha River. Farm paddocks border the east and west sides of the site.

The wider Corbridge site is located within undulating hummocky terrain consistent with glacial moraine landforms. The location of the proposed development is within a natural large hollow basin running east to west with a gully exiting the basin at the western end. An existing irrigation reservoir/lake is located within a portion of this basin (refer photo 1).

Photo 1 – site location (looking SW)

3.1 GEOLOGICAL MAPPING

The New Zealand Geological Map (3) 1:250,000 classifies the site as OIS4 (Late Pleistocene) glacier deposits described as unweathered to slightly weathered, loose, poorly sorted, bouldery gravel, sand, and silt (till); often with contorted bedding.

This mapping is consistent with the findings of the T&T report (4) which indicated that the underlying stratigraphy included glacial till, glacial outwash and glacial lake deposits.

3.2 GROUNDWATER

The depth to groundwater is likely to range from 40 to 65m below ground level, depending upon ground elevation, at a level consistent with the Clutha River. The site is currently serviced by three water supply bores and water race from Luggate Creek.

3.3 NATURAL HAZARDS

The ORC and QLDC GIS hazard mapping systems (1) (2) indicate no significant natural hazards that require site specific assessment. Section 1 Block II Lower Wanaka SD in the southern extent of the site is mapped as being potentially contaminated land described as “sheep dip”. We do not envisage that this would prevent development of the site subject to a detailed HAIL assessment being carried out prior to development. This report does not specifically provide comment on contaminated land.

Ground shaking from a large earthquake can trigger liquefaction within saturated loose silt and sand layers. Depending upon the depth below ground to these layers, liquefaction may result in ground settlement and ejection of liquefied soils at the ground surface. The QLDC GIS hazard mapping system (2) does not extend to the site in question. However, Liquefaction is not deemed a significant risk at the site due to the considerable depth to water table inferred from bore data. The specific design of any structures on the perimeter of the lake should however consider the presence of saturated soils and potential associated localised shallow liquefaction risk. Mitigation options, if required, could include the construction of gravel rafts and waffle slab/foundation systems.

3.4 SEISMIC HAZARD

There are two active fault lines near the subject site. The Cardrona Fault which lies 5km to the west, and the Grandview Fault which lies 10km to the east. These faults have an estimated recurrence interval of 5,500 and 22,000 years, respectively, meaning the risk posed by these faults to the life of the proposed development is considered low.

The Alpine Fault lies approximately 80km northwest of the site and has an estimated recurrence interval of 300 years. Of the three faults the Alpine Fault is most likely to produce shaking at the site during the lifetime of any structure. There is a 30% probability of a magnitude 8 or greater earthquake occurring within the next 50 years on this fault. Such an event will likely cause strong ground shaking in the Wanaka area.

3.5 GEOTECHNICAL ENGINEERING CONSIDERATIONS

The underlying stratigraphy of the site is likely to provide adequate bearing capacity for the establishment of buildings, particularly if founded on the glacial till and outwash deposits. There is some

potential for finer grained lake deposits and windborne deposits to provide bearing capacities of lower order. The specific engineering design associated with the development's structures can be undertaken in such a manner as to address any low bearing soils following specific geotechnical investigations of proposed building platforms. To provide some context we would envisage that the glacial till and outwash deposits would provide bearing capacities in excess of 300kPa ultimate bearing capacity as required under NZS3604:2011.

As mentioned above in section 3 localised shallow liquefaction risk should be considered during the detailed design of structures in close proximity to the lake due to the potential presence of saturated soils caused by exfiltration seepage from the lake.

The Queenstown Lakes region is within an area of seismic activity. Appropriate seismic loading allowances should be considered in the design of any buildings, foundations, earthworks and retaining structures associated with the development.

3.6 SEISMIC SOIL CLASS

For the purposes of detailed design, the underlying deposits are classified as subsoil Class D (Deep soil site) in terms of clause 3.1.3 of NZS1170.5:2004.

4. INFRASTRUCTURE ASSESSMENT

The proposed development will see the creation of several sound studios and associated buildings. Initial estimates supplied by the developer indicate up to 1200 people could be employed on a daily basis with tourist visitors also expected. This level of usage will create significant water supply, stormwater and wastewater infrastructure demand.

4.1 WATER SUPPLY

4.1.1 Demand

The buildings and man-made lake will require a significant water supply. The buildings will require a potable and firefighting supply and the Lake will require a supply to compensate for exfiltration through the base and sides of the Lake. This exfiltration rate will vary depending upon how the lake is to be lined (natural or geosynthetic liner).

4.1.1.1 Potable supply

As mentioned, it is envisaged that up to 1200 staff will be employed at the facility once operational. In addition, if tourism facilities are operational, we estimate an additional 500 visitors per day on top of the staff numbers. On the basis that the facility is day use only, with no overnight accommodation, we would estimate a potable water demand of 100L/person/day, equating to a potable average demand of 170m^3/day and a peak hour demand of approximately 7L/sec using a peak hour factor of 6 (obtained from QLDC's Land Development and Subdivision Code of Practice 2018 V1.1 (6)) . This level of demand is comfortably serviceable via a bore supply.

4.1.1.2 Firefighting

Firefighting requirements for residential, industrial and commercial developments are described in NZS PAS 4509:2008 NZ Fire Fighting Service Firefighting Water Supplies Code of Practice (7). With reference

to table 1 of this standard, and based on potential size and usage, the buildings within the Silverlight development are likely to be classified as requiring up to FW6 to FW7 water supply provisions for non-sprinklered structures and FW2 for sprinklered structures. Appendix A includes a spreadsheet provided by the client with estimated building footprint areas. The FW6/7 requirements are significantly more arduous than FW 2 although the FW 2 requirements would be in addition to the water required to service any sprinkler systems.

With reference to table 2 of NZS4509:2008 FW 2 requirements (in conjunction with a sprinkler system) are:

- Reticulated supply: 750L/min within 135m and an additional 750L/min within 270m, whilst maintaining 100kPA residual pressure in the watermain, or;
- Non reticulated: minimum storage volume 45m^3/30 mins firefighting time within 90m.

FW 6 requirements are:

- Reticulated Supply: 6000L/min within 135m and an additional 6000L/min within 270m, whilst maintaining 100kPA residual pressure in the watermain, or;
- Non reticulated: 2160m^3/180 mins of firefighting time within 90m.

FW7 requires specific assessment in accordance with Appendix H and J of NZS4509:2008.

4.1.1.3 Lake requirements

The man-made lake/reservoir requires a water supply to maintain lake levels by offsetting exfiltration seepage through the base and sides of the Lake. This is discussed in the HCL report which considered the supply requirements of a 1.5m deep 80,000m^2 lake located as per the current proposition. This report indicated a daily demand to offset exfiltration ranging from 4965m^3/day up to approximately 9,855m^3/day depending upon the liner installed. The report also indicated that approximately 4896 m^3/day was available from the annual Corbridge Water supply based on utilising 80% of this supply capacity. The current Corbridge supply comprises three bores and a water race take.

4.1.2 **Supply Options**

Based on the above assessment maintaining the lake represents the largest demand in terms of water supply (although this report has not undertaken any specific assessment beyond a review of the HCL report).

Creating this body of water will also potentially contribute to meeting the firefighting requirements. Given that a large portion of the development will be located around the perimeter of the man-made lake, provision of a non-reticulated water supply would be a pragmatic method to meet firefighting requirements. The available firefighting supply within the man-made lake would exceed the FW6 and the likely FW7 storage requirements by an order of magnitude.

An alternative, or addition, to the lake supply would be to establish large scale water tank storage providing both firefighting and potable supply requirements. This tank storage could be located on the higher ground to the north of the development to provide maximum head/pressure (estimated at 20-

25m/200-250 kPa available) with a reticulated pipe supplying water to the development from there. Pressure booster pumps could be incorporated into the scheme if required. The tank storage would be fed from the bores available within the site via pumps triggered by float switches.

Water tank storage fed from one of the site bores would be the most efficient way to provide the potable supply to the development. As discussed above the tank storage could be enlarged to meet the firefighting requirements if the lake storage option were not deemed suitable to meet all firefighting requirements.

In addition to the three private bores and water race currently servicing the site there is an existing QLDC owned and operated bore that feeds a 150mm dia watermain. This main runs though the wider site in a west to east direction towards Stevenson Road and may be available for connection subject to approval by QLDC. A plan of the existing QLDC services and private bores is included in Appendix B.

At this concept stage we consider it feasible to achieve a water supply that will meet the potable, and firefighting requirements whilst at the same time allowing for the maintenance of the man-made Lake to a desirable level.

4.2 STORMWATER DISPOSAL

Given the estimated size of the development significant impervious areas will be created. These impervious areas will generate stormwater run off that will need to be managed as part of the development. Both the New Zealand Building Code and QLDC's Land Development and Subdivision Code of Practice provide rules and guidance on appropriate ways to manage run off generated from development. In the case of this development there are several options available, two of which include:

- Direct soakage to ground from developed areas. The T&T report indicated the presence of outwash gravels in the underlying stratigraphy suitable for on-site disposal of stormwater. Run off from impervious areas could be directed to underground storage and soakage devices.

- Attenuated discharge to soakage devices or overland flowpaths via the man-made Lake. This option would see run off discharged initially to the Lake where it would be attenuated and slowly released either to soakage to ground devices or via the existing overland flowpath to the west. If the run off from the Lake were discharged overland, then the peak flow rate would need to be managed such that it did not exceed the predevelopment peak flow rate for the same flowpath for any given storm intensity and duration. This is a common method of stormwater management and is highly effective for sites such as this one.

Given the large surface area of the proposed lake, water levels within the lake would be subject to only minor fluctuation resulting from attenuation. QLDC's COP (6) would require any stormwater management system to be designed to consider the impact of climate change. There are no significant issues with managing stormwater from the proposed development.

4.3 WASTEWATER DISPOSAL

The developer has indicated that up to 1200 staff will be employed at the facility and we estimate another 500 persons per day could visit the tourism facilities. This number of people will generate a significant volume of wastewater. With reference to table H4 of NZS1547:2012 (8) we estimate the daily wastewater flows generated from the development would be up to 50L/person, equating to a total peak daily demand of 85m^3/day. Given that the facility is day operations only the wastewater will be reasonably highly concentrated comprising mainly kitchen waste and toilet waste without the diluting benefit of bath and shower use.

There are two options to manage this wastewater:

- Option 1 On site treatment and disposal

  Typically, systems of this size and nature include secondary treatment plants incorporating treatment mechanisms such as filtration, aeration, activated sludge, and UV treatment of wastewater before it is then discharged to land. A system capable of managing up to 85m^3 per day represents a reasonably large commercial on site treatment plant and would be comparable with a ski field operation, large campsite, or similar. Depending upon the land disposal method specified, an area of up to 2 hectares may be required.

  Regional consent would be required in the form a discharge permit due to the volume and nature of the discharge. It is likely that conditions of that consent would include monitoring of wastewater flows and concentrations along with bore water sampling to ensure no contamination of the groundwater. On site systems work best with steady in flows. Large fluctuations in flow rates can affect performance of the treatment plants.

- Option 2 Reticulated connection to QLDC's sewage treatment plant Project Pure

  Project Pure is located approximately 2km east of the proposed development off Stevenson Road. Ideally the wastewater generated from this development would be conveyed to Project Pure via a pressure sewer. The estimated peak flow of 85m^3 per day is not significant compared with peak flows managed from Wanaka for example. This option would be subject to approval from QLDC.

  Both options are considered feasible from an engineering perspective, subject to obtaining consents and approvals.

5. CONCLUSIONS

Meyer Cruden Engineering have undertaken a preliminary desktop geotechnical and infrastructure assessment for a proposed film studio development at Corbridge Estates. Based on this preliminary assessment we consider the development to be viable from a geotechnical and infrastructure perspective.

Based on an assessment of available GIS data there are no site specific natural hazards to be mitigated at the site. A HAIL assessment maybe required in relation to potential contaminated land within the site.

Underlying soils will likely provide suitable conditions for development subject to specific geotechnical investigations and engineering design of foundations being completed at the time of design of the development.

Water supply to the site is viable and several potential options are available to meet the potable, firefighting and lake supply requirements. Supply source options include three private bores within the site, a water race take from Luggate Creek and a nearby QLDC bore feeding a 150mm diameter water main that traverses the site. Connection to the QLDC watermain would be subject to approval.

Stormwater disposal from the site is viable and can potentially take the form of direct disposal to ground or attenuation via the lake in conjunction with disposal to ground or overland flow throttled to predevelopment peak run off rates. The design of stormwater disposal systems would be subject to resource and building consent requirements and would need to consider climate change allowance.

Wastewater generated from the development can potentially be managed via reticulation and connection to QLDC's Project Pure facility 2km to the east or via on site treatment and disposal. Connection to QLDC's system would require their approval. On site treatment and disposal will require resource consent from the Otago Regional Council.

6. REFERENCES

1. **ORC.** *GIS Hazard Mapping System.*

2. **QLDC.** *GIS Hazard Mapping System.*

3. **GNS.** GNS Science Geological Maps, 1:250,000. [Online] https://data.gns.cri.nz/geology/.

4. **Taylor, Tonkin &.** *Geotechnical Investigation Report, Corbridge Downs Subdivision, SH6, Wanaka, rp892491.* 2012.

5. **Ltd, Horrell Contracting.** *Development of Corbridge Downs, Reservoir/Pond Investigations.* 2011.

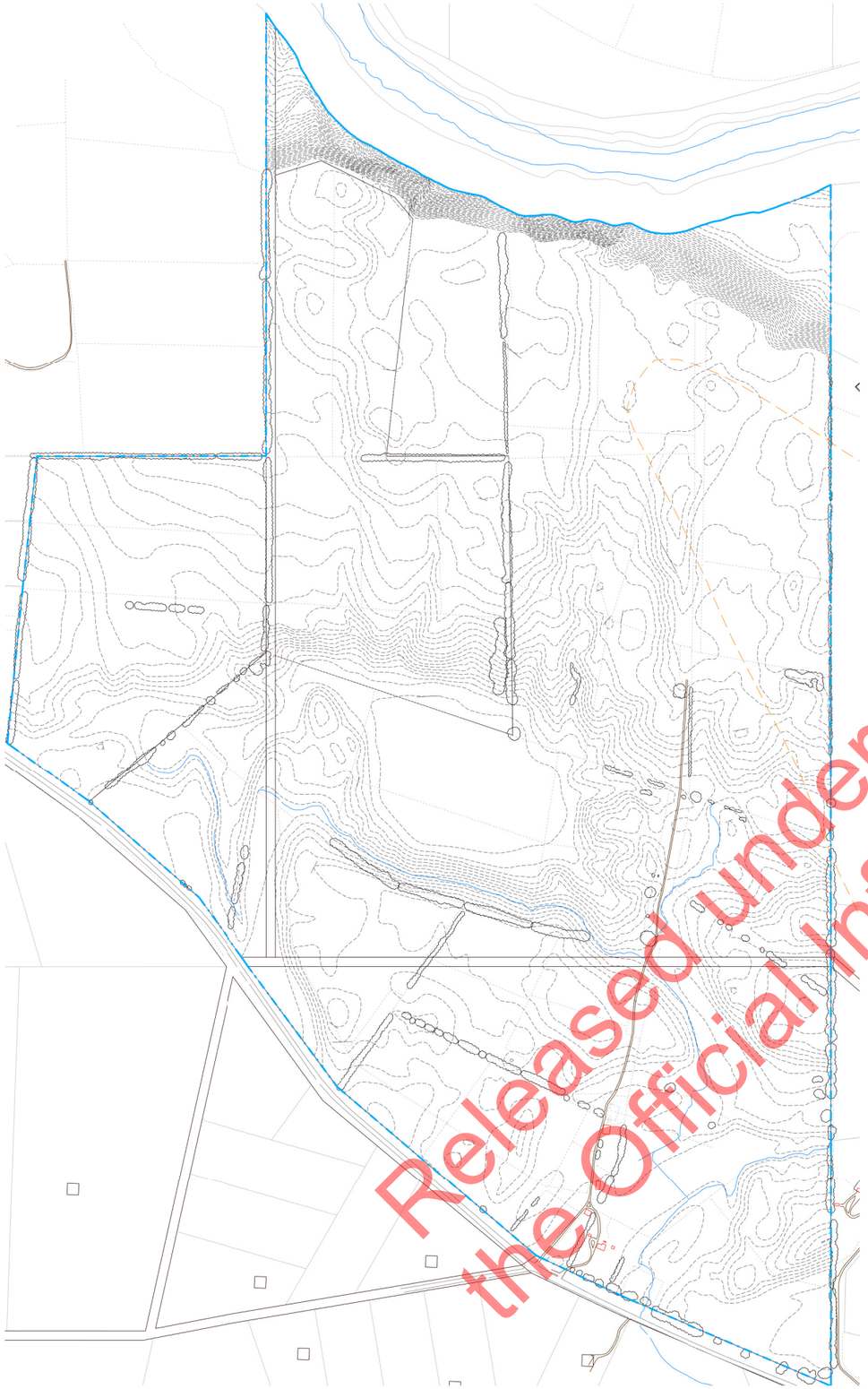
6. **QLDC.** QLDC Land Develoment and Subdivision Code of Practice V1.1. 2018.

7. **Standards, New Zealand.** NZS4509:2008 New Zealand Fire Servces Firefighting Water Supplies Code of Practice. 2008.

8. —. NZS1547:2012 On-site domestic wastewater management. 2012.

APPENDICES

APPENDIX A – SCHEME PLAN



1 EXISTING SITE SURVEY PLAN
SCALE: 1 : 6000

2 PROPOSED SITE PLAN
SCALE: 1 : 6000

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EXISTING & PROPOSED SITE PLANS

Scale @ A1 1 : 6000

TILT ARCHITECTURE

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PROPOSED SITE DEVELOPMENT PLAN

2020107 Scale @ A1: 1 : 2000 Meyer Cruden engineering Ltd

TILT ARCHITECTURE

Silverlight Studios Build Phase#1

Building	Floor Area (FT)	Floor Area (Sq Mt)	Floor Level	Phase	Use
SOUND STAGES					
Stage 1	25,000.00	2,322.58	Ground	1	Primary shooting stage
Stage 2	25,000.00	2,322.58	Ground	1	Primary shooting stage
Stage 3	25,000.00	2,322.58	Ground	1	Primary shooting stage
Stage 4	25,000.00	2,322.58	Ground	1	Primary shooting stage
Outdoor Green Screen	9,900.00	919.74	N/A	1	Primary shooting
TOTAL STAGES/GREENSCREEN	**109,900.00**	**10,210.04**			
WORKSHOP/STORAGE					
Workshop Ground Floor (Construction)	11,000.00	1,021.93	Ground	1	Set Building/Construct
Workshop Top Floor (Wardrobe)	11,000.00	1,021.93	Floor 1	1	Costume Making
Props/Set Dec Storage	8,000.00	743.22	Ground/Floor 1	1	Props/Design Storage
Additional	10,000.00	929.03	Misc	1	All Dept Storage
TOTAL WORKSHOP/STORAGE	40,000.00	3,716.12			
OFFICE SPACE					
Venice					
Crew office space	12,000.00	1,114.84	Floor 1	1	
TDB/Specialty	10,000.00	929.03	Ground	1	
Italian Village (Private Production offices)					
Village buildings for Production Heads and Design	20,000.00	1,858.06	Ground/1st Floor	1	Office space/Storage/Catering
Nantucket					
Village building for Porduction Building for Crew services	8,750.00	812.90	Ground/1st Floor	1	DIR/Prod Offices/Green Rm
Paris					
Production Offices	10,000.00	929.03	1st Floor	1	Crew Offices
TOTAL OFFICE SPACE	**60,750.00**	**5,643.86**	**Ground/1st Floor**	**1**	
Commercial					
Resteraunts	10,000.00	929.03	Ground Floor	1	Crew & Public catering
Coffee Shops	2,500.00	232.26	Ground Floor	1	Crew & Public catering
Shops (Arri Rental etc)	10,000.00	929.03	Ground Floor	1	Commercial
TDB/Specialty	10,000.00	929.03	Ground Floor	1	Commercial
TOTAL COMMERCIAL	**32,500.00**	**3,019.35**			
Additional					
Grip/Camera/LX Base	20,000.00	1,858.06	Ground Floor	1	Truck Tech Base
Cast Trailer Park	10,000.00	929.03	Ground Floor	1	Cast Green Room/Trailers
Wardrobe/Make-up Trailer Park	15,000.00	1,393.55	Ground Floor	1	Make-up/Wardrbe Application
Car Parking	50,000.00	4,645.15	Ground Floor	1	Crew / Public Parking
TOTAL ADDITIONAL	**95,000.00**	**8,825.79**			
Building Phase One TOTALS	**228,250.00**	**21,205.11**			

APPENDIX B – SERVICES PLAN FROM QLDC'S GIS SYSTEM

QLDC Services Map

The information provided on this map is intended to be general information only. While considerable effort has been made to ensure that the information provided on this map is accurate, current and otherwise adequate in all respects, Queenstown Lakes District Council does not accept any responsibility for content and shall not be responsible for, and excludes all liability, with relation to any claims whatsoever arising from the use of this map and data held within.

QUEENSTOWN LAKES DISTRICT COUNCIL

2020197

0 0.45 0.9 1.8 km

Meyer Cruden engineering Ltd

Scale: 1:9,028

Map Date: 14/10/2020

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