Ladies Mile HIF

Housing Infrastructure Fund Scoping and Concept Design

Contact Details

Name: Brandon Ducharme, PMP, MBA, CMEngNZ, CPEng, P.Eng

WSP Opus
Queenstown Office
Level 1, Five Mile Centre, Grant Road, Frankton
PO Box 2323, Wakatipu, Queenstown 9349
New Zealand

Telephone: +64 3 440 2400
Mobile: +64 27 601 2383

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Prepared by:

Brandon Ducharme | Senior Project Manager

Reviewed by:

Richard Hilliard | Senior Engineer Transportation

Approved for Release by:

Reece Gibson | Work Group Manager - Transportation

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1 Introduction

The report herein details the infrastructure concept design and transportation analysis for the Ladies Mile Housing Infrastructure Funding (HIF) site access points and 3 waters.

The QLDC is required to develop concept design and analysis works to coincide with the HIF Detailed Business Case (DBC) submission to secure funding from the Ministry of Business, Innovation, and Employment (MBIE) for infrastructure investments that will encourage development of housing along the Ladies Mile corridor.

The objective of this concept design is to detail the bulk and lead infrastructure requirements that require HIF funding and to provide a progressed level of detail and next steps required in subsequent and detail design phases. Refer to the Ladies Mile Housing Infrastructure Fund strategic case.

Recommendations are provided to assist the QLDC in making informed infrastructure decisions and to provide robust infrastructure funding requirements into the DBC.

Not included in this report are any further findings or scope of works related to Integrated Transport Planning or any alterations to the Stalker Road roundabout.

2 Background

The QLDC engaged WSP Opus in December 2017 to undertake the infrastructure concept design for the proposed Ladies Mile HIF site.

WSP Opus has attended optioneering sessions led by Harrison Grierson, QLDC HIF Programme Manager, to define the basis of concept design to be analysed for the detailed business case.

Opus has developed 2D concept designs and rough order costings for the proposed QLDC developed side road access points and supporting 3 waters services linking the Ladies Mile development to existing transport and 3 waters infrastructure with respect to the programme options and outcomes from the Optioneering Workshop on 16/11/2017 (Refer to Appendix A – Ladies Mile HIF DBC-Long List Options v4.0).

A summary of these options is provided below:

Table 1: Summary Schedule of Options

OPTION	SCOPE
Programme 1: Do Minimum	450 Mixed lots on area D2 only (Stalker)
Programme 2: Intermediate	D2 (Stalker) Plus Area B (Walker) PLUS 25ha at west end of D1
Programme 3: Preferred	D2 (Stalker) Plus Area B (Walker) PLUS 25ha at west end of D1 PLUS area A PLUS Henry's Land
Programme 4: Full Ladies Mile Master Plan Development	Full Ladies Mile Master Plan (D2 (Stalker) Plus Area B (Walker) PLUS 25ha at west end of D1 PLUS area A PLUS Henry's Land Plus east end of D1 but excludes Area C)

This report is presented in four main sections; Transportation, Water, Waste Water, and Storm Water.

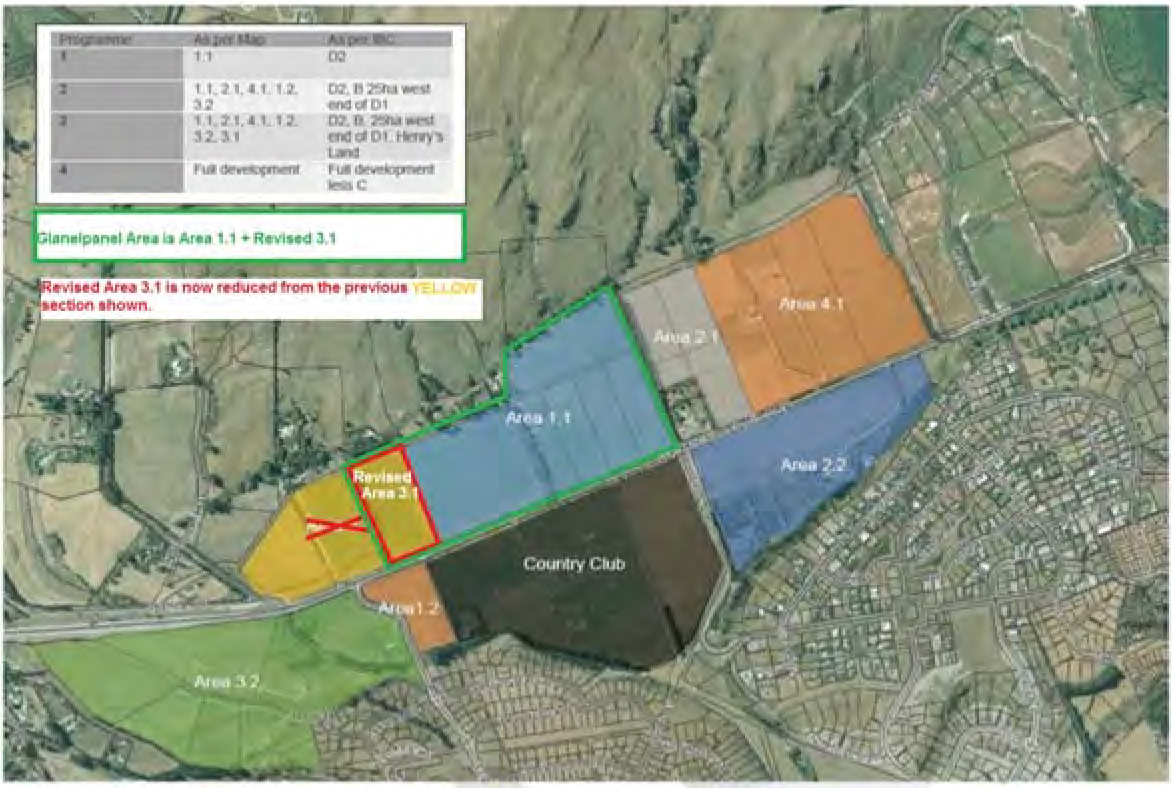

Figure 1: Summary of Development Site Area

3 Summary of Works

The following summarises the work performed to date in accordance with the methodology proposed in the WSP Opus Offer of Service.

3.1 Traffic Turning Counts

WSP Opus has conducted traffic counts on the main access point intersections to establish a baseline dataset for further modelling.

3.2 Traffic Modelling

WSP Opus has performed traffic modelling and assessment of the turn count data obtained in the field and has provided summary of key findings that revealed congestion issues on State Highway (SH6) under the various programme options of development. These have been reported on through memos 1, 2 and 3 appended to this report in Appendix B.

Upon further evaluation, it was deemed necessary to undertake an integrated transport planning exercise, and which is concurrently underway to determine:

a) the impacts of the various programme scenarios and on SH6,

b) sustainable development size

c) transport planning measure required to mitigate the impacts from the increased development in the area.

WSP Opus have been engaged to undertake this exercise and this is being reported on separately.

3.3 Services & Amenities

In addition, WSP Opus performed BeforeUDig-Planning inquiry lodgements to gather services types and locations within in the Ladies Mile access point vicinities to allow for feasibilities and costing provisions of intersection alignments and 3 waters infrastructure improvements.

3.4 Site Roading Access Points

WSP Opus has developed 2D intersection layouts for the three (3) access points to the Ladies Mile development site using existing aerials, and prepared costing estimates based on the quantities derived.

See Appendix C for intersection concept designs.

3.5 3 Waters Alignment and Costings

WSP Opus developed 2D 3-waters infrastructure alignments for the water, waste water and storm water bulk infrastructures required to service the Ladies Mile site, and prepared costing estimates based on the quantities derived.

See Appendix D for Ladies Mile HIF development site 3 waters infrastructure concept design.

4 General Introduction

The scope of concept design presented herein is focused on provision of the bulk civil infrastructure services required to enable development, hence requiring Housing Infrastructure Fund (HIF) funding.

5 Transportation

5.1 Introduction

Three access points to the development have been considered and are shown in Figure 2 below. The access options were determined in an optioneering workshop held on 16/11/2017. The workshop considered the access requirements for the various stages and sizes of the development from the do-minimum, smallest least ambitious Programme 1 to the largest, most ambitious development, Programme 4. The access requirements for each programme are shown in the table below:

Table 2: Programme Option Site Access

	Programme			
Access Option	1	2	3	4
Roundabout at Howards Drive (offset South)	×	×	×	×
Roundabout at Howards Drive (offset West)	×	×	×	×
Access off Lower Shotover Road				×
Second Roundabout at the East end of Ladies Mile				×

Figure 2: Ladies Mile Development Site Three Access Intersections

Note that in addition to the three (3) access points shown above, a further option was discussed at the Optioneering workshop to locate an additional access (not shown above) to the development between Stalker Road and Howards Drive, this was only for the do-minimum option. However, with increasing traffic volumes on SH6 the right turn from Howards Drive will likely become ever more difficult and improvements to this intersection will be needed at some point in the future. Therefore, it makes sense to provide access in conjunction with improvements to the Howards Drive intersection rather than to provide a separate access and add a further access point along an already busy stretch of highway. The additional access option was not considered further and no design was completed for it.

5.2 Access Options Discussion

The access points for Ladies Mile development herein are each challenged by a unique set of variables. The following explores each in detail.

5.2.3 Howards Drive Roundabout

The proposed access point at Howards Drive is consistent across all programme options. The main issue at this location is the limited available road corridor to construct an access point to the north as it will encroach into the surrounding properties. The road corridor and surrounding land is shown in the diagram below:

Figure 3: Howard Drive Access Point Site Constraints

The main constraint is the Pet Lodge to the north-east of the existing Howards Drive intersection. At this stage, there is no agreement to use the Pet Lodge land and therefore the roundabout would need to be positioned to avoid the Pet Lodge. This means that constructing the roundabout will have a greater impact on the other land in the area. However, encroachment into 50m the setback reserve land to the South of SH6 will have less impact on the property owners as this land is not developable. Note there is also a setback for the HIF (as shown indicatively on the north side above), however the impact is minimal to the development, apart from the connecting road. Impacting on the HIF development area to the north west is a satisfactory alternative due to the roundabout being built to provide access to this area and the development can be designed around it.

With the constraints considered, three (3) options were developed for the roundabout and are discussed in more detail in the following section:

Option 1: Offset to the South of SH6

Option 2: Offset to the West of Howards Drive

Option 3: Central positioning

5.2.4 Howards Drive Roundabout Options

All three (3) roundabouts have been designed with a 40-m diameter centre island. The size is based on the minimum requirements of the *Austroads Guide to Road Design Part 4B, Roundabouts*, it is also consistent with the SH6-Stalker Road-Lower Shotover Road roundabout. A smaller 35 m diameter roundabout has been suggested to assist with property constraints as an issue but it was determined that a smaller roundabout would quickly reach capacity, causing a constraint on the network, and does not meet the minimum Austroads requirements and thus it is not recommended.

The roundabouts have been designed with approximately 100 m of merge/diverge on the SH6 approaches and exits. This length has assumed to be appropriate, based on the other roundabouts in the area. Detailed traffic modelling will be required to confirm the required dual laning for queuing and efficiency of the roundabout.

The Option 1 roundabout has been designed to have a slight offset to the south of SH6. The location has been designed to minimise the property impacts and therefore reduce the potential land purchase costs and impacts on developable land. The main area affected is the set-back reserve to the south-west of the Howards Drive intersection. However, as it is designated reserve, the land is not developable for residential purposes and therefore minimises the impact on the land owners.

An offset to the north of SH6, although similar in principle, is not a good alternative as either:

a. Realignment SH6 to meet the roundabout would encroach into the Pet Lodge, or

b. Would require a further offset to the west and realignment of Howards Drive would have a greater impact on the Queenstown Country Club (QCC) land.

Option 2 has an offset to the west of the existing Howards Drive intersection, the intention behind this was to provide greater separation between the HIF access road and the Pet Lodge, such that a bund or similar screening could be constructed. This option has a greater impact on the land to the north and south of SH6, in particular the re-alignment of Howards Drive cutting into the Queenstown Country Club land, this land may already be under development and therefore preclude this option from being constructed. Similarly, the leg to access the Ladies Mile site does not take advantage of the existing road reserve and therefore could reduce its development potential.

Option 3 provides a roundabout alternative centred on the cross road of SH6 and Howard Drive, and was developed to provide an unbiased base of design with respect to impacts on surrounding properties.

Table 3: Options Analysis

	OPTION			
Issue	**1**	**2**	**3**	**Comment**
Encroaching into property south east of SH6/Howards Drive intersection	1	3	2	Mainly into set-back reserve and will have minimal impact on Ladies Mile HIF development. Option 1 has a greater impact due to off-set to south
Lack of visual and audible protection of Pet Lodge	2	3	1	Option 1: Not enough room to construct a bund or acoustic fencing, but vegetation could also help. Option 2: Design shows only protection to the west
Encroachment into Queenstown Country Club developable land	2	1	3	Development of this area may preclude Option 2
Encroachment into set-back reserve to southwest of Howards Drive	2	1	3	Option 3 has the least impact, while Option 2 has a greater impact than Option 1. However, this set-back reserve land is not developable and will therefore have minimum impact on the property owner (Country Club).
Encroachment into HIF Development Land	3	1	2	Option 2 could reduce potential yield from the development dependent on final road alignment. Option 1 and 3 use the existing road reserve.
Land purchase and designation	3	2	1	Greater for Option 2 than Option 1
Total Score	**14**	**12**	**13**	**Note the highest numerical score represents highest advantage over alternative options.**

Note in the table above – the relative merit score of 1, 2, 3 is assigned on the basis of benefit in order precedence where 1 is assigned to the least beneficial over others and 3 is assigned to the highest benefit over others.

Further to Table 3, Option 2 would likely need to be positioned with an offset to the south as well. This would allow for a bund to be constructed to the south of the Pet Lodge property as well as allowing enough room for SH6 widening (under the current design the widened SH6 sits right on the boundary of the Pet Lodge). However, this would result in there being a greater encroachment into the Queenstown Country Club development area due to realigning the approach from Howards Drive.

5.3 Lower Shotover Road Access

Access via Lower Shotover Road would provide access to the HIF Development from the west and forms part of Programmes 4. The location of the access has been assumed to use the existing paper road, approximately 60 m to the north of Spence Road. It has been assumed that right turn bays would be required in this location given the potential future traffic using Lower Shotover Road (which would need to be checked with further detailed traffic modelling should this option progress). Providing access at this location although feasible is not ideal, the issues are listed below:

- The paper road is approximately 10-m wide, which is insufficient to construct a road to the required standard. It is suggested a 20-m wide road corridor would be needed as a minimum.
- The distance between the proposed intersection and Spence Road intersection does not provide sufficient room to install right turn bays as per Austroads guidelines. It is feasible but not desirable. Right turn bays will be determined through traffic modelling and Austroads Turn Warrant as a next step.
- Land purchase would be required to form the intersection and provide the required road corridor width.

Options to resolve the above issues could include:

- Positioning the access further to the north, or
- Using the existing SH6-Stalker Road-Lower Shotover Road Roundabout and altering the Lower Shotover Road leg (although this would be a car centric transport solution).

An initial appraisal of the alternative options shows that further land purchase would be required for both options but the roundabout alteration would be costlier as this would involve realigning Lower Shotover Road and potentially Spence Road also.

5.4 McDowell and SH6 Intersection

An access at the west end of the development is included in Programme 4 for evaluation. Although no specific location has been identified, it has been assumed that McDowell Drive would provide a suitable access point due to it being an existing road and access to SH6.

A roundabout is assumed to be the most appropriate access solution due to the increasing volumes of traffic using SH6. As traffic increases it would make the right turn move from a tee intersection very difficult and may even be restricted in the future. The right turn could reasonably be expected to be the predominant manoeuvre to access Queenstown and Frankton and with only a left turn option, this would limit the efficiency of the intersection. A roundabout is considered a Safe Systems approach to intersection design; however, the integration of the existing walking/cycling trail would need to be carefully considered. Also as a tee intersection currently exists, it is therefore not considered further.

As with the Howards Drive roundabout, the McDowell Drive roundabout has been designed with a 40m diameter central island. The size is based on the minimum requirements of the Austroads Guide to Road Design Part 4B, Roundabouts, it is also consistent with the SH6-Stalker Road-Lower Shotover Road roundabout.

The roundabout has been designed with approximately 100m of merge/diverge on the SH6 approaches and exits. This length has assumed to be appropriate based on the other roundabouts in the area. Detailed traffic modelling will be required to confirm the required dual laning for queuing and efficiency of the roundabout.

5.5 Public Transport, Walking & Cycling Solutions

Walking and cycling facilities have not been considered in detail at this stage, due to there being a further study that will evaluate potential public transport solutions, e.g. bus stops, park and ride and MRT, and active (walking and cycling) modes of transport (integrated transport planning assessment). Walking and cycling facilities will be somewhat dependent upon the findings of this study and will determine the need and location for likes of pedestrian crossings, cycle path routes, footpaths and how these integrate with the proposed housing development that presents a change opportunity to change people's travel behaviours and reduce their reliance on private motor vehicles which is threatening the capacity of the SH6 Frankton-Ladies Mile Highway, and affecting the liveability of Queenstown. Integrating land use and transport planning and delivery is a key theme of the recently released (April 2018), draft Government Policy Statement (GPS), on Land Transport to create liveable cities and a mode neutral transport system.

An allowance has been made for footpaths in the cost estimates for the roundabouts as an initial appraisal on the understanding that this infrastructure will be required in some form.

6 Three Waters

The concept design approach for the Ladies Mile HIF development enabling works is detailed in this section. It covers the infrastructure QLDC will need to provide in order to allow development in the area. There is still outstanding information required through subsequent design stages to confirm the concept designs due to the amount of development near the site which is rapidly changing the existing infrastructure.

The scope of 3 waters infrastructure is to provide trunk reticulation in the State Highway (or outside the project area) for the developer-built services to connect to. No local reticulation within the site is included in the drawings or costings. However, there are pump stations and reservoirs that will have to be located within the development areas (or nearby) which will require connection with the services in the State Highway. These services will not be local reticulation, although in the case of the water falling main piping, service to the development site will be taken off the failing main piping.

The area of development that has been assessed for 3 waters service by QLDC for investment under the Ladies Mile HIF project includes areas 1.1, 1.2, 2.2, 3.1 and 3.2 as shown in Figure 4 below. The total number of dwellings across this area numbers 1100 total.

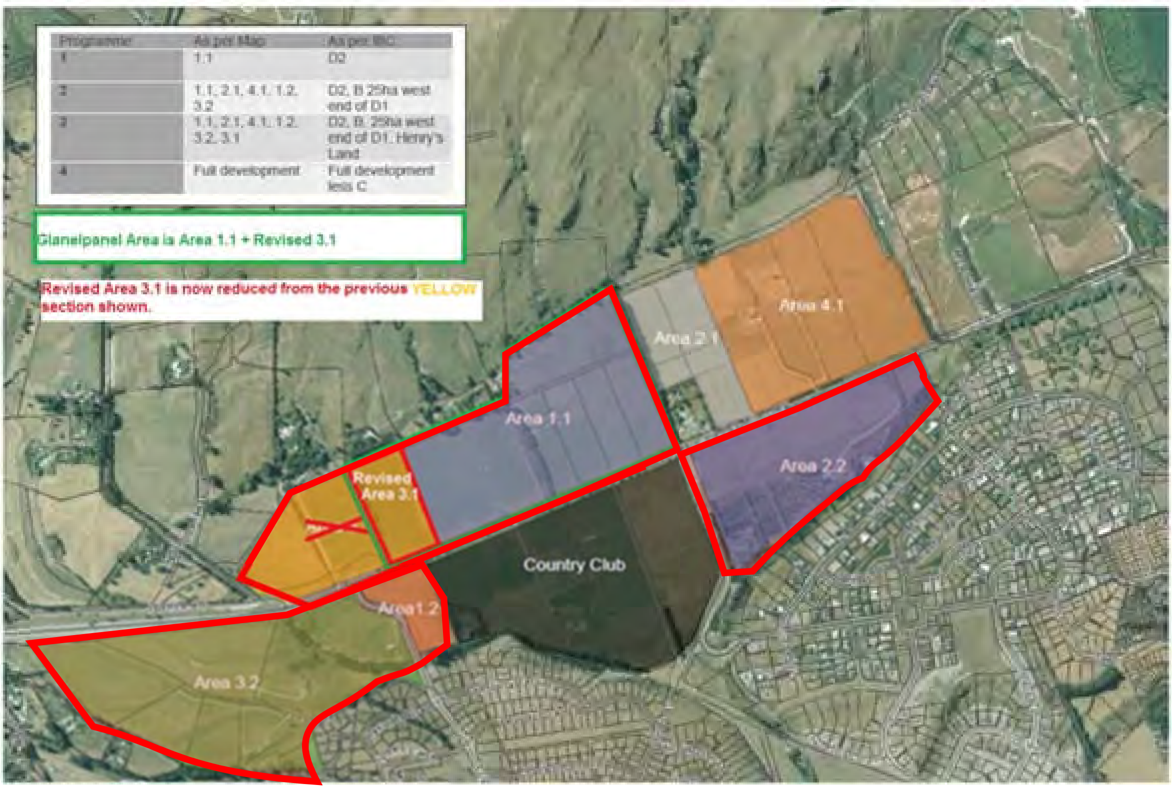

Figure 4: Ladies Mile Development area extents for 3 waters design (shown outlined in red)

6.1 Water Supply

There is currently no water supply to the Ladies Mile HIF area. The master planning work QLDC has been undertaking recommends reservoirs located at height to service consumers without the need for booster pumping. At this stage, there is no specific location identified for the reservoirs, but a minimum height has been identified.

The existing bore field at Shotover Country is current undergoing a capacity upgrade, which will also provide sufficient capacity to service the Ladies Mile development without further upgrades. QLDC is still looking at how the existing Kelvin Heights intake and Jacks Point intake can be dovetailed into the existing QLDC network for the purpose of ensuring a future proofed scheme that will meet the demands of their future growth projections. However, the long-term planning from QLDC indicates that 4,400 m^3/day will be provided for the Ladies Mile area by 2058, which is plenty of supply.

New reticulation from the Shotover Country bore field is required to charge the new water reservoirs that are needed to service the development. Due to the constrained corridor through Old School Road, where the existing trunk water main and proposed trunk main to the Frankton area are located, the new trunk main to Ladies Mile will need to follow an alternative route.

The proposed water main route is adjacent to the existing pipe from the bore field and up through Stalker Road.

The recommended position of the new water reservoirs is on Slope Hill above HIF programme area 1.1 and is at a level of approximately RL 423 m to match the height of the reservoirs at Quail Rise. This level will give a working pressure of between 400 and 600 kPa to the development areas. The location of the reservoirs is not confirmed at this stage, but work has been started to secure an appropriate site (in terms of access and elevation) by QLDC.

Reservoir design parameters defined by the QLDC Land Development and Subdivision Code of Practice require service for 6 hours average demand + fire storage as the worst-case scenario. This resulted in 6 hours of 63 l/s total demand, and a reservoir size of 1360 m^3. In order to provide adequate resilience to the supply, two reservoirs of 1000 m^3 are proposed.

Table 4 – Summary of Water Design Calculations

Calculation of Reservoir Sizing:	
Water Demand per dwelling	1000 l/day
Fire Demand from reservoir	3000 l/min
Total number of dwellings	1100
Average water usage	1100 m^3/day (13 l/s)
Average water usage including fire demand	63 l/s
Storage of 6 hours average demand + fire demand	1360 m^3
Calculation of pipeline sizing:	
Peak flow (rising main to reservoir)	33 l/s
Peak flow (falling main from reservoir)	51 l/s
Pipe size – Rising main to reservoir	DN280 PE
Pipe size – Falling main from reservoir	DN315 PE (allows for fire demand flow)
Velocity of rising main	0.75 m/s
Velocity of falling main	0.9 m/s

Assumptions:

- That water requirements are 1000 l/dwelling/day as confirmed by QLDC on 4 May 2018.
- That the number of dwellings for design basis irrespective of programme option yields is 1100 as advised by QLDC on 30 April 2018.
- Peak Day Demand (PDD) is Average Day Demand x 2.0
- Trunk rising main sizing is based on PDD x 1.33

- Trunk falling main sizing is based on PDD x 2.0
- Water pressure level of service within the development will be a minimum of 400 kPa based on the height of the reservoirs at RL 423 m.
- That the upgraded bore supply will supply demand of 2200 m^3/day
- Steel reservoirs have been assumed for costing purposes, as has been recently used at the Middleton reservoir and is the QLDC's preference going forward.

Refer to Appendix D - Three Waters Concept Design Alignment, H101 for the proposed water supply alignments and details.

6.1.1 Concept Design for Programme

Refer to the attached concept plan showing the water supply pipes.

- 2030 m of DN280 PE100 water pipe (rising to reservoir)
- 1310 m of DN315 PE100 water pipe (falling to development areas)
- 2 No. 1000 m^3 water reservoirs

6.1.2 Recommendations

1. It is recommended to arrange an easement for the pipes through the Ladies Mile development now, before building locations are set.

2. Identifying a suitable parcel of land for the construction of the reservoirs and commencing purchase negotiations should be carried out as soon as possible to ensure land at the optimal RL can be secured.

6.2 Waste Water

Waste water in the Ladies Mile area currently relies on pump stations to return waste water to the top of the gravity main located in the approach to the Shotover River Bridge. This gravity main acts more as a force main, or inverted siphon through to the launder in the Shotover Waste Water Treatment Plant on the far (west) side of the Shotover River.

The existing operational pipe across the bridge is a DN450 steel pipe, and initial assessment by QLDC (and information provisions in the Glenpanel SHA Report) indicates that this pipe has approximately 70 l/s spare capacity. As there is no clear information on the remaining capacity of the DN300 PVC pipe upstream of the bridge, only the smaller rising main discharges will be proposed as discharge into this pipe, and a new rising main to connect to the existing DN450 would be necessary to accommodate flow from areas 1.1 and 3.1.

The fall of the land across the site is generally towards Lake Hayes to the east, requiring a pumped solution to return the waste water towards the Shotover Waste Water Treatment Plant to the west. There are three distinct areas that will require individual pump stations due to localised fall of the land. Areas 2.2, 1.2 and 3.2 will require two smaller pump stations. These pump stations will be built by QLDC. A third pump station will be required for the Areas 1.1 and 3.1, which will be the responsibility of the developer. A rising main in the State highway corridor will be provided by QLDC, from the anticipated location of the pump station through to the existing DN450 pipe at the bridge.

The first pump station is located at the edge of area 3.2 and will pump 8 l/s (gravity PWWF) to the gravity pipes in the State highway via a DN160 PE100 rising main.

The second pump station is located on the edge of area 2.2 and will pump 9 l/s (gravity PWWF) to the adjacent Queenstown Country Club pump station via a DN160 PE100 rising main. The Queenstown Country Club pump station does not have additional capacity, and so will require an upgrade to accommodate the extra 9 l/s. The DN160 PE rising main should be able to accommodate the extra flow without exceeding maximum recommended velocities (estimated to be between 1.5 m/s and 3 m/s as the current design is unknown), and hence requires further assessment.

The ground profile information for the area between the Queenstown Country Club pump station and the HIF area 2.2 is not fully understood at this time. The original LiDAR data indicates dips in the ground that would make laying a gravity wastewater pipe between these two locations unfeasible. However, construction drawings from Fluent for the new DN1200 storm water pipe down Howards Drive suggest there may have been changes made to the final ground surface. With more information, it may be discovered that a gravity pipe could be built shallow enough to connect into the 3.5 m deep pump station wet well.

The Shotover Waste Water Treatment Plant was built with capacity for the Ladies Mile development, and hence there is an available pipe entry to the headworks launder within the plant.

Provisional costing for 12 hours storage at each pump station site has been included to accommodate the gravity flows in the event of an outage. This may not be required if an appropriate level of storage can be achieved within the pipe network, which will become apparent in the design of the local reticulation by the developer.

Assumptions:

- Design flows as per the QLDC Land Development and Subdivision Code.
- That the number of dwellings in the HIF area is 1100
- Some (approximately 70 dwellings) of the dwellings in area 3.1 may be able to discharge directly to the existing gravity pipe in the State Highway.

Refer to Appendix D - Three Waters Concept Design Alignment, H101 for the proposed waste water alignments and details.

6.2.1 Concept Design for Programme

Refer to the attached concept plan showing the waste water pipelines.

- New Pump station to pump 8 l/s, with storage for 70 m^3 and 360 m of DN160 PE100 rising main
- New Pump station to pump 9 l/s, with storage for 75 m^3 and 390 m of DN160 PE100 rising main
- 1720 m of DN225 PE100 rising main along SH6 from the approximate location of the developer pump station to the existing DN450 steel pipe near the bridge

6.2.2 Recommendations

1. Determining appropriate locations for the two (2) new pump stations early in the development process would allow for an appropriate area of land to be set aside for the infrastructure and inform where easements for the rising mains could be accommodated.

2. Obtaining new LiDAR or other surface information of the changing landscape now would help for furthering design of the waste water systems.

3. Undertaking further investigation/modelling into the performance of the existing DN300 pipe should be carried out to confirm what additional capacity, if any, it has.

6.3 Storm Water

The hillside above the development areas 1.1 and 3.1 generally flows into the development area and then along east towards Lake Hayes, discharging outside the extents of the development. This is the natural secondary flow path we anticipate the developer utilising. There is a section of land from which the storm water runoff will reach the State Highway at Howards Drive. The remainder will need to be accommodated in a swale and discharge to Lake Hayes in future stages of development.

The Queenstown Country Club has constructed a storm water network from Howards drive to discharge into the Kawarau River per the plan shown in Appendix I – Queenstown Country Club Trunk Stormwater Pipeline Design Plan (Design by Fluent Solutions).

Hence, existing infrastructure exists in Howards Drive, where the Queenstown Country Club project included capacity in the storm water pipe to accommodate up to 1.5 m^3/s from the Ladies Mile HIF development areas. The design report states that the designed capacity of the pipe, and the proportion allowing for contribution from Ladies Mile has been included in Appendix H – Queenstown Country Club Trunk Stormwater Pipeline Design Report (Design by Fluent), refer to Section 2.2 of the report for Ladies Mile contribution – referred to as 'Glenpanel'. The QLDC cost share component of this pipe (per the agreement with the Queenstown Country Club) has been included as a final cost with no further contingencies in the HIF cost estimate.

There is an existing DN1050 stub to connect to at the intersection of Howards Drive and Jones Road. It is assumed that pre-development storm water from areas 1.1, 3.1 and 2.2 can discharge to this pipe without attenuation. The total 1% ARI event flow from these areas is approximately 1.4 m^3/s. This is based on a runoff coefficient C = 0.6. Attenuation on site to reduce post-development flows down to the pre-development levels is recommended as there is little additional capacity in the existing DN1050 pipe.

In the lower section of the development area, 1.2 and 3.2 flow towards the Shotover River, and as such, a new pipe between the development and the river outfall is required. This pipe would likely be located within the State Highway reserve, which appears to be the only public land available. The flow is approximately 0.41 m^3/s, requiring a DN500 storm water pipe.

Attenuation of the storm water flow on site is possible if using rain gardens, swales or attenuation basins. In certain cases, the local roads may provide this attenuation volume. Further work is required to understand where the secondary paths will be located, whether attenuation is fully attainable within the site, and therefore what the final size of the storm water pipes will need to be.

QLDC will need to instruct the level of attenuation to be achieved by the developer within the site at detailed design stage. It is recommended that all flow over and above the pre-development flows is held on site in order to reduce the size of the pipes to be constructed within QLDC roads and the State Highway.

Assumptions:

- That no storm water attenuation or soakage is being included within the development (this could be incorporated to reduce some of the flow needed to be conveyed to the river for discharge).
- That some form of treatment within the development site will be provided to improve the water quality of the storm water discharge to the river to comply with the Otago Regional Plan.
- That a pipe and outfall is necessary and energy dissipation will be required at the base of the hill before discharge into the river from areas 1.2 and 3.2.
- That a stilling basin will be required for energy dissipation to prevent erosion of the river at the discharge point.
- That the areas 1.1, 3.1 and 2.2 will be able to discharge to the pipe in Howards Drive.
- The available cover at the edge of the development at Howards Drive is approximately 1.4 m. This is based on a slope of 0.15% and pipe size of DN1050 in order to connect into the existing DN1050 in Howards Drive.

Refer to Appendix D - Three Waters Concept Design Alignment, H101 for the proposed storm water alignments and details.

6.3.1 Concept Design for Programme

Refer to the attached concept plan showing the storm water pipe lines.

- 150 m of DN1050 RCRRJ pipe
- 220 m of DN500 RCRRJ pipe

6.3.2 Recommendations

1. Initiate discussion with the NZ Transport Agency for approval to install the storm water pipe within the State Highway reserve down to the Shotover River.

6.4 Additional 3 Waters Design Considerations

As the Ladies Mile HIF development is part of a larger area of development at this location, the proposals given above may need to work within a larger network of infrastructure.

For water, the size of both the reservoirs and pipes could be upsized to provide service to more properties.

For storm water, the proposed pipes will not be able to service other areas of development due to either capacity issues of existing pipes, or the location of the pipes. But new storm water can be installed in the State Highway to discharge at Lake Hayes. This pipe would need to accommodate the overland flow from the hill above the development, as the secondary flow path.

For waste water, there is an abandoned (leaky), waste water pipe across the Shotover Bridge that could be used to sleeve a new pipe through if the current pipe is found to be insufficient for additional flow from the other development areas. Refer to Appendix G - Shotover River Bridge Live Load Assessment under New Proposed Services Final Report to QLDC 13 Nov 17, which indicates in the conclusion (Refer to option 5) that installation of two 450mm diameter watermains, and duplication of the a 314mm waste water pipe are feasible. Note that Quail Rise HIF design basis utilised the available water capacity of the bridge in congruence with this live load assessment report; while the risk mitigation contingency plan being proposed for Ladies Mile HIF proposes utilisation of the remaining available waste water load capacity on the bridge.

7 Cost Estimates

The following table summarises the cost estimates in accordance with the programme options for input to the business case.

Table 5: **Cost Estimate Summary**

	Programme Options			
Cost Components	**1**	**2**	**3**	**4**
Programme Description	Do-Minimum	Intermediate	Preferred	Full Ladies Mile Master Plan Development
ROC - Transportation (Construction)	$5,050,000	$5,050,000	$5,050,000.00	$10,750,000
ROC – 3 Waters (Construction)	$6,820,000	$6,820,000	$6,820,000	$6,820,000
ROC - Total (Construction)	**$11,870,000**	**$11,870,000**	**$11,870,000**	**$17,570,000**
Professional Fees (Design, Tendering & Evaluation)	$902,900	$902,900	$902,900	$1,346,600
MSQA	$301,000	$301,000	$301,000	$448,900
Total Base Estimate	**$13,073,900**	**$13,073,900**	**$13,073,900**	**$19,365,500**
Normal Contingency (30%)	$3,930,600	$3,930,600	$3,930,600	$5,818,100
High Risk Contingency (50%): Reservoir	$480,000	$480,000	$480,000	$480,000
Queenstown Country Club Stormwater Agreement (No Contingencies)	$1,700,000	$1,700,000	$1,700,000	$1,700,000
Total Estimate with Contingencies	**$19,212,500**	**$19,212,500**	**$19,212,500**	**$27,391,600**

The rough order cost (ROC) estimate schedules for construction of the concept designs are attached. The budget requirements for the project are derived as follows and detailed in separate cost estimates that have been prepared for both Transportation and 3 Waters:

- Refer to Appendix E - Transportation Intersection Designs ROC
- Refer to Appendix F - Three Waters Estimate ROC

Cost Estimate Notes:

- The capital and construction costs for all three (3) roundabout options at Howards Drive are expected to be similar irrespective of the option selected, the main component difference is the land purchase costs that have not been included in the cost estimates.
- An arbitrary allowance has been made for footpaths/cycleways around the intersections although no design has been undertaken.

- The three waters costs are consistent across all programmes as it has been assumed that future proofing the three waters infrastructure is prudent due to potential increased density or size of development.
- A contingency of 30% has been included given the uncertainties at this phase of design.
- On road and bulk storm water infrastructure have been costed separately and are reflected in the transport and 3 water ROC estimates respectively.
- Wherever possible the rates used to build up the ROC estimates are based on recently tendered rates.
- A cost for the water reservoir has been included as an indicative cost. Further information on the requirements for capacity and Structural/Geotech Engineering requirements are needed to generate a more accurate cost estimate.
- An arbitrary allowance has been allotted to cover of service protection and relocations.

8 Risks

The key risks are identified below without further detailed risk analysis, to be managed going forward;

1. No integrated land use and transport planning performed to date to confirm access requirements, public transport demand/capacity and infrastructure, walking, cycling connections, and maximum allowable development sizes.
   a. Integrated transport design outcomes could dictate physical constraints to the proposed infrastructure in concept design.
2. Ground Conditions (contaminated land, suitability for road construction).
3. Services – initial appraisal has been performed however no service or utility providers have been engaged at this stage. Coordination would be required for upgrades, etc.
4. Land owner cooperation and negotiating.
5. Cut and fill volumes are performed using 2-Dimensional plans based upon road construction requirements; have not accounted for embankments, cut/fills, etc.
6. Suitable location for reservoirs is not able to be secured.
7. Future location of the water treatment plant requires for relay of trunk water mains to reach reservoir.
8. Storm water discharge to the State Highway is not accepted by NZTA as per the Government Roading Powers Act.
9. Storm water from HIF areas is not attenuated on site, requiring larger pipes.
10. The existing unused waste water pipe across the bridge may prove to be unsuitable for sleeving a new rising main through precluding the primary risk mitigation alternative for the proposed waste water treatment infrastructures.

9 Next Steps

The following list summarises the next steps required in progressing the design toward more certainty and through to further detailed phases within the HIF programme.

1. Integrated Transport Planning assessment is concurrently underway. This will enable the designs to be refined for both transport and three waters by:
   a. Defining the maximum possible development yield, based on integrated transport solutions.
   b. Public transport requirements and associated infrastructure now and in the future.
   c. Walking and cycling connections.
2. Undertake a study of alternative access options for the western access point (currently off Lower Shotover Road). This could include alterations to the Stalker Road-SH6-Lower Shotover Road roundabout or a more northern access point of Lower Shotover Road.
3. Progress the three waters master plan to determine the location and sizing of the water supply reservoirs.
4. Engage the Queenstown Country Club to negotiate preferred alignments for Howard Drive / SH6 Roundabout.
5. Discussions with surrounding land-owners to negotiate alignments details.
6. Site investigations to confirm ground conditions and any remediation measures:
   a. Proceed with intrusive geotechnical investigation, including soakage/permeability tests. The above to be procured by the QLDC and arranged by WSP Opus.
   b. WSP Opus Confirmation Survey to confirm extents and spot checks on depths.
7. Engage services and perform potholing tests to confirm service locations, etc.
8. Confirm reservoir locations, and begin securing land.
9. Engage NZ Transport Agency to gain approval of storm water concept design in principle; storm water reticulation via SH6 as suitable and feasible option.
10. Perform feasibility study on Shotover Country Club Pump station and rising main to confirm the suitability and/or requirements to discharge wastewater from area 2.2
11. Confirm Capacity of DN300 in SH6 to enable design of discharges from new pump stations.

10 Acknowledgements

This report has been prepared by Brandon Ducharme – Senior Project Manager of WSP Opus Queenstown Offices, with professional engineering and design support and supervision provided by the following WSP Opus Team of professionally qualified engineering design specialists:

- Reece Gibson – Transportation Engineering Supervision
- Richard Hilliard – Transportation Engineering Supervision
- Giulio Chapman-Olla – Pavement Engineering Supervision
- Amy Prestidge – 3 Waters Engineering Supervision
- Hayley Tregoweth – 3 Waters Engineering Design
- Brendan Schicker – 3 Waters Design and Drafting
- Dr. Paul Jaquin – Geotechnical Assessments
- Nick Divers – Structural and Bridging Engineering Supervision
- Steven J. Forbes – Civil Infrastructure design and Draughting

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11.3 Appendix C - Intersection Concept Designs

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Page 5 – C02.1 HOWARD DRIVE ROUNDABOUT - OPTION 1

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11.5 Appendix E – Intersection Estimates ROC

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11.6 Appendix F - Three Waters Estimate ROC

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11.7 Appendix G - Shotover River Bridge Live Load Assessment under New Proposed Services Final Report to QLDC 13 Nov 17

11.8 Appendix H – Queenstown Country Club Trunk Stormwater Pipeline Design Report (Design by Fluent)

22 Page Design Report by Fluent

11.9 Appendix I – Queenstown Country Club Trunk Stormwater Pipeline Design Plan (Design by Fluent)

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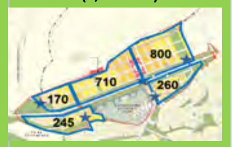
Appendix A - Ladies Mile HIF DBC-Long List Options v4.0

Queenstown Lakes District Council
Housing Infrastructure Fund - Ladies Mile

Investor: QLDC
Facilitator: Tom Lucas
Initial Workshop: 12/12/2017

Version No.: 4
Last Modified by: David Somerville 18/06/2018

Strategic Response			Programme Options			
			Programme 1	Programme 2	Programme 3	Programme 4
Strategic Alternatives	**Strategic Options**	**Intervention options**	**DO NOTHING (450 lots)**	**DO MINIMUM (750 lots)**	**PREFERRED (1,100 lots)**	**MORE AMBITIOUS (2,185 lots)**
		Notes: 1. ★ = access point 2. √√ more ticks = more intensity	 	 	 	
To increase the supply of developable land	Road access to enable subdivision for new sections	SH6 at Howard Drive	√	√	√	√
		Lower Shotover Road	x	x	x	√
		SH6 at McDowell Road	x	x	x	√
		Stalker Road	x	√	√	√
		Howards Drive	x	√	√	√
Improved Accessibility	Public transport	SH6 bus stops	√ (approx. 20% on PT)	√ (approx. 25% on PT)	√ (need 27% on PT just to achieve 900 lots - achievable beyond that?)	√
		Internal bus stops (Developer cost)	√ (approx. 20% on PT)	√ (approx. 25% on PT)	√ (need 27% on PT just to achieve 900 lots - achievable beyond that?)	√
		Increased frequency	√ (approx. 20% on PT)	√ (approx. 25% on PT)	√ (need 27% on PT just to achieve 900 lots - achievable beyond that?)	√√√
		Direct routes	√ (approx. 20% on PT)	√ (approx. 25% on PT)	√ (need 27% on PT just to achieve 900 lots - achievable beyond that?)	√
	Active travel	SH6 pedestrian/cycle crossing	√	√	√	√√
		Improved walking/cycling	x	√	√	√√
	Park and Ride	Park and ride hub for 'Cromwell' traffic	x	√ (20% turn-in at Alec Robins)	√ (>20%+ turn-in at Alec Robins)	√ (++% turn-in at Alec Robins)
		Park and ride hub for 'local' traffic (or use local bus?)	To be agreed outside HIF	To be agreed outside HIF	To be agreed outside HIF	To be agreed outside HIF
		Land for PnR in planned Buffer Zone	To be agreed outside HIF	To be agreed outside HIF	To be agreed outside HIF	To be agreed outside HIF
		Bus priority on SH6 (for Park n Ride and network buses)	x	√ (not essential but improves attractiveness)	√	√
	SH6 relief	Arthurs Point diversion	x	x	Peak	Permanent
		4-laning of SH6	x	x	x	?
		New Shotover bridge	x	x	x	?
		New Kawerau bridge	x	x	x	?
		MRT	x	x	x	?
	Planning Controls	Lead Policy Trigger Points for further incremental SH6 relief (within existing 1100 HOLD point)	450	450 and 750	450, 750, 1100	450, 750, 1100 and ??
		Speed restrictions	80 km/hr	80 km/hr	80 km/hr	80 km/hr
	Other change opportunities	Non-car dependent subdivisions				
Efficient infrastructure that enables housing development	Water supply infrastructure	New dedicated rising and falling mains from Shotover Country borefield	√	√	√	√√
		Expansion of Shotover Country borefield (beyond 26 MLD) with additiona	x	x	x	to be evaluated
		Reservoir(s) at Site 1 (Stalker land, including pipe route-CHECK)	√	√	√	√
		Reservoir at Site 2 (Threepwood, including pipe route-CHECK)	x	x	x	to be evaluated
		Allow storage capacity for Queenstown Country Club	√	√	√	√
		Reticulation mains within the site	x	x	x	to be evaluated
		Additional UV and chlorination treatment at bore	QLDC to confirm	QLDC to confirm	QLDC to confirm	to be evaluated
		Trunk main along SH6 to Howards Drive	√	√	√	√√
		Trunk main along SH6 beyond Howards Drive (east)	x	x	x	to be evaluated
		Trunk main along Howards Drive (south), tie-in to Jones Ave WTP	x	x	x	to be evaluated
	Wastewater infrastructure	Dedicated rising main to Shotover WWTP	x	x	x	to be evaluated
		For Area A: WWPS + Connection to existing gravity in SH6	x	√	√	√
		For Area B: WWPS + Connection to QCC WWPS (incl upgrade of WWPS)	x	√	√	√
		Sewer trunk main along SH6 from Howard Drive to Shotover Bridge	√	√	√	√√
	Stormwater infrastructure	New pipeline to Shotover River	x	For Area A only	For Area A only	to be evaluated
		New pipeline to Lake Hayes Creek in SH6 corridor	x	x	x	to be evaluated
		Glenpanel pipeline across SH6 to existing QCC SW main (for Glenpanel flo	√	√	√	√
		Secondary overland flowpaths (Developer cost)	√	√	√	√
		Cut-off drains at base of slope on north side of subdivision (developer cos	√	√	√	√
		On-site detention basins (developer cost)	√	√	√	√
		Internal reticulation (developer cost)	√	√	√	√

Other Options evaluated but not included in the programmes

To increase the supply of developable land	Road access to enable subdivision for new sections	Left In/Left Out entrance on SH6	**Discounted for safety reasons**
		Modify Stalker Rd roundabout for access	**Only possible if Henry Land becomes available**
		SH6 midway between Stalker Rd and Howards Dr (existing tree lined drive	**Not permitted by NZTA, too close to Stalker Roundabout**
Efficient infrastructure that enables housing development	Water supply infrastructure	New dedicated stand-alone water source and treatment	**Not efficient when so close to existing supply**
		Connect to existing watermain on SH6	**Not enough capacity**
		Connect to existing reticulation in Shotover Country/Lake Hayes Estate	**Not enough capacity**
		Use existing rising main along Old School Road	**Not enough capacity??**
	Wastewater infrastructure	New WWTP within development, with disposal to land or river (Shotover/	**Not efficient when so close to existing supply**
		Connect to existing gravity sewer at Stalker roundabout (existing tee beer	**Not enough capacity???**
		Connect to existing rising main at Howards Dr roundabout (requires WWP	**Not enough capacity???**

STEPS TO IMPLEMENT PREFERRED PROGRAMME (1,100 LOTS)

	Sequence	Action / Intervention	Trigger	Funding Mechanism
1	Prior to first lots	Construct access Roundabout at Howards Drive	DA for Development	HIF
2	Prior to first lots	Construct Bus Stops and Underpass on SH	DA for Development	HIF
3	Prior to first lots	Improve PT Level of Service - Target 20%	DA for Development	ORC
4	By end of 450th lot	Construct Park & Ride East of Ladies Mile	Design @150. Construct @300.	NZTA
5	Park & Ride Complete	Improve PT Level of Service - Target 25%	Park & Ride Complete	ORC
6	By end of 750th lot	Construct Bus Priority Lane (Park & Ride to Shotover Bridge)	Design @450. Construct @600.	QLDC / NZTA
7	Priority Lane Complete	Improve PT Level of Service - Target 27%	Priority Lane Complete	ORC
8	By end of 900th lot	Implement Diversion Improvements	Design @750. Construct @825.	QLDC / NZTA
9	By end of 1,100th lot	Improve PT Level of Service - Target 29%	900 Lots	ORC
10	Prior to 1,101st lot	Future PT Infrastructure / Modal Shift	900 Lots	QLDC / NZTA / ORC

Appendix B – Modelling and Scenario Analysis

Memorandum

To	Warren Ladbrook
Copy	Ulrich Glasner, Simon Leary, Brandon Ducharme
From	Richard Hilliard
Office	Dunedin Office
Date	21 February 2018
File	6-XQ074.01
Subject	Ladies Miles HIF Development Traffic Modelling

Dear Warren,

An initial traffic model has been completed looking at the various access options along SH6 Ladies Mile, the outcomes can be summarised as follows:

- Assuming full development of Ladies Mile (1621 units, as per the yield estimates from Blair Devlin, QLDC) plus background trips results in an increase in SH6 demand of over 100% by 2030 (at current background growth, and assuming Ladies Mile trips are generated at same rate as existing Shotover Country and Lake Hayes Estate)
- Howards Drive access (roundabout)
    - The existing intersection (in its current layout) reaches capacity (for side road) before 2025 without development of Ladies Mile, in both AM and PM peak periods.
    - A four leg 40m island diameter roundabout, with minor widening on south approach can accommodate forecast demand in all development scenarios beyond 2030. However, if access to a park and ride site (or similar facility) is provided in addition at this location, further widening may be necessary.
- It has been assumed that McDowell Drive would provide an additional access to Ladies Mile HIF to the East of Howards Drive (as per programme 4). However, the results should an alternative location for this access be chosen, would not differ.
- Development access at McDowell Drive would need to be provided via a roundabout, a priority controlled intersection is predicted to have insufficient capacity (particularly for right turns out, although most may then choose to re-assign via an alternative access point to the west)
- New roundabout midblock between Stalker Road and Howards Drive T intersection – results are satisfactory, similar to Howards Drive roundabout. However, it is unclear as to benefits of locating roundabout midblock, over ease of introducing at Howards Drive.
- Stalker Road roundabout:
    - Existing intersection reaches capacity (for Stalker Road) before 2025 without development of Ladies Mile, in AM peak period. This is an issue currently occurring on certain days due to Shotover Bridge capacity and friction at Tucker Beach Road.
    - Consequently, any development trips added at the roundabout (either directly on the side road, or indirectly via SH6 and other access points) show further deterioration of performance, that renders any physical improvements largely ineffective
    - Need to further investigate a means to reduce total trips, and investigate access arrangements for potential park and ride facilities

In addition to the above, the following points should also be noted:

- Consideration of the wider impacts of the development on the roading network could determine the speed of development and wider infrastructure projects to cope with the increase demand.
- At current growth (5.7%, average over last 6 years), the westbound Shotover Bridge will be operating at capacity by 2020, and eastbound by 2023 (although the latter is probably close to being reached now due to the eastbound merge at the eastbound exit from the Hawthorne Drive roundabout).

- Even at a more modest growth (3.0%, average over last 10 years), westbound bridge capacity is reached by 2022

Supporting Information

The following is a more detailed look at the modelling undertaken. It is based on the higher yield estimates provided and on an assumption of fairly rapid development which has been simplified into two main blocks – 2025 and 2030. This essentially gives a worst-case scenario which will highlight any potential issues with the existing and proposed access arrangements along Ladies Mile.

Base Counts

Base 2018 turning volumes have been derived from counts undertaken in late January 2018 at the SH6/Howards Drive and SH6/Stalker Road intersections. These have been compared with January 2017 volumes from NZTA TMS site 00600991, to adjust for seasonality.

Growth

Has been based on historic growth at NZTA TMS site 00600991. “Medium growth” has been applied in all traffic models, calculated as 5.7% per annum in line with the 2011-2017 average (2015 to 2017 has been much higher at 9.0%).

Table 1 below shows that **without development**, the current highest volumes on the bridge are 1451v/h westbound in the morning peak hour, and 1255v/h eastbound in the evening peak hour. At medium growth, the westbound direction on Shotover Bridge (estimated to be around 1600v/h per direction) reaches capacity at 2020 in the AM peak (but by 2022 in the low growth scenario). In the eastbound direction, capacity is predicted to be reached at 2023 in the PM peak.

Period	Direction	Growth	Volume by year												
			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
AM	Westbound	"Medium"	1451	1533	1616	1699	1781	1864	1946	2029	2112	2194	2277	2360	2442
		"Low"	1451	1495	1540	1585	1629	1674	1718	1763	1808	1852	1897	1941	1986
	Eastbound	"Medium"	706	746	786	826	866	907	947	987	1027	1067	1107	1148	1188
		"Low"	706	727	749	771	792	814	836	857	879	901	922	944	966
PM	Westbound	"Medium"	998	1055	1112	1168	1225	1282	1339	1396	1452	1509	1566	1623	1680
		"Low"	998	1029	1059	1090	1121	1151	1182	1213	1243	1274	1305	1335	1366
	Eastbound	"Medium"	1255	1326	1398	1469	1541	1612	1683	1755	1826	1898	1969	2041	2112
		"Low"	1255	1293	1332	1370	1409	1448	1486	1525	1563	1602	1640	1679	1717

"Medium" = 5.7% per annum, based on 2011-2017 historic growth at NZTA TMS Site "Shotover - before Lower Shotover Rd" 00600991
"Low" = 3.1% per annum, based on 2007-2017 historic growth at NZTA TMS Site "Shotover - before Lower Shotover Rd" 00600992
(Note, 2015-2017 growth on same site is 9.0% per annum)
Less than 90% of bridge capacity (1440v/h per direction)
Within 10% of bridge capacity (1440-1600v/h per direction)
Higher than bridge capacity (1600v/h per direction)

Table 1

This suggests that a high shift to public transport (and active modes) will be required to accommodate all future background and local development growth.

Development Scenarios

Below shows the development land assumptions and the programme access scenarios.

Access Scenarios	Housing Yield							
	Programme 1		Programme 2		Programme 3		Programme 4	
	5 Year 1.1	10 Year 1.1	5 Year 1.1	10 Year All except 2.2, 3.1	5 Year 1.1, 3.1	10 Year All except 2.2	5 Year 1.1, 3.1	10 Year All
Howards Drive Roundabout Only	466	466	466	1133				
Roundabout Between Howards Drive and Stalker Road	466	466						
Howards Drive Roundabout + Lower Shotover Road					653	1428		
Howards Drive + Lower Shotover Road + Eastern Access (McDowell Dr)							653	1621

Table 2

Document Set ID: 5953267
Version: 1, Version Date: 10/12/2018

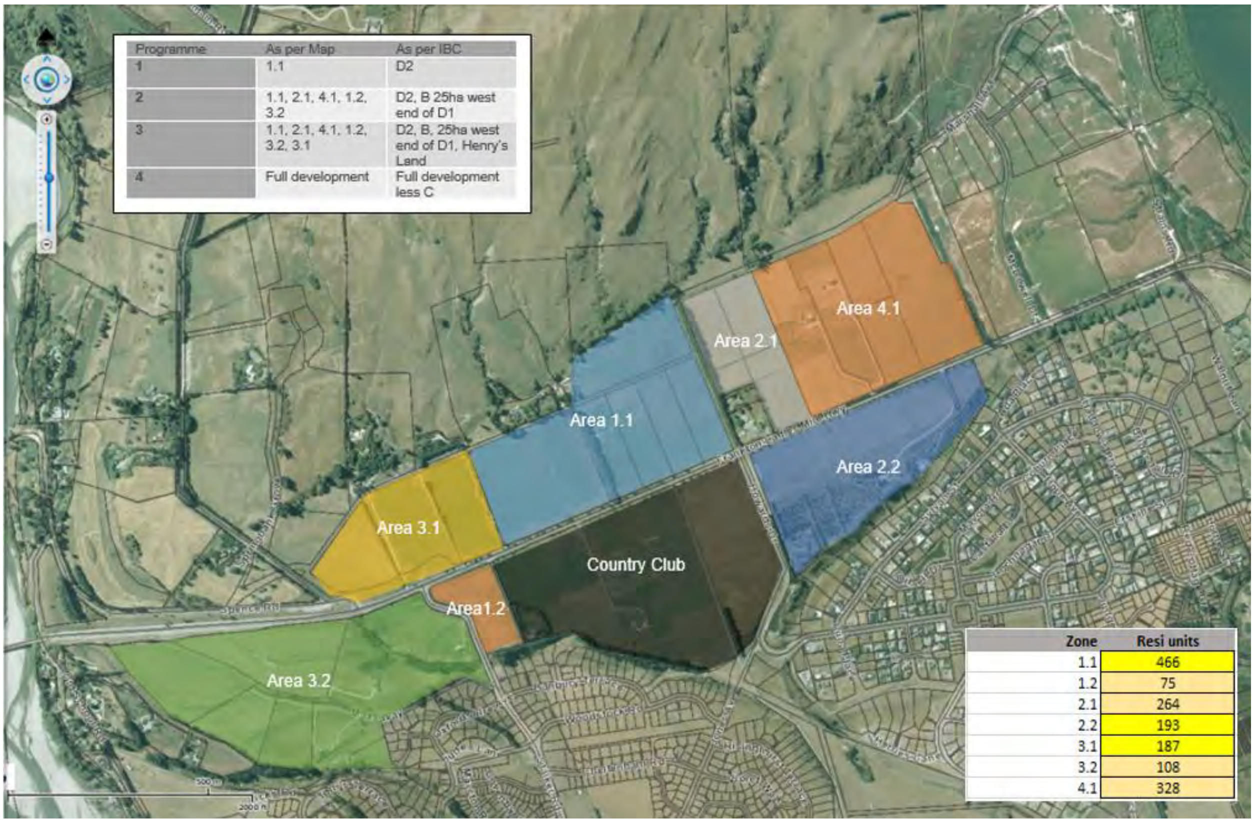


Figure 1

This gives the following scenarios:

Scenario	2025		2030	
	Development	Access	Development	Access
1a	1.1	Howards Drive (north)	1.1	Howards Drive (north)
1b		Midblock Roundabout (north)		Midblock Roundabout (north)
2		Howards Drive (north)	1.1, 1.2, 2.1, 3.2, 4.1	Howards Drive (north), Lower Shotover Road , Stalker Road
3	1.1, 3.1	Howards Drive (north), Lower Shotover Road	1.1, 1.2, 2.1, 3.1, 3.2, 4.1	Howards Drive (north and south), Lower Shotover Road , Stalker Road
4			All	Howards Drive (north and south), Lower Shotover Road , Stalker Road, Mcdowell Drive

Table 3

Trip Rates, Trip Distribution, Trip Assignment

Trip rates have been assumed to be the same as for Shotover Country and Lake Hayes Estate, based on the approximate number of units occupied and the traffic volumes counted at the two access intersections onto SH6.

These rates are calculated as below:

	IN Rate	OUT Rate
AM Peak Hour	0.19	0.55
PM Peak Hour	0.47	0.30

Table 4

Document Set ID: 5953267
Version: 1, Version Date: 10/12/2018

These rates could be lowered due to increased use of PT/other modes in the future, but have been set at these levels for the initial assessment.

Trip distribution to and from each of the 7 zones has been assumed to be as the existing distribution of Shotover Country and Lake Hayes Estate vehicles as counted in the January 2018, and assigned either to SH6 West (to/from Frankton) or SH6 East (to/from Gibbston). Assignment to and from the nearest access intersection within each zone has been done assuming that internal links are available through each zone within Ladies Mile, and therefore some trips do not necessarily enter/exit the zone at the nearest access point.

Total Demand

For the purposes of the assessment, no adjustments to demand have been made to account for:

- Increased PT mode share
- Increased active mode share
- Peak spreading
- Suppressing of demand due to congestion

Consequently, it is considered that the traffic demand used in the analysis below are worst case, as network effects elsewhere will have the natural effect of suppressing these levels of growth, particularly by 2030.

SH6/Mcdowell Drive (Programme 4 at 2030 only)

McDowell Drive has been chosen as the access point to the east of Howards Drive as per Programme 4. This access option is only considered for Programme 4 (all 7 zones) at 2030. Figure 2 below shows the forecast traffic volumes (no capping of demand for Shotover Bridge capacity). Note that in this full development scenario:

- In the AM peak, westbound demand on the Shotover Bridge is 3085v/h, almost twice the capacity of the existing facility
- In the PM peak, eastbound demand on the Shotover Bridge is 2679v/h, around 67% higher than the capacity of the existing facility

This demonstrates the level of mode shift that must occur for the network performance to be satisfactory at 2030.

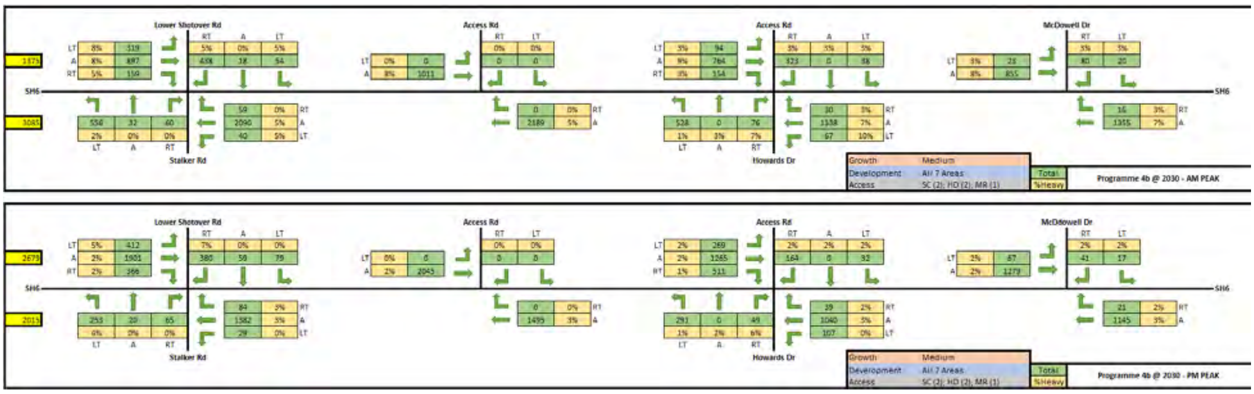


Figure 2

Table 5, below shows the results (degrees of saturation) for a priority controlled T-intersection (similar to existing but upgraded to provide a westbound right turn bay), and a roundabout (single lanes on all three approaches).

Degrees of Saturation	AM Peak Hour		PM Peak Hour	
	Priority	Roundabout	Priority	Roundabout
SH6 East	77%	**96%**	64%	75%
McDowell Drive	**1404%**	14%	**719%**	16%
SH6 West	49%	55%	71%	82%

Table 5

As shown, a priority controlled intersection is not appropriate as a form of intersection to access any future development. The predicted background growth in volumes on SH6 result in few opportunities for the side road traffic to egress McDowell Drive. The introduction of a roundabout results in satisfactory operation (even assuming full unconstrained background growth) of the intersection, so would be the preferred option to provide access to and from Area 4.1 (and any additional development land immediately to the east).

SH6/Howards Drive (All Programmes)

Table 6, below shows the results of an assessment of the SH6/Howards Drive intersection **without development** for the three model years (assuming Medium growth).

Degrees of Saturation	AM Peak Hour			PM Peak Hour		
	2018	2025	2030	2018	2025	2030
Howards Drive	65%	**290%**	**1140%**	58%	**427%**	**684%**
SH6 East	37%	57%	71%	30%	44%	54%
SH6 West	23%	48%	**118%**	52%	**98%**	**165%**

Table 6

The results show that egress from Howard's Drive is predicted to be oversaturated before 2025 in both peak periods, predominantly by right turning vehicles being unable to turn across the two streams of SH6 through traffic, and consequently then blocking left turn movements out of the side road. By 2030, problems are also predicted for the right turn movement into Howards Drive. Consequently, before 2025, improvements to the intersection would appear to be required, independently to access improvements for future development.

Table 7, below shows the results (degrees of saturation) for a roundabout introduced at the SH6/Howards Drive intersection (similar to size and geometry to the existing roundabout at SH6/Stalker Road), under the various development scenarios. It is assumed that the section of SH6 between Stalker Road and Howards Drive would be widened to two lanes in each direction, as merge/diverge pairs would leave a relatively short section of single lane road in the middle. It is also assumed that the westbound SH6 approach (and exit) would widened to two lanes in the vicinity of the roundabout (similar to the existing east side of the SH6/Stalker Road roundabout). Howards Drive and the north access leg would be single lane in each direction.

Scenario	Degrees of Saturation	AM Peak Hour		PM Peak Hour	
		2025	2030	2025	2030
1a	**Howards Drive**	69%	**92%**	34%	43%
	SH6 East	47%	58%	43%	54%
	Ladies Mile	32%	35%	23%	31%
	SH6 West	31%	36%	57%	69%
1b	Access into Ladies Mile not provided at Howards Drive in this option. If intersection is retained as existing then operation will be as per Table above (i.e. oversaturated operation on Howards Drive approach in both peak periods by 2025). If Howards Drive is realigned to the west to form a 4-leg roundabout midblock between Stalker Road and Howards Drive, then results will be as Scenario 1a				
2	**Howards Drive**	Results as per Scenario 1a	**109%**	Results as per Scenario 1a	49%
	SH6 East		84%		65%
	Ladies Mile		87%		77%
	SH6 West		42%		82%
3	**Howards Drive**	64%	**109%**	33%	48%
	SH6 East	42%	73%	42%	62%
	Ladies Mile	19%	70%	14%	61%
	SH6 West	30%	41%	55%	78%
4	**Howards Drive**	Results as per Scenario 3a	**134%**	Results as per Scenario 3a	60%
	SH6 East		73%		67%
	Ladies Mile		56%		53%
	SH6 West		41%		80%

Table 7

The results show that the proposed roundabout can accommodate the predicted demand flows in most scenarios, except in the AM peak 2030 period where the Howards Drive leg is predicted to be over capacity. Further tests have indicated that a minor widening over 40m to two lanes on this approach results in the worst case scenario 4 AM peak 2030 results improving from a degree of saturation of 134% in the above table to 89%. This suggests that a 40m island diameter roundabout can accommodate all future demand scenarios investigated.

SH6/Midblock Roundabout (between Stalker Road and Howards Drive) (Programme 1b only)

This access option is only considered for Programme 1b (1.1 and 3.1) at 2025 and 2030.

Table 8, below shows the results (degrees of saturation) for the introduction of a 40m island diameter roundabout (similar to size and geometry to the existing roundabout at SH6/Stalker Road), under the various development scenarios. It is assumed that the section of SH6 between Stalker Road and the new roundabout would be widened to two lanes in each direction, as merge/diverge pairs would leave a relatively short section of single lane road in the middle. It is also assumed that the westbound SH6 approach (and exit) would widened to two lanes in the vicinity of the roundabout (similar to the existing east side of the SH6/Stalker Road roundabout). The north access leg would be single lane in each direction.

Degrees of Saturation	AM Peak Hour		PM Peak Hour	
	2025	2030	2025	2030
SH6 East	56%	68%	37%	44%
Ladies Mile	30%	32%	22%	27%
SH6 West	28%	33%	55%	64%

Table 8

As shown above, operation is satisfactory in all scenarios. If the Howards Drive link were re-aligned to form a fourth leg at this roundabout, then the results would be as per scenario 1a in the previous section. If left as a T intersection, Howards Drive would be over saturated by 2025 as per Table 5.

SH6/Stalker Road (All Programmes)

Table 9 below shows the results of an assessment of the SH6/Stalker Road intersection **without development** for the three model years (assuming Medium growth).

Degrees of Saturation	AM Peak Hour			PM Peak Hour		
	2018	2025	2030	2018	2025	2030
Stalker Road	62%	**107%**	**169%**	29%	44%	59%
SH6 East	45%	67%	85%	38%	58%	73%
Lower Shotover Road	22%	34%	43%	42%	77%	**122%**
SH6 West	29%	40%	47%	50%	69%	89%

Table 9

The results show that egress from Stalker Road is predicted to be oversaturated before 2025 in the AM peak periods, predominantly due to the high level of westbound SH6 traffic. By 2030, problems are also predicted for movements out of Lower Shotover Road in the PM peak period.

Note that the above assessment does not take account of the capacity constraint of Shotover Bridge – that is, if improvements were made to this roundabout, then operational issues would still be experienced due to blocking back from the westbound merge point towards the bridge. In the PM peak, eastbound flows heading towards the roundabout would also be capped (at the west side of Shotover Bridge), and so problems predicted in the table above for vehicles on Lower Shotover Road are overstated. Consequently, modelling of the development options at this location all show poor operational performance under all scenarios, and are therefore not set out in detail.

Further work/Recommendations

Next stage of the modelling would look to investigate the impacts of two additional elements:

- Application of a PT-reduction factor for both development related and background trips, to dampen the demand to more sustainable levels (which could also incorporate a peak spreading element)
- Re-assignment of the above “lost” trips into a Park and Ride (or some similar) facility along the Ladies Mile corridor, and investigate the impact on turning movements and access/egress arrangements along the corridor.

Memorandum

To	Warren Ladbrook
Copy	Simon Leary, Ulrich Glasner, Brandon Ducharme
From	Richard Hilliard
Office	Dunedin Office
Date	28 February 2018
File	6-XQ074.01
Subject	Ladies Mile HIF - Updated Traffic Assessment

Dear Warren,

Following our meeting on 22 February 2018, to help better understand the impacts of traffic generated by the Ladies Mile HIF development, we have reanalysed the traffic model to show the number of trips that will need to be taken off the road to maintain network efficiency and the timing; our findings are presented following.

For simplicity, we have based these findings on an average yield of 100units/year and considered the full development (programme 4, 1621 units). However, other scenarios for the alternate programme options could also be presented by varying the input parameters, upon request. Refer to attached programme options and outcomes from the Optioneering Work Shop on 2/12/2017 (Refer to Appendix A - Ladies Mile HIF DBC-Long List Options v1.0). A summary of these options is provided below:

Summary Schedule of Options

OPTION	SCOPE
Programme 1: Do Minimum	450 mixed lots on area D2 only (Stalker)
Programme 2: Less Ambitious	Programme 1 PLUS area B (Walker) PLUS 25ha at west end of D1
Programme 3: Programme 2 Plus	Programme 2 PLUS area A PLUS Henry's Land
Programme 4: Full Ladies Mile Development	Full Ladies Mile Master Plan (Programme 3 and includes east end of D1 but excludes Area C)

The following sections summarise the performance of Shotover Bridge (as this is likely to be most greatly affected by development on Ladies Mile) under different growth/development scenarios. The analysis has been done for the AM peak, as the critical westbound direction towards Frankton/Queenstown (PM peak eastbound flow is constrained at the west end of the bridge so has less direct impact on the operation of the Ladies Mile section of SH6.

Existing Situation

AM peak count undertaken at end of January 2018, and re-based to a 2018 “average” based on seasonality from the previous year. This results in demand flow of **1451v/h** heading westbound across Shotover Bridge.

Previous work undertaken by Abley Transportation Consultants (ATC) has indicated a one-way bridge capacity of 1590v/h – for the purposes of this analysis, this has been rounded to **1600v/h**. This suggests that the current bridge is operating at around **90% capacity** during the AM peak hour period. Observations of the bridge operation suggest that this is reasonably accurate, with intermittent queueing back to the Stalker Road roundabout (and beyond) on most days.

Future Scenario Tests

To establish the level of future vehicle trips that would need to be removed from this westbound movement in the AM peak (i.e. onto other modes), a range of several variables have been considered.

- Background growth
  - Low (3.1% p.a. on SH6 through trips based on 2007-2017 average) on SH6; (2.3% p.a. on local trips based on QLDC forecasts).
  - Medium to Low (5.7% p.a. on SH6 through trips based on 2007-2017 average, deteriorating by 0.1% p.a.) on SH6; (2.3% p.a. on local trips based on QLDC forecasts, deteriorating by 0.05% p.a.).
  - Medium (5.7% p.a. on SH6 through trips based on 2011-2017 average) on SH6; (2.3% p.a. on local trips based on QLDC forecasts).
  - High (9.0% p.a. on SH6 through trips based on 2015-2017 average) on SH6; (2.3% p.a. on local trips based on QLDC forecasts).

- Development Size
  - Programme 0 – no development on Ladies Mile.
  - Programme 1 – 466 units on area 1.1 only.
  - Programme 2 – 923 units on areas 1.1, 2.1 and 2.2.
  - Programme 3 – 1293 units on all areas except 4.1.
  - Programme 4 – 1621 units on all areas.

- Opening
  - First units open at 2020.
  - First units open at 2022.
  - First units open at 2024.

- Opening Rate
  - 50 units per year.
  - 100 units per year.
  - 150 units per year.

- Trip Rates – A fixed trip rate has been assumed for all development scenarios of 0.55 departure trips per unit and 0.19 arrival trips per unit in the AM peak. This is based on the current level of trips from Shotover Country and Lake Hayes Estate (as counted in January 2018), and is lower than that predicted by the Trips Data Base Bureau for similar residential developments. However, further sensitivities could be run on these trip rate assumptions.

- Trip Distribution – Has been assumed to be the same as distribution from the Shotover Country and Lake Hayes Estate. This results in 86% of trips heading towards Shotover Bridge in the AM peak.

The analysis does not currently take account of other potential future factors such as peak spreading, increased use of ride-sharing, active modes, etc that could result in a lowering of overall vehicle trips. However, these could easily be accommodated in future modelling scenarios by adjusting the underlying growth rate (either on SH6 through trips, local trips or both).

Potential Public Transport Solutions

A range of solutions have been tested, based on a Park & Ride (P&R) facility being provided somewhere along the Ladies Mile corridor to provide direct public transport (PT) provision to Frankton/Queenstown, and therefore removing vehicle trips from the Shotover Bridge:

- Existing services (4 inbound buses per hour) – capacity around 100/h
- Increased local services (6 buses per hour) – capacity around 200p/h.
- Dedicated P&R (10 buses per hour) in addition to local services (4 buses per hour) – capacity around 550p/h.
- Dedicated double-decker bus P&R (10 per hour) in addition to local services (4 per hour) – capacity around 900p/h.
- New Mass Rapid Transport (MRT) facility (e.g. gondola) with lower level capacity (small units every 20 seconds) – capacity around 2000p/h.
- New MRT facility (e.g. gondola) with higher level capacity (large units every 30 seconds) – capacity around 4000p/h.

The above list is not exhaustive and clearly there are many other options in between the above (and it is assumed that the introduction of an (MRT) system would reduce the level of bus-based capacity back to existing levels), but the figures above are intended to provide an initial indicative range.

Key Findings

Attached is an output showing the results for two of the variables:

- Do nothing, with existing background growth
- Full development (programme 4) starting in 2020 with a yield of 100units/year.

However, the results can be obtained for any combination of the above variables. The value indicates the predicted number of vehicles using the bridge over the 1600v/h capacity that must be accommodated by other means:

- Green spectrum indicates that these extra trips can be accommodated by local bus based solutions,
- Blue spectrum indicates a higher capacity bus-based P&R solution,
- Yellow spectrum indicates where a higher capacity MRT solution is required.

With no development, a dedicated Park and Ride facility would be needed (not necessarily at a maximum 6-minute frequency) by 2023 in the worst case High Growth scenario and by 2028 in the best case Low Growth scenario. A more likely requirement is around 2025/6 (assuming an increase in local services, operating at full loading before this date). An MRT operation is required by 2031 in the High Growth worst case, 2035-2040 in the more realistic Medium/Medium-Low growth scenarios.

With full development (Programme 4) at mid-build rate from 2020 (100 units/year), a dedicated Park and Ride facility would be needed (not necessarily at a maximum 10 per hour frequency) by 2022/3 in all growth scenarios. An MRT operation is brought forward to 2026 assuming High Growth, and by 2028/2030 in the more realistic Medium/Medium-Low Growth scenarios.

Encl:
(1) Sample output from future scenario Analysis
(2) Appendix A - Ladies Mile HIF DBC-Long List Options v1.0

Future Scenarios Analysis

No Development, Background Growth Only

Growth Rate	Ladies Mile Programme	First Open	Units/year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
Low Growth	Programme 0	n/a	n/a	0	0	0	0	3	41	79	117	155	193	231	269	307	345	384	422	460	498	536	574	612	650	688	726	764	802	840	878	916	954	992	1030	1068	1106	1145	1183	1221	1259	1297
Medium Growth	Programme 0	n/a	n/a	0	0	0	13	67	121	175	229	282	336	390	444	498	552	606	660	714	768	822	876	930	984	1038	1092	1146	1200	1254	1307	1361	1415	1469	1523	1577	1631	1685	1739	1793	1847	1901
High Growth	Programme 0	n/a	n/a	0	0	0	73	147	221	295	369	443	517	591	665	739	813	887	961	1035	1109	1183	1257	1332	1406	1480	1554	1628	1702	1776	1850	1924	1998	2072	2146	2220	2294	2368	2442	2516	2590	2664
Medium to Low Growth	Programme 0	n/a	n/a	0	0	0	7	56	105	153	200	245	290	334	376	418	459	498	537	574	611	646	680	714	746	777	808	837	865	892	919	944	968	991	1013	1034	1054	1073	1091	1108	1124	1139

Full Development

Growth Rate	Ladies Mile Programme	First Open	Units/year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
Low Growth	Programme 4	2020	100	0	0	0	60	145	230	316	401	487	572	657	743	828	913	999	1084	1170	1255	1303	1341	1379	1417	1455	1493	1531	1569	1607	1645	1683	1722	1760	1798	1836	1874	1912	1950	1988	2026	2064
Medium Growth	Programme 4	2020	100	0	0	6	107	209	310	411	513	614	715	816	918	1019	1120	1221	1323	1424	1525	1589	1643	1697	1751	1805	1859	1913	1967	2021	2075	2129	2183	2237	2291	2344	2398	2452	2506	2560	2614	2668
High Growth	Programme 4	2020	100	0	0	46	168	289	410	532	653	774	896	1017	1139	1260	1381	1503	1624	1745	1867	1951	2025	2099	2173	2247	2321	2395	2469	2543	2617	2691	2765	2839	2913	2987	3061	3135	3209	3283	3357	3431
Medium to Low Growth	Programme 4	2020	100	0	0	3	101	198	295	390	484	577	669	760	850	939	1027	1113	1199	1284	1368	1413	1448	1481	1513	1545	1575	1604	1632	1660	1686	1711	1735	1758	1780	1801	1821	1840	1858	1875	1891	1906

Memorandum

To	arren Lad roo
Copy	Si on Leary Iric lasner randon Duc ar e
From	Ric ard illiard
Office	Dunedin O ice
Date	Marc
File	
Subject	Ladies Mile IF date to re ious Tra ic Assess ent

Dear arren

lease ind an u date to t e tra ic odellin or t e Ladies Mile IF de elo ent T is ai s to address t e ey oints raised in t e eetin et een LDC and S O us on Marc t ese ein

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date t e tra ic odel to consider t e e ects o di ertin tra ic ia Art urs oint to reduce tra ic enterin Ladies Mile

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us ta e and Ca acity

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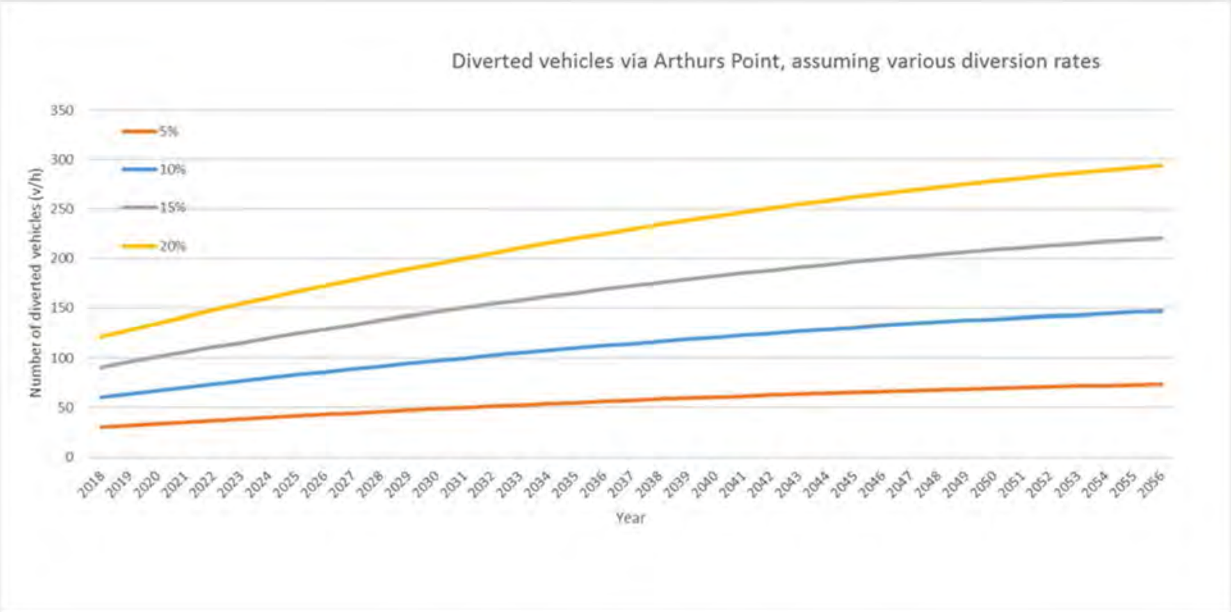

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Ladies Mile HIF Development

Diversion Scenarios: Various Growth, Programme 4 (Full Devlopment)

Growth Rate	Ladies Mile Programme	First Open	Units/year	AP Divert	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Low Growth	**Programme 4**	**2020**	**100**	**0%**	0	0	0	60	145	230	316	401	487	572	657	743	828	913	999	1084	1170	1255	1303	1341
Medium Growth	**Programme 4**	**2020**	**100**	**0%**	0	0	6	107	209	310	411	513	614	715	816	918	1019	1120	1221	1323	1424	1525	1589	1643
High Growth	**Programme 4**	**2020**	**100**	**0%**	0	0	46	168	289	410	532	653	774	896	1017	1139	1260	1381	1503	1624	1745	1867	1951	2025
Medium to Low Growth	**Programme 4**	**2020**	**100**	**0%**	0	0	3	101	198	295	390	484	577	669	760	850	939	1027	1113	1199	1284	1368	1413	1448
Low Growth	**Programme 4**	**2020**	**100**	**5%**	0	0	0	27	111	195	280	364	449	533	618	702	787	871	955	1040	1124	1209	1256	1293
Medium Growth	**Programme 4**	**2020**	**100**	**5%**	0	0	0	72	171	271	371	470	570	669	769	868	968	1067	1167	1267	1366	1466	1528	1580
High Growth	**Programme 4**	**2020**	**100**	**5%**	0	0	10	129	248	366	485	604	722	841	960	1078	1197	1315	1434	1553	1671	1790	1871	1943
Medium to Low Growth	**Programme 4**	**2020**	**100**	**5%**	0	0	0	66	161	256	350	442	534	624	714	802	890	977	1062	1147	1230	1313	1357	1390
Low Growth	**Programme 4**	**2020**	**100**	**10%**	0	0	0	0	77	160	244	327	411	495	578	662	745	829	912	996	1079	1163	1209	1245
Medium Growth	**Programme 4**	**2020**	**100**	**10%**	0	0	0	36	134	232	330	428	525	623	721	819	917	1015	1112	1210	1308	1406	1466	1517
High Growth	**Programme 4**	**2020**	**100**	**10%**	0	0	0	91	206	322	438	554	670	786	902	1018	1134	1250	1366	1481	1597	1713	1792	1860
Medium to Low Growth	**Programme 4**	**2020**	**100**	**10%**	0	0	0	31	124	217	309	401	491	580	668	755	841	927	1011	1094	1176	1258	1301	1333
Low Growth	**Programme 4**	**2020**	**100**	**15%**	0	0	0	0	43	125	208	291	373	456	538	621	704	786	869	951	1034	1116	1162	1197
Medium Growth	**Programme 4**	**2020**	**100**	**15%**	0	0	0	1	97	193	289	385	481	577	674	770	866	962	1058	1154	1250	1346	1405	1454
High Growth	**Programme 4**	**2020**	**100**	**15%**	0	0	0	52	165	278	392	505	618	731	844	957	1071	1184	1297	1410	1523	1636	1712	1778
Medium to Low Growth	**Programme 4**	**2020**	**100**	**15%**	0	0	0	0	88	179	269	359	448	535	622	708	793	876	959	1041	1123	1203	1245	1276
Low Growth	**Programme 4**	**2020**	**100**	**20%**	0	0	0	0	9	90	172	254	335	417	499	580	662	744	825	907	989	1070	1115	1149
Medium Growth	**Programme 4**	**2020**	**100**	**20%**	0	0	0	0	60	154	248	343	437	532	626	720	815	909	1003	1098	1192	1287	1344	1391
High Growth	**Programme 4**	**2020**	**100**	**20%**	0	0	0	14	124	234	345	455	566	676	787	897	1007	1118	1228	1339	1449	1560	1633	1696
Medium to Low Growth	**Programme 4**	**2020**	**100**	**20%**	0	0	0	0	51	140	229	317	405	491	576	660	744	826	908	989	1069	1148	1188	1218

Growth Rate	AP Divert	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
Low Growth	**0%**	1379	1417	1455	1493	1531	1569	1607	1645	1683	1722	1760	1798	1836	1874	1912	1950	1988	2026	2064
Medium Growth	**0%**	1697	1751	1805	1859	1913	1967	2021	2075	2129	2183	2237	2291	2344	2398	2452	2506	2560	2614	2668
High Growth	**0%**	2099	2173	2247	2321	2395	2469	2543	2617	2691	2765	2839	2913	2987	3061	3135	3209	3283	3357	3431
Medium to Low Growth	**0%**	1481	1513	1545	1575	1604	1632	1660	1686	1711	1735	1758	1780	1801	1821	1840	1858	1875	1891	1906
Low Growth	**5%**	1330	1367	1404	1441	1479	1516	1553	1590	1627	1664	1701	1738	1776	1813	1850	1887	1924	1961	1998
Medium Growth	**5%**	1632	1684	1737	1789	1841	1893	1946	1998	2050	2102	2154	2207	2259	2311	2363	2416	2468	2520	2572
High Growth	**5%**	2014	2085	2156	2228	2299	2370	2442	2513	2584	2656	2727	2798	2869	2941	3012	3083	3155	3226	3297
Medium to Low Growth	**5%**	1423	1454	1484	1513	1542	1569	1595	1620	1645	1668	1690	1711	1732	1751	1769	1787	1803	1818	1832
Low Growth	**10%**	1281	1317	1354	1390	1426	1462	1498	1534	1571	1607	1643	1679	1715	1752	1788	1824	1860	1896	1932
Medium Growth	**10%**	1567	1618	1668	1719	1769	1820	1870	1921	1971	2022	2072	2123	2173	2224	2274	2325	2375	2426	2476
High Growth	**10%**	1929	1997	2066	2135	2203	2272	2340	2409	2477	2546	2615	2683	2752	2820	2889	2957	3026	3095	3163
Medium to Low Growth	**10%**	1364	1394	1423	1452	1479	1505	1530	1555	1578	1601	1622	1643	1662	1681	1698	1715	1730	1745	1759
Low Growth	**15%**	1232	1267	1303	1338	1373	1408	1444	1479	1514	1549	1585	1620	1655	1690	1726	1761	1796	1831	1867
Medium Growth	**15%**	1502	1551	1600	1649	1698	1746	1795	1844	1893	1941	1990	2039	2088	2136	2185	2234	2283	2332	2380
High Growth	**15%**	1844	1910	1976	2041	2107	2173	2239	2305	2371	2436	2502	2568	2634	2700	2766	2831	2897	2963	3029
Medium to Low Growth	**15%**	1306	1335	1363	1390	1416	1442	1466	1489	1512	1533	1554	1574	1593	1610	1627	1643	1658	1672	1685
Low Growth	**20%**	1183	1217	1252	1286	1320	1355	1389	1423	1458	1492	1526	1561	1595	1629	1664	1698	1732	1767	1801
Medium Growth	**20%**	1438	1485	1532	1579	1626	1673	1720	1767	1814	1861	1908	1955	2002	2049	2096	2143	2190	2237	2284
High Growth	**20%**	1759	1822	1885	1948	2011	2074	2138	2201	2264	2327	2390	2453	2516	2579	2642	2706	2769	2832	2895
Medium to Low Growth	**20%**	1247	1275	1302	1328	1354	1378	1401	1424	1445	1466	1486	1505	1523	1540	1556	1571	1586	1599	1612

Alternative Transport Modes

Existing Load
Existing Bus Services
Extra Local Buses
Bus P&R
Double Decker P&R
Low Mass Rapid Transport i.e. gondola
Max Mass Rapid Transport

Appendix C- Intersection Concept Designs

QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

CONCEPT DESIGN

Project No: 6-XQ074.01

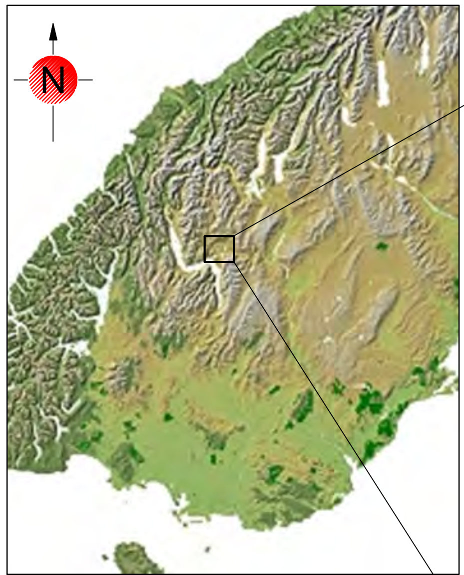
Date: MARCH 2018

DRAWING INDEX

Document Set ID: 5953267
Version: 1, Version Date: 10/12/2018

QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND

LADIES MILE SH6



LOCATION MAP

LOCATION PLAN
SCALE 1:50,000 (A1)
1:100,000 (A3)

CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Nelson Office
+64 3 548 1099
Private Bag 36
Nelson 7042
New Zealand

Designed	Approved	Approved Date
H. TREGOWETH		27/6/18

Drawn	Scales
S. FORBES	AS SHOWN

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
LOCATION PLAN

Project No.	Sheet. No.	Revision
6-XQ074.01	G01	A

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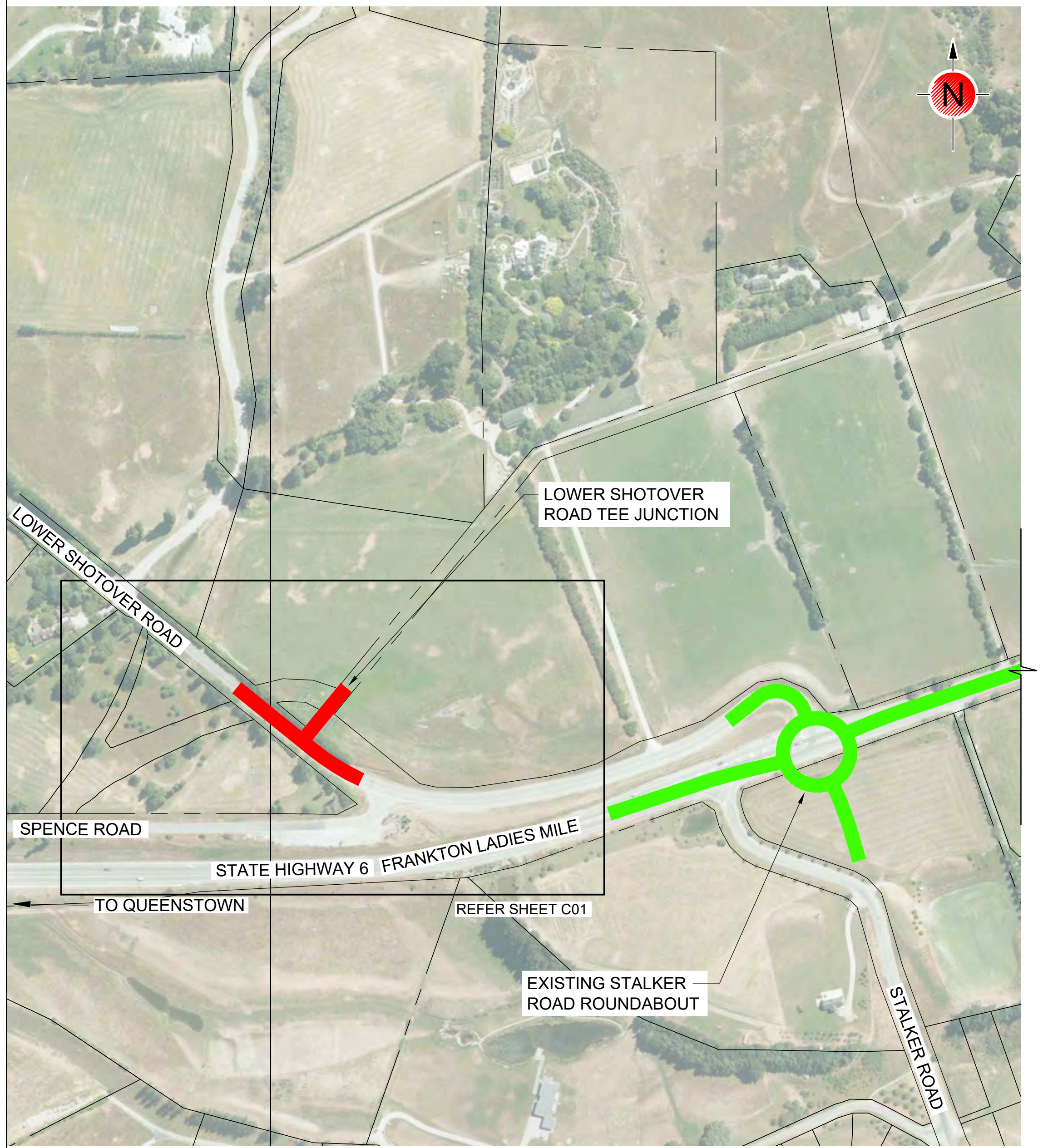

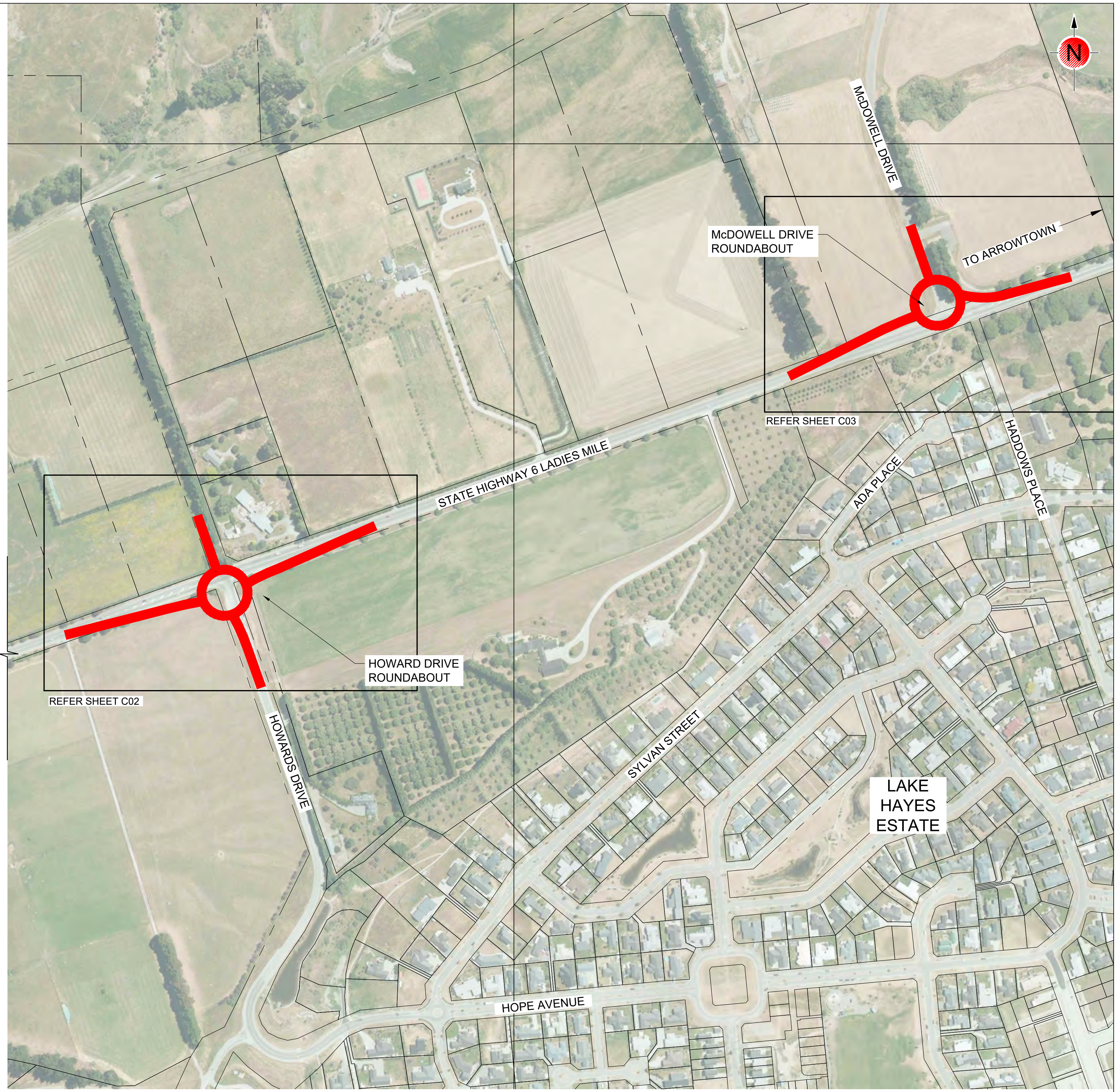

SITE PLAN

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CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Nelson Office
+64 3 548 1099
Private Bag 36
Nelson 7042
New Zealand

Designed	Approved	Approved Date
H. TREGOWETH		27/6/18
Drawn	Scales	
S. FORBES	AS SHOWN	

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
SITE PLAN

Project No.	Sheet. No.	Revision
6-XQ074.01	G02	A

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PLAN
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1:1000 (A3)

DRAWING IN PROGRESS
PLOTTED ON 2018-3-9 AT 1:08 PM
CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

Designed	Approved	Approved Date
S.A.		27/6/18
Drawn	**Scales**	
T.S.	AS SHOWN	

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
PLAN
LOWER SHOTOVER ROAD T JUNCTION

Project No.	Sheet No.	Revision
6-XQ074.01	C01	A

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LEGS	EXIT RADIUS (m)
LEG 1	89.6
LEG 2	41.9
LEG 3	52.3
LEG 4	68.4

NOTE:
1. ALL ENTRY RADIUSES ARE 35m.
2. APPROACH SPEED HAS BEEN ASSUMED TO 80 KM/HR.
3. ENTRY SPEED AT ROUNDABOUT IS 40KM/HR.

PLAN

SCALE 1:500 (A1)
1:1000 (A3)

1:500 @ A1 / 1:1000 @ A3: 0 5 10 15 20 25 30 35 40 45 50 m

CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

Designed	Approved	Approved Date
V DUBE		27/6/18
Drawn	Scales	
V DUBE	AS SHOWN	

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
PLAN
HOWARD DRIVE ROUNDABOUT - OPTION 1

Project No.	Sheet. No.	Revision
6-XQ074.01	C02.1	A

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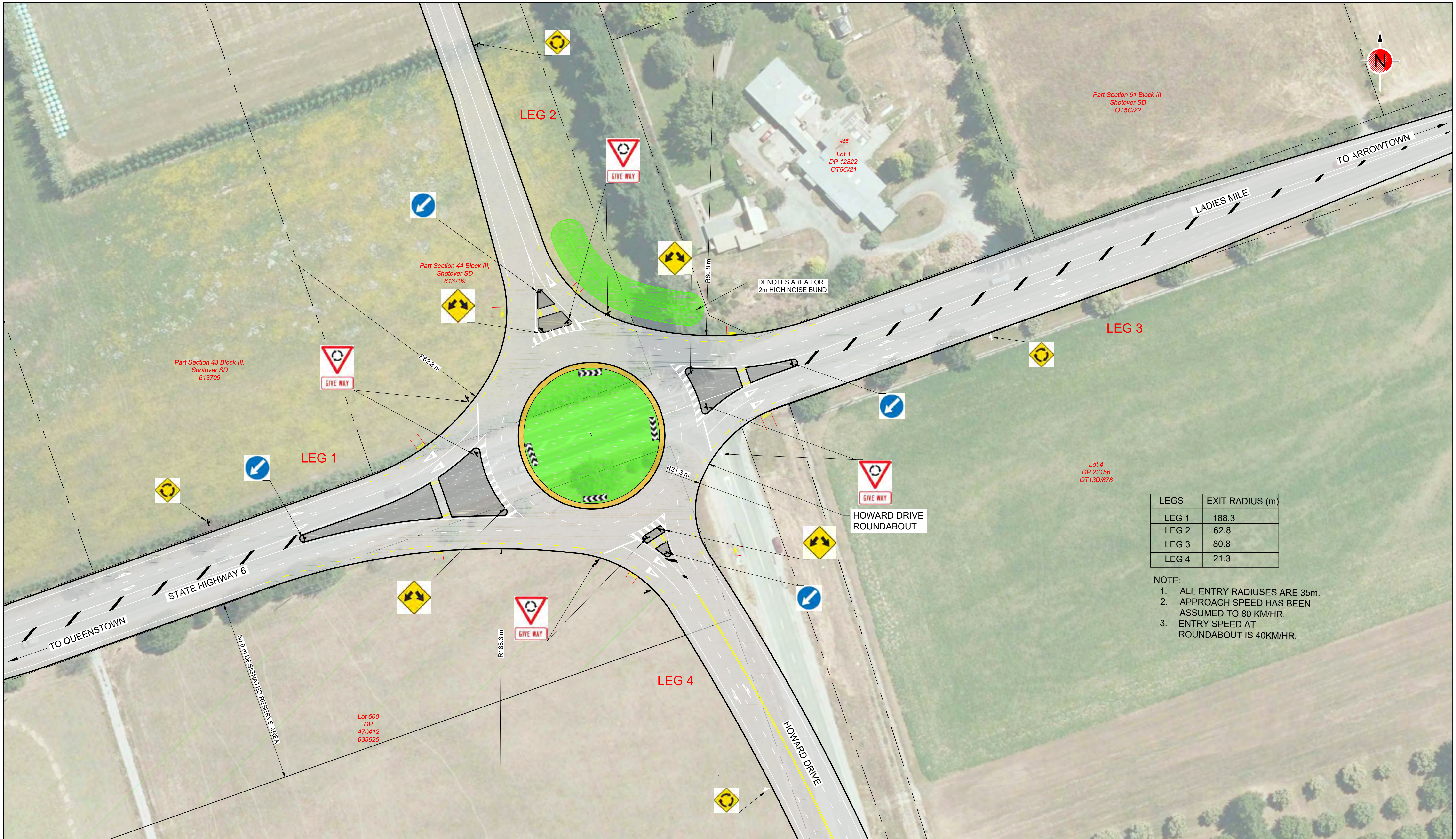

LEGS	EXIT RADIUS (m)
LEG 1	188.3
LEG 2	62.8
LEG 3	80.8
LEG 4	21.3

NOTE:
1. ALL ENTRY RADIUSES ARE 35m.
2. APPROACH SPEED HAS BEEN ASSUMED TO 80 KM/HR.
3. ENTRY SPEED AT ROUNDABOUT IS 40KM/HR.

PLAN
SCALE 1:500 (A1)
1:1000 (A3)

CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

Designed	Approved	Approved Date
V DUBE		27/6/18

Drawn	Scales
V DUBE	AS SHOWN

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
PLAN
HOWARD DRIVE ROUNDABOUT - OPTION 2

Project No.	Sheet. No.	Revision
6-XQ074.01	C02.2	A

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LEGS	EXIT RADIUS (m)
LEG 1	57.7
LEG 2	62.8
LEG 3	80.8
LEG 4	67.0

NOTE:
1. ALL ENTRY RADIUSES ARE 35m.
2. APPROACH SPEED HAS BEEN ASSUMED TO 80 KM/HR.
3. ENTRY SPEED AT ROUNDABOUT IS 40KM/HR.

PLAN
SCALE 1:500 (A1)
1:1000 (A3)

CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

Designed: V DUBE
Approved
Approved Date: 27/6/18
Drawn: V DUBE
Scales: AS SHOWN

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
PLAN
HOWARD DRIVE ROUNDABOUT - OPTION 3

Project No.: 6-XQ074.01
Sheet. No.: C02.3
Revision: A

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CONCEPT DESIGN

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	RG	27/6/18

QUEENSTOWN LAKES DISTRICT COUNCIL

OPUS
Dunedin Office
+64 3 471 5500
Private Bag 1913
Dunedin 9016
New Zealand

Designed	Approved	Approved Date
V.DUBE		27/6/18

Drawn	Scales
B.CHHETRI	1:500(A1) 1:1000(A3)

Project
QUEENSTOWN LAKES DISTRICT COUNCIL
HOUSING INFRASTRUCTURE FUND
LADIES MILE SH6

Sheet
PLAN
McDOWELL DRIVE ROUNDABOUT

Project No.	Sheet. No.	Revision
6-XQ074.01	C03	A

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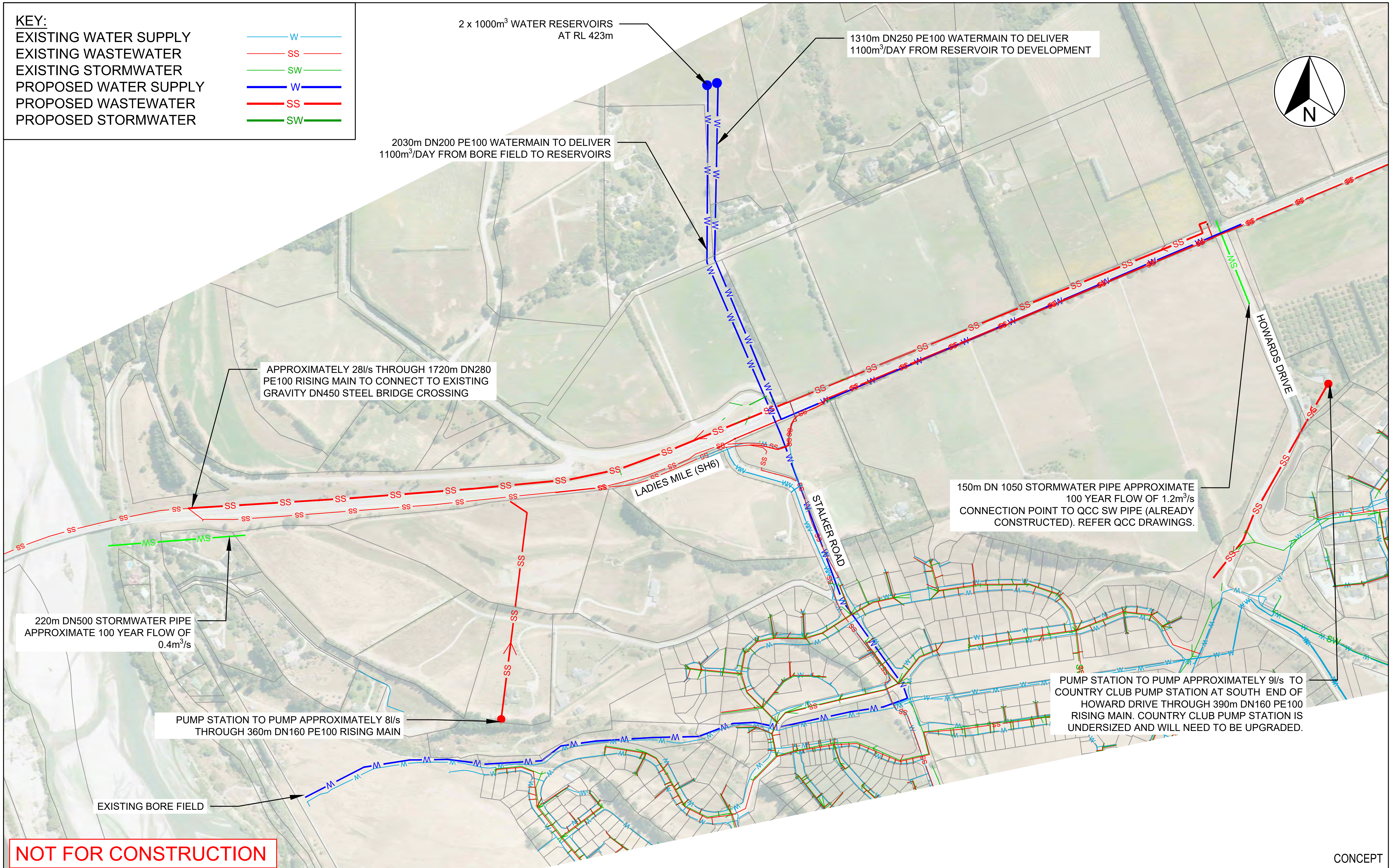
Appendix D - Three Waters Alignment and Capacity Maps



NOT FOR CONSTRUCTION

CONCEPT

Revision	Amendment	Approved	Revision Date
A	CONCEPT DESIGN	A.P	10.05.2018
B	CONCEPT DESIGN UPDATES	A.P	25.05.2018
C	CONCEPT DESIGN UPDATES	A.P	01.06.2018
D	CONCEPT DESIGN UPDATES	A.P	27-06-2018

QUEENSTOWN LAKES DISTRICT COUNCIL

wsp | OPUS
Christchurch Office
+64 3 363 5400
PO Box 1482
Christchurch 8140
New Zealand

Designed	Approved	Approved Date
H.T	A.P	01.06.2018

Drawn	Scales
H.T/J.J	NTS

Project: QUEENSTOWN LAKES DISTRICT COUNCIL
LADIES MILE

Sheet: 3 WATERS CONCEPT

Project No.	Sheet. No.	Revision
6-XQ074.01	H01	D

Appendix E - Intersection Estimates ROC

SUMMARY ESTIMATE SHEET

Project: QLDC LADIES MILE - HOWARD DRIVE | File No: XQ074.01
Office: Queenstown | Status: Preliminary Assessment
SUMMARY ESTIMATE FOR: Proposed Roading Connection | Purpose: ROC
Option 1 | Cost Index: 1116 (Sept 2017)

Approved: Giulio Chapman-Olla | Date: 26-Jun-18 | Page: 1 of 1

Item	Description	Unit	Quantity	Rate	$	$
1	CONTRACTORS QUALITY PLAN (incorporating Site Safety Plan, Environmental Management Plan and Sediment Control & Site Management Plan)					
1.1	Preparation of CQP incl SSP, EMP & SCP	LS	1	10000	$10,000.00	
1.2	Management of CQP incl SSP, EMP & SCP	LS	1	30000	$30,000.00	$40,000.00
2	TRAFFIC MANAGEMENT PLAN					
2.1	Preparation of Temporary Traffic Management Plan	LS	1	3000	$3,000.00	
2.2	Management of TTMP/Traffic Control	LS	1	45000	$45,000.00	$48,000.00
3	ESTABLISHMENT	LS	1	20000	$20,000.00	$20,000.00
4	DAYWORKS					
4.1	Labour	hr	80	50	$4,000.00	
4.2	Plant	%	1.1	10000	$11,000.00	
4.3	Materials	%	1.1	8000	$8,800.00	$23,800.00
5	LOCATION & PROTECTION OF SERVICES					
5.1	Location of Services & Liaison with Utility Authorities	LS	1	10000	$10,000.00	
5.2	Relocation & Protection of Services	PS	1	30000	$30,000.00	$40,000.00
6	EARTHWORKS					
6.1	Clearing of Site	LS	1	20000	$20,000.00	
6.2	Topsoil Stripping - 200mm deep (to waste)	m^3	2350	50	$117,500.00	
6.3	Cut & Undercut to Waste	m^3	5480	50	$274,000.00	
6.4	Sawcut Existing Kerb & Seal	m	30	15	$450.00	
6.5	Granular Bulk Fill	m^3	3530	50	$176,500.00	$588,450.00
7	DRAINAGE					
7.1	Supply and Install 750mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection) (Pipe size to be confirmed by Design)	m	160	800	$128,000.00	
7.2	Supply and Install 600mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection) (Pipe size to be confirmed by Design)	m	50	650	$32,500.00	
7.3	Supply and Install 225mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection)	m	0	300	$0.00	
7.4	Supply and Install 1.05m Dia.SWMH Chamber 1.5m deep with HD Lid (Incl. bedding & pipe connection)	ea	0	10000	$0.00	
7.5	Supply and Install 1.5m Dia.SWMH Chamber 2.0m deep with HD Lid (Incl. bedding & pipe connection)	ea	4	13000	$52,000.00	

Item	Description	Unit	Quantity	Rate	$	$
7.6	Supply and Install Double Back Entry Sump (Incl. bedding & pipe connection)	ea	4	7000	$28,000.00	
7.7	Supply and Install Single Back Entry Sump (Incl. bedding & pipe connection)	ea	8	3500	$28,000.00	
7.8	Supply and Install NZTA F2 110mm dia Subsoil drainage pipe (Incl.bedding, Filter material, pipe connection, Geotextile filter wrap & cleaning eye)	m	600	60	$36,000.00	
7.9	Arrow Irrgation Pipe Bypass Works	LS	0	40000	$0.00	
7.10	Remove Existing SW Sump and Manhole ConnectionPipe	ea	0	1000	$0.00	
7.11	Site Stormwater Diversion Works	PS	1	100000	$100,000.00	
7.12	Remove Existing Concrete Kerb & Channel	m	100	50	$5,000.00	$409,500.00
8	CONCRETE WORKS					
8.1	500mm Wide Kerb & Channel	m	1350	120	$162,000.00	
8.2	Construct 300mm Wide Semi-Mountable kerb	m	426	100	$42,600.00	
8.3	Form Pedestrian Kerb	m	20	100	$2,000.00	
8.4	100mm Concrete Island Infill with embedded stones	m^2	580	150	$87,000.00	$293,600.00
			475			
9	PAVEMENT CONSTRUCTION (CBR4)					
9.1	300mm Sub-base AP65 (solid measure)	m^3	4965	160	$794,400.00	
9.2	180mm Basecourse AP40 (solid measure)	m^3	2980	190	$566,200.00	
9.3	Running Course (looase measure)	m^3	70	350	$24,500.00	$1,385,100.00
10	SURFACING					
10.1	Nominal 50mm AC14 Asphaltic Concrete	m^2	4200	50	$210,000.00	
10.2	Nominal 100mm AC20 Asphaltic Concrete	m^2	4200	120	$504,000.00	
10.3	Membrane Seal	m^2	4200	8	$33,600.00	
10.4	Chipseal surfacing (2 Coat 3/5)	m^2	10700	10	$107,000.00	$854,600.00
11	FOOTPATH CONSTRUCTION - (NOT SHOWN ON CONCEPT PLAN)					
11.1	Timber Batten Edging incl Pegs	m	720	20	$14,400.00	
11.2	100mm AP40 Basecourse (solid measure)	m^3	145	170	$24,650.00	
11.3	Nominal 25mm Mix 10 Asphaltic Concrete	m^2	1080	35	$37,800.00	
11.4	Cycle Coloured Surface (AS2700 G13 Emerald Green or Similar)	m^2	0	120	$0.00	
11.5	Fun Yellow Tactile Audio Pavers	m^2	24	500	$12,000.00	
11.6	Resting Rails	ea	16	1200	$19,200.00	
11.7	Provisional Sum for Pedestrian Solution and bus stops	lot	1	955000	$955,000.00	$1,063,050.00
12	ROAD LIGHTING					
12.1	Relocate Existing Lighting Column (Incl. Fitting luminares and power disconnection)	ea	2	2000	$4,000.00	
12.2	Supply & Install New 12m High Lighting Column with 3m Outreach Arm (Incl. 152W LED luminaires)	ea	3	4500	$13,500.00	
12.3	Supply & Install New 8m High Lighting Column with Post Top Luminaire Mounting Spigot (Incl. 102W LED luminaires) (Based on 45m spacing)	ea	15	3500	$52,500.00	
12.4	Power Cable Installation (Incl. Trenching and ducting if required)	LS	1	10000	$10,000.00	
12.5	Commisioning of Lighting Columns	LS	1	3000	$3,000.00	$83,000.00
13	PAVEMENT MARKINGS					

Item	Description	Unit	Quantity	Rate	$	$
13.1	Reflectorised Pavement marking	LS	1	7000	$7,000.00	
13.20	Redundant Pavement Marking Removal (Sand Blasting)	LS	1	2000	$2,000.00	$9,000.00
14	TRAFFIC SERVICES					
14.1	Install PW-8 Rotary Junction Sign	ea	4	750	$3,000.00	
14.2	Install RG-6R Rotary Give Way Sign	ea	8	750	$6,000.00	
14.3	Install RG-17 Keep Left (inc. Duroflex PS 03 mounting)	ea	4	350	$1,400.00	
14.4	Install PW-5 Diverge Sign	ea	4	1200	$4,800.00	
14.5	Install PW-69 Chevron Board	ea	4	1200	$4,800.00	
14.6	Install RG-1 50 km/hr speed limit sign	ea	4	750	$3,000.00	
14.7	Install RG-1 80 km/hr speed limit sign	ea	4	750	$3,000.00	
14.8	SN-1 Street Sign	ea	4	250	$1,000.00	$27,000.00
15	LANDSCAPING					
15.1	Existing Tree Removal	LS	1	20000	$20,000.00	
15.2	Imported Topsoil 100mm Min. depth (solid measure)	m^3	350	100	$35,000.00	
15.3	Grassing and Hydroseeding (Grass for road berm areas only)	m^2	3500	2.8	$9,800.00	
15.4	Realignment of existing Timber Post and 7 Wire fence	m	475	100	$47,500.00	$112,300.00
16	RETAINING WALLS					
16.1	Slope Stabilisation Works (Allowance for Soil Nailing based on square metre rate for Andrews Rd Soil Nailing 2017) (4000m2 x $150)	PS	0	600000	$0.00	
16.1	Post & Rail H5 Timber Retaining Wall (under 1.5m High)	PS	0	100000	$0.00	$0.00
17	AS-BUILT DATA & RAMM					
17.1	Road construction RAMM information	LS	1	4000	$4,000.00	
17.2	As Built drawings	LS	1	6000	$6,000.00	$10,000.00
	TOTAL					$5,007,400.00
	Main Uncertainies					
A	Pavement Design (To be confirmed after testing)					
B	Lighting Design					
C	Services (To be confirmed after pot-holing)					

SUMMARY ESTIMATE SHEET

Project:	QLDC LADIES MILE - LOWER SHOTOVER ROAD	File No:	XQ074.01
Office:	Queenstown	Status:	Preliminary Assessment
SUMMARY ESTIMATE FOR:	Proposed Roading Connection	Purpose:	ROC
	T Junction	Cost Index:	1116 (Sept 2017)
Approved:	Giulio Chapman-Olla	Date: 15-May-18	Page: 1 of 1

Item	Description	Unit	Quantity	Rate	$	$
1	CONTRACTORS QUALITY PLAN (incorporating Site Safety Plan, Environmental Management Plan and Sediment Control & Site Management Plan)					
1.1	Preparation of CQP incl SSP, EMP & SCP	LS	1	10000	$10,000.00	
1.2	Management of CQP incl SSP, EMP & SCP	LS	1	30000	$30,000.00	$40,000.00
2	TRAFFIC MANAGEMENT PLAN					
2.1	Preparation of Temporary Traffic Management Plan	LS	1	2000	$2,000.00	
2.2	Management of TTMP/Traffic Control	LS	1	35000	$35,000.00	$37,000.00
3	ESTABLISHMENT	LS	1	20000	$20,000.00	$20,000.00
4	DAYWORKS					
4.1	Labour	hr	80	50	$4,000.00	
4.2	Plant	%	10000	1.1	$11,000.00	
4.3	Materials	%	8000	1.1	$8,800.00	$23,800.00
5	LOCATION & PROTECTION OF SERVICES					
5.1	Location of Services & Liaison with Utility Authorities	LS	1	10000	$10,000.00	
5.2	Relocation & Protection of Services	PS	1	30000	$30,000.00	$40,000.00
6	EARTHWORKS					
6.1	Clearing of Site	LS	1	20000	$20,000.00	
6.2	Topsoil Stripping - 200mm deep (to waste)	m^3	1850	50	$92,500.00	
6.3	Cut & Undercut to Waste	m^3	2300	50	$115,000.00	
6.4	Sawcut Existing Kerb & Seal	m	45	15	$675.00	
6.5	Granular Bulk Fill	m^3	2300	50	$115,000.00	$343,175.00
7	DRAINAGE					
7.1	Supply and Install 750mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection) (Pipe size to be confirmed by Design)	m	50	800	$40,000.00	
7.2	Supply and Install 600mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection) (Pipe size to be confirmed by Design)	m	540	650	$351,000.00	
7.3	Supply and Install 225mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection)	m	30	300	$9,000.00	
7.4	Supply and Install 1.05m Dia.SWMH Chamber 1.5m deep with HD Lid (Incl. bedding & pipe connection)	ea	6	10000	$60,000.00	
7.5	Supply and Install 1.5m Dia.SWMH Chamber 2.0m deep with HD Lid (Incl. bedding & pipe connection)	ea	2	13000	$26,000.00	

Item	Description	Unit	Quantity	Rate	$	$
7.6	Supply and Install Double Back Entry Sump (Incl. bedding & pipe connection)	ea	2	7000	$14,000.00	
7.7	Supply and Install Single Back Entry Sump (Incl. bedding & pipe connection)	ea	6	3500	$21,000.00	
7.8	Supply and Install NZTA F2 110mm dia Subsoil drainage pipe (Incl.bedding, Filter material, pipe connection, Geotextile filter wrap & cleaning eye)	m	1080	60	$64,800.00	
7.9	Arrow Irrgation Pipe Bypass Works	LS	1	40000	$40,000.00	
7.10	Remove Existing SW Sump and Manhole ConnectionPipe	ea	0	1000	$0.00	
7.11	Site Stormwater Diversion Works	PS	1	100000	$100,000.00	
7.12	Remove Existing Concrete Kerb & Channel	m	0	50	$0.00	
7.13	Reuse and install existing 300mm Dia. Culvert	m	10	300	$3,000.00	
7.14	Culvert Headwalls	ea	4	300	$1,200.00	$730,000.00
8	CONCRETE WORKS					
8.1	500mm Wide Kerb & Channel	m	145	120	$17,400.00	
8.2	Construct 300mm Wide Semi-Mountable kerb	m	0	100	$0.00	
8.3	Form Pedestrian Kerb	m	0	100	$0.00	
8.4	100mm Concrete Island Infill with embedded stones	m^2	0	150	$0.00	$17,400.00
9	PAVEMENT CONSTRUCTION (CBR4)					
9.1	375mm Sub-base AP65 (solid measure)	m^3	2570	160	$411,200.00	
9.2	160mm Basecourse AP40 (solid measure)	m^3	1020	190	$193,800.00	
9.3	Running Course (looase measure)	m^3	8	350	$2,800.00	$607,800.00
10	SURFACING					
10.1	Nominal 50mm DG14 Asphaltic Concrete	m^2	2650	50	$132,500.00	
10.2	Membrane Seal	m^2	2650	8	$21,200.00	
10.3	Chipseal surfacing (2 Coat 3/5)	m^2	3685	10	$36,850.00	$190,550.00
11	FOOTPATH CONSTRUCTION - (NOT SHOWN ON CONCEPT PLAN)					
11.1	Timber Batten Edging incl Pegs	m	300	20	$6,000.00	
11.2	100mm AP40 Basecourse (solid measure)	m^3	23	170	$3,910.00	
11.3	Nominal 25mm Mix 10 Asphaltic Concrete	m^2	225	35	$7,875.00	
11.4	Cycle Coloured Surface (AS2700 G13 Emerald Green or Similar)	m^2	0	120	$0.00	
11.5	Fun Yellow Tactile Audio Pavers	m^2	2	500	$1,000.00	
11.6	Resting Rails	ea	2	1200	$2,400.00	$21,185.00
12	ROAD LIGHTING					
12.1	Relocate Existing Lighting Column (Incl. Fitting luminares and power disconnection)	ea	0	2000	$0.00	
12.2	Supply & Install New 12m High Lighting Column with 3m Outreach Arm (Incl. 152W LED luminaires)	ea	4	4500	$18,000.00	
12.3	Supply & Install New 8m High Lighting Column with Post Top Luminaire Mounting Spigot (Incl. 102W LED luminaires) (Baed on 45m spacing)	ea	5	3500	$17,500.00	
12.4	Power Cable Installation (Incl. Trenching and ducting if required)	LS	1	20000	$20,000.00	
12.5	Commisioning of Lighting Columns	LS	1	3000	$3,000.00	$58,500.00
13	PAVEMENT MARKINGS					

Item	Description	Unit	Quantity	Rate	$	$
13.1	Reflectorised Pavement marking	LS	1	9000	$9,000.00	
13.20	Redundant Pavement Marking Removal (Sand Blasting)	LS	1	2000	$2,000.00	$11,000.00
14	TRAFFIC SERVICES					
14.1	Install RG-6 Give Way Sign	ea	2	750	$1,500.00	
14.2	Install PW-26 Curve Advisoy with minor road on left & right Sign	ea	2	750	$1,500.00	
14.3	Reinstall PW-17 Curve Advisory Sign	ea	1	750	$750.00	
14.4	Install RG-1 80km Speed Limit Sign	ea	4	1200	$4,800.00	
14.5	Install RG-1 50km Speed Limit Sign	ea	1	1200	$1,200.00	
14.6	Reinstall PW-34 School Bus & PW34.1 Bus Route Sign	ea	1	750	$750.00	
14.7	Install SN-1 Street Sign	ea	2	250	$500.00	$11,000.00
15	LANDSCAPING					
15.1	Existing Tree/Hedge Removal	LS	1	10000	$10,000.00	
15.2	Imported Topsoil 100mm Min. depth (solid measure)	m^3	22	100	$2,200.00	
15.3	Grassing and Hydroseeding (Grass for road berm areas only)	m^2	215	2.8	$602.00	
15.4	New & Realigned existing Timber Post and 7 Wire fence	m	200	100	$20,000.00	$32,802.00
17	AS-BUILT DATA & RAMM					
17.1	Road construction RAMM information	LS	1	4000	$4,000.00	
17.2	As Built drawings	LS	1	6000	$6,000.00	$10,000.00
	TOTAL					$2,194,212.00
	Main Uncertainies					
A	Pavement Design (To be confirmed after testing)					
B	Lighting Design					
C	Services (To be confirmed after pot-holing)					

SUMMARY ESTIMATE SHEET

Project: QLDC LADIES MILE - McDOWEL DRIVE | File No: XQ074.01

Office: Queenstown | Status: Preliminary Assessment

SUMMARY ESTIMATE FOR: Proposed Roading Connection | Purpose: ROC

Roundabout | Cost Index: 1116 (Sept 2017)

Approved: Giulio Chapman-Olla | Date: 15-May-18 |

Item	Description	Unit	Quantity	Rate	$	$
1	CONTRACTORS QUALITY PLAN (incorporating Site Safety Plan, Environmental Management Plan and Sediment Control & Site Management Plan)					
1.1	Preparation of CQP incl SSP, EMP & SCP	LS	1	10000	$10,000.00	
1.2	Management of CQP incl SSP, EMP & SCP	LS	1	30000	$30,000.00	$40,000.00
2	TRAFFIC MANAGEMENT PLAN					
2.1	Preparation of Temporary Traffic Management Plan	LS	1	3000	$3,000.00	
2.2	Management of TTMP/Traffic Control	LS	1	45000	$45,000.00	$48,000.00
3	ESTABLISHMENT	LS	1	20000	$20,000.00	$20,000.00
4	DAYWORKS					
4.1	Labour	hr	80	50	$4,000.00	
4.2	Plant	%	10000	1.1	$11,000.00	
4.3	Materials	%	8000	1.1	$8,800.00	$23,800.00
5	LOCATION & PROTECTION OF SERVICES					
5.1	Relocation of existing power pole by Utility Authority	LS	1	10000	$10,000.00	
5.2	Location of Services & Liaison with Utility Authorities	LS	1	10000	$10,000.00	
5.3	Relocation & Protection of Services	PS	2	30000	$60,000.00	$80,000.00
6	EARTHWORKS					
6.1	Clearing of Site	LS	1	20000	$20,000.00	
6.2	Topsoil Stripping - 200mm deep (to waste)	m^3	2000	50	$100,000.00	
6.3	Cut & Undercut to Waste	m^3	2700	50	$135,000.00	
6.4	Sawcut Existing Kerb & Seal	m	30	15	$450.00	
6.5	Granular Bulk Fill	m^3	2900	50	$145,000.00	$400,450.00
7	DRAINAGE					
7.1	Supply and Install 750mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection) (Pipe size to be confirmed by Design)	m	160	800	$128,000.00	
7.2	Supply and Install 600mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection) (Pipe size to be confirmed by Design)	m	0	650	$0.00	
7.3	Supply and Install 225mm Dia. PVC-U SN8 Pipe (Incl. bedding & pipe connection)	m	0	300	$0.00	
7.4	Supply and Install 1.05m Dia.SWMH Chamber 1.5m deep with HD Lid (Incl. bedding & pipe connection)	ea	4	10000	$40,000.00	
7.5	Supply and Install 1.5m Dia.SWMH Chamber 2.0m deep with HD Lid (Incl. bedding & pipe connection)	ea	4	13000	$52,000.00	

Item	Description	Unit	Quantity	Rate	$	$
7.6	Supply and Install Double Back Entry Sump (Incl. bedding & pipe connection)	ea	2	7000	$14,000.00	
7.7	Supply and Install Single Back Entry Sump (Incl. bedding & pipe connection)	ea	8	3500	$28,000.00	
7.8	Supply and Install NZTA F2 110mm dia Subsoil drainage pipe (Incl.bedding, Filter material, pipe connection, Geotextile filter wrap & cleaning eye)	m	600	60	$36,000.00	
7.9	Arrow Irrgation Pipe Bypass Works	LS	0	40000	$0.00	
7.10	Remove Existing SW Sump and Manhole ConnectionPipe	ea	0	1000	$0.00	
7.11	Site Stormwater Diversion Works	PS	1	20000	$20,000.00	
7.12	Remove Existing Concrete Kerb & Channel	m	0	50	$0.00	$318,000.00
8	CONCRETE WORKS					
8.1	500mm Wide Kerb & Channel	m	460	120	$55,200.00	
8.2	Construct 300mm Wide Semi-Mountable kerb	m	400	100	$40,000.00	
8.3	Form Pedestrian Kerb	m	18	100	$1,800.00	
8.4	100mm Concrete Island Infill with embedded stones	m^2	705	150	$105,750.00	$202,750.00
9	PAVEMENT CONSTRUCTION (CBR4)					
9.1	300mm Sub-base AP65 (solid measure)	m^3	4160	160	$665,600.00	
9.2	180mm Basecourse AP40 (solid measure)	m^3	2500	190	$475,000.00	
9.3	Running Course (looase measure)	m^3	60	350	$21,000.00	$1,161,600.00
10	SURFACING					
10.1	Nominal 50mm AC14 Asphaltic Concrete	m^2	4000	50	$200,000.00	
10.2	Nominal 100mm AC20 Asphaltic Concrete	m^2	4000	120	$480,000.00	
10.3	Membrane Seal	m^2	4000	8	$32,000.00	
10.4	Chipseal surfacing (2 Coat 3/5)	m^2	8450	10	$84,500.00	$796,500.00
11	FOOTPATH CONSTRUCTION - (NOT SHOWN ON CONCEPT PLAN)					
11.1	Timber Batten Edging incl Pegs	m	650	20	$13,000.00	
11.2	100mm AP40 Basecourse (solid measure)	m^3	51	170	$8,670.00	
11.3	Nominal 25mm Mix 10 Asphaltic Concrete	m^2	510	35	$17,850.00	
11.4	Cycle Coloured Surface (AS2700 G13 Emerald Green or Similar)	m^2	0	120	$0.00	
11.5	Fun Yellow Tactile Audio Pavers	m^2	13.2	500	$6,600.00	
11.6	Resting Rails	ea	12	1200	$14,400.00	$60,520.00
12	ROAD LIGHTING					
12.1	Relocate Existing Lighting Column (Incl. Fitting luminares and power disconnection)	ea	1	2000	$2,000.00	
12.2	Supply & Install New 12m High Lighting Column with 3m Outreach Arm (Incl. 152W LED luminaires)	ea	3	4500	$13,500.00	
12.3	Supply & Install New 8m High Lighting Column with Post Top Luminaire Mounting Spigot (Incl. 102W LED luminaires) (Baed on 45m spacing)	ea	12	3500	$42,000.00	
12.4	Power Cable Installation (Incl. Trenching and ducting if required)	LS	1	40000	$40,000.00	
12.5	Commisioning of Lighting Columns	LS	1	3000	$3,000.00	$100,500.00
13	PAVEMENT MARKINGS					
13.1	Reflectorised Pavement marking	LS	1	7000	$7,000.00	

Item	Description	Unit	Quantity	Rate	$	$
13.20	Redundant Pavement Marking Removal (Sand Blasting)	LS	1	2000	$2,000.00	$9,000.00
14	TRAFFIC SERVICES					
14.1	Install RG-19.1 Give Way Sign Supplemetary	ea	6	750	$4,500.00	
14.2	Install RG-6R Rotary Give Way Sign	ea	6	750	$4,500.00	
14.3	Install RG-17 Keep Left (inc. Duroflex PS 03 mounting)	ea	3	350	$1,050.00	
14.4	Install RG-1 50m Speed Limit Sign	ea	3	1200	$3,600.00	
14.5	Install PW-69 Chevron Board	ea	5	1200	$6,000.00	
14.6	Relocate PW-29 Pedestrians Sign & TW-4B Slippery	ea	2	500	$1,000.00	
14.7	Install AD-5 Sign	ea	3	5000	$15,000.00	
14.8	Install PW-5 Diverge Signs	ea	3	500	$1,500.00	
14.9	Relocate SN-1 Street Sign, Memorial and Track Signs	ea	4	250	$1,000.00	$38,150.00
15	LANDSCAPING					
15.1	Existing Tree Removal	LS	1	20000	$20,000.00	
15.2	Imported Topsoil 100mm Min. depth (solid measure)	m^3	300	100	$30,000.00	
15.3	Grassing and Hydroseeding (Grass for road berm areas only)	m^2	2975	2.8	$8,330.00	
15.4	Realignment of existing Timber Post and 7 Wire fence	m	285	100	$28,500.00	$86,830.00
16	GUARDRAIL					
16.1	Adjustments to Timber Post Guardrail	PS	1	100000	$100,000.00	$100,000.00
17	AS-BUILT DATA & RAMM					
17.1	Road construction RAMM information	LS	1	4000	$4,000.00	
17.2	As Built drawings	LS	1	6000	$6,000.00	$10,000.00
	TOTAL					$3,496,100.00
	Main Uncertainies					
A	Pavement Design (To be confirmed after testing)					
B	Guardrail Design - Existing to be amended					
C	Lighting Design					
D	Services (To be confirmed after pot-holing)					

Appendix F - Three Waters Estimates ROC

Ladies Mile HIF
Concept Design Engineers Estimate - 3 Waters

By	AP and HT		
Date:	25/05/2018		
Reviewed By	AP		
Date:	26/06/2018		

Item	Description	Unit	Total Quantity	Rate	Total
1	**PRELIMINARY AND GENERAL**				
1.1	Establishment	%	6%	$ 5,185,200	$ 311,112
1.2	Overhead	%	15%	$ 5,185,200	$ 777,780
1.3	Traffic Management Plan (TPM)	%	1%	$ 5,185,200	$ 51,852
1.4	Manage TMP	%	4%	$ 5,185,200	$ 181,482
1.5	Survey and Setout	%	6%	$ 5,185,200	$ 311,112
	Sub-Total				**$ 1,633,338.00**
2	**WATERMAIN INSTALLATION**				
2.1	**Pipe Installation**				
2.1.3	Supply, weld and lay DN280 PE100 PN12.5 watermain (includes all valves and fittings and reinstatement)	m	2030	$ 400.00	$ 812,000.00
2.1.2	Supply, weld and lay DN315 PE100 PN12.5 watermain (includes all valves and fittings and reinstatement)	m	1310	$ 450.00	$ 589,500.00
2.2	**Testing & Inspections**				
2.2.1	Pressure Testing and Commissioning	LS	1	$ 50,000.00	$ 50,000.00
2.3	**Water Reservoir**				
2.3.1	1000m3 Steel Reservoir	ea	2	$ 400,000.00	$ 800,000.00
	Sub-Total				**$ 2,251,500.00**
3	**WASTEWATER INSTALLATION**				
3.1	**Pipe Installation**				
3.1.1	Supply and lay DN225 PE100 Pressure Pipe (includes all valves and fittings and reinstatement)	m	1720	$ 360.00	$ 619,200.00
3.1.2	Supply and lay DN160 PE100 Pressure Pipe (includes all valves and fittings and reinstatement)	m	750	$ 280.00	$ 210,000.00
3.1.3	N/A	LS	0	$ -	$ -
3.2	**Pump Stations**				
3.2.1	12 l/s Capacity (~4.5kW)	ea	2	$ 550,000.00	$ 1,100,000.00
3.2.2	Upgrade to Country Club pump station	LS	1	$ 50,000.00	$ 50,000.00
3.3	**Storage for Pump Stations (provisional item)**				
3.3.1	Tank of approximately 70-75 m3	ea	2	$ 200,000.00	$ 400,000.00
3.3	**Testing & Inspections**				
3.3.1	Testing and Commissioning	LS	1	$ 50,000.00	$ 50,000.00
	Sub-Total				**$ 2,429,200.00**
4	**STORMWATER INSTALLATION**				
4.1	**Pipe Installation**				
4.1.1	Supply and lay DN1050 RCRRJ	m	150	$ 1,600	$ 240,000.00
4.1.2	Supply and lay DN525 RCRRJ	m	220	$ 950	$ 209,000.00
4.2	**Stilling Basin**				
4.2.1	Construct SW stilling basin at discharge of DN525 pipe	LS	1	$ 50,000	$ 50,000.00
4.3	**Testing and Commissioning**				
4.3.1	Testing and Commissioning	LS	1	$ 5,500.00	$ 5,500.00
4.4	**Queenstown Country Club Agreement (See Below U.1)**				
	Sub-Total				**$ 504,500.00**
	SUMMARY SCHEDULE				
S.1	**PRELIMINARY AND GENERAL**				$ 1,633,338.00
S.3	**WATERMAIN INSTALLATION**				$ 2,251,500.00
S.4	**WASTEWATER INSTALLATION**				$ 2,429,200.00
S.5	**STORMWATER INSTALLATION**				$ 504,500.00
	TOTAL AMOUNT OF Estimate				**$ 6,818,538.00**
	Contractors Margin 12%	%	12%		$ 818,225
	Contingency	%	30%		$ 2,291,029
U.1	**Stormwater Cost share with Country Club**	LS	100%	1700000	$ 1,700,000
	Total including contingency				**$ 11,627,791.33**

Appendix G - Shotover River Bridge Live Load Assessment under New Proposed Services Final Report to QLDC 13 Nov 17

SH6 Shotover River Bridge Live Load Assessment under Proposed New Services

6-632074.00

Release 2 – 13 November 2017

SH6 Shotover River Bridge Live Load Assessment under Proposed New Services

6-632074.00

Prepared By

Dejan Novakov
Senior Engineer

Reviewed By

Russell Nichols
Team Leader – Bridge Management

Approved for Release By

Russell Nichols
Team Leader – Bridge Management

Opus International Consultants Ltd

Wellington Office
Level 9, Majestic Centre
100 Willis Street, PO Box 12-003
Wellington, New Zealand

Telephone: +64 4 471 7000
Facsimile: +64 4 471 1397

Date: 13/11/2017
Reference: 6-32074.00/01

Status: Release 2

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Appendices

Executive summary

Opus International Consultants Ltd (Opus) have been engaged by Queenstown Lakes District Council (QLDC) to investigate the possibility for installation of new services and relocation of existing services on SH6 Shotover River Bridge (BSN_9921). The aim of this investigation was to establish the effect of the proposed works on the HPMV, Posting and Rating capacities of the bridge's superstructure and, based on the results, obtain approval from NZ Transport Agency to complete the works.

In addition to the proposed relocation and/or decommission of some of the existing services five 'Options' for installation of new services have been considered.

Firstly an assessment of the "as-is" bridge was completed, followed by the assessment of the bridge including the additional/relocated/decommissioned services. Assessment of the overall capacity of the superstructure was completed on a computer model of the bridge superstructure considering the 'Option' that would result in the highest additional dead load. Assessment of the deck cantilever was completed using an in-house developed EXCEL spreadsheet considering 'Options' that result in a highest dead load acting on the deck cantilever.

Results of the assessment of the "as-is" bridge confirmed that the bridge currently has adequate capacity to support full HPMV and Class 1 Posting loading. The critical Rating CLASS is 105%, governed by the internal spans. The deck capacity factor (DCF) is 1.09.

Including any of the proposed 'Options' for installation of new and relocation/decommission of existing services, the bridge would still have sufficient capacity to carry full HPMV and Class 1 Posting loading. However, under the most adverse "Option', the bridge's overweight capacity would reduce from CLASS 105% to CLASS 99%, again governed by the internal spans. Although still above, or close to, CLASS 100%, installation of new services is likely to reduce the scope of overweight vehicles that could cross the bridge. Note, however, that there are other bridges on this section of SH6 that have even lower Overweight load capacity, so the installation of new services may not necessarily reduce the capacity of the whole route. The deck capacity factor (DCF) is 1.08.

We note also that the above reduction in Rating CLASS is for the 'Option' with the largest additional weight, which includes installation of two new 450mm diameter watermains, one under the downstream and the other under the upstream "armpit" (cantilever deck). For other options the reduction in the capacity may be a bit smaller but considering the accuracy of this type of assessment we recommend that the above values be adopted (and used to update the HSIMS datasheets, should the work proceed) independent of which 'Option' is to be implemented.

The reduction in the DCF under the additional load is marginal and, again considering the accuracy of this type of assessment, we conclude that either of the proposed options is acceptable.

We conclude and recommend that, subject to the approval from NZ Transport Agency, any of the proposed "Options' can be implemented and that HSIMS Datasheet be updated in accordance with the Rating Capacities obtained, as presented in Appendix A of this report.

1 Introduction

1.1 Background

Opus International Consultants Ltd (Opus) have been engaged by Queenstown Lakes District Council (QLDC) to investigate the possibility for installation of new services and relocation of existing services on SH6 Shotover River Bridge (BSN_9921). The aim of this investigation was to establish the effect of the proposed works on the HPMV, Posting and Rating capacities of the bridge's superstructure and, based on the results, obtain approval from NZ Transport Agency to complete the works. Results, conclusions and recommendations of the completed assessment are presented as follows.

1.2 Bridge Description and Condition

Shotover River Bridge, shown in Figure 1, is a two lane, 11 span (span arrangement 22.86 m + 9 x 30.48 m + 22.86 m), post-tensioned concrete box girder bridge. It was constructed in 1975. The bridge was most likely designed to the Ministry of Works' 1956 Bridge Manual and, therefore, for the H20-S16-72 live load classification. This loading generally induces a lesser demand on the structure than the HN-HO-72 loading as specified in the current Bridge Manual. We are not aware if any live load assessments have been completed since the construction of the bridge to confirm if it would comply with the current loading demand.

Figure 1 – Shotover River Bridge

Considering the age of the bridge and referring to the site inspection photos, superstructure elements were considered to be in a 'good or fair' condition in accordance with Table 7.5 of the Bridge Manual.

1.3 Information Available

The following information was made available for this assessment:

- Drawings (MoW 7/49/2/7004/1 - /66, 1971 – stamped as-Built 27/2/75;
- Opus, 2016, SH6 Shotover River Bridge Detailed Inspection 2016, Report #1799;

- Mark-up of existing services layout and proposed; and

- Miscellaneous correspondence.

2 Existing and Proposed Services

There is currently a number of existing services on the bridge. QLDC is proposing to install new watermain(s) and also discontinue and/or relocate some of their existing services on the bridge.

Existing services and proposed changes to those are:

a) There are two 150mm diameter PVC ducts under the downstream deck cantilever ("armpit"). No changes are proposed to these services;
b) There is a 314mm diameter wastewater pipe in the downstream chamber of the two-box girder. QLDC has decommissioned this pipe (the pipe is empty);
c) There is a 314mm diameter wastewater pipe in the upstream chamber of the box girder. QLDC may consider to relocate this pipe to under the upstream "armpit" (for H&S reasons). This would be in combination with new pipes, as discussed in Options 3 and 4 below;
d) There is a small diameter fibre-optic cable in the upstream chamber of the box girder. No changes are proposed to this service;
e) There is a 200mm diameter gas pipe under the upstream "armpit". No changes are proposed to this service, and
f) There is a 150mm diameter telecom duct under the upstream "armpit". No changes are proposed to this service.

Several options for the new services are proposed by QLDC, as follows:

i) Option 1 – Installation of a single 450 mm diameter watermain under the downstream "armpit";
ii) Option 2 – Installation of a single 600 mm diameter watermain under the downstream "armpit";
iii) Option 3 – Installation of two 450mm diameter watermains, one under the downstream and the other under the upstream "armpit". Also relocation of the existing 314mm diameter wastewater pipe from the upstream chamber to the downstream "armpit" – see item c) above;
iv) Option 4 – Installation of two 300mm diameter watermains, one under the downstream and the other under the upstream "armpit". Also relocation of the existing 314mm diameter wastewater pipe from the upstream chamber to the downstream "armpit" – see item c) above.
v) Option 5 – as option 3 and 4 but leave the existing 314mm diameter wastewater pipe and install another 314mm diameter wastewater pipe under the downstream "armpit".

3 Assessment Criteria and Methodology

The purpose of the assessment was to:

a) Confirm the HPMV, Posting and Rating capacity of the existing superstructure, including the existing services ("as-is" state),and

b) Investigate the effect of the proposed services (Options 1 to 5 above) on the HPMV, Posting and Rating capacity of the bridge.

The live load assessment of the bridge superstructure was carried out in accordance with Section 7 of the NZ Transport Agency Bridge Manual 3rd Edition (Bridge Manual), the New Zealand Concrete Standard (NZS 3101: 2006), British Code BD44/95, Canadian Highway Bridge Design Code S6-16, Section 8 – Concrete Structures and NZTA OPermit bridge structural data guide (April 2016).

The following parameters and assumptions were used in the analysis of the bridge:

a) The bridge box girder has been assessed as carrying two loading lanes within the 8.53m kerb to kerb width, in accordance with the section 3 of the Bridge Manual;
b) According of the age of this structure and referring to the site inspection photos, superstructure elements were considered to be in a 'good or fair' condition in accordance with Table 7.5 of the Bridge Manual;
c) Characteristic strengths for concrete were taken from the as-built drawings;
d) Characteristic strengths for the steel reinforcement were taken from the nominal historic values provided in Section 7.3.2 of the Bridge Manual. Given the structure was constructed in 1975, the characteristic yield strength was taken as 275 MPa;
e) The pre-stressing forces were taken from the as-built drawings;
f) The flexural capacity of the bridge superstructure and the flexural and shear capacity of the deck cantilever were assessed in accordance with NZS3101;
g) The shear capacity of the bridge superstructure was assessed in accordance with Canadian Code S6-16, and British Code BD44/95.
h) Where the material and/or thickness of the services pipes was not known, reasonable assumptions were made to assess their weights.

A grillage computer model of the bridge was developed and a structural analysis performed using Microstran – structural analysis software. Figure 2 shows grillage view of the bridge model developed.

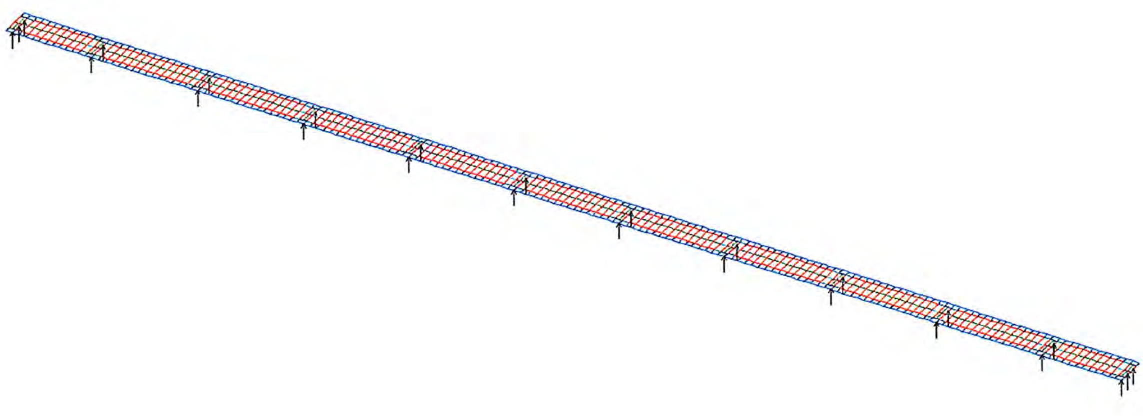

Figure 2 – Grillage view of Shotover River Bridge Microstran V9.2 model

The deck cantilever was analysed using an in house developed Excel spreadsheets.

4 Results

Two analyses of the computer model were completed. The first one was to enable assessment of the "as-is" bridge's live load capacity. In the second analysis we added the weights of the proposed new services and allowed for a new distribution of the weights from the existing services and reassessed the live load capacity of the superstructure and the cantilever deck. Results, are presented as follows.

4.1 "As-is" state

The capacity of the Shotover River Bridge, as it is at present, assessed in accordance with Section 7 of the Bridge Manual, is summarised in Table 1.

The results are shown for the following loadings:

a) HPMV (0.95 x HN_72 + 0.95 x HN_72)
b) Posting (0.85 x HN_72 + 0.85 x HN_72)
c) Rating (0.85 x HO_72 + 0.95 x HN_72)

Table 1: The assessed "as-is" bridge live load capacities

	Flexural Capacity		Shear Capacity	
Span	**1 & 11**	**2 to 10**	**1 & 11**	**2 to 10**
HPMV GROSS:	>100%	>100%	>100%	>100%
Posting Class 1 GROSS:	>100%	>100%	>100%	>100%
Rating CLASS:	>120%	>120%	107%	105%
DCF:	1.09			

As can be seen from Table 1 above, the bridge currently has adequate capacity to support full HPMV and Class 1 Posting loading. The critical Rating CLASS is 105%, governed by the internal spans. The DCF factor is 1.09.

4.2 Proposed new and relocated services

Sizes and locations of the proposed additional and relocated services are presented in Section 2 above. In the assessment of the overall capacity of the superstructure we have considered Option 5 in Section 2 above, as it results in the highest overall dead load.

In the assessment of the deck cantilever we have considered Options 3 and 5 in Section 2 above, as these result in a (similar) highest dead load acting on the deck cantilever.

The assessed capacity of the Shotover River Bridge including the proposed additional and relocated services is summarised in Table 2. HPMV, Posting and Rating loads used in the assessment are the same as presented in Section 4.1 above.

Table 2: Assessed bridge capacities including proposed new and relocated existing services

Basis	**Flexural Capacity**		**Shear Capacity**	
Span	**1 & 11**	**2 to 10**	**1 & 11**	**2 to 10**
HPMV GROSS:	>100%	>100%	>100%	>100%
Posting Class 1 GROSS:	>100%	>100%	>100%	>100%
Rating CLASS:	>120%	>120%	101%	99%
DCF:	1.08			

As can be seen from Table 2 above, under additional loading from the proposed services the bridge would still have adequate capacity to support full HPMV and Class 1 Posting loading. However, the bridge's overweight capacity would reduce, from CLASS 107% and CLASS 105% to CLASS 101% and CLASS 99% for the end and the internal spans respectively. Although still above, or close to CLASS 100%, installation of new services is likely to reduce the scope of overweight vehicles that could cross the bridge.

The reduction in the deck's DCF is marginal.

5 Conclusions and Recommendations

Based on the results of the completed assessment, any of the proposed options for installation of new and relocation of existing services, the bridge would have sufficient capacity to carry full HPMV and Class 1 Posting loading. However, the bridge's overweight capacity would reduce, from CLASS 107% to CLASS 101% for the end spans and from CLASS 105% to CLASS 99% for the internal spans. Although still above, or close to, CLASS 100%, installation of new services is likely to reduce the scope of overweight vehicles that could cross the bridge. Note, however, that there are other bridges on this section of SH6 that have even lower Overweight load capacity, so the installation of new services may not necessarily reduce the capacity of the whole route.

We note that the above reduction in Rating CLASS is for the Option with the largest additional weight – Option 5: installation of two 450mm diameter watermains, one under the downstream and the other under the upstream "armpit" and duplication of a 314mm diameter wastewater under the downstream arm. For other options the reduction may be a bit smaller but considering the accuracy of this type of assessment we recommend that the above values be adopted independent of which option is to be implemented.

The reduction in the deck DCF is marginal and, again considering the accuracy of this type of assessment, we conclude that either of the proposed options is acceptable.

We provide in Appendix A the updated HSIMS datasheets the Opermit system, in accordance with the Rating Capacities given above, should the installation of the new and relocation of the existing services, as proposed above, be completed.

Appendix A

HSIMS Datasheets

GENERAL ELEMENT DATA (FORM No. BSD1)

Note: This form must be completed for all structures.

This sheet is accompanied by ...3... Element Data sheets.

Location data

Bridge Name	Shotover River Bridge
Road Identification	SH6
Route Position	983/9.10
Bridge Structure Number (BSN)	9921
Region	07 – Dunedin
Road Controlling Auth. or NZTA Region	NZTA Region 7A – Central Otago

Bypass data

Bypass Type	1
Bypass Description	Via Local Road

Posting data

Posting	0	%

Structural data

Direction	1	
Width	8.53	m
RestrictX (Increasing)	0	m
RestrictX (Decreasing)	0	m
Comments		

Prepared: Chuanbo Wang.......................... DATE: 30 / 10 / 2017

Checked: Renand Tamayo.......................... DATE: 30 / 10 / 2017

Certified for release: .... DATE: .... /.......... / ....

Bridge Inspection Engineer ....

DECKSLAB ELEMENT DATA (FORM No. BSD2)

Bridge Name	Shotover River Bridge
BSN	9921
Direction	1

DECKSLAB element no. ...1... of ...1...

Type	**DECKSLAB**
Description	Prestressed concrete deck - Cantilever Slab
Impact Code	2
DCF	1.08
Comments	

Prepared: Chuanbo Wang.. DATE: 30 / 10 / 2017

Checked: Renand Tamayo.. DATE: 30 / 10 / 2017

BEAM ELEMENT DATA (FORM No. BSD4)

Bridge Name	Shotover River Bridge
BSN	9921
Direction	1

BEAM element no. ...1... of ...2...

Type	**BEAM**	
Description	Prestressed concrete box girder Spans 1 and 11	
Impact Code	3	
Estd	1	
Ecentre	1	
Estd(12)		
Estd(16)		
Ecentre(12)		
Ecentre(16)		
Span	22.86	m
MCAP	6000	kNm
SCAP	1010	kN
Comments	MCAP and SCAP determined to achieve Rating CLASS of 120% and 101% respectively as per the assessment.	

Prepared: Chuanbo Wang .... DATE: 30 / 10 / 2017

Checked: Renand Tamayo .... DATE: 30 / 10 / 2017

BEAM ELEMENT DATA (FORM No. BSD4)

Bridge Name	Shotover River Bridge
BSN	9921
Direction	1

BEAM element no. ...2... of ...2...

Type	**BEAM**	
Description	Prestressed concrete box girder Spans 2 to 10	
Impact Code	3	
Estd	1	
Ecentre	1	
Estd(12)		
Estd(16)		
Ecentre(12)		
Ecentre(16)		
Span	30.48	m
MCAP	9200	kNm
SCAP	1120	kN
Comments	MCAP and SCAP determined to achieve Rating CLASS of 120% and 99% respectively as per the assessment.	

Prepared: Chuanbo Wang.. DATE: 30 / 10 / 2017

Checked: Renand Tamayo.. DATE: 30 / 10 / 2017

Appendix H - Queenstown Country Club Trunk Stormwater Pipeline Design Report (Design by Fluent)

Sanderson
GROUP

Queenstown Country Club Retirement Village

Trunk Stormwater Pipeline Design Report for Engineering Approval

14 June 2017

Fluent
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Sanderson Group

Queenstown Country Club Retirement Village

Trunk Stormwater Pipeline Design Report for Engineering Approval

Task	Responsibility	Signature
Project Manager:	Derrick Railton	Derrick E Railton
Prepared By:	Derrick Railton	Derrick E Railton
Reviewed By:	Gary Dent	Gary Dent
Approved For Issue By:	Derrick Railton	Derrick E Railton

Issue Date	Revision No.	Author	Checked	Approved

Prepared By:
Fluent Infrastructure Solutions Ltd
Suite 2, First Floor
23-27 Beach Street
PO Box 1204
Queenstown 9348
Telephone: + 64 3 974 4586
Email: office@fluentsolutions.co.nz
Web: www.fluentsolutions.co.nz

Job No.: Q000320
Date: 14 June 2017
Reference: RP-17-06-12 DER Q000320

Sanderson Group

Queenstown Country Club Retirement Village

Trunk Stormwater Pipeline Design Report for Engineering Approval

1.0 Introduction

1.1 Background

Fluent Solution's 17 March report "Queenstown Country Club Retirement Village - Stage 1: Infrastructure Design Report for Engineering Approval" outlined the design criteria and design standards used for infrastructure services design for the retirement village and ancillary activities planned for the "North" and "South" sites of the QCC development. That report did not, however, cover the design of the trunk stormwater pipeline that receives stormwater from the development and conveys it direct to the Kawarau River via the disposal drain currently used by Lake Hayes Estate (LHE). The design of that trunk pipeline is the subject of this report.

For completeness the stormwater design criteria previously presented in the 17 March report is repeated in this report. Plans and other information relating to the design of the trunk pipeline are presented in the Appendices.

The intention is that this pipeline will be vested in the Queenstown Lakes District Council and become a public stormwater pipeline.

1.2 Area Served

The trunk stormwater pipeline was originally designed to serve only the QCC development. However, at request, consideration was subsequently given to increasing the pipeline size to also accommodate stormwater flows from the planned Glenpanel subdivisional development to the north of Ladies Mile, directly across the road from the QCC development. At the time of writing, the decision whether or not to include stormwater from this adjacent development was imminent but had not been confirmed.

To cover both options then, this report presents the design for the combined development option, noting that design for the QCC-only option is essentially the same, but with slightly smaller pipe sizes. The vertical and horizontal alignments are the same, except for some shallower pipe depths along upper section by Howards Drive for the QCC - only option. Further design detail is presented below.

1.3 Engineering Acceptance Application

This report submission is a formal Engineering Acceptance application for the trunk stormwater pipeline design pursuant to Resource Consent Conditions 18(d), and 18(k) that require as summarised in the following Table 1.1:

Table 1.1: Consent Condition Compliance - Proposed Stormwater Management System

Condition	Description & Comment
18	*Unless otherwise authorised by the Manager of Resource Management Engineering, prior to the commencement of any works on the land being developed the consent holder shall provide to the Queenstown Lakes District Council for review and certification, copies of design certificates in the form of Schedule 1A of QLDC's Land Development and Subdivision Code of Practice, specifications, calculations and design plans as is considered by Council to be both necessary and adequate, in accordance with Condition (4), to detail the following engineering works required:*
	Comment: The stormwater design is outlined in the following Section 2. Drawings and supporting calculations for the proposed stormwater management system are included in the appendices. This report and the following detail is intended to give Council confidence that the stormwater collection reticulation and the trunk main have been designed to a sufficient level of detail so that compliance with the QLDC COP is a minimum standard for all future stages of the proposed development.
18(d)	*The provision of a stormwater collection and disposal system which shall provide both primary and secondary protection for future development within each lot, in accordance with Council's standards and connection policy. This shall include:* *(i) A reticulated primary system to collect and dispose of stormwater from all potential impervious areas within each lot; and* *(ii) The individual lateral connections shall be designed to provide gravity drainage for the entire area within each lot; and* *(v) A secondary protection system consisting of secondary flow paths to cater for the 1% AEP storm event and/or setting of appropriate building floor levels to ensure that there is no inundation of any buildable areas within the lots, and no increase in run-off onto land beyond the site from the pre-development situation* *(vi) All lots shall be designed to ensure there is no standing water / surface ponding following (up to and including) a 5% AEP rain event.*
	Comment: The proposed stormwater management system is designed to provide conveyance of runoff flows from the post-development QCC site for up to a 1% Annual Exceedance Probability (AEP) event including allowance for climate change (2^{o}C increase by 2090) and operates independently of the neighbouring LHE and SOC systems. Lots are designed to slope towards the roads with sufficient grade so that no ponding would occur during rain events greater than the 5% AEP. Individual lot lateral connections are designed to provide direct connection into the road kerb and channel.
18(k)	*The provision of Design Certificates for all engineering works associated with this development submitted by a suitably qualified design professional (for clarification this shall include all Roads, Water, Wastewater and Stormwater reticulation). The certificates shall be in the format of the QLDC's Land Development and Subdivision Code of Practice Schedule 1A Certificate".*
	Comment: The Schedule 1A certificate is presented in Appendix A.

1.4 Scope of Report

The trunk stormwater pipeline comprises three parts:

1. The section along Howards Drive, from Ladies Mile to Jones Ave;
2. The section from Jones Ave down to the “transition structure” at the bottom of the hill, just before the main drain; and
3. The energy dissipating “transition structure” and short section of culvert across to the main drain.

This report and request for Engineering Approval covers the first two parts in order to facilitate construction of the critical-path pipeline. The energy dissipating “transition structure” requires special design and is dependent on which option is chosen, so the design for this is to be submitted separately to the pipeline design.

2.0 Trunk Stormwater Pipeline Design

2.1 Stormwater Design Criteria (Previously Submitted)

2.1.1 Introduction

The existing entire QCC Retirement Village development site is not currently serviced by any formed stormwater collection and disposal system. The QCC site is located above the existing stormwater reticulation systems that are part of the two neighbouring communities, Lake Hayes Estate (LHE) and Shotover Country (SOC) as shown on Figure 2.1.

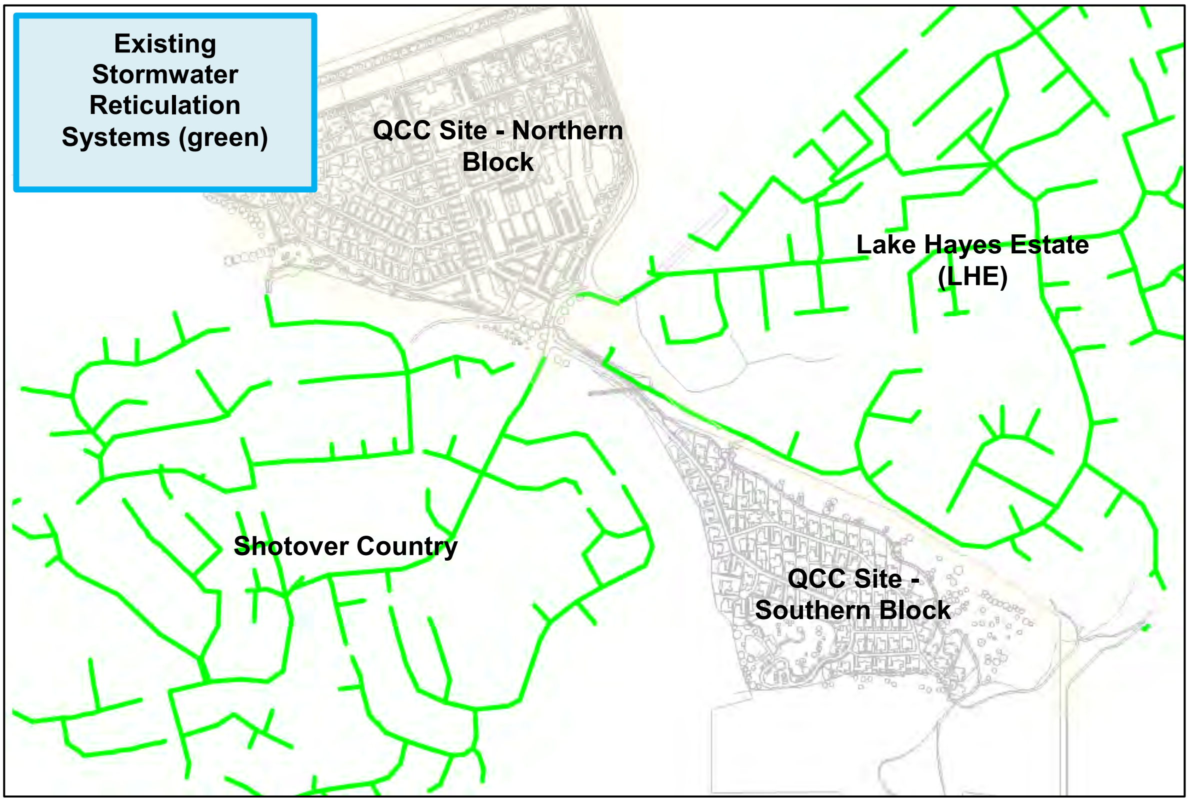


Figure 2.1: Existing Stormwater Reticulation Systems in Vicinity of QCC Site

In the course of the engineering assessment for subdivision consent, it was identified that neither the LHE nor the SOC stormwater networks had capacity to accept runoff flows from the proposed QCC development. It was concluded that the disposal of stormwater would of necessity have to be direct to the Kawarau River via the disposal drain currently used by LHE. This drain would be enlarged to provide capacity for both the LHE and QCC site areas.

The following sections of this report further discuss the proposed stormwater management system.

2.1.2 Proposed Stormwater Management System

The proposed stormwater management system is designed to provide conveyance of runoff flows from the post-development QCC site for up to a 1% Annual Exceedance Probability (AEP) event including allowance for climate change (2^{o}C increase by 2090) and operates independently of the neighbouring LHE and SOC systems.

2.1.3 Stormwater Management Overview

Figure 2.2 shows the proposed system which is primarily comprised of a trunk main (900 / 1050mm dia - for QCC only) running from Jones Avenue to the receiving drainage channel. This conveys runoff flows from the Northern block and the Southern block, discharging to the existing drainage channel to the Kawarau River.

The section of pipeline bordering Howards Drive, as currently designed to serve QCC only has been previously submitted in the 17 March 2017 report and approved as part of the Northern block infrastructure. The redesign of this section of pipeline to also serve the Glenpanel development is described further below.

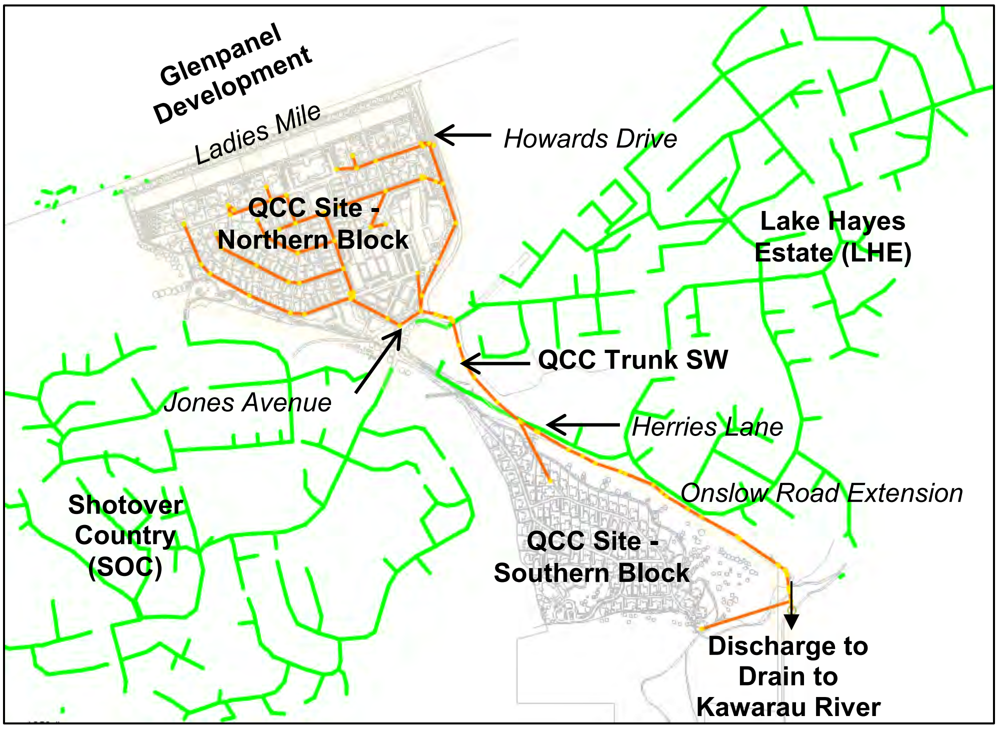


Figure 2.2: Proposed Stormwater Management System Outline

2.1.4 Stormwater Runoff Flow Assessment Design Flows

The hydraulic and hydrological modelling software Infoworks ICM (ICM) was used to estimate the peak stormwater runoff flows. The model utilises a combination of 1D analysis for pipes and 2D analysis for surfaces (roading design) to estimate runoff flows from the catchments. The input parameters used in the model can be found in Appendix B.

Stormwater flows were estimated for the 1% AEP storm event for the following durations: 0.5 hour, 1 hour, 2 hour, 4 hour, 6 hour, and 12 hour. The peak runoff flow occurred for the 1 hour duration storm, at a flow of 3.32m^3/s at the trunk main outlet to the LHE drain, where flows discharge into the existing channel which flows to the Kawarau River. Additionally, the Queenstown Lakes Code of Practice requires that climate change be a design consideration. Rainfall data from HIRDS for the 1% AEP storm event is based on a 2ºC temperature increase, being the median projection for 2090, and is included in the design. As noted above, the proposed piped stormwater management system provides provision as both a primary and secondary system with conveyance for the 100 year ARI event.

The runoff estimates generated from the model are presented in Table 2.1 below.

Table 2.1: Model Results

Storm Duration	Peak Post-Development Flow - Northern Block (m^3/s)	Peak Post-Development Flow - Trunk Main Outlet (m^3/s)
100 year, 0.5 hr	2.13	3.07
100 year, 1 hr	**2.25**	**3.32**
100 year, 2 hr	1.77	2.70
100 year, 4 hr	1.34	2.13
100 year, 6 hr	1.13	1.85
100 year, 12 hr	0.82	1.71
2 year, 1 hr (half)	*All velocities in pipes were above 0.6m/s	

The pipe reticulation design was also assessed for low flow velocities as per the 2015 Subdivision Code (Cl 4.3.9.5): *"The minimum velocity should be at least 0.6m/s at a flow of half the 50% AEP design flow."* At half of the 2 year ARI (for the critical storm duration), the velocity in all pipes in the system were above 0.6m/s.

2.2 Combined Option - Including Glenpanel

The land bordering Ladies Mile across the road from the QCC site is proposed to be developed as a Special Housing Area (SHA) called Glenpanel. Lowe Environmental Impact (LEI) has provided a preliminary stormwater management report for the area in August 2016 - "Stormwater Infrastructure Assessment, Glenpanel - Special Housing Area". The preliminary stormwater design provided by LEI presents options for utilising onsite detention/soakage and/or conveyance through the QCC stormwater infrastructure across Ladies Mile, and an indicative secondary flow path for extreme events towards Lake Hayes. The Queenstown Lakes District Council (QLDC) has expressed concern about the ability to dispose of stormwater through ground soakage and has indicated support for a stormwater connection into the QCC trunk SW system.

The proposed QCC-only trunk SW pipeline runs from the Howards Drive entrance to QCC, down to Jones Avenue and thence down around the foot of the hillside to Herries Lane, continuing on to the main drain running into the Kawarau River (Figure 2.2). This pipeline starts at 600mm diameter, increasing to 825mm down to Jones Avenue, then to 900mm down to Herries Lane, finishing at 1050mm for the remaining distance to the main drain.

In order to also serve Glenpanel, an assessment has been completed to assess the increase in pipeline capacity gained by increasing pipe sizes up to a maximum of 1200mm diameter. Increasing the pipeline size by just one (or two) pipe sizes (up to about 1200mm diameter) can deliver significant gains in pipeline capacity whilst not having a great impact on pipeline installation costs. Beyond this size larger machinery is required to handle the bigger pipes and installation costs increase more significantly.

The assessment undertaken shows that an increase in pipeline capacity of 1.5 cubic metres per second (m^3/s) (or 1500 litres per second) can realistically be achieved through the measures shown in Table 2.2. This increase in pipeline capacity is governed by the sections of pipeline on flatter grades.

It is noted that the pipeline size along Howards Drive increases significantly compared to the QCC-only pipe size design because the Glenpanel discharge over this length is significantly greater than that from the contributing part of QCC.

Table 2.2: Summary of pipeline changes needed to accommodate an extra 1.5cumec

Section of Pipeline	Changes to Pipe Size/Depth Required
Howards Drive from Ladies Mile to QCC Entrance	900mm dia. - this is a new pipe section not forming part of the QCC works.
QCC Entrance down to Jones Ave	The pipeline size increases to 1050mm diameter for the full distance to Jones Avenue and the depth of the pipeline increases to pick up the pipeline from Glenpanel. Additionally, the line gets deep towards Jones Ave due to grade requirements for the 1050 pipe.
Jones Ave to top end of Herries Lane	The 900mm pipeline increases one pipe size to 1050mm.
Herries Lane to bottom of hill (by the Main Drain)	The 1050mm pipeline again increases just one pipe size to 1200mm dia.

2.3 Trunk Stormwater Pipeline Design

2.3.1 Scope of Report

The trunk stormwater pipeline comprises three parts:

1. The section along Howards Drive, from Ladies Mile to Jones Ave;
2. The section from Jones Ave down to the “transition structure” at the bottom of the hill, just before the main drain; and
3. The energy dissipating “transition structure” and short section of culvert across to the main drain.

This report and request for Engineering Approval covers the first two parts in order to facilitate construction of the critical-path pipeline. The energy dissipating “transition structure” requires special design and is dependent on which option is chosen, so the design for this is to be submitted separately to the pipeline design.

2.3.2 QCC Trunk Stormwater Pipeline Design Philosophy

The design of the trunk stormwater pipeline differs in a number of regards to conventional stormwater design practice, as explained below. This departure from conventional practice has been discussed with and agreed to by the QLDC Chief Engineer (Ulrich Glasner).

The pipeline is designed then, as a continuous pipeline, as opposed to conventional design with discrete straight sections of pipe between manholes. The design focus is to make the pipeline as hydraulically contiguous and efficient as possible, whilst at the same time providing flexibility to route the pipeline according to the ground profile and to avoid existing services, particularly two high voltage cables on the same general pipeline alignment. Connections to the pipeline are kept to a minimum.

Key benefits of this approach include:

- Achieving an almost constant grade over most of the pipeline route.
- An overall reduction in pipeline depth.
- A reduction in the number of manholes needed.
- A reduction in pipe size in some instances.
- The elimination of most drop manholes.
- The avoidance of conflict with existing services.

The pipeline design and further background is presented below. Note that some sections of the trunk SW pipeline towards the top end, by Howards Drive, are designed more conventionally.

The original conventional design of the trunk SW pipeline down from Jones Ave identified a combination of ‘flat’ and steeper pipe sections, some at significant depth, and conflicts with many existing services on the same general pipeline alignment. At the 100 year design flow the ‘flat’ sections would run full and the steeper sections only partly full, meaning these steeper sections run at greater velocities, in places developing super critical flow and hydraulic jumps at grade transitions in the pipeline.

The conventional way to manage such transitions is to use drop manholes and increase pipe sizes on certain pipeline sections. These manholes, however, make the pipeline system, hydraulically inefficient and lead to greater depth pipe sections, larger pipes and overall higher cost.

The pipeline design, then, looks to make the various pipeline sections hydraulically more contiguous and efficient, including designing to a more consistent grade, and better manage hydraulically the grade transitions by recognising that much of the pipeline will be running as open channel flow. With this approach the continuity of the pipeline, including venting of the pipeline at key points to avoid negative pressures, is important and provided for.

The conventional approach looks to place manholes at all changes in grade and angle, and at 100m centres (max) for maintenance access, 'burning' energy at nearly every manhole. Manholes in conventional design serve three main purposes:

- Accommodating changes in angle and grade, and drops in pipe inverts;
- Providing access for maintenance;
- Accommodating pipeline junctions.

In this regard, for pipe sizes 900mm and larger, the design looks to replace most manholes with factory fabricated bends rated to that of the pipe, and to place "inspection" manholes on straight sections of pipeline - still nominally at 100m centres. This recognises that maintenance access is still important, but that with such large diameter pipe the manholes do not need to be on changes in grade or angle. Rather, for hydraulic efficiency they are better placed on straight pipe sections. In this way the risk of sedimentation in the pipeline is effectively eliminated and the need for maintenance access is provided purely as a precaution.

With regard to pipe junctions, the section of pipeline down from Jones Ave (to which this design approach predominantly relates) has only two connections, one for the Southern block SW and one for the Onslow Road West / East subdivision. In each case, to maintain hydraulic efficiency a factory fitted WYE junction is placed on the pipeline to accommodate these flows. At each connection a conventional manhole is placed just a few metres out from the WYE junction to direct incoming flows into the pipe.

The design of the trunk stormwater pipeline is detailed on the appended drawings, as listed below. These drawings relate to Option 2 (including Glenpanel), noting that the design for QCC-only (Option 1) is similar:

1. Howards Drive Section:

N471B	Overview Plan and Long Section

2. Lower Section from Jones Ave:

N420C	Overview
N450.2A to N456.2A	Plans and Longsections
N460A	Special Manhole Detail
N461.2A - N463.2A	Cross Sections
N261B	Typical Details

The construction specification for the pipeline is presented in Appendix C.

2.3.3 Alignment and Construction around Hillsides

A key feature of the pipeline design has been the ability to optimise the vertical and horizontal alignments, achieving close to constant grades for much of the pipeline by following the lower contours of the hillside running down from the QCC site's (southern) terrace. In places, in order to maintain a constant grade, the pipeline rises close to and sometimes above the existing surface. This has been accommodated by the available space away from local roading to place fill (cover) over the pipe and, where necessary, to construct a platform up to, against, and over the pipe to maintain adequate (700mm minimum) cover.

Figure 2.3 shows a typical cross sectional and photographic illustration of this - full cross sections are given on the drawings.

Easements across Council reserve land and across QCC land, as applicable, will be formalised in due course.

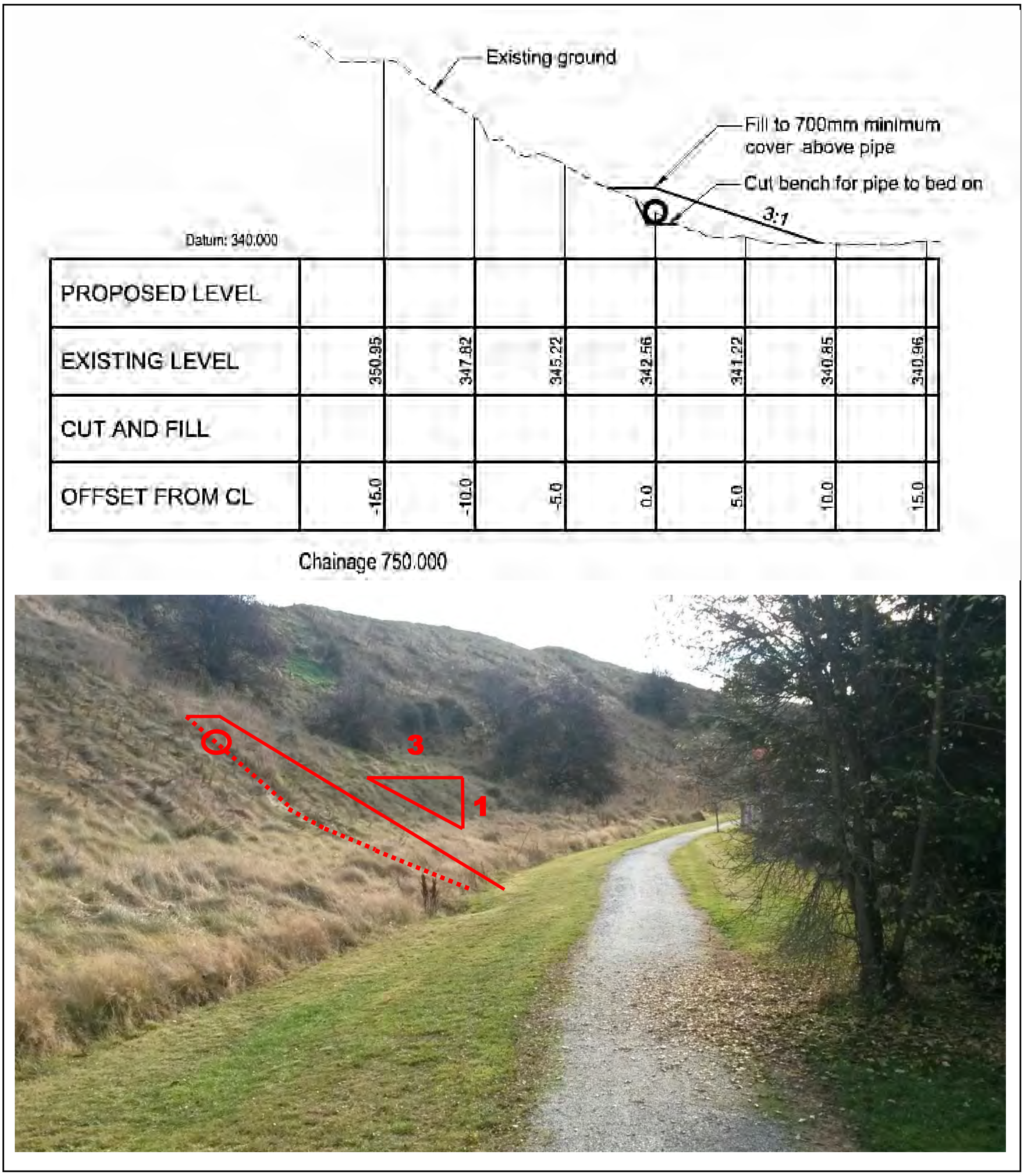


Figure 2.3: Typical Example of Construction around Lower Slopes of Hillside

In constructing the fill embankments shown in Figure 2.3, specific geotechnical advice has been sought from Geosolve Ltd, who have provided construction detail as per Figure 2.4. With a finished slope of 3H to 1V, compared to the existing slopes of 1.5H to 1V, the finished construction acts as an effective buttress at the toe of the slope to enhance slope's and the pipeline's stability.

2.3.4 The Howard's Drive Pipeline Section

The design of the Howard's Drive section of trunk SW pipeline for the **QCC-only** Option 1 has previously been submitted with the 17 March Design Report, that has been subsequently been approved by Council. In that instance the design is to conventional standards and pipe sizes range from 600 to 825mm diameter down to Jones Avenue.

For Option 2, the addition of 1.5cumecs of stormwater from Glenpanel increase flows in this section of pipeline significantly, and the design of the pipeline is governed more to accommodate Glenpanel, than QCC. The flat grade of Howards Drive away from Ladies Mile and the need to run the pipeline from Ladies Mile, rather than just from the Howards Drive QCC entrance, has particular design consequences.

To minimise the pipe size a constant and as steep as possible pipe gradient needs to be achieved. Starting at a depth to invert at Ladies Mile of approximately 1.8m depth, and utilising the available grade to Jones Av., a pipe size of 900mm increasing to 1050mm diameter is determined. This results in pipe depths up to 5m. To accommodate such depths without affecting Howards Drive and without the need for trench shields, the pipeline alignment has been moved into QCC land, as shown on the drawings.

At this point, for Option 2, the design of this pipe section is subject to confirmation and refinement, pending confirmation of detail relating to the Glenpanel development. If Option 2 is confirmed, final construction drawings will be submitted to Council for confirmation prior to construction, but for this Engineering Approval application, the appended preliminary drawings are considered sufficient, at least for approval in principle of this top end section.

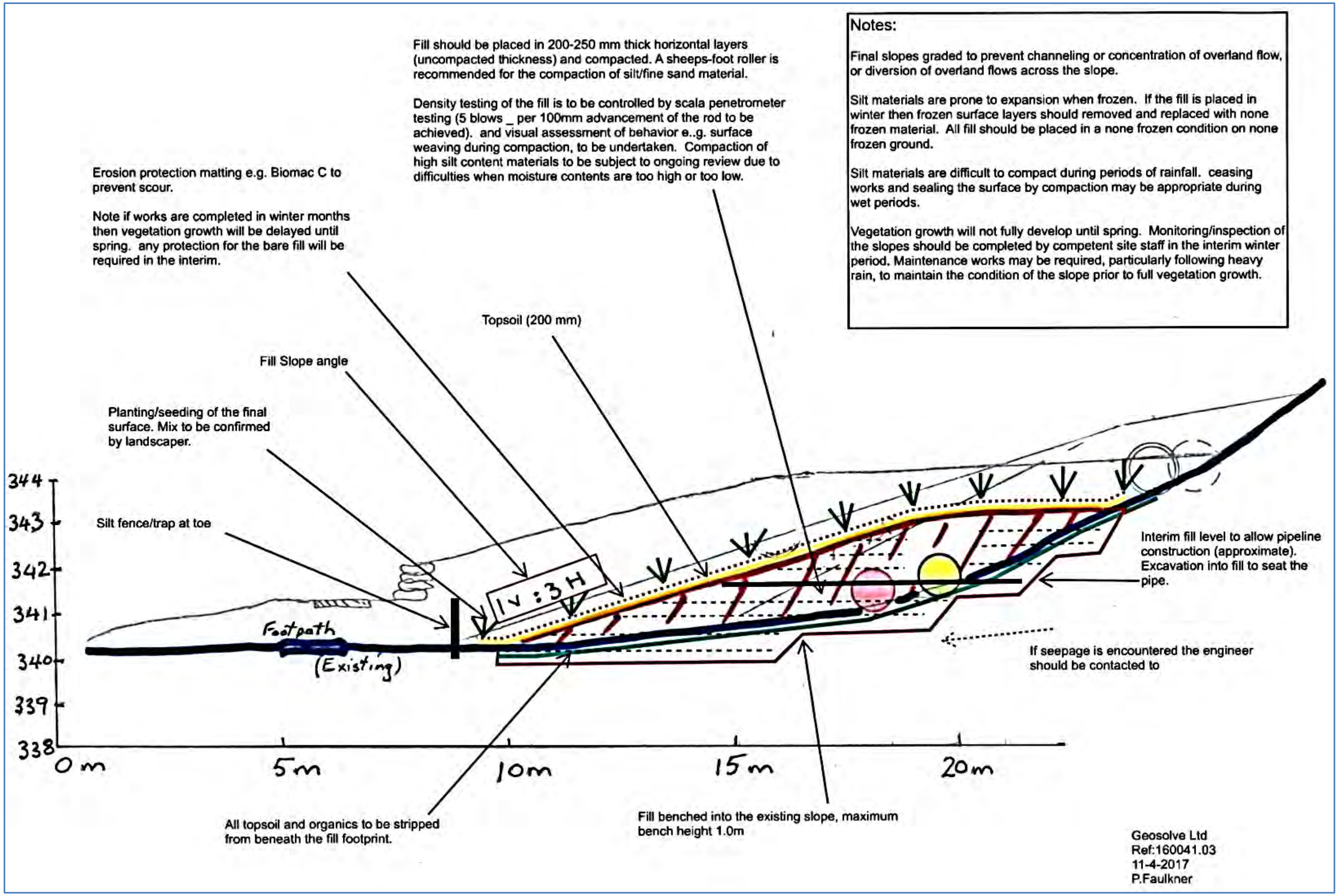


Figure 2.4: Conceptual Arrangement for Pipeline around Foot of Slope with Geotechnical Notes by Geosolve

3.0 Prior Consultation with Council

Consultation with Council, prior to this application for Engineering Approval has been undertaken to prepare the way for this application. This has included:

- Various discussions with QLDC Chief Engineer Ulrich Glasner regarding the design approach for the trunk SW pipeline, concluding in a meeting on 1 June 2017 between Ulrich, Andrew Iremonger (QLDC) and Derrick Railton (Fluent Solutions) at which the finalised design was presented.
- 31 May 2017 walkover of the pegged pipe alignment with Mike Healy (QLDC) to discuss design and construction matters.
- 9 June 2017 walkover of the section of pipeline on Council reserve land with Council's Reserves and Recreation Manager Stephen Quin.

From these meetings various matters were raised and are addressed as follows.

1. Mike: The need for a Hazard Assessment relating to the risk and implications of pipeline failure. This is addressed in the following Section 4.0.
2. Mike: The need to maintain quality control during construction, particularly with regard to ensuring every individual pipe is properly jointed and that the pipeline is laid to the correct line and grade.

   Quality control of the pipeline installation will be achieved by:

   - regular monitoring of the pipeline bedding and backfill placement and compaction, and
   - checking every joint (as the pipeline is large enough for person entry) for the correct placement of the rubber ring and measurement/recording of the gap (at four locations) at each joint for comparison against the manufacturer's limits.
3. Mike and Stephen: With regard to the pipeline section from Herries Lane to Howards Drive, over Council reserve land, Stephen was in general agreement with the proposal. Both he and Mike wanted to ensure that where the walking track was modified and raised near 24 Herries Lane that an appropriate gradient was included to ensure ease of use for cycles. It was agreed that any stormwater needs to be managed and this should include improvements to the existing swale at the foot of the embankment.

   It is proposed that at the time of completion of the pipeline construction, close liaison will be maintained with Mike Healy to ensure that the footpath/cycleway is graded and completed to Council's satisfaction, and to optimise drainage/soakage measures in the immediate area.
4. Stephen: The QLDC policy of replacing a tree where one has been removed was noted and this will be undertaken by QCC.

4.0 Risk Management Assessment

The potential for the trunk SW pipeline to fail and cause flooding of property in Lake Hayes Estate was identified as a key concern during the consultation process with Council. The section of pipeline between Herries Lane and Howards Drive, where is traverses the 'steeper' slopes running down from the upper terrace was a more particular concern.

The following risk and hazard assessment has therefore been undertaken:

Hazard / Risk	Assessment / Mitigation
1) Risk of pipeline failure due to earthquake / liquefaction	Geosolve have assessed the issue of liquefaction and advised per email to Fluent Solutions dated 31 May 2017 that liquefaction is a non-issue for practically most of the pipeline due to depth to groundwater. At the very southern end of the pipeline, over the last 20m or so (CH0-CH20), where the pipeline extends down to the low lying area around the Kawarau River, the ground here may have the potential to liquefy but the risk would be expected to dissipate rapidly as the pipeline climbs up the hill. Geosolve conclude that liquefaction in this area is unlikely to have a significant impact on the overall performance of the pipeline. It is noted that the risk of earthquake induced failure coinciding with a major storm event is very low. This, together with the low risk of failure of the pipeline in an earthquake, means that the risk of failure of the pipeline in an earthquake causing flooding of local properties is very low. For most of the time the pipeline will be empty or only be conveying modest flows.
2) Risk of failure due to slope subsidence due to earthquake or other events, such as scouring of the hillside by concentrated stormwater run-off.	The existing terrace slopes have remained stable for a long period of time. In locations where the pipeline is laid along the slope, the proposed work will see the placement of additional constructed fill against the hillside, graded off at a stable slope of 3H:1V. This fill will provide an effective buttress that will further stabilise the slope and reduce the risk of slope failure even more.
3) Risk of failure due to scouring of the hillside by concentrated stormwater run-off	Generally, stormwater runoff down and off the slope is evenly distributed across the slope. A strong dense grass sward is well established on the slope that helps reduce scour and the potential for concentration of runoff. Particular attention will be given to re-establishing this grass sward over the new work following construction. For the most part then, there is little risk of scouring as a result of concentrated stormwater runoff. Geosolve have a general advice note (see Figure 2.4) that final slopes are to be graded to prevent channeling or concentration of overland flow, or diversion of overland flows across the slope. As construction is completed along the slope, Geosolve will be engaged to review the final land forms and provide direction where additional work is required to comply with their general advice note.

Hazard / Risk	Assessment / Mitigation
	Regarding the potential for concentration of stormwater, there is the potential for this at around Chainage 930 to 950m. Particular measures are to be taken here under Geosolve's direction to provide appropriate measures for stormwater control and scour protection. Additionally, Geosolve will review the area generally to identify any other areas requiring particular scour protection.
4) Risk of failure due to pipe or pipe-joint failure	Pipes are manufactured to proven quality standards and are nominally designed to accommodate pressures of 6m head or more. The pipes in this instance will not be under pressure and for the most time (until a 1%AEP storm) will be flowing partly full under atmospheric pressure. Bends on the pipeline are manufactured to the pipe pressure rating of the pipe. Finally, during construction, quality control measures will be followed, particularly in checking each installed joint.

APPENDIX A

Schedule 1A of QLDC's SCoP

SCHEDULE 1A

DESIGN CERTIFICATE – LAND DEVELOPMENT / SUBDIVISION

ISSUED BY: Fluent Infrastructure Solutions Ltd

(Approved certifier firm/suitability qualified design professional)

TO: Sanderson Group - Queenstown Country Club Ltd

(Developer/owner)

TO BE SUPPLIED TO: Queenstown Lakes District Council

(Territorial authority)

FOR: Trunk stormwater pipeline to serve the QCC Development

(Description of land development/subdivision)

AT: Terraced land lying between Lake Hayes Estates and Shotover Country
being 420 Frankton - Ladies Mile Highway, Lake Hayes

(Address)

Fluent Infrastructure Solutions Ltd *(Consultant/designer)* has been engaged by Queenstown Country Club Ltd *(Developer/owner)*

to provide Professional Engineering services for the land development and/or subdivision described above.

I Derrick Railton have the qualifications and experience relevant to this project as set out herein and have designed the land development/subdivision and confirm that the design is to current engineering practice, and that I believe on reasonable grounds that it satisfies all relevant resource consent conditions, all relevant Queenstown Lakes District Council (insert name of authority) requirements and applicable codes and standards.

I/My practice holds professional indemnity insurance to the amount of $2,000,000 and includes run-off cover.

Date 14 June 17

(Signature of approved certifier on behalf of the approved certifier firm)

Derrick Railton – Director / Senior Civil Environmental Engineer; BE Civil CPEng PE (No.16223)

(Name, title and professional qualifications)

NOTE – This statement shall only be relied upon by the territorial authority named above. Liability under this statement accrues to the approved certifier firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the territorial authority on this land development/subdivision, whether in contract, tort, or otherwise (including negligence), is limited to the sum of $ (insert)

APPENDIX B

Supporting Stormwater Calculations

APPENDIX D
QCC Retirement Village – Stage 1 Only
Earthworks and Infrastructure Design Report for Engineering Approval
Stormwater Design – Model Input Parameters and Results

1.0 Introduction

The hydraulic and hydrological modelling software Infoworks ICM (ICM) was used to estimate the peak stormwater runoff flows. The model utilises a combination of 1D pipes and 2D surfaces (roading 3D design surface) to measure runoff flows from the catchments.

Figure 1.1 below shows the elements of the model.

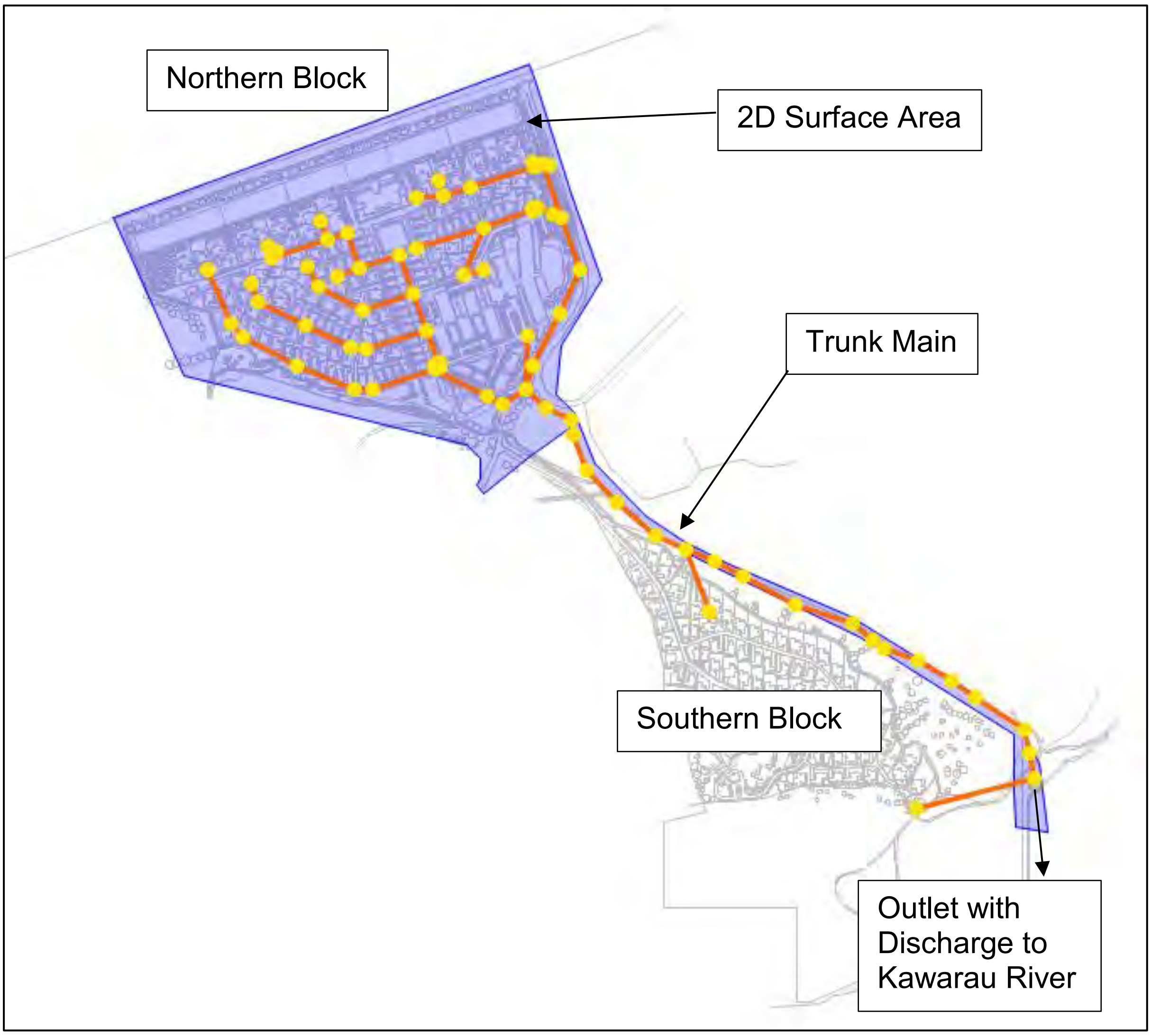


Figure 1.1: Model Layout and Elements

The following sections describe the model results and input parameters.

2.0 Assumed Development Density – Residential Lots

For the Northern Block area, blocks of lots were modelled individually with the average assessed pervious and impervious areas within each lot taken into account. The respective pervious and impervious areas were derived from a sample area of 13 houses which provides a general representation of the lot density for the entire Northern Block area. Figure 2.1 shows the selected lots and Table 2.1 shows the lot density analysis sample.

Figure 2.1: Lot Density Sample Area – Selected Lots

Table 2.1: Lot Density Analysis

House Sample Number	House Area (m2)	Pavement Area (m2)	Driveway Area (m2)	Grass Area (m2)		Total Area (m2)	Area Pervious (m2)	Area Impervious (m2)		% Imp	% Perv
1	233	40	91	189		552	189	363		66	34
2	233	40	91	179		542	179	363		67	33
3	265	23	95	234		617	234	383		62	38
4	233	40	91	180		543	180	363		67	33
5	233	40	91	185		548	185	363		66	34
6	169	13	29	217		428	217	211		49	51
7	157	13	18	213		401	213	188		47	53
8	169	13	29	194		405	194	211		52	48
9	157	13	18	268		456	268	188		41	59
10	157	13	18	279		467	279	188		40	60
11	157	13	18	244		432	244	188		44	56
12	169	13	29	224		435	224	211		49	51
13	157	13	18	239		427	239	188		44	56
									Average	53	47

Note that impervious areas taken into account for each lot consist of the house, outdoor areas, and driveway. It was found that an average development density for the lots was approximately 53% impervious and 47% pervious. Therefore, the model utilised these percentages.

The perviousness of a surface is determined by the Conjugate Curve Number. Conjugate Curve Numbers with an associated Initial Abstraction factor of 0.05mm were used in the model. Based on the *Hydrologic Modeling System HEC-HMS Technical Reference Manual, March 2000*, the conjugate curve number assumed for pervious surfaces was 57 and 98 for the impervious surfaces for the lots. Medical buildings and the gym were assumed as all impervious.

3.0 Catchment Soil Characteristics

In ICM, the QCC site was modelled using both 1D (pipes) and 2D (roading 3D design surface) elements. The general classification of soils within the site is poorly drained loam. This classification provided the basis for the appropriate infiltration values and Curve Numbers used for estimating the post-development flow.

As described above, the road areas were modelled using a 2D hydraulic surface based on the 3D roading topographical design. The infiltration values were based on a fixed infiltration rate of 5% of the total runoff (i.e. total runoff about of 95% due to the highly impervious nature of the roads).

4.0 Design Storm Rainfalls

A series of triangular rainfall hyetographs (rainfall depth versus time graph) were developed for a range of storm durations. The developed rainfall hyetographs were imported into the Infoworks ICM model and runoff flows were calculated. The triangular hyetograph methodology, development of storm rainfall intensities from historical rainfall events, and allowance for climate change is described below.

4.1.1 Triangular Hyetograph

The triangular hyetograph methodology adopted by the Christchurch City Council *"Advanced Analysis" method provided in the "Waterways, Wetlands and Drainage Guideline" using recorded data at the Queenstown Airport has been applied for this effects assessment.* The triangular hyetograph utilises the average rainfall intensity for a given duration as the basis for design with the peak intensity being at 2 times the average intensity and occurring at 0.7 times the duration.

An example of a typical triangular hyetograph for a 2 hour duration is shown below.

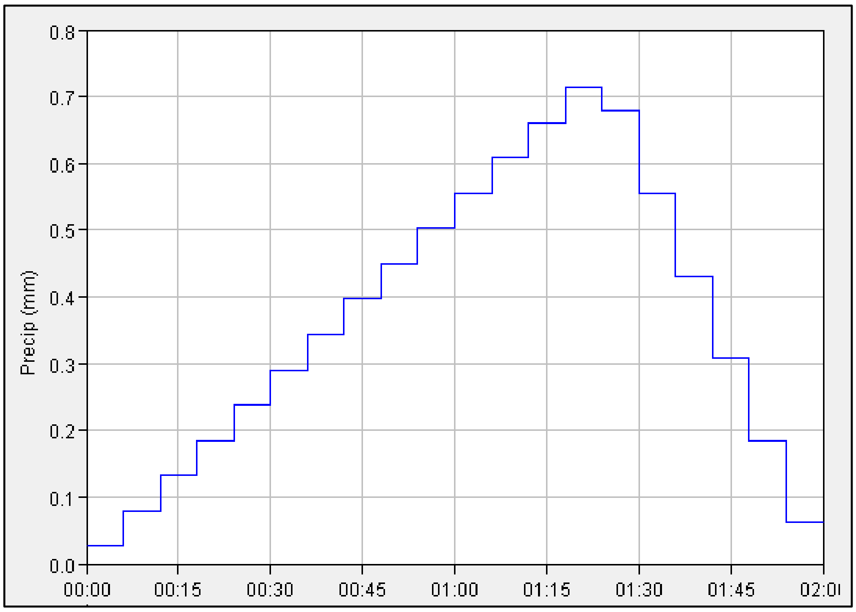


Figure 4.1: Sample 2 Hour Duration Storm Hyetograph

4.1.2 Historical Rainfall Data

To ensure that the design flow estimates are based on appropriate rainfall patterns, the design hyetographs were compared with three recent major storm rainfall events and a normalised rainfall curve derived from a set of 24 hour duration maximum rainfalls from 10 storm rainfall events at Queenstown Airport. The 24 hour data is presented in Figure 4.2. The following points are noted in regard to a 24 hour duration storm rainfalls from the data in Figure 2.2:

a. The total 24 hour rainfall depth for the three recorded storm events would have current ARI of approximately 20 years without allowance for climate change.

b. The peak rainfall intensity for the design hyetograph is greater than the maximum recorded intensity for the three highest recorded 24 hour storm events and greater than the peak of the normalised curve peak intensity using the 24 hour rainfall data including allowance for climate change.

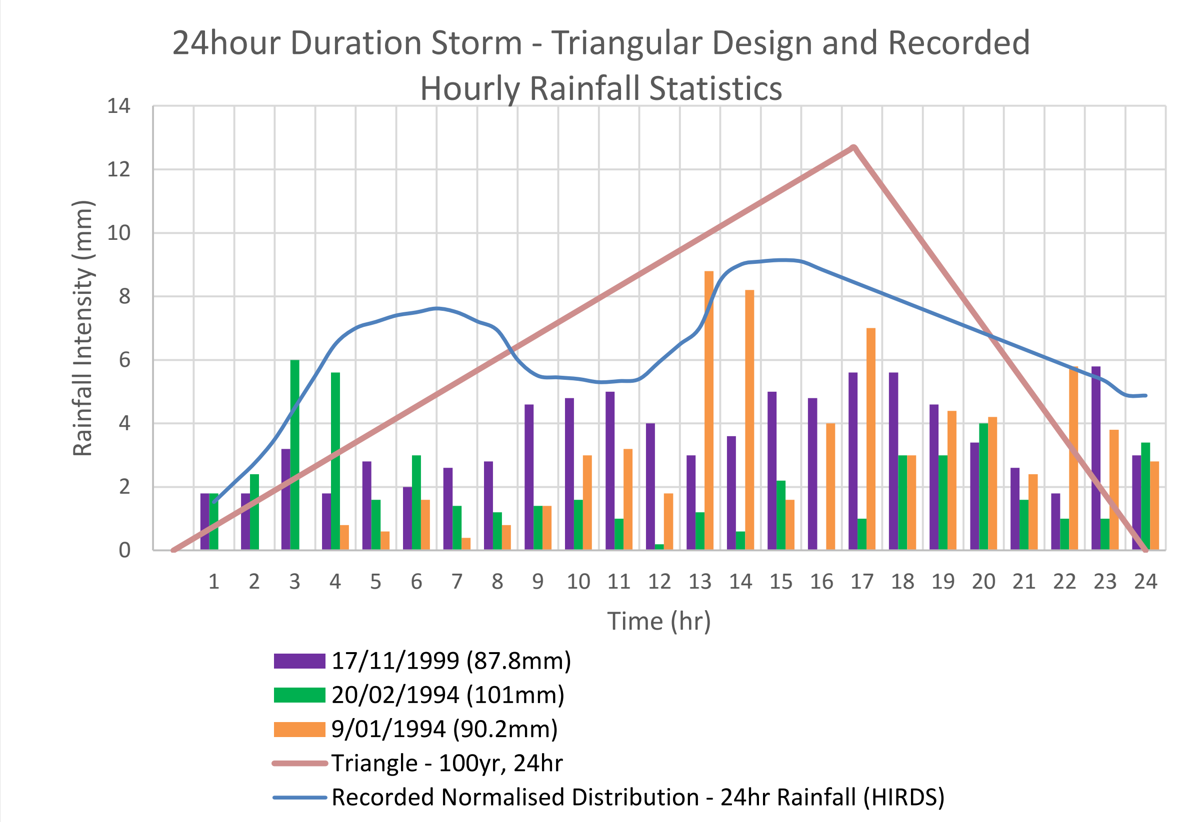


Figure 4.2: Rainfall Data Comparison

4.1.3 Climate Change

The Queenstown Lakes Code of Practice requires that climate change be a design consideration. Rainfall data from HIRDS for the 1% Annual Exceedance Probability (AEP) storm event based on a 2ºC temperature increase, being the median projection for 2090, was used to generate the design hyetographs for a range of storm durations.

4.1.4 Storm Durations

The ICM model was used to measure the pre- and post-development runoff flows from the site. Stormwater flows were estimated for the 1% AEP storm event for the following durations: 0.5 hour, 1 hour, 2 hour, 4 hour, 6 hour, and 12 hour.

5.0 Northern Area and Trunk Main Design

The layout of the stormwater collector reticulation is provided in Drawing No. N420 in Appendix C. The reinforced concrete pipe sizes and gradient for the pipeline sections are also included in the long sections in the drawings.

6.0 Model Runoff Flow Results

6.1 Flow Summary

The runoff estimates generated from the model are presented in Table 6.1 below.

Table 6.1: Model Results

Storm Duration	Peak Post-Development Flow – Northern Block (m^3/s)	Peak Post-Development Flow – Trunk Main Outlet (m^3/s)
100 year, 0.5 hr	2.13	3.07
100 year, 1 hr	**2.25**	**3.32**
100 year, 2 hr	1.77	2.70
100 year, 4 hr	1.34	2.13
100 year, 6 hr	1.13	1.85
100 year, 12 hr	0.82	1.71
2 year, 1 hr (half)	*All velocities in pipes were above 0.6m/s	

As required by the 2015 Subdivision Code (Cl 4.3.5) the proposed piped stormwater management system provides provision as both a primary and secondary system with conveyance for the 1% AEP event. The peak runoff flow occurred for the 1 hour duration storm, at a flow of 3.32m^3/s at the trunk main outlet, where flows discharge into the existing channel which flows to the Kawarau River.

The design was also assessed for low flow velocities as per the 2015 Subdivision Code (Cl 4.3.9.5): *"The minimum velocity should be at least 0.6 m/s at a flow of half the 50% AEP design flow."* At half of the 2 year ARI (for the critical storm duration), the velocity in all pipes in the system were above 0.6m/s.

6.2 Hydraulic Analysis Result

A flow profile for the two critical collection reticulation pipe strings for the Northern Block is provided in Figures 6.1, 6.2, and 6.3 below.

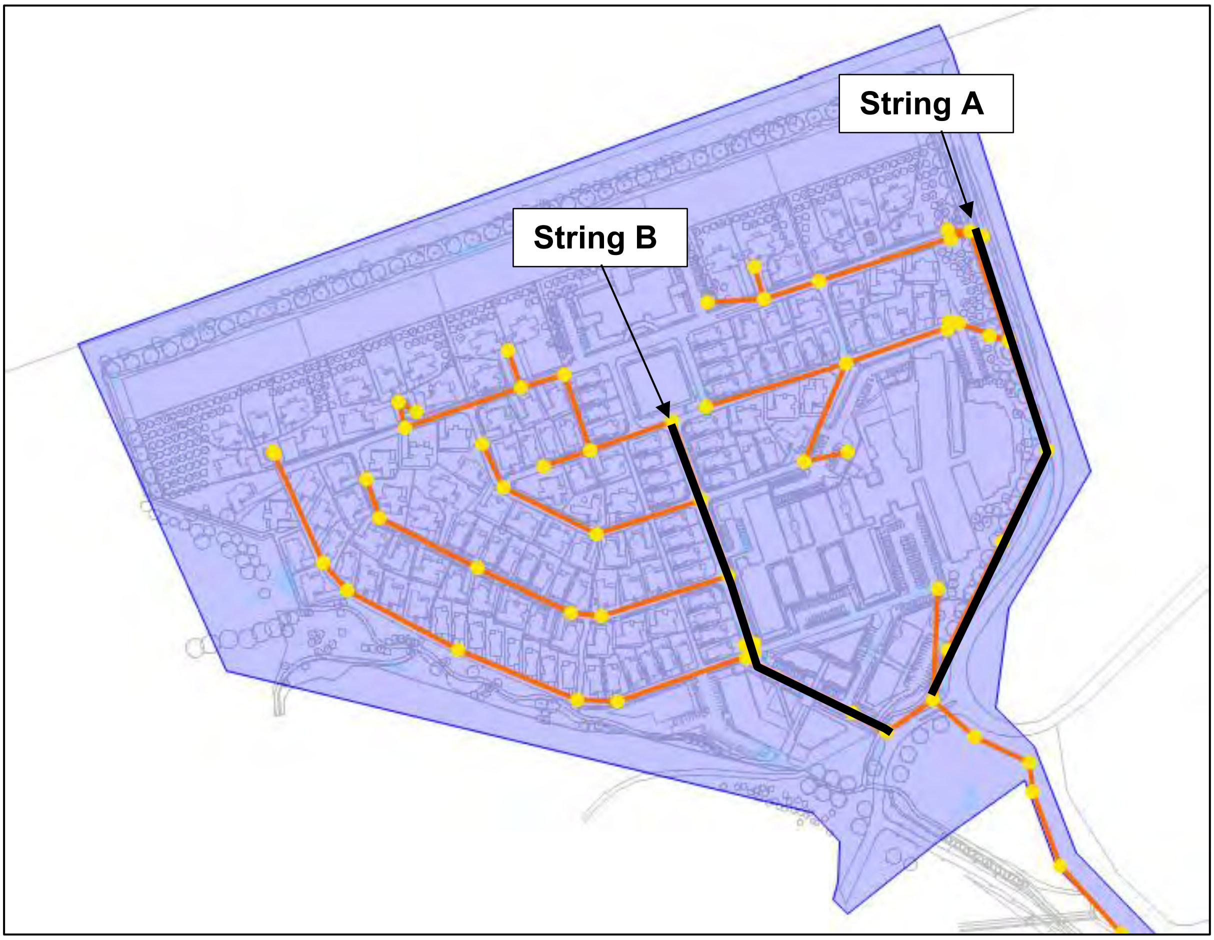


Figure 6.1: Reticulation Layout Plan – Highlighted Critical Pipe Strings

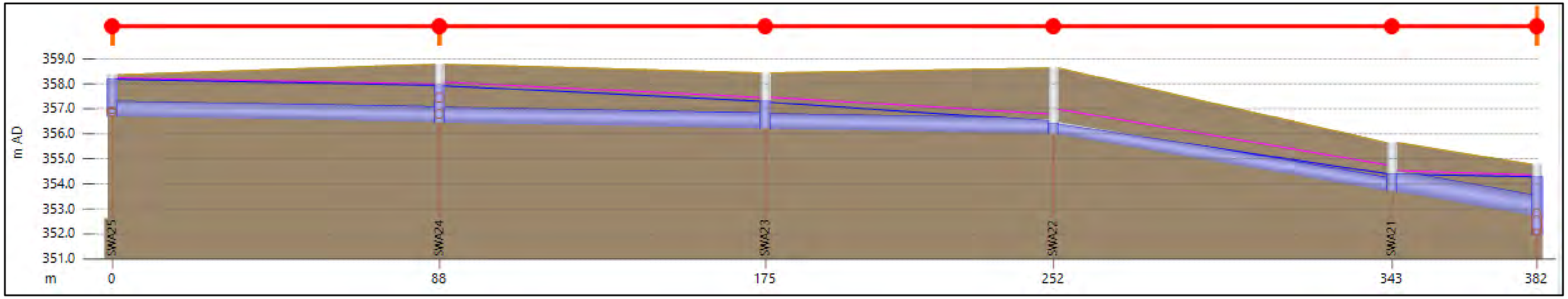


Figure 6.2: Flow Profile – String A

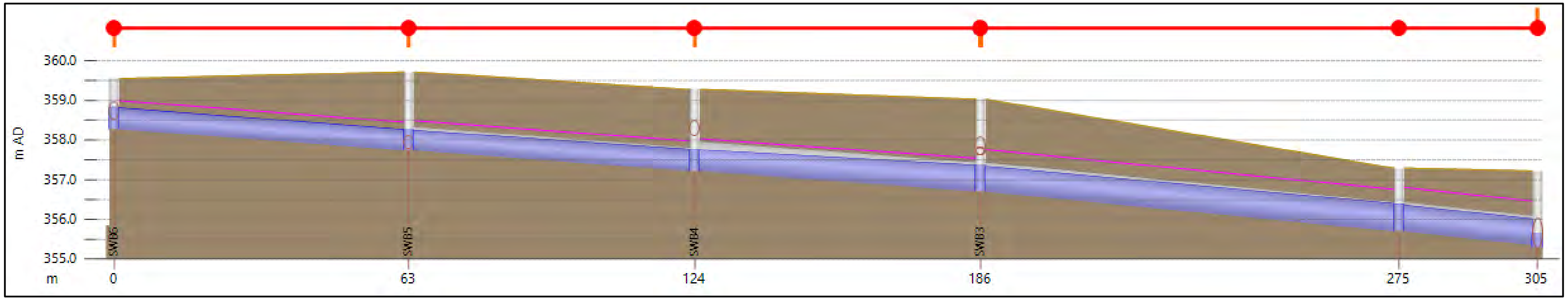


Figure 6.3: Flow Profile – String B

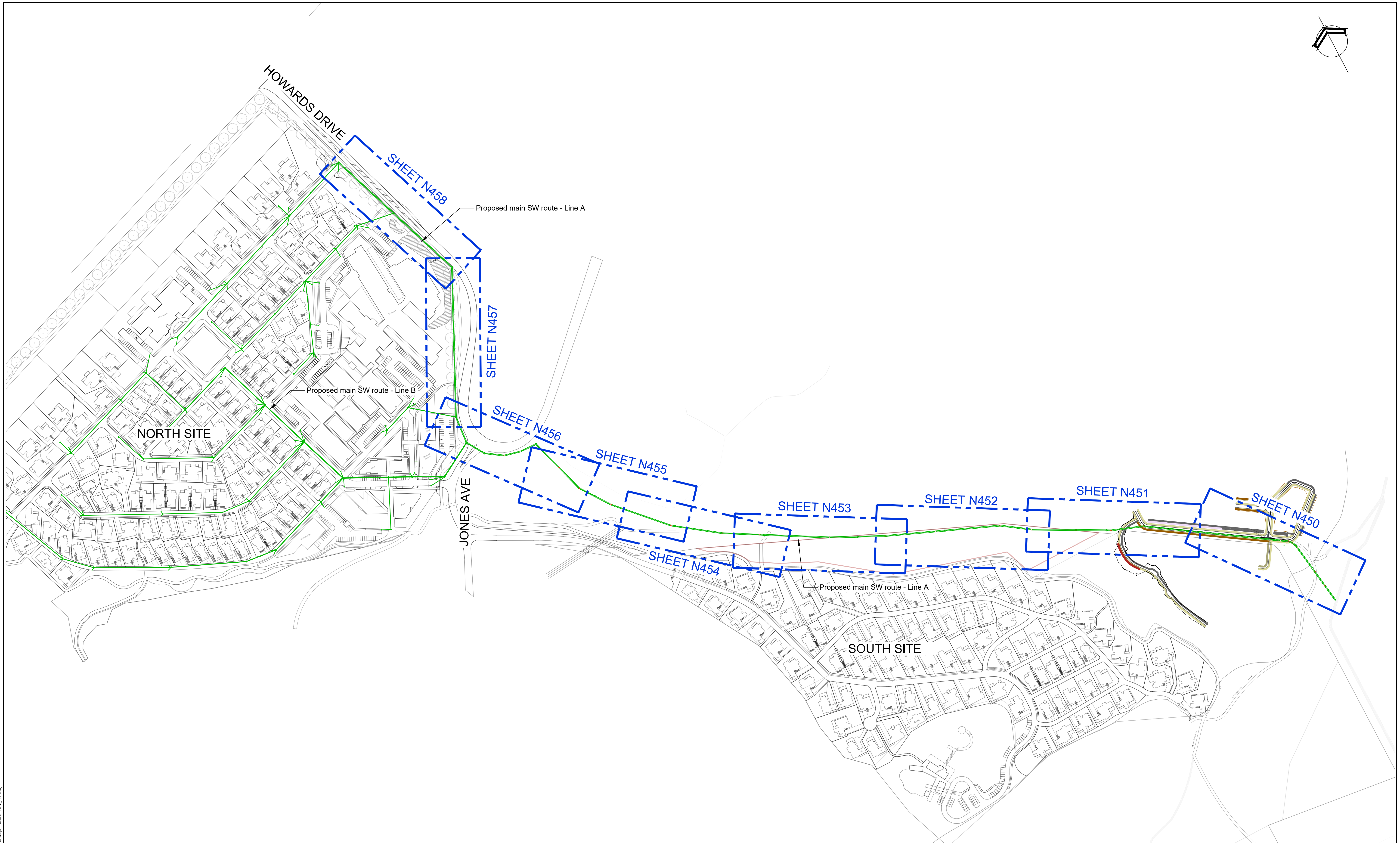
APPENDIX C

Fluent Solutions Technical Specification
(Appended as a separate accompanying document)

APPENDIX D

Howards Drive Section:
N471 - Overview Plan and Long Section

Lower Section from Jones Ave:
N420C - Overview
N450.2A to N456.2A - Plans and Longsections
N460A - Special Manhole Detail
N461.2A - N463.2A - Cross Sections
N261B - Typical Details



STORM WATER TRUNK MAIN INDEX PLAN
1:2000 at A1
1:4000 at A3

Revision		App	Date
C	Issued for Engineering Approval	DER	26 May'17
B	Updated SW Trunk Main	DER	---- April'17
A	Issued for Consent	DER	March'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	March '17
Approved	D. Railton	March '17

Fluent SOLUTIONS
Level 2, Burns House, 10 George Street
PO Box 5240, Dunedin 9058
T: 03 929 1263
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

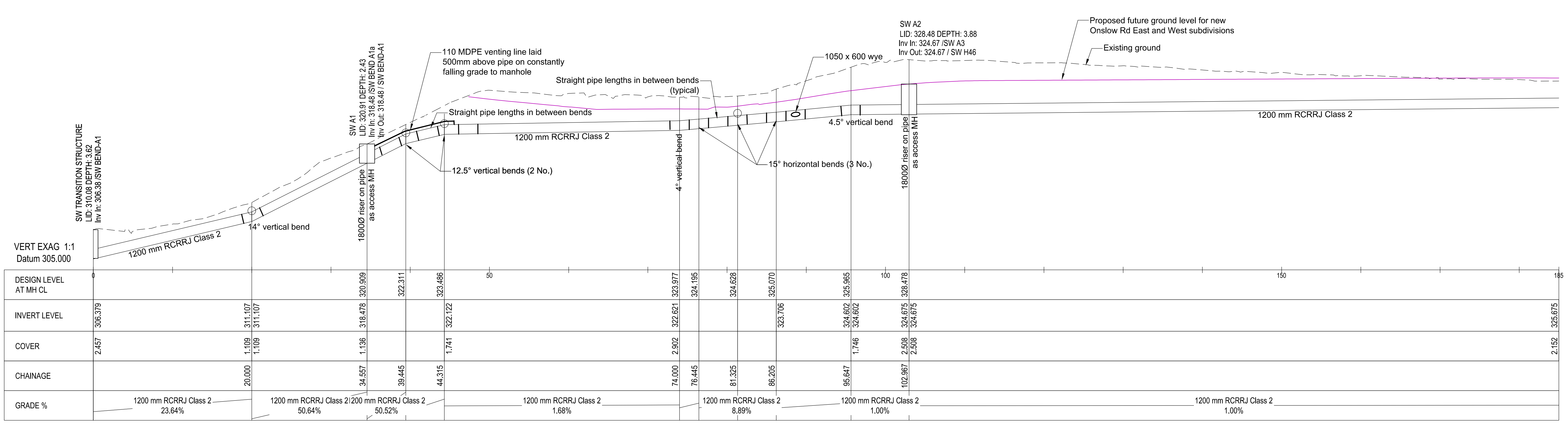
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Main
Overall Plan

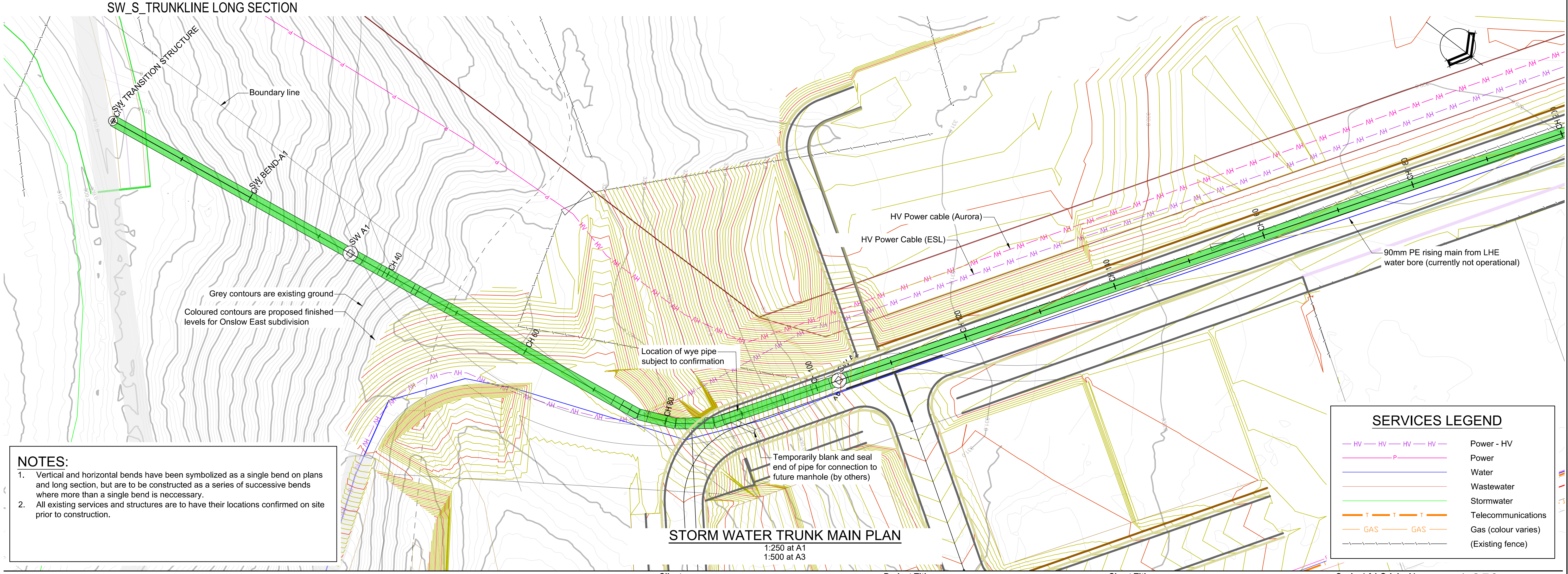
Scale (A1 Original) 1:2000

Issue
For Engineering Approval

Project No	Sheet	Revision
Q000320	N420	C



SW_S_TRUNKLINE LONG SECTION



NOTES:

1. Vertical and horizontal bends have been symbolized as a single bend on plans and long section, but are to be constructed as a series of successive bends where more than a single bend is neccessary.
2. All existing services and structures are to have their locations confirmed on site prior to construction.

STORM WATER TRUNK MAIN PLAN
1:250 at A1
1:500 at A3

Revision	Description	App	Date
A	Issued for Engineering Approval	DER	26 May'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

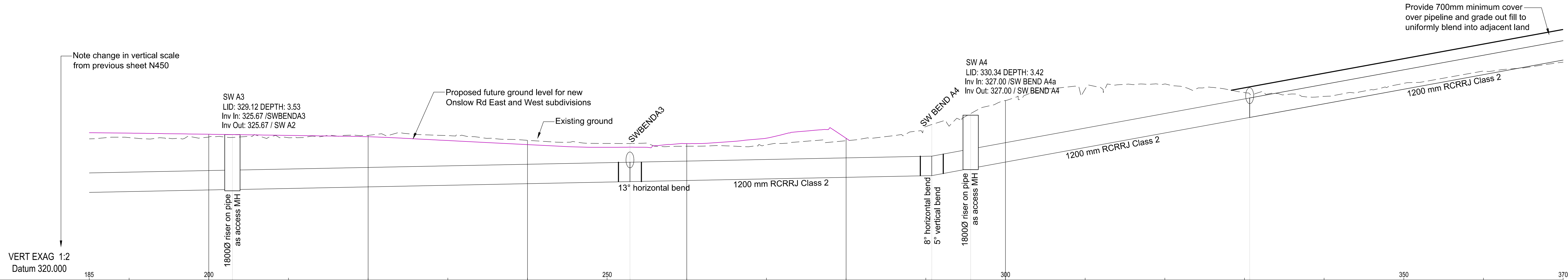
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Mains
Plan & Long Section
OPTION 2

Scale (A1 Original) 1:250 m

Issue
For Engineering Approval

Project No	Sheet	Revision
Q000320	N450.2	A



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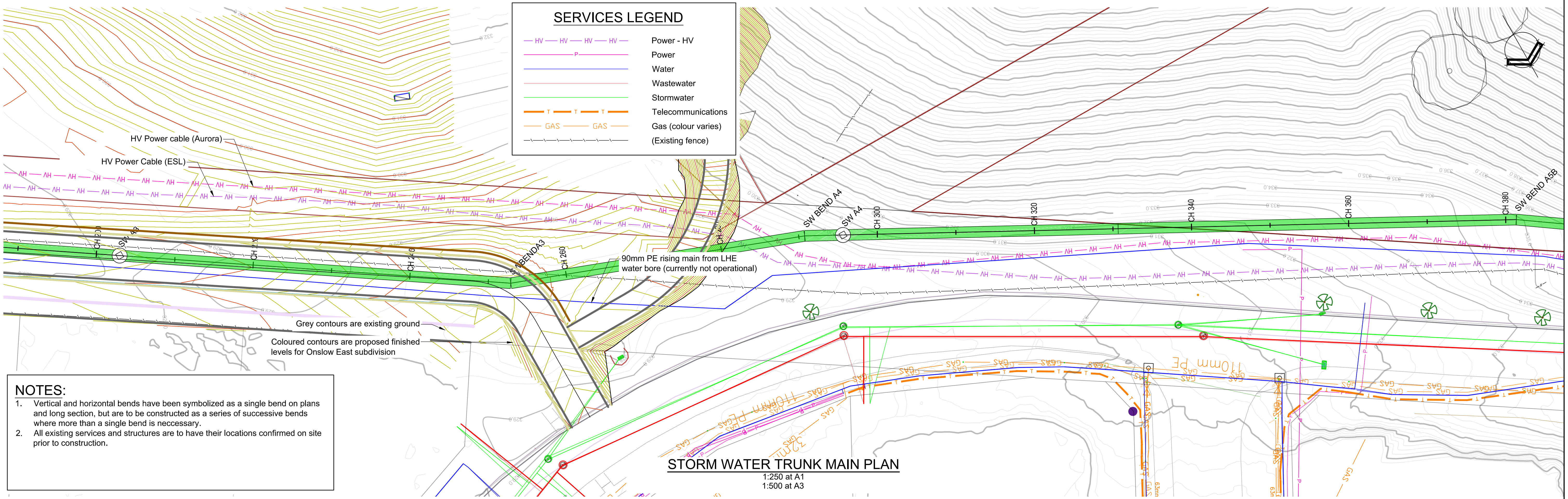
INVERT LEVEL	325.670	326.169 326.169	326.548 326.548	326.997 326.997	330.199 330.199	334.837
COVER	1.980	1.099 1.099	1.914 1.914	2.148 2.148	0.185 0.185	-1.324
CHAINAGE	202.967	252.864	290.751	295.631	330.656	
GRADE %	1200 mm RCRRJ Class 2 1.00%	1200 mm RCRRJ Class 2 1.00%	1200 mm RCRRJ Class 2 9.18%	1200 mm RCRRJ Class 2 9.14%	1200 mm RCRRJ Class 2 9.15%	

SW_S_TRUNKLINE LONG SECTION



SERVICES LEGEND

— HV — HV —	Power - HV
— P —	Power
	Water
	Wastewater
	Stormwater
— T — T —	Telecommunications
— GAS — GAS —	Gas (colour varies)
	(Existing fence)

NOTES:

1. Vertical and horizontal bends have been symbolized as a single bend on plans and long section, but are to be constructed as a series of successive bends where more than a single bend is neccessary.
2. All existing services and structures are to have their locations confirmed on site prior to construction.

STORM WATER TRUNK MAIN PLAN
1:250 at A1
1:500 at A3

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

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Sanderson GROUP

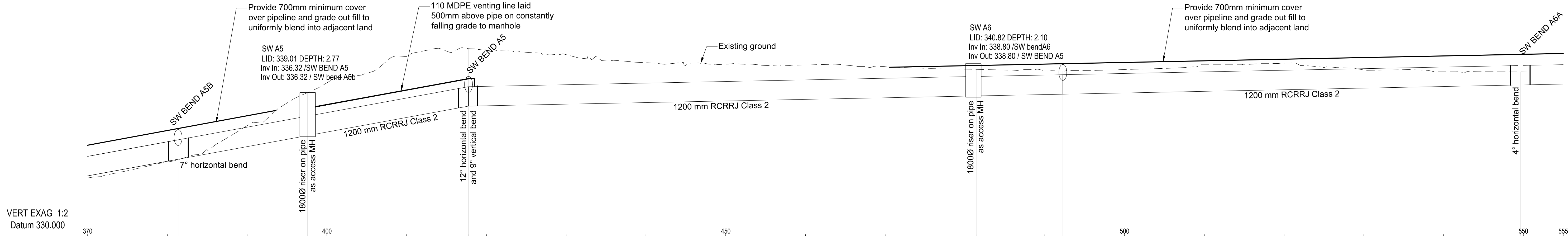
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Mains
Plan & Long Section
OPTION 2

Scale (A1 Original) 1:250 m

Issue
For Engineering Approval

Project No	Sheet	Revision
Q000320	N451.2	A



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COVER	-1.324	1.400 1.400	2.303 2.303	0.375 0.375	0.153 0.153	-0.481
CHAINAGE	381.350	397.584	417.758	481.059	492.262	549.642
GRADE %	1200 mm RCRRJ Class 2 9.14%	1200 mm RCRRJ Class 2 9.16%	1200 mm RCRRJ Class 2 1.00%	1200 mm RCRRJ Class 2 1.00%	1200 mm RCRRJ Class 2 1.01%	

SW_S_TRUNKLINE LONG SECTION

SERVICES LEGEND

- Power - HV
- Power
- Water
- Wastewater
- Stormwater
- Telecommunications
- Gas (colour varies)
- (Existing fence)

NOTES:

1. Vertical and horizontal bends have been symbolized as a single bend on plans and long section, but are to be constructed as a series of successive bends where more than a single bend is necessary.
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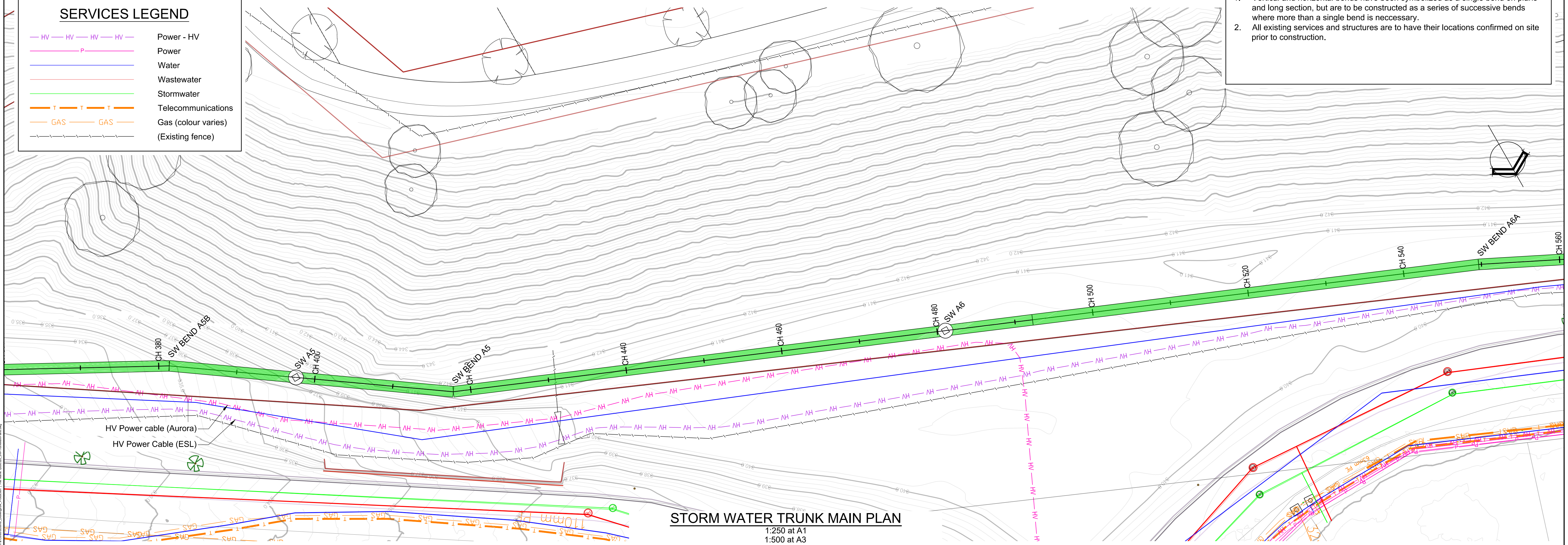

STORM WATER TRUNK MAIN PLAN
1:250 at A1
1:500 at A3

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
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Project Title
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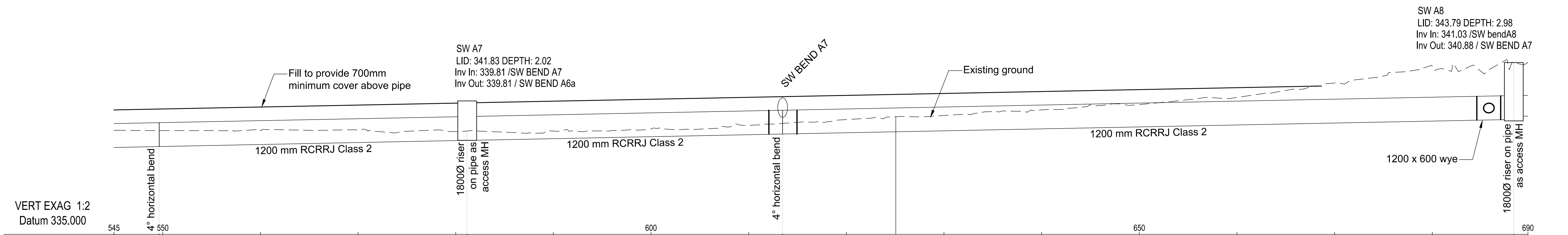
Sheet Title
Stormwater Trunk Mains
Plan & Long Section
OPTION 2

Scale (A1 Original) 1:250 m
Issue For Engineering Approval
Project No Q000320
Sheet N452.2
Revision A



DESIGN LEVEL AT MH CL		340.858	341.828	341.488	343.789
INVERT LEVEL	338.915	339.494 339.494	339.809 339.809	340.132 340.132	340.881 341.982
COVER	0.153	-0.481 -0.481	-0.813 -0.813	-0.747 -0.747	1.612
CHAINAGE		549.642	581.179	613.477	688.354
GRADE %	1200 mm RCRRJ Class 2 1.01%	1200 mm RCRRJ Class 2 1.00%	1200 mm RCRRJ Class 2 1.00%	1200 mm RCRRJ Class 2 1.00%	1050 mm RCRRJ Class 2 1.00%

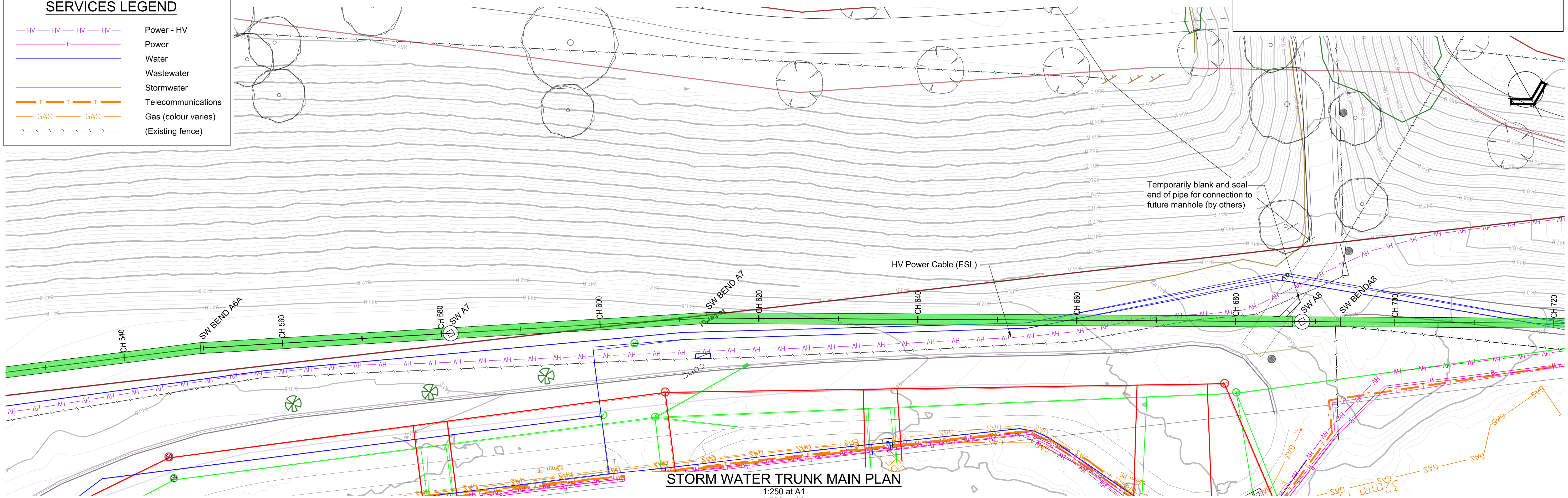
SW_S_TRUNKLINE LONG SECTION

NOTES:

1. Vertical and horizontal bends have been symbolized as a single bend on plans and long section, but are to be constructed as a series of successive bends where more than a single bend is neccessary.
2. All existing services and structures are to have their locations confirmed on site prior to construction.

SERVICES LEGEND

- Power - HV
- Power
- Water
- Wastewater
- Stormwater
- Telecommunications
- Gas (colour varies)
- (Existing fence)



STORM WATER TRUNK MAIN PLAN
1:250 at A1
1:500 at A3

Surveyed	-		-
Designed	D. Railton		Nov '16
Drawn	H.W & C.H		'17
Reviewed	D. Railton		-
Approved	-		-

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client: Sanderson GROUP

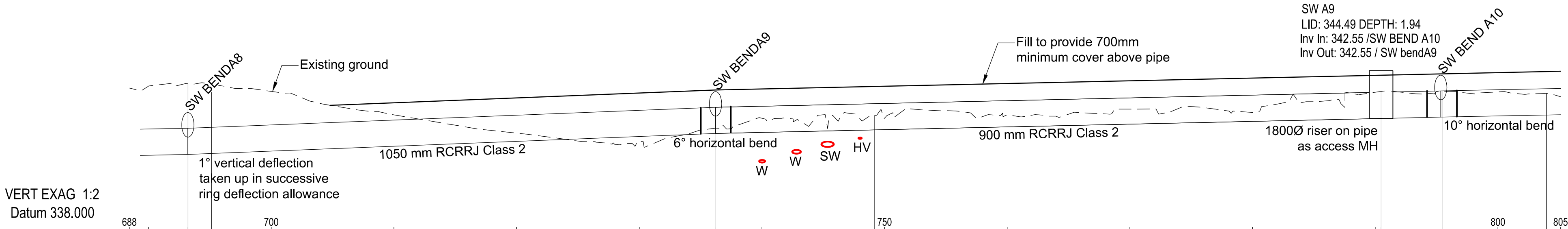
Project Title: Queenstown Country Club FINE RETIREMENT LIVING

Sheet Title: Stormwater Trunk Mains Plan & Long Section OPTION 2

Scale (A1 Original) 1:250 m

Issue: For Engineering Approval

Project No	Sheet	Revision
Q000320	N453.2	A



DESIGN LEVEL AT MH CL		342.286 / 343.960	343.137	344.487	343.804
INVERT LEVEL	341.033	341.082 / 341.082	341.933 / 341.933	342.545 / 342.545	342.600
COVER	1.612	1.732 / 1.732	-0.927 / -0.927	-0.047 / -0.047	-0.091
CHAINAGE		693.200	736.219	790.477	???

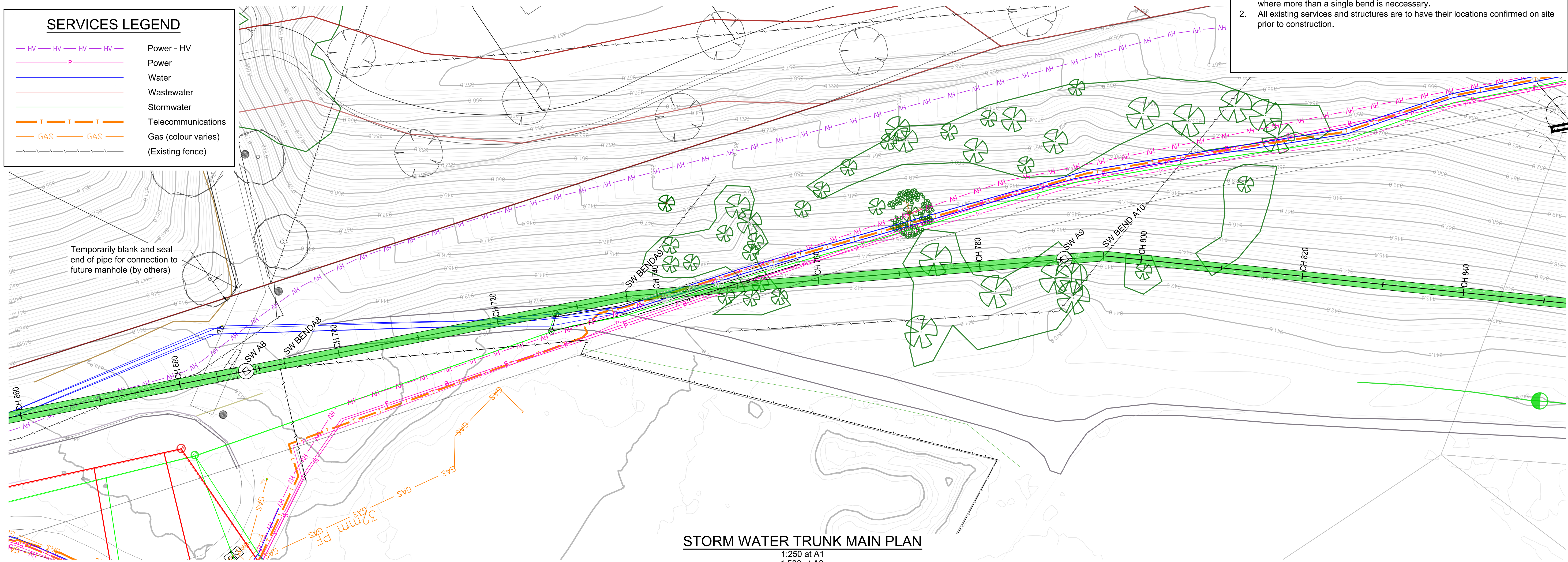
GRADE %				
	1050 mm RCRRJ Class 2 1.00%	1050 mm RCRRJ Class 2 1.98%	1050 mm RCRRJ Class 2 1.13%	1050 mm RCRRJ Class 2 1.13%

SW_S_TRUNKLINE LONG SECTION

NOTES:
1. Vertical and horizontal bends have been symbolized as a single bend on plans and long section, but are to be constructed as a series of successive bends where more than a single bend is neccessary.
2. All existing services and structures are to have their locations confirmed on site prior to construction.

SERVICES LEGEND

- Power - HV
- Power
- Water
- Wastewater
- Stormwater
- Telecommunications
- Gas (colour varies)
- (Existing fence)



STORM WATER TRUNK MAIN PLAN
1:250 at A1
1:500 at A3

A	Issued for Engineering Approval	DER	26 May'17
Revision		App	Date

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS

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PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

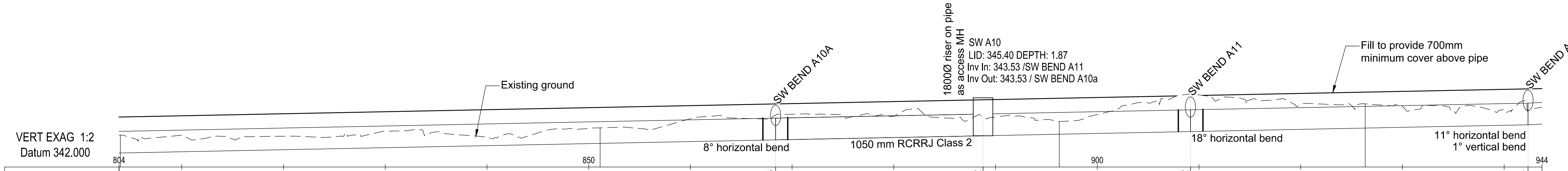
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Mains
Plan & Long Section
OPTION 2

Scale (A1 Original) 1:250 m

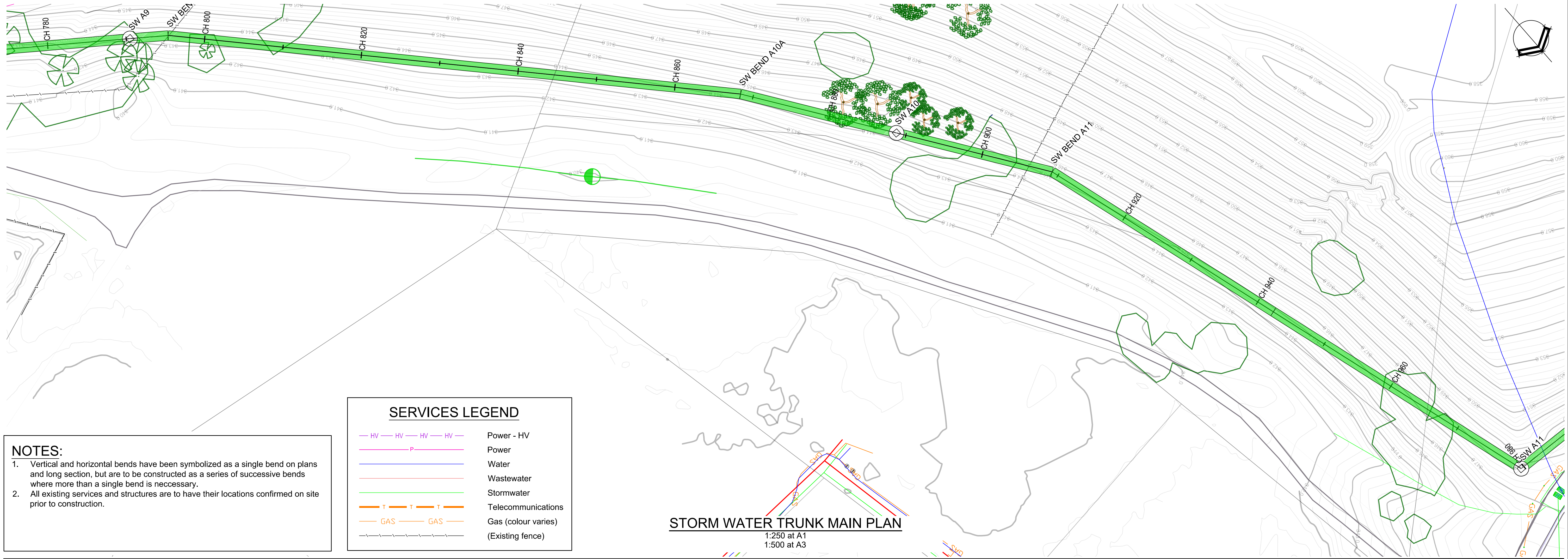
Issue
For Engineering Approval

Project No	Sheet	Revision
Q000320	N454.2	A



DESIGN LEVEL AT MH CL		344.535	345.402	344.942	345.274
INVERT LEVEL	342.600	343.331 343.331	343.535 343.535	343.738 343.738	344.070
COVER	-0.091	0.077 0.077	-0.196 -0.196	0.721 0.721	-0.451
CHAINAGE		868.380	888.769	909.158	942.351
GRADE %	1050 mm RCRRJ Class 2 1.00%	1050 mm RCRRJ Class 2 1.00%	1050 mm RCRRJ Class 2 1.00%	1050 mm RCRRJ Class 2 1.00%	

SW_S_TRUNKLINE LONG SECTION



NOTES:

1. Vertical and horizontal bends have been symbolized as a single bend on plans and long section, but are to be constructed as a series of successive bends where more than a single bend is neccessary.
2. All existing services and structures are to have their locations confirmed on site prior to construction.

SERVICES LEGEND

HV — HV — HV — HV	Power - HV
P	Power
	Water
	Wastewater
	Stormwater
T — T — T	Telecommunications
GAS — GAS	Gas (colour varies)
	(Existing fence)

STORM WATER TRUNK MAIN PLAN

1:250 at A1
1:500 at A3

Surveyed	-		-
Designed	D. Railton		Nov '16
Drawn	H.W & C.H		'17
Reviewed	D. Railton		-
Approved	-		-

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

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43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

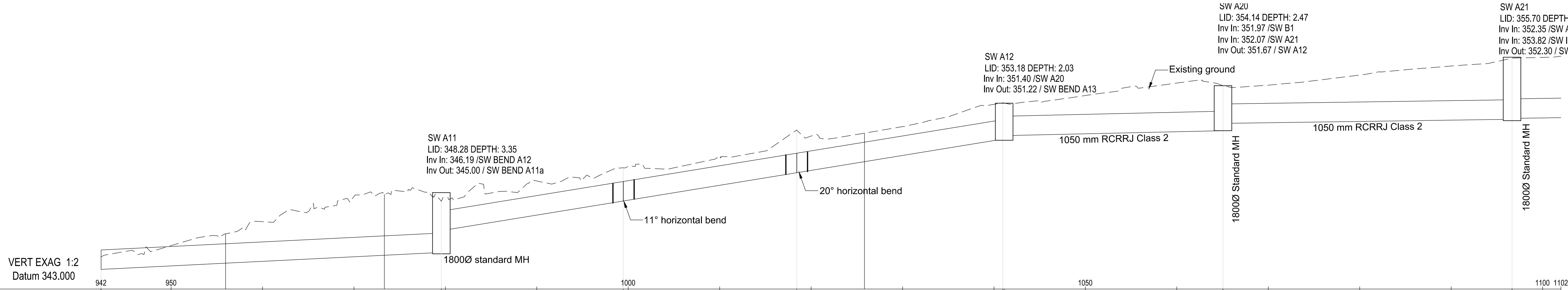
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Mains
Plan & Long Section
OPTION 2

Scale (A1 Original) 1:250 m

Issue For Engineering Approval

Project No	Sheet	Revision
Q000320	N455.2	A

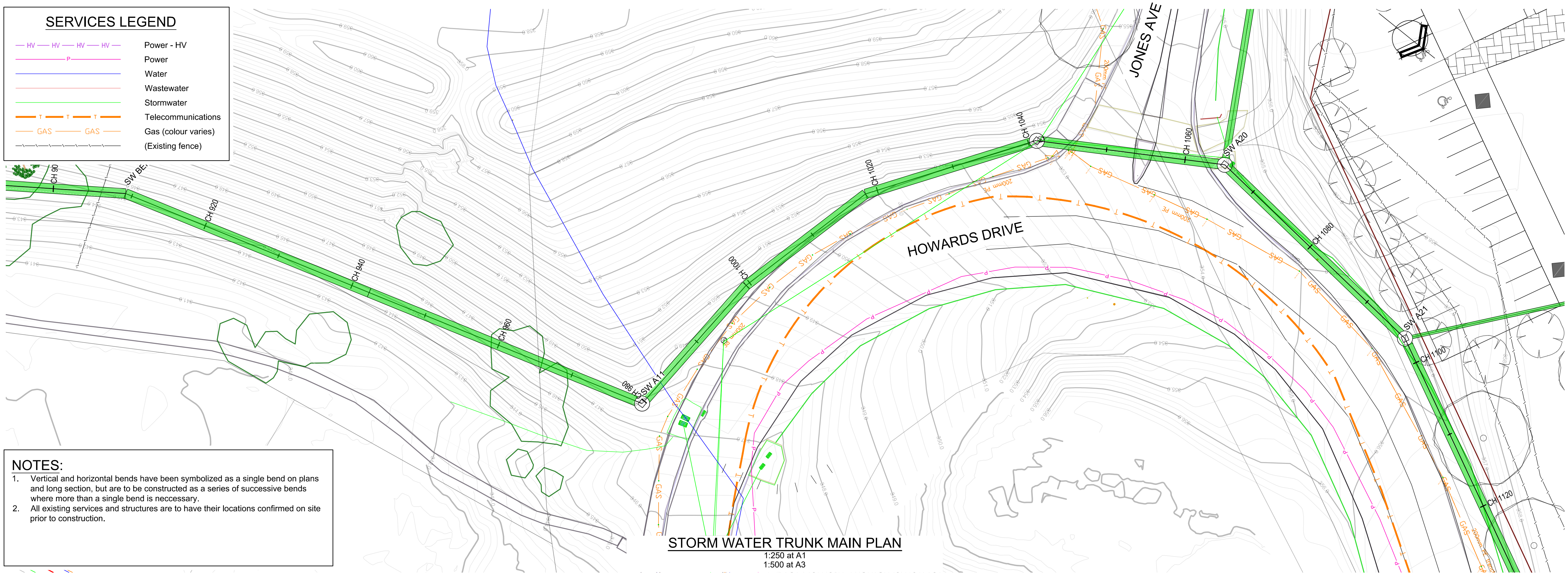


DESIGN LEVEL AT MH CL		348.277			353.182	354.137	355.695	
INVERT LEVEL	344.070	345.000 346.195	347.819 347.819	349.369 349.369	351.225 351.400	351.671 352.069	352.297 352.347	352.904
COVER	-0.451	1.659 0.464	0.678 0.678	1.182 1.182	0.814 0.639	1.323 0.925	2.209 2.160	4.569
CHAINAGE		979.566			1041.118	1065.047	1096.658	
GRADE %	1050 mm RCRRJ Class 2 2.50%	1050 mm RCRRJ Class 2 8.17%	1050 mm RCRRJ Class 2 8.16%	1050 mm RCRRJ Class 2 8.19%	1050 mm RCRRJ Class 2 1.13%	1050 mm RCRRJ Class 2 0.72%	1050 mm RCRRJ Class 2 0.72%	

SW_S_TRUNKLINE LONG SECTION

SERVICES LEGEND

- HV — HV — HV — HV: Power - HV
- P: Power
- Water
- Wastewater
- Stormwater
- T — T — T: Telecommunications
- GAS — GAS: Gas (colour varies)
- (Existing fence)



NOTES:

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2. All existing services and structures are to have their locations confirmed on site prior to construction.

STORM WATER TRUNK MAIN PLAN
1:250 at A1
1:500 at A3

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

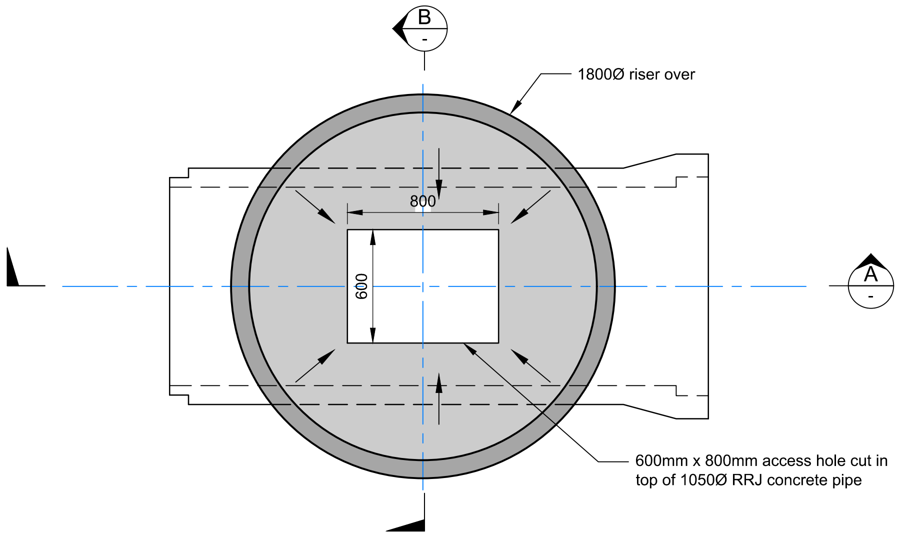
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Mains
Plan & Long Section
OPTION 2

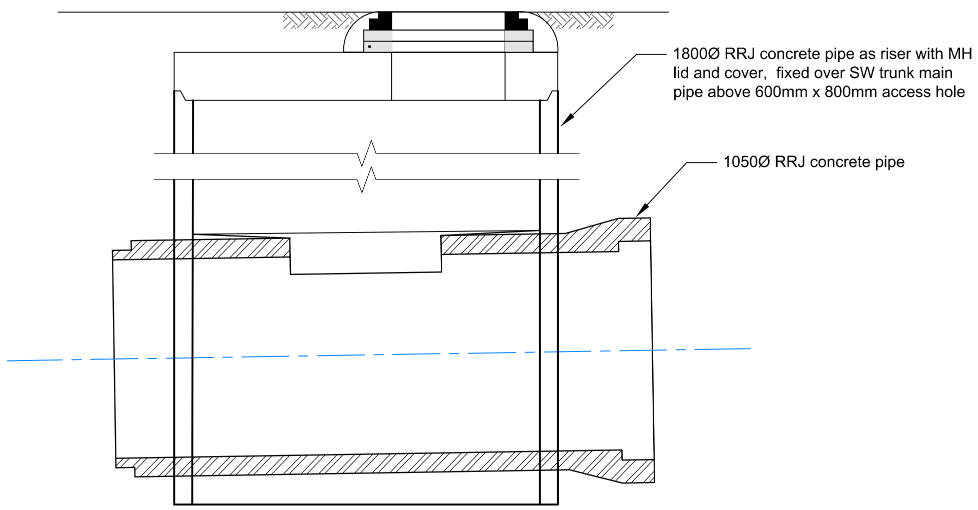
Scale (A1 Original) 1:250 m

Issue For Engineering Approval

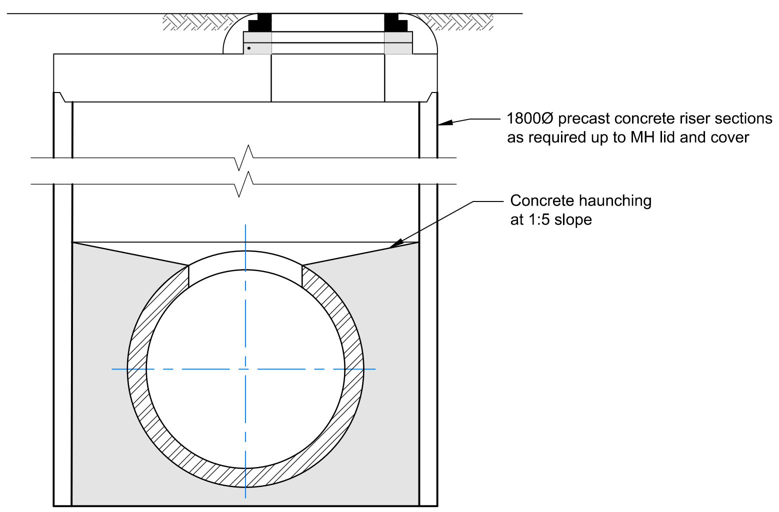
Project No	Sheet	Revision
Q000320	N456.2	A



STORMWATER TRUNK MAIN
RISER MANHOLE - PLAN
1:20 @ A1
1:40 @ A3



SECTION A -
1:20 @ A1
1:40 @ A3



SECTION B -
1:20 @ A1
1:40 @ A3

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS

Suite 2, 1st Floor, 23 - 27 Beach St
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

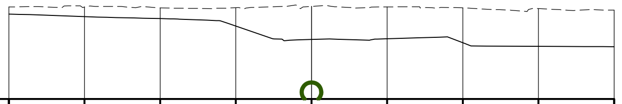
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
SW Trunk Main Details

Scale (A1 Original) AS SHOWN

Issue
For Engineering Approval

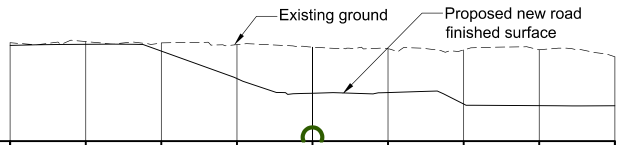
Project No	Sheet	Revision
Q000320	N460	A



Datum: 325.000

PROPOSED LEVEL	330.64	330.47	330.34	329.84	328.95	329.00	328.73	328.50	328.48
EXISTING LEVEL	330.64	330.47	330.34	329.84	328.95	329.00	328.73	328.50	328.48
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

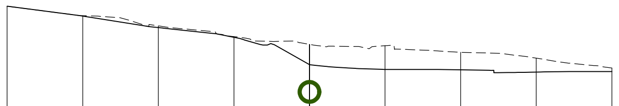
Chainage 120.000



Datum: 325.000

PROPOSED LEVEL	331.32	331.40	330.95	329.13	328.16	328.21	327.44	327.34	327.34
EXISTING LEVEL	331.32	331.40	330.95	329.13	328.16	328.21	327.44	327.34	327.34
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0		5.0	10.0	15.0	

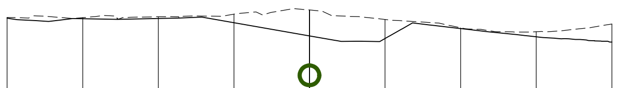
Chainage 100.000



Datum: 320.000

PROPOSED LEVEL	329.40	328.76	328.00	327.36	325.56	325.24	325.22	325.07	325.10
EXISTING LEVEL	329.40	328.76	328.00	327.36	325.56	325.24	325.22	325.07	325.10
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

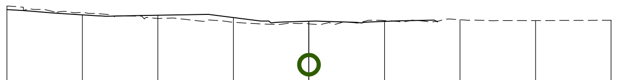
Chainage 80.000



Datum: 320.000

PROPOSED LEVEL	326.75	326.72	326.73	326.46	325.59	325.41	326.07	325.53	325.18
EXISTING LEVEL	326.75	326.72	326.73	326.46	325.59	325.41	326.07	325.53	325.18
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

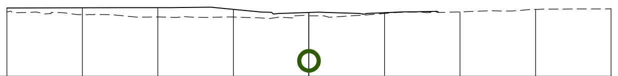
Chainage 60.000



Datum: 325.000

PROPOSED LEVEL	329.91	329.57	329.54	329.39	329.14	329.13			
EXISTING LEVEL	329.91	329.57	329.54	329.39	329.14	329.13			
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00			
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

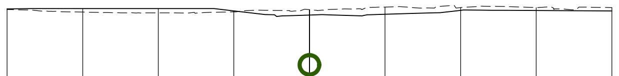
Chainage 200.000



Datum: 325.000

PROPOSED LEVEL	329.55	329.57	329.57	329.46	329.25	329.24			
EXISTING LEVEL	329.55	329.57	329.57	329.46	329.25	329.24			
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00			
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

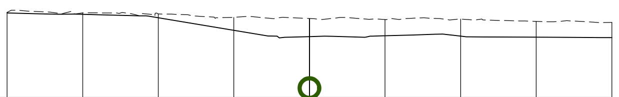
Chainage 180.000



Datum: 325.000

PROPOSED LEVEL	329.58	329.60	329.60	329.45	329.17	329.22	329.48	329.47	329.44
EXISTING LEVEL	329.58	329.60	329.60	329.45	329.17	329.22	329.48	329.47	329.44
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

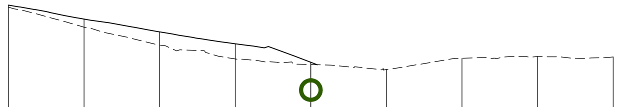
Chainage 160.000



Datum: 325.000

PROPOSED LEVEL	329.62	329.53	329.31	329.48	329.06	329.11	329.09	329.02	328.99
EXISTING LEVEL	329.62	329.53	329.31	329.48	329.06	329.11	329.09	329.02	328.99
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

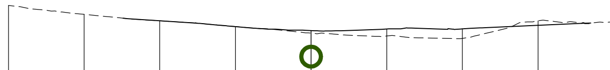
Chainage 140.000



Datum: 325.000

PROPOSED LEVEL	332.67	331.74	330.90	330.11	328.89				
EXISTING LEVEL	332.67	331.74	330.90	330.11	328.89				
CUT AND FILL	0.00	0.00	0.00	0.00	0.00				
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0		5.0	10.0	15.0	20.0

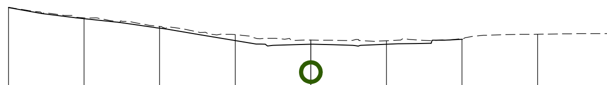
Chainage 280.000



Datum: 325.000

PROPOSED LEVEL			329.20	328.82	328.56	328.66	328.67	328.90	
EXISTING LEVEL			329.20	328.82	328.56	328.66	328.67	328.90	
CUT AND FILL			0.00	0.00	0.00	0.00	0.00	0.00	
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0		5.0	10.0	15.0	20.0

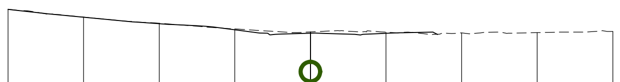
Chainage 260.000



Datum: 325.000

PROPOSED LEVEL	330.92	330.18	329.55	328.74	328.49	328.49	328.82		
EXISTING LEVEL	330.92	330.18	329.55	328.74	328.49	328.49	328.82		
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 240.000



Datum: 325.000

PROPOSED LEVEL	330.57	330.05	329.61	329.21	328.99	328.98			
EXISTING LEVEL	330.57	330.05	329.61	329.21	328.99	328.98			
CUT AND FILL	0.00	0.00	0.00	0.00	0.00	0.00			
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 220.000

A	Issued for Engineering Approval	DER	26 May'17	
Revision		App	Date	

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

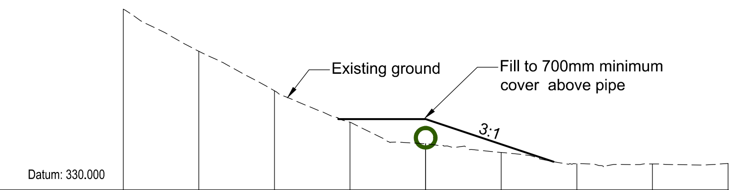
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Main
Cross Sections
OPTION 2

Scale (A1 Original) 1:250 m

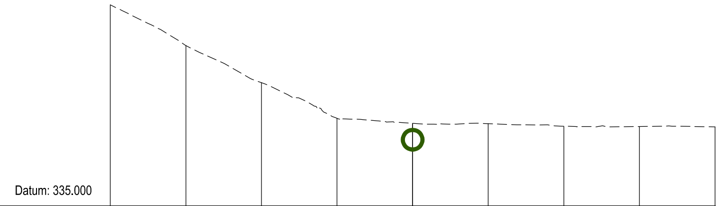
Issue
For Engineering Approval

Project No	Sheet	Revision
Q000320	N461.2	A



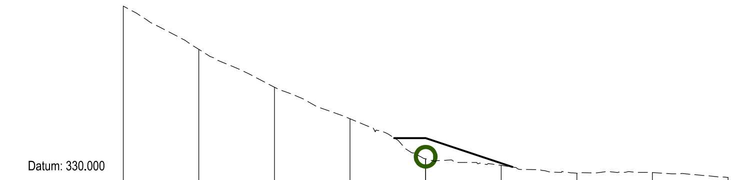
PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 360.000



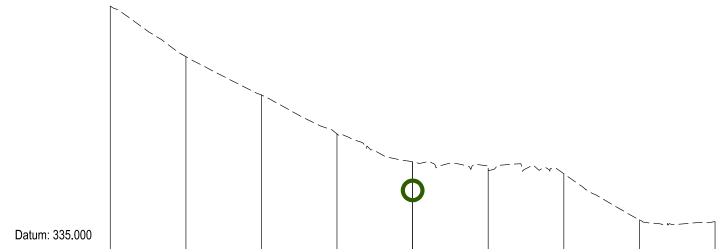
PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 480.000



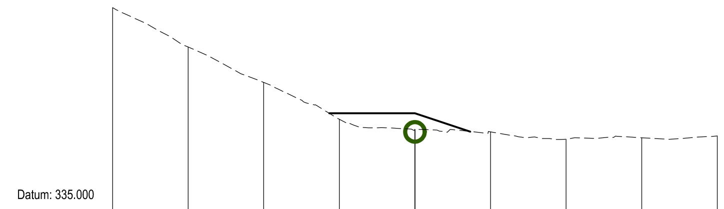
PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 340.000



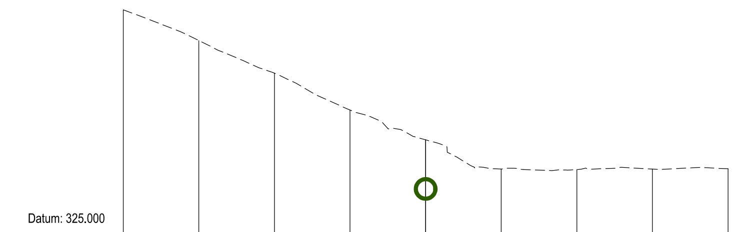
PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 440.000



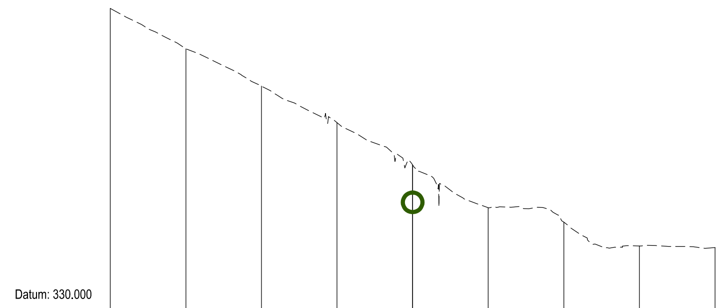
PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 560.000



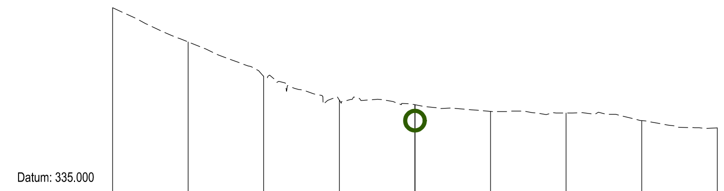
PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 300.000



PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 400.000



PROPOSED LEVEL									
EXISTING LEVEL									
CUT AND FILL									
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

Chainage 520.000

Revision		App	Date
A	Issued for Engineering Approval	DER	26 May'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS

43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

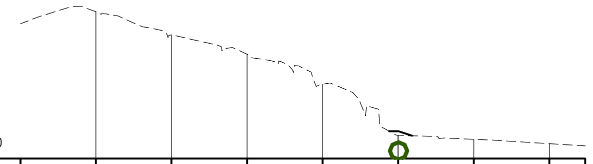
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Main
Cross Sections
OPTION 2

Scale (A1 Original) 1:250 m

Issue
For Engineering Approval

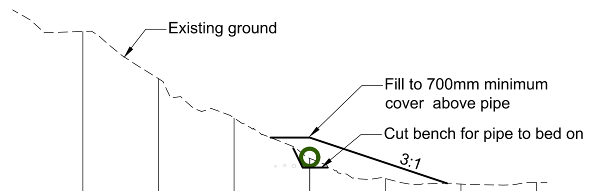
Project No	Sheet	Revision
Q000320	N462.2	A



Datum: 350.000

PROPOSED LEVEL	359.69	358.16	356.89	354.90	351.54	351.27	350.98
EXISTING LEVEL	359.69	358.16	356.89	354.90	351.54	351.27	350.98
CUT AND FILL							
OFFSET FROM CL	-20.0	-15.0	-10.0	-5.0	0.0	5.0	10.0

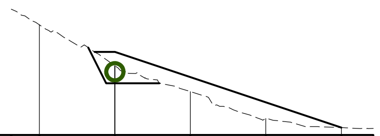
Chainage 1025.834



Datum: 340.000

PROPOSED LEVEL							
EXISTING LEVEL	350.95	347.82	345.22	342.56	341.22	340.85	340.96
CUT AND FILL							
OFFSET FROM CL	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0

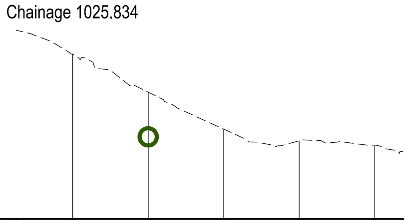
Chainage 750.000



Datum: 340.000

PROPOSED LEVEL					
EXISTING LEVEL	347.29	344.58	342.87	341.09	340.48
CUT AND FILL					
OFFSET FROM CL	-5.0	0.0	5.0	10.0	15.0

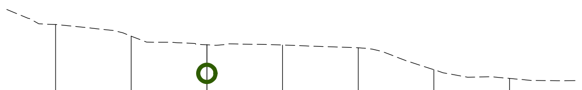
Chainage 900.000



Datum: 340.000

PROPOSED LEVEL	350.88	348.37	345.93	345.15	344.82
EXISTING LEVEL	350.88	348.37	345.93	345.15	344.82
CUT AND FILL					
OFFSET FROM CL	-5.0		5.0	10.0	15.0

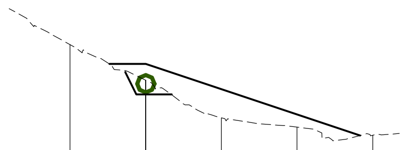
Chainage 975.000



Datum: 340.000

PROPOSED LEVEL	345.00	344.23	343.65	343.63	343.45	341.99	341.41
EXISTING LEVEL	345.00	344.23	343.65	343.63	343.45	341.99	341.41
CUT AND FILL							
OFFSET FROM CL	-10.0	-5.0	0.0	5.0	10.0	15.0	20.0

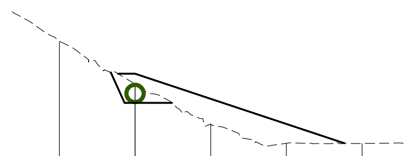
Chainage 700.000



Datum: 335.000

PROPOSED LEVEL					
EXISTING LEVEL	346.26	343.91	341.44	340.82	340.29
CUT AND FILL					
OFFSET FROM CL	-5.0	0.0	5.0	10.0	15.0

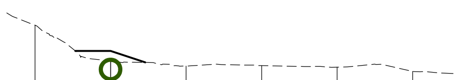
Chainage 850.000



Datum: 340.000

PROPOSED LEVEL					
EXISTING LEVEL	348.25	345.37	342.75	341.49	341.47
CUT AND FILL					
OFFSET FROM CL	-5.0	0.0	5.0	10.0	15.0

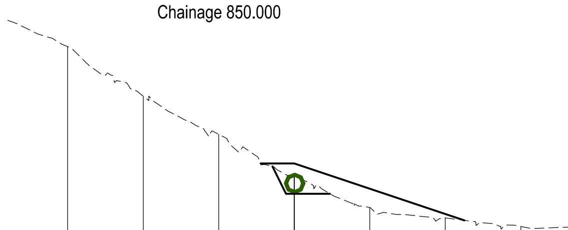
Chainage 950.000



Datum: 340.000

PROPOSED LEVEL						
EXISTING LEVEL						
CUT AND FILL						
OFFSET FROM CL	-5.0	0.0	5.0	10.0	15.0	20.0

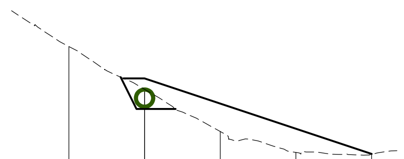
Chainage 650.000



Datum: 340.000

PROPOSED LEVEL							
EXISTING LEVEL	352.21	348.93	346.42	343.62	341.59	340.90	340.34
CUT AND FILL							
OFFSET FROM CL	-15.0	-10.0	-5.0	0.0	5.0	10.0	15.0

Chainage 800.000



Datum: 340.000

PROPOSED LEVEL					
EXISTING LEVEL	347.85	345.02	342.22	340.84	340.71
CUT AND FILL					
OFFSET FROM CL	-5.0		5.0	10.0	15.0

Chainage 925.000

A	Issued for Engineering Approval	DER	26 May'17
Revision		App	Date

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS
43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client
Sanderson GROUP

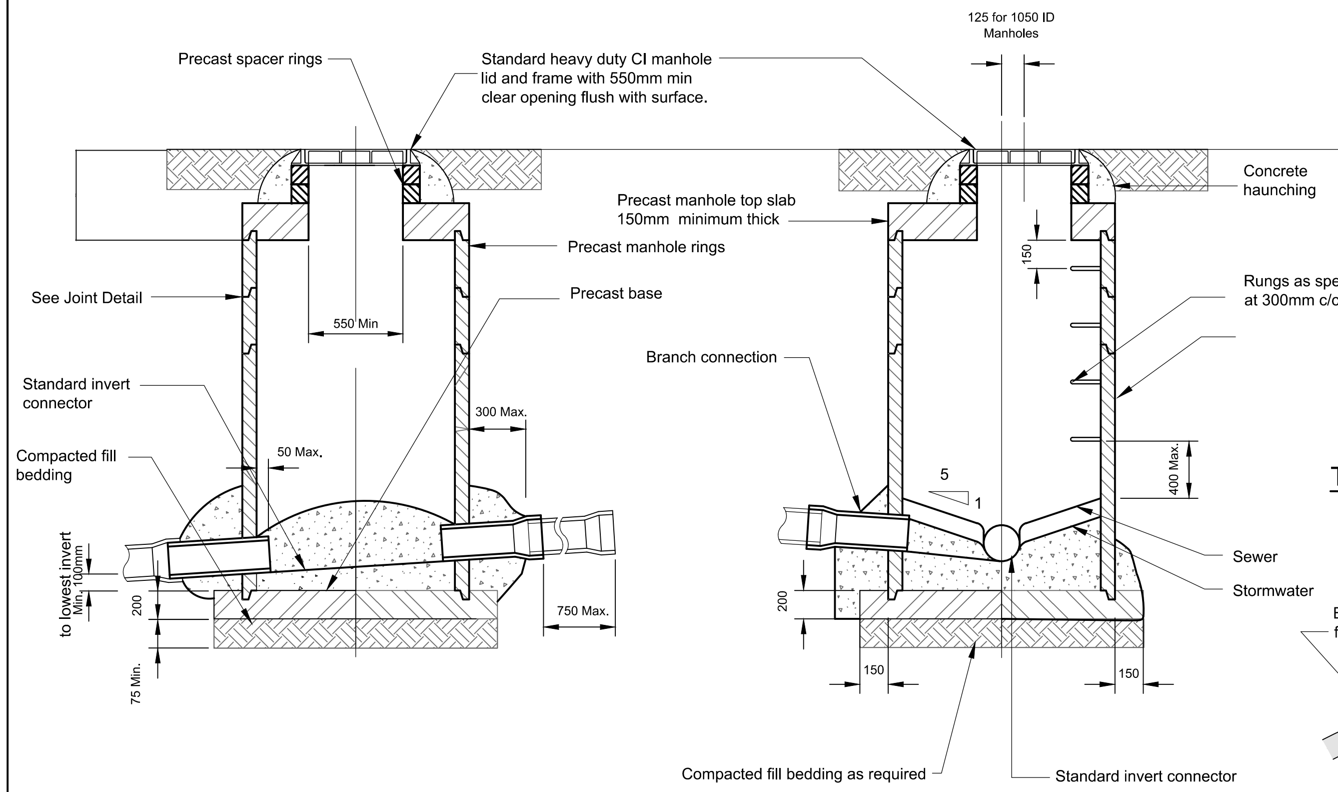
Project Title
Queenstown Country Club
FINE RETIREMENT LIVING

Sheet Title
Stormwater Trunk Main
Cross Sections
OPTION 2

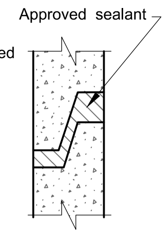
Scale (A1 Original) 1:250 m

Issue For Engineering Approval

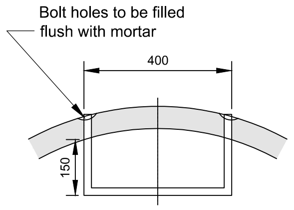
Project No	Sheet	Revision
Q000320	N463.2	A



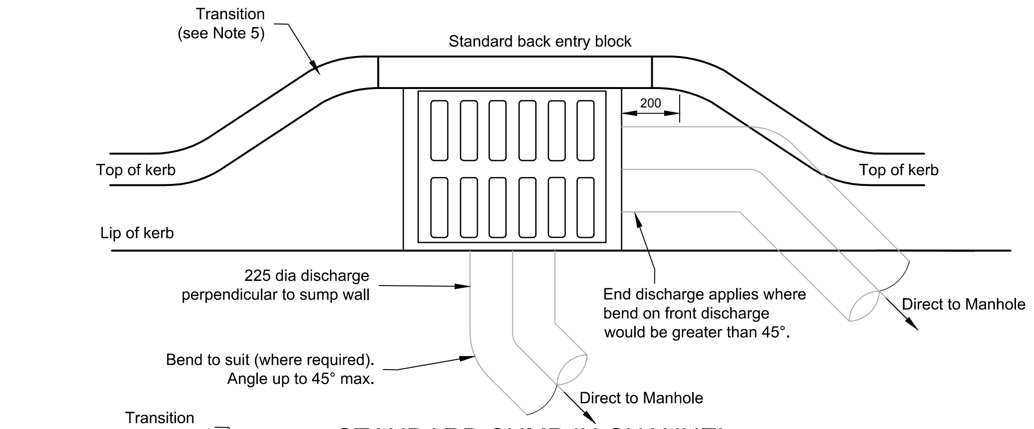
STANDARD PRECAST CONCRETE CIRCULAR MANHOLE DETAILS



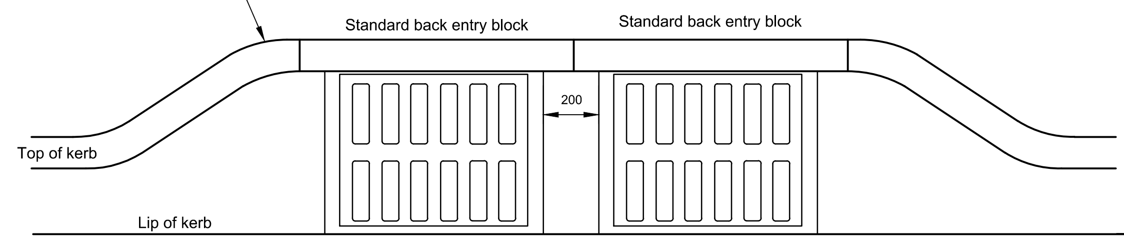
TYPICAL JOINT DETAIL



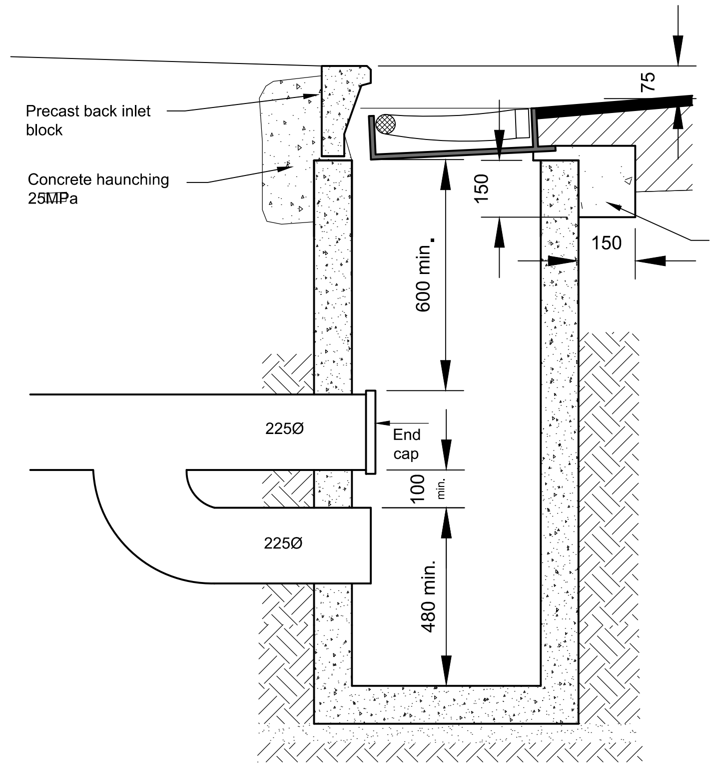
PLAN OF STEPPED IRONS



STANDARD SUMP IN CHANNEL

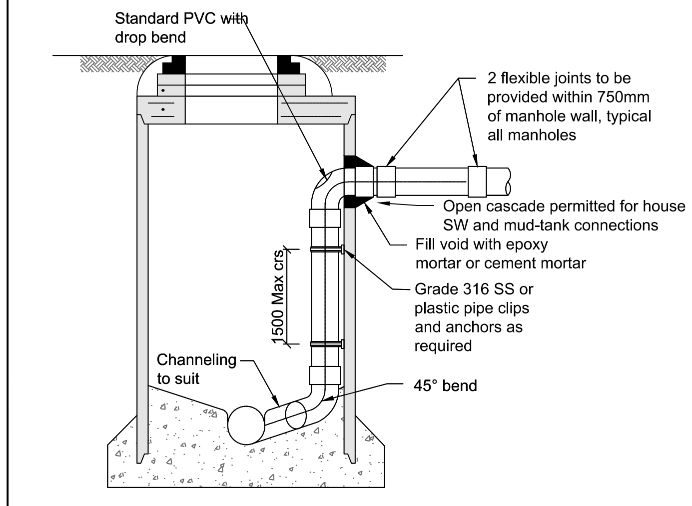


STANDARD DOUBLE SUMP IN CHANNEL

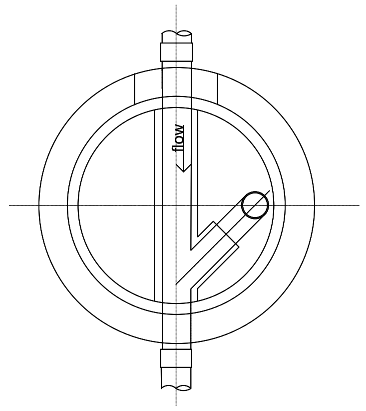


STANDARD SUMP - SECTION

(225 Dia pipes for single sumps, 300 dia pipes for double sumps)



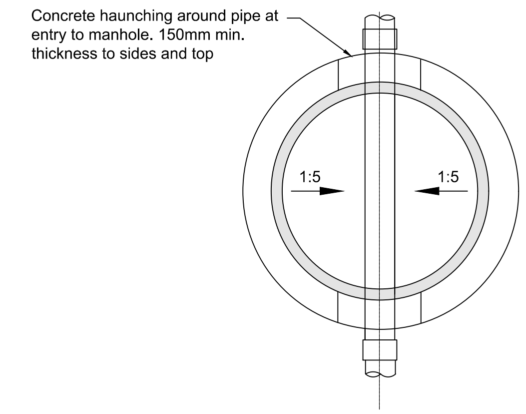
SECTIONAL ELEVATION



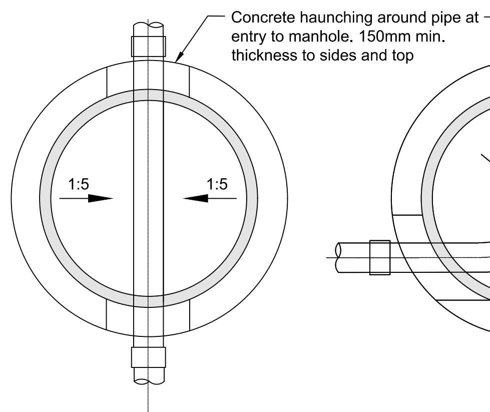
PLAN

TYPICAL INTERNAL DROP

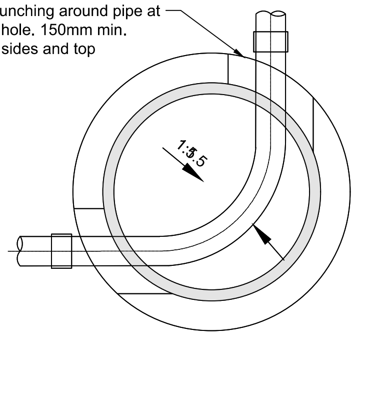
Suitable for insitu and precast MH



PLAN - STRAIGHT THROUGH



PLAN - STRAIGHT THROUGH



PLAN - ANGLE

NOTES:
1. Road sumps to be placed at 90m (max.) intervals
2. Double sumps to be installed in place of single sumps at all:
   a) undervertical curves in roads
   b) on all roads with vertical gradients exceeding 10%.
   Specific design required where gradient exceeds 12°
3. Sump leads to intersect side or backwall of sump box at 90%
4. Site - specific design required to reduce syphon from 200Ø down to 150Ø
5. Where gradients exceed 10%, channel transition into double mudtank to be 800mm and channel to be formed directly into back entry.
6. To be used where back of kerbs are separated by a strip of berm/grass prior to the footpath. Where footpath is directly adjacent to the kerb, use road sump with edge of sump extending into the road area.

Revision		App	Date
B	Revised MH haunch slope	DER	May'17
A	Issued for Concent	DER	March '17

Surveyed	Paterson Pitts	Dec 2017
Designed	H Wightman	Jan 2017
Drawn	HMW/CH	Jan 2017
Reviewed	D. Railton	March '17
Approved	D. Railton	March '17

Fluent SOLUTIONS

Suite 2, 1st Floor, 23 - 27 Beach St
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client: Sanderson GROUP

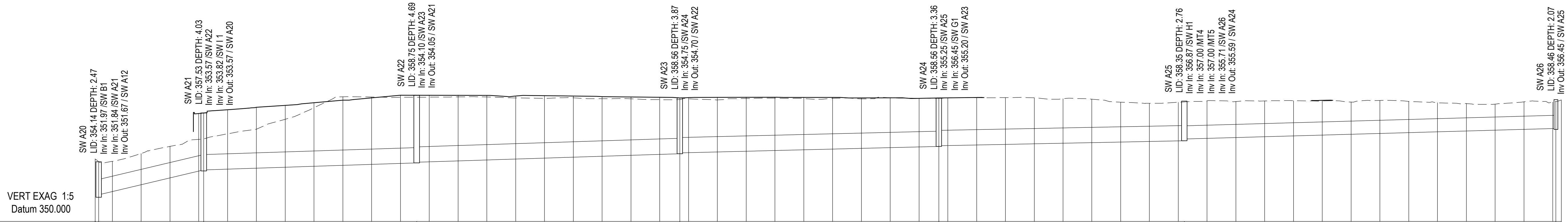
Project Title: Queenstown Country Club FINE RETIREMENT LIVING

Sheet Title: Typical Manhole Details

Scale (A1 Original): AS SHOWN

Issue: For Construction

Project No	Sheet	Revision
Q000320	N261	B

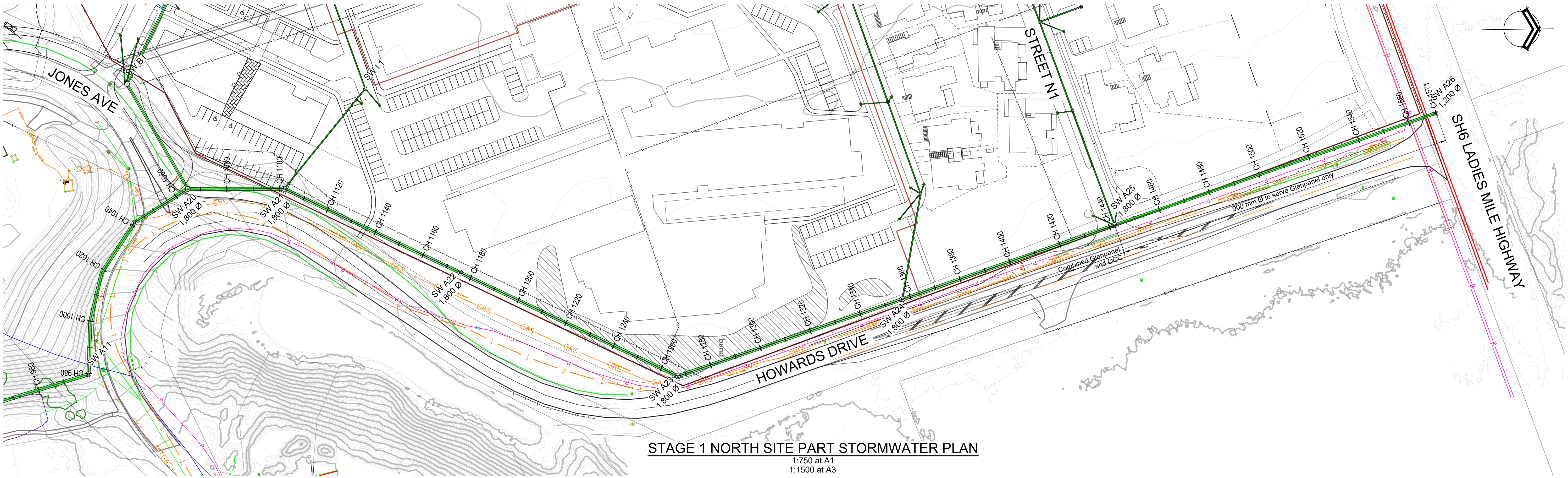


	SW A20	SW A21	SW A22	SW A23	SW A24	SW A25	SW A26
DESIGN LEVEL AT MH CL	354.137	357.526	358.748	358.563	358.559	358.349	358.455
INVERT LEVEL	351.842	353.573 353.573	354.053 354.103	354.697 354.747	355.197 355.247	355.588 355.714	356.449
COVER	1.152	1.865 1.865	3.418 3.368	2.620 2.570	2.220 2.170	1.617 1.656	1.029
CHAINAGE	1065.232	1101.715	1175.632	1266.959	1356.898	1442.089	1571.083

	A20–A21	A21–A22	A22–A23	A23–A24	A24–A25	A25–A26
GRADE %	1050 mm RCRRJ Class 2 4.74%	1050 mm RCRRJ Class 2 0.65%	1050 mm RCRRJ Class 2 0.65%	1050 mm RCRRJ Class 2 0.50%	1050 mm RCRRJ Class 2 0.40%	900 mm RCRRJ Class 2 0.57%
PIPE DETAILS (CL to CL LENGTHS)	1050 mm RCRRJ Class 2 LENGTH: 36.524	1050 mm RCRRJ Class 2 LENGTH: 73.919	1050 mm RCRRJ Class 2 LENGTH: 91.328	1050 mm RCRRJ Class 2 LENGTH: 89.941	1050 mm RCRRJ Class 2 LENGTH: 85.192	900 mm RCRRJ Class 2 LENGTH: 128.996

STAGE 1 NORTH TRUNKLINE LONG SECTION STA 1065 - 1572

Horiz: 1:750 at A1
Horiz: 1:1500 at A3



STAGE 1 NORTH SITE PART STORMWATER PLAN

1:750 at A1
1:1500 at A3

Revision		App	Date
B	Shifted SW and added Glenpanel pipe	DER	14 Jun'17
A	Issued for approval	DER	02 Jun'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	-
Approved	-	-

Fluent SOLUTIONS

43/159 Gorge Road
PO Box 1204, Queenstown 9348
T: 03 974 4586
E: office@fluentsolutions.co.nz

Client: Sanderson GROUP

Project Title: Queenstown Country Club FINE RETIREMENT LIVING

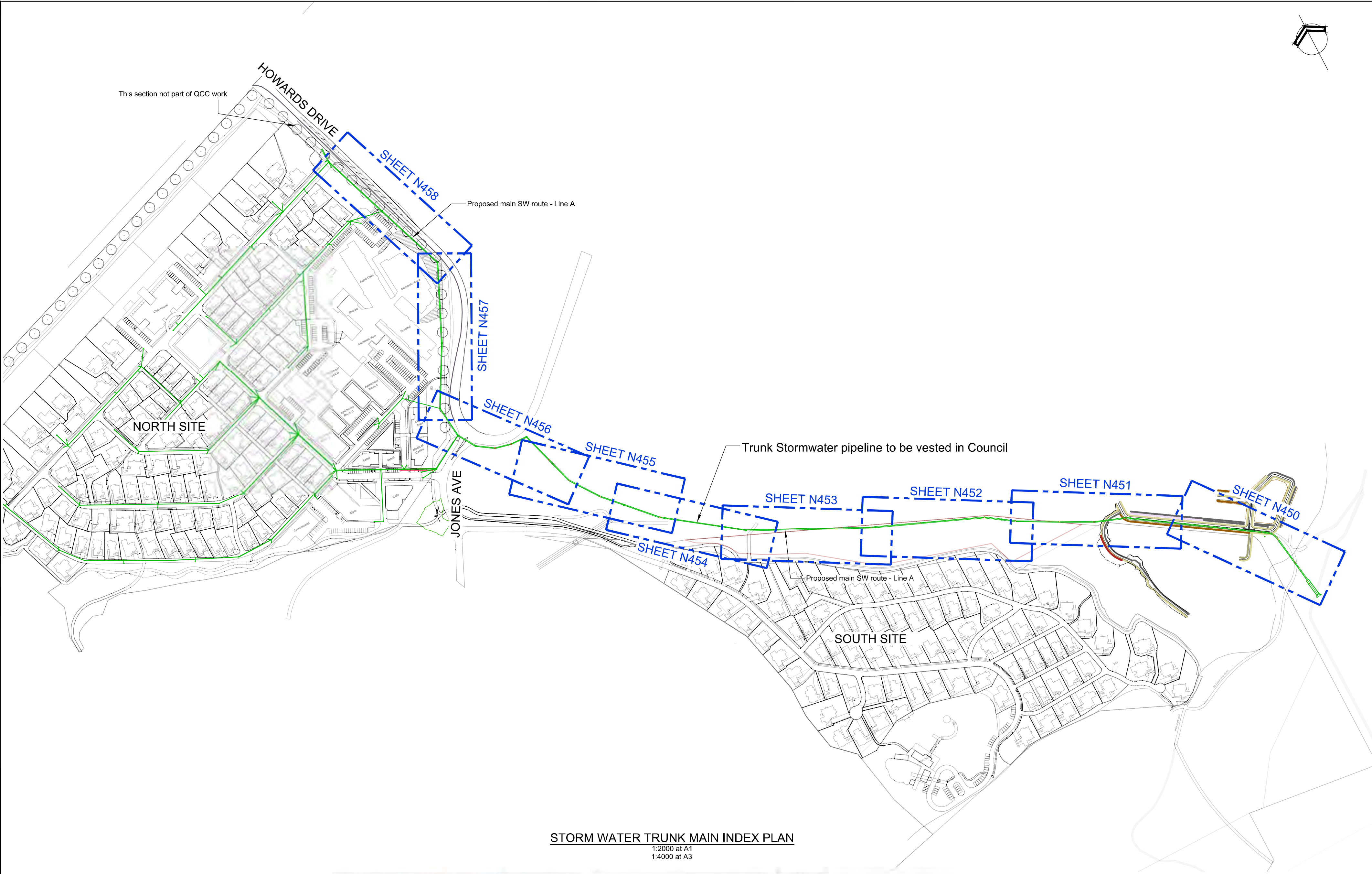
Sheet Title: Stormwater Trunkline STA 1065 - 1572

Scale (A1 Original) ##### m

Issue: For Engineering Approval

Project No	Sheet	Revision
Q000320	N471	B

Appendix I - Queenstown Country Club Trunk Stormwater Pipeline Design Plan (Design by Fluent)



STORM WATER TRUNK MAIN INDEX PLAN

1:2000 at A1
1:4000 at A3

Revision		App	Date
D	Notes added	DER	22 Jun'17
C	Issued for Engineering Approval	DER	26 May'17
B	Updated SW Trunk Main	DER	April'17
E	Construction Issue	DER	03 Aug'17

Surveyed	-	-
Designed	D. Railton	Nov '16
Drawn	H.W & C.H	'17
Reviewed	D. Railton	March '17
Approved	D. Railton	March '17

Verify all dimensions on site before commencing work. Prioritise figured dimensions over scaling. Refer all discrepancies to the drawing office.

Fluent SOLUTIONS
Level 2, Burns House, 10 George Street T: 03 929 1263
PO Box 5240, Dunedin 9058 E: office@fluentsolutions.co.nz

Client: Sanderson GROUP

Project Title: Queenstown Country Club FINE RETIREMENT LIVING

Sheet Title: Stormwater Trunk Main Overall Plan

Scale (A1 Original)	1:2000	
Issue	For Construction	
Project No	Sheet	Revision
Q000320	N420	E

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