THREE WATERS ASSESSMENT REPORT

GLENPANEL

Glenpanel – Special Housing Area
March 2019

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GLENPANEL

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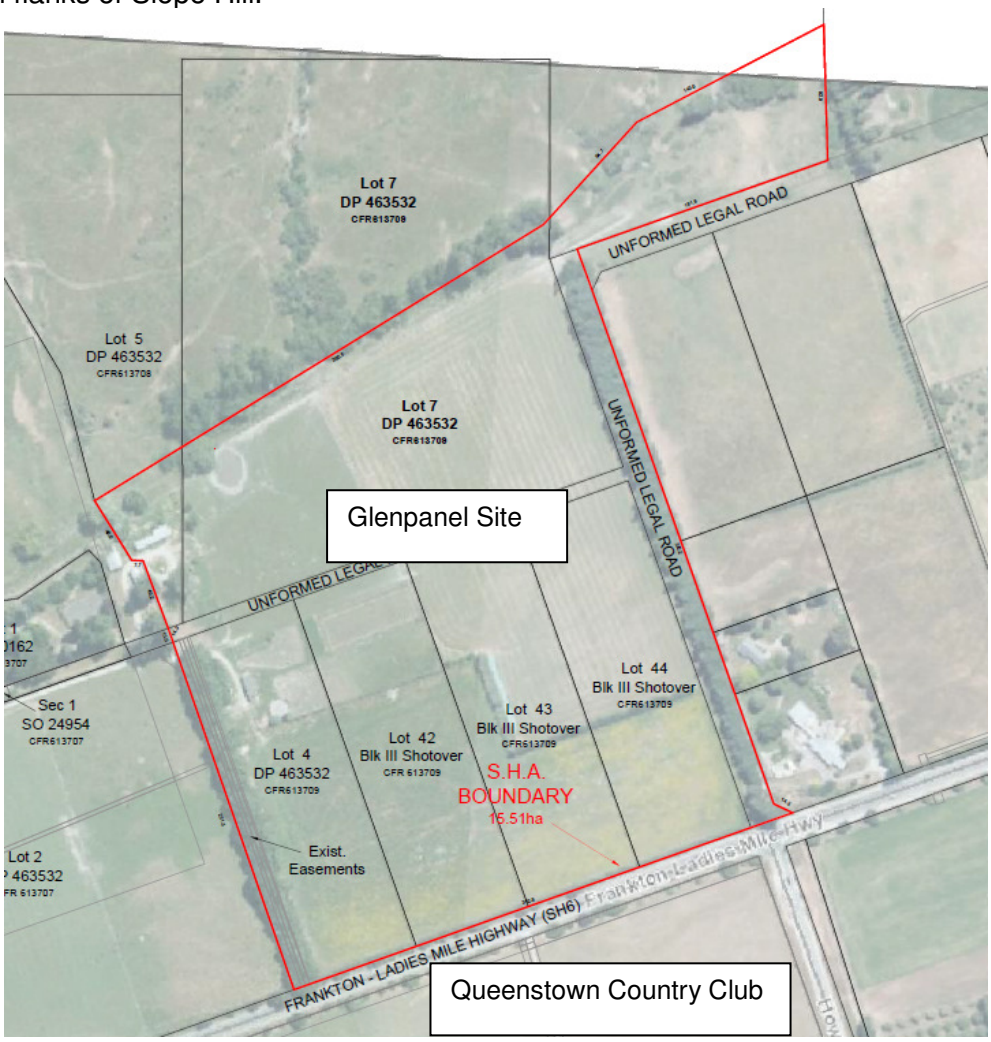
1 INTRODUCTION

Clark Fortune McDonald & Associates (CFM) has been engaged to assess 3 waters infrastructure options for a proposed development on land located on the northern side of Ladies Mile opposite the Queenstown Country Club.

The proposal seeks to develop a Special Housing Area (SHA) creating low to medium density residential activities.

The site is legally described as Lots 4 & 7 D.P.463532 & Sections 42 – 44 Block III Shotover Survey District. The total site area comprises approx 15 ha and is contained in Record of Title 613709.

The site has frontage to the Frankton Ladies Mile Highway (SH6). The site adjoins the southern flanks of Slope Hill.



The site is relatively flat gently sloping towards Lake Hayes to the east.

The development area is presently zoned Rural General under the QLDC District Plan (the Plan).

This report is preliminary and for the SHA expression of interest only. Further information and detailed engineering design will be required as development proceeds.

The report considers infrastructure demands based on the proposed residential activities.

2 SCOPE OF WORK

The scope of work includes examination of existing QLDC as-built records, confirmation of capacity of existing services to determine the adequacy of the existing infrastructure, and recommendation of infrastructure servicing options.
The report considers the recommendations contained in the WSP OPUS Ladies Mile Housing Infrastructure Fund Scoping and Concept Design. The subject site sits within area 1.1 in this study.

3 DESIGN STANDARDS

Site development standards include, but are not limited to, the following:

- QLDC Land Development and Subdivision Code of Practice adopted 3 May 2018.
- NZS4404:2010
- Drinking-Water Standards for New Zealand 2005.
- NZS PAS 4509:2008, New Zealand Fire Service Fire-fighting Water Supplies Code of Practice.
- Water for Otago, Otago Regional Council regional water plan.
- Document for New Zealand Building Code Surface Water - Clause E1 / Verification Method 1.

4 PROPOSED DEVELOPMENT PLAN

The Masterplan for the development proposes a mix of residential activities over the site. The basis of the design considers a possible 150 dwelling equivalent (DE) summarised as follows:

- 46 DE – Rural Edge Lots.
- 74 DE – 67 Residential lots, 7 of which will be 2 unit capable
- 30 DE – Super lots to contain Multi Unit development.

The Masterplan and the above scope of development is indicative and subject to change.

The following report examines the feasibility of connecting into the existing QLDC infrastructure adjoining the site that currently services Lake Hayes Estate and Shotover Country subdivisions.

The demand figures above are used in assessing demands for wastewater and water supply in the following sections of the infrastructure report.

5 WASTEWATER

5.1 Design flows – Glenpanel SHA

Demand based on anticipated activities has been determined in accordance with the development standards:
Refer QLDC Code of Practice.

No of residential units/DE:	150
Average dry weather flow:	250 l / person / day.
Dry weather diurnal peak factor:	2.5.
Infiltration factor:	2.
Occupancy:	3 person / du.
Dry weather average daily flow:	***113 m^3 / day.***
Peak hour flow:	***6.5 l / sec.***

5.2 Existing infrastructure

As part of the development of the Stalker Road roundabout; QLDC's existing sewer rising mains were re-located and upgraded in size.

Concurrently; a 125mm OD PN12.5 PE100B sewer main was laid across the state highway to the subject property. The 125mm main (100mm bore) is connected to a manifold that joins the Shotover Country 150mm rising main and the Lake Hayes Estate rising main to the existing 375mm gravity main that ultimately crosses the Shotover River and discharges to the Shotover Waste Water Treatment plant.

A schematic of the arrangement of sewer pipelines has been drawn by Fluent Solutions for the Queenstown Country Club SHA and figure 3.2 is reproduced below. The 125mm line is highlighted for clarity.

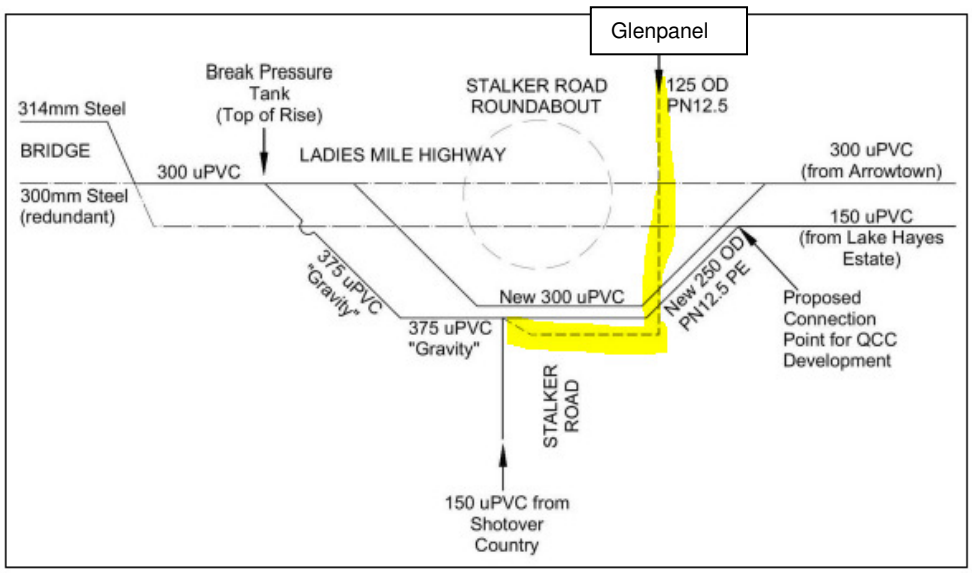


Figure 3.2: Schematic Diagram of Sewer Pipework at the Western End of Ladies Mile

(figure 3.2 courtesy of Fluent Solutions.)

The capacity of the existing 375 uPVC “Gravity” pipeline which was laid at 0.65% has been calculated at 150l/s with a velocity of 1.5m/s.

Approx. flows expected from the completed developments are summarised below.

Lake Hayes Estate	– 25l/s
Shotover Country	– 25l/s
Queenstown Country Club	– 12 l/s
Glenpanel SHA	– 7 l/s
Total	- 69 l/s

This would leave a balance capacity of 81l/s available to service the Ladies Mile area.

Modelling and capacity of the main across the Lower Shotover Bridge would need to be confirmed. It appears however from previous reporting that there is sufficient capacity to service the demand created by this development.

It may be required to examine the storage capacities at each of the existing pump stations and synchronise the discharges to ensure all pumps are not discharging simultaneously.

5.3 Proposed Servicing for the Glenpanel SHA

It is proposed that new gravity sewer reticulation will be constructed internally to service the SHA. This would likely by 150mm – 225mm diameter mains.

At the end of the gravity reticulation a new foul sewer pump station will be required. Appropriate storage and standby generation would also be constructed to provide for at least 8 hours emergency storage.
The pump station rising main could then be connected to the existing 125mm pressure connection at the Stalker Road roundabout.

Alternative connection could be a possible main along Howards Drive into the Queenstown Country Club WWPS. This could also service area 2.2 recently put under contract for purchase by QLDC. Subject to further topographic survey it may be possible to connect the development to this WWPS by gravity without the need for an additional WWPS. The Queenstown Country Club WWPS would require some upgrades, similarly the rising main from the QCC WWPS may not be of sufficient capacity to cater for all demands.

The WSP OPUS HIF report recommends a new DN225 rising main may be required to service areas 1.1 and 3.1. This is based on the preferred demands in this catchment of 640 dwellings. This would be constructed by QLDC. If this is the preferred option of QLDC, the Glenpanel SHA can connect to this new rising main.

The HIF report also confirms that a pump station is required to service this area. The applicant would provide a pump station with sufficient capacity to service their demand.

5.4 Required upgrades

Any effects on the QLDC's wider infrastructure being the Shotover Waste Water Treatment Plant will be mitigated by the imposition of headworks fees at the time of connection to Council's service. QLDC have included a Ladies Mile catchment in a new Development Contribution policy adopted at 1 Dec 2018. The current figure being levied is $3,500 per residential unit. The additional 150 residential units under the current levy would net Council 150 x $3,500 = $525,000.00 ex GST.

6 STORMWATER

The development of the site area will increase stormwater runoff and introduce contaminants into the receiving aquatic environment.

6.1 Stormwater Catchments

The topography of the development area is predominantly flat. The site slopes west to east generally falling towards Lake Hayes. Prior to any development the Ladies Mile flats north of the state highway discharged to Lake Hayes through a gully located in Strains property.

Slope Hill adjoins the development area to the north. The southern flanks of Slope Hill have a number of gullies that break the catchment into smaller areas.

The run off from the hillside catchment above the subject site needs to be managed to ensure flows from the hillside do not create downstream nuisance to the development area. These hill side catchments have already had open cut off drains constructed by the land owners to manage the run off flows. This management method is not expected to change post development.

6.2 Existing Reticulation

The Queenstown Country Club recently constructed storm water reticulation in Howards Drive that is considered to have sufficient capacity to service pre-development flows from the site.
There is also existing storm water infrastructure in the way of cut off drains/swales that deal with the hill side run-off.

6.3 Hydrological analysis

Runoff has been considered in earlier reporting by Lowe Environmental Impact in their report dated 10 August 2016. Further hydrological analysis was completed by Fluent when sizing the new stormwater main constructed in Howards Drive.
It is not considered necessary at this time that any further analysis is needed and that the existing documentation adequately assesses run-off from the subject site.

6.4 Runoff quality

Stormwater can contain a number of contaminants which may adversely affect the receiving environment. Studies in New Zealand and abroad have identified urban development as a major contributor to the declining quality of aquatic environments. It is estimated that upwards of 40% of the contaminant content of this runoff can be attributed to run-off from roads.

At this site stormwater will be generated by run-off from the following:

- Roofs of residential buildings;
- Urban roadways;
- Footpaths; and
- Other hard-standing areas.

Based on available information it is expected that stormwater from the above named developed surfaces could contain the following contaminants:

- Suspended solids;
- Oxygen demanding substances;
- Pathogens; and
- Dissolved contaminants.

The dissolved stormwater contaminants of concern at this site can cause an aquatic risk to the ecology of the receiving environment. The parameters of concern are as follows:

(1) Hydrocarbons and Oils

These are associated with vehicle use, although there is potential for spillages of hydrocarbon products to occur. They may be in solution or absorbed into sediments. Routine stormwater discharges are likely to have low concentrations ranging between 1 and 5g/m^3 total hydrocarbons over each storm event.

(2) Toxic Metals

A variety of persistent trace-metal compounds are carried in stormwater in both solid and dissolved forms. The most commonly measured metals of concern are zinc, copper, and chromium (mostly associated with vehicles and roads).

(3) Nutrients

Fertiliser application and animal waste associated with the current agricultural use of the site have the potential to generate high levels of nutrients such as phosphorus and nitrogen within stormwater runoff. High nutrient levels are not anticipated within the post-development stormwater runoff as, agricultural activities, such as grazing in particular, will cease.

6.4.1 Expected Contaminant Levels

Ranges of contaminant levels area provided by both the Auckland Regional Council (TP 10 and 53) and NIWA (Williamson 1993). This data can be used to predict the likely contaminant loading levels associated with changes in land use. Contaminant levels anticipated for this development have been estimated from TP10 and are included in Table 1 below.

Table 1 – Estimated Contaminant Loading Ranges for Land Use Types (kg/ha/year)

Land Use	Total Susp. Solids	Total Phosph.	Total Nitrogen	BOD	Lead (median)	Zinc	Copper
Road	281-723	0.59-1.5	1.3-1.5	20-33	0.49-1.10	0.18-	0.03-

						0.45	0.09
Residential	60-340	0.46-0.64	3.4-4.7	12-20	0.03-0.09	0.07-0.20	0.09-0.27
Pasture	103-583	0.01-0.25	1.2-7.1	NA	0.004-0.015	0.02-0.17	0.02-0.04
Grass	80-588	0.01-0.25	1.2-7.1	NA	0.03-0.10	0.02-0.17	0.02-0.04

6.4.2 Construction-Stage Stormwater

Construction stage stormwater has the greatest potential to cause discharge of sediment laden runoff to the receiving environment. We would suggest that the applicant provide details of the proposed stormwater management plan as part of the engineering design phase of the project.

It is proposed that erosion and sedimentation measures in accordance with GD-05 'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region,' dated June 2016 be applied to this development. Detention ponds will provide stormwater treatment before it is discharged to ground or to the existing stormwater reticulation. The primary contaminant removal mechanism of all pond systems is settling or sedimentation.

6.5 Stormwater Management Objectives

The following draft overall objectives should be recognised while assessing stormwater management options for the development area:

- Primary protection for 5% AEP storms;
- Secondary protection (overland flow paths) for 1% AEP storms;
- Regulatory Compliance;
- Avoidance of increases in downstream peak flows resulting from the increase in developed surface areas;
- Sustainable management of the effects of the proposed development;
- Minimisation of pollution of receiving waterways through the reduction of stormwater contaminants from roadways;
- Erosion protection in the stormwater discharge zone;
- Construction and maintenance costs.

6.6 Stormwater Management Approaches

This Section of the report introduces options available for Glenpanel stormwater management, in particular traditional design (big pipe), Low Impact Design (LID) or Sustainable Urban Drainage (SUD) approaches.

6.6.1 Traditional Approaches (Big Pipe)

The traditional approach to stormwater management has been to direct all runoff from residential allotments and roadways to a pipe network which discharges to the nearest receiving water body, with minimal effort made to replicate the pre-development hydrological regime.
Arguably the big pipe approach has one advantage over LID and SUD approaches: lower construction and maintenance costs.

6.6.2 LID / SUD Approaches

Some LID options are presented below. These have been sourced from the *Low Impact Design Manual* for the Auckland Region TP124 (Shaver et al. 2000), the *On-Site Stormwater Management Guideline* (NZWERF, 2004) and *Waterways, Wetlands and Drainage Guide* (CCC, 2003).

- Clustering and alternative allotment configuration. Fewer, smaller allotments, with more open space. This approach is less economic for the Developer and is also at odds with some of the principals of modern urban design.
- Reduction in setbacks. Reduction in the front setback reduces the length of driveway required. Correspondingly, the total amount of impervious area within the development is reduced. This approach presents some compliance issues with QLDC District Plan rules.
- Reduction in developed surfaces. This approach applies mainly to transport related aspects of residential developments such as reduced carriageway widths, use of grassed swales as opposed to kerb & channel, and alternative turning head design.
- Vegetated filter strips and swales. Stormwater from roadways is directed through a densely vegetated strip, and then into a road-side swale. Swales are generally used for conveyance of stormwater however they do have contaminant removal properties such as sediment removal efficiency of 20 – 40% (Waterways, Wetlands and Drainage Guide, CCC 2003). Stormwater velocity is reduced so this approach is beneficial in reducing peak flows.
- Infiltration Trench. Infiltration trenches can be constructed in place of swales if natural soils are sufficiently free draining. This is applicable to sites with limited available open space. Infiltration trenches also have the ability to store stormwater. Infiltration trenches can reduce peak flows however they present maintenance issues.
- Infiltration Basin. The suitability of this option is reliant upon free draining natural soils, adequate depth to groundwater, and sufficient open space to construct.
- Soakage chambers. These allow direct discharge of stormwater to groundwater or free drainage soils. Soakage chambers require clean, pre-treated stormwater.
- Permeable paving. This option allows stormwater to permeate directly into pavement layers, and is applicable for low traffic areas with low ground water levels and free draining non-cohesive soils. Construction and maintenance costs for this option are high.
- Detention Ponds. These are used to reduce peak discharges to pre-development levels. They allow for settlement of suspended solids by vegetation. They require sufficient open space to construct.

6.7 Management Options

Many options are available to avoid, remedy or mitigate the adverse effects associated with residential development on receiving environments.

For the Glenpanel project the recommended stormwater management strategy is to provide an integrated treatment train approach to water management, which is premised on providing control at the catchment wide level, the allotment level, and the extent feasible in conveyance followed by end of pipe controls. This combination of controls provides a satisfactory means of meeting the criteria for water quality, volume of discharge, erosion and flood control (if required).

Table 2 – Recommendations

	Recommendations	Remarks
Collection	Combinations of LID/SUD measures, kerb & channel, swales, open channels and pipes.	(1) Where allotment density allows direct roadway runoff to grass swales (primary treatment) – also for secondary overland flow during flood events. (2) Where natural soils allow incorporate infiltration measures. (3) Kerb & channel & pipework to provide primary protection.
Treatment	Combinations of swales, detention ponds and end of pipe structures (gross pollution traps and filters).	(1) Pipework to discharge to detention / infiltration ponds. (2) End of pipe structures and fore bay bunds to provide pre-treatment of stormwater before infiltration to ground water.
Disposal	Use attenuation prior to discharging to existing stormwater to ground or to existing reticulation.	(1) Sufficient space is available to construct detention ponds. (2) Where natural soils allow incorporate infiltration ponds. (3) Post development discharge not to exceed pre-development levels.

6.8 Stormwater Concept Design

Runoff from undeveloped areas shall be directed around the developed areas via grass swales, and then discharged to ground. This will replicate the pre-development runoff scenario for the undeveloped areas. The developed areas will be serviced using a hybrid LID/SUD/Big Pipe design. This will incorporate a combination of grass swales, kerbs, pipework and detention areas.

The development area can be broken into smaller sub-catchments: Separate pipe networks are then proposed - one for each catchment. Each network will discharge to its own disposal area adjacent the southern boundary of the site. Secondary overflow paths will be provided for in swales or road ways. Overflows can discharge to the existing Stormwater main located in Howards Drive.
The existing DN 1050 main will need extended approx. 150m along Howards Drive under the State Highway to reach the subject site.

7 WATER RETICULATION

7.1 Water supply design

To assess the demand and supply requirements for the proposed Glenpanel SHA the following aspects have been considered:

- Water demands
- Water availability
- Existing infrastructure
- Storage requirements
- Irrigation requirements

7.2 Design flows – Glenpanel SHA – QLDC

Demand based on the anticipated activities for the Glenpanel SHA have been determined in accordance with the development standards:

Refer QLDC code of practice 6.3.5.6.

No of residential units:	150.
Average daily demand:	700 l / person / day.
Occupancy:	3.0 person / du.
Peak Day factor:	6.6.
Average Daily demand:	***315 m^3 / day.***
Peak day demand:	***24.0 l/ sec.***

QLDC Code of practice also allows for a lower demand when supported by metering data approved by QLDC. Shotover Country had completed a 12-month metering trial on 50 randomly selected houses. The trial results have been analysed and indicate the lower demands are in line with actual usage.

7.3 Design flows – Glenpanel SHA – With modelling data

Demand based on medium density residential activities has been determined in accordance with the development standards:

Refer NZS4404:2010.

No of residential units:	150.
Average daily demand:	250 l / person / day.
Occupancy:	3.0 person / du.
Peak day factor:	6.6.
Average Daily demand:	***113 m^3 / day.***
Peak hour demand:	***8.6 l / sec.***

It can be seen above that applying the lower figures has approximately one third of the demand.

It is the opinion of the author that the lower demands should be adopted for this project.

One significant consideration for the Average Daily Demand for the QLDC code of practice is irrigation demand. Irrigation for private use varies greatly and is generally uncontrolled.

The irrigation demand for reserves, streetscapes and open spaces is anticipated to be managed by QLDC once these assets vest.

It is noted that the subject site is service by a pressurised Irrigation supply from the Arrow Irrigation Company. This supply can be used for irrigation purposes to the public amenity areas.

7.4 Required Fire fighting demand

The design of the new water infrastructure will need to meet the requirements of SNZ PAS 4509 – NZ Fire Service Firefighting Water Supplies Code of Practice.

7.4.1 Residential fire fighting demand – reticulated supply - non sprinklered

Water supply classification:	FW2.
Required water flow within 135m:	12.5 l / sec
Additional water flow within 270m:	12.5 l / sec.
Max No. of hydrants to provide flow:	2.
Minimum pressure	100kPa.

7.5 Existing Infrastructure

Shotover Country developed a 300mm water bore adjoining the Shotover River. Upgrades to the existing Water Treatment Plant at Lake Hayes Estate have also been undertaken.

Shotover Country and QLDC have jointly constructed a new 1,000m³ water storage reservoir on Jones' Hill. The reservoir and associated rising/falling mains were commissioned in August 2014.

This water supply system is now capable of delivering 70l/s for 16 hours per day. This equates to 4,032m³ of potable water per day.

The System is connected to the existing Lake Hayes water supply scheme which provides a level of redundancy and security of supply.

The rising and falling mains as well as the domestic reticulation constructed for the subdivision have been modelled and sized by Tonkin and Taylor Ltd. Pipe work has been sized for the fully built zone to meet QLDC's levels of service.

A 150mm water main was extended to the Stalker Road roundabout and across the highway in early 2016. This main adjoins the subject site. The static water pressure in the pipe is approx. 150kPa given its relative elevation to the Shotover Country water reservoir.

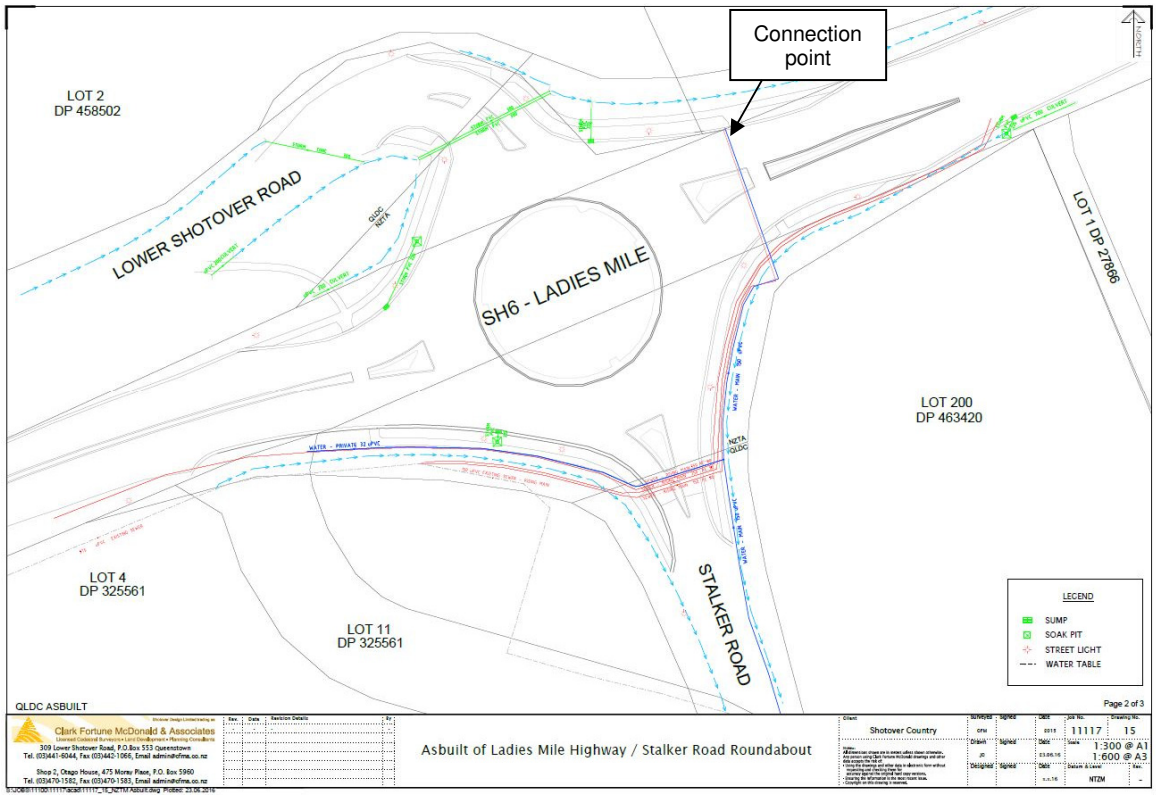
QLDC are currently underway on an upgrade to the water supply network which involves the construction of a bore field with several new bores and new treatment plant.

The WSP OPUS HIF report indicates the new system has been designed to provide 4,400m³/day to the Ladies Mile Area by 2058.

As mentioned above the Arrow Irrigation Company (AIC) network currently services the subject site. The main race is piped from the inlet of the Shotover syphon around the side of Slopehill. There is pressure reticulation with mains of 150mm in diameter that currently runs spray irrigators running through the property. The pressure reticulation crosses the State Highway adjacent the Stalker Road roundabout and continues along to Howards Drive and Lake Hayes Estate.

7.6 Concept Design

To service the proposed development, treated water from the QLDC/Shotover Country scheme would be utilised. It is anticipated that up to 9l/s would be required for this development. The initial connection point could be the existing 150mmØ water main on the north side of the State highway.
It is noted that the WSP OPUS HIF report proposes a new DN200 dedicated rising main be constructed from the Shotover bore field and treatment plant to a new reservoir site.

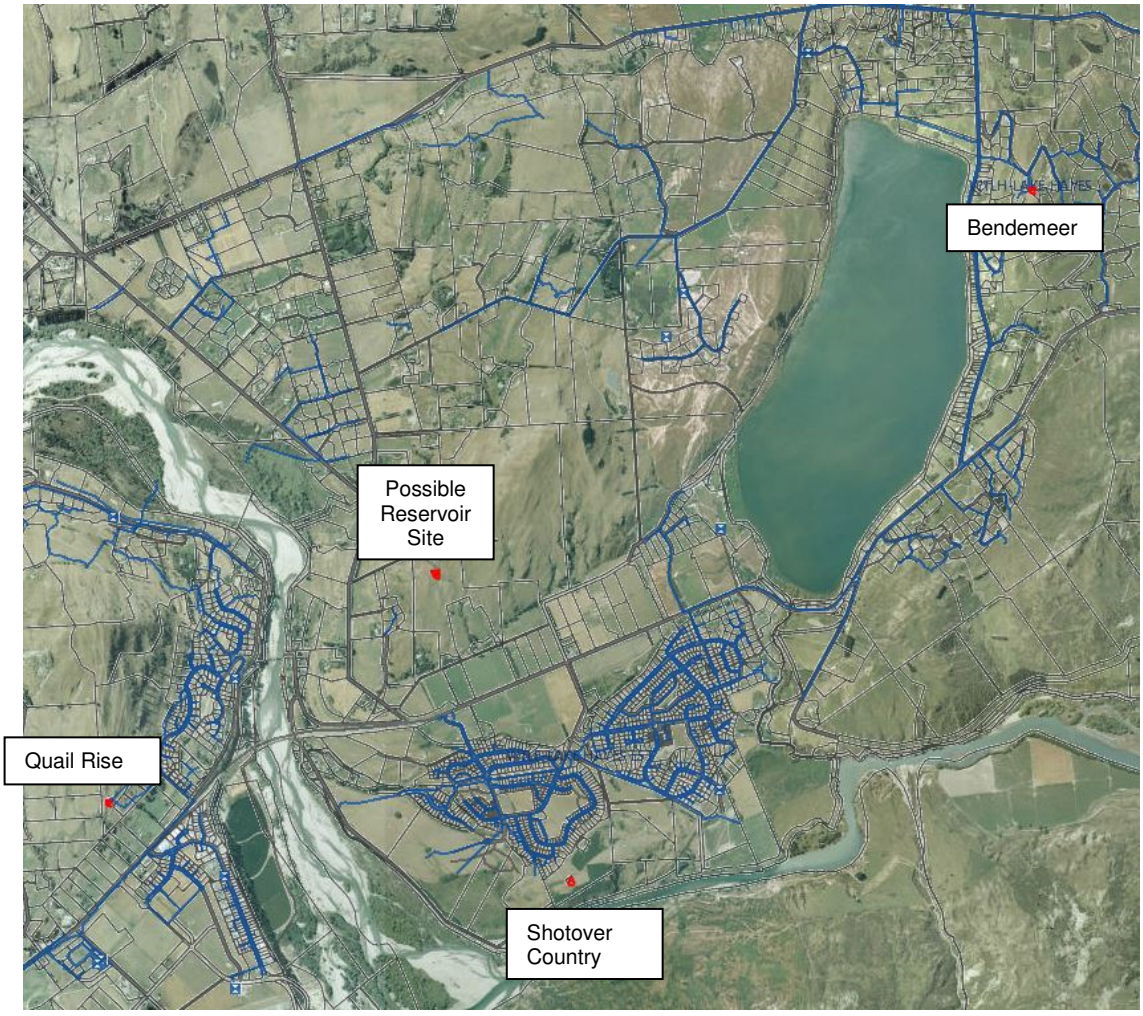


Water from the existing connection point would need to be pumped via booster pump to a higher-level water reservoir. A reservoir would be sited at a suitable elevation to provide the suitable domestic pressures of between 300kPa & 900kPa to the development. From the reservoir, gravity reticulation would be installed to service the properties for domestic and firefighting supply. Internal reticulation in the development would be sized accordingly but is anticipated that mains of 150mmØ would be required.

It is proposed that a new reservoir will be established on Slope Hill at a suitable elevation to service the development. The minimum elevation of the reservoir has been identified as 423masl. The applicant owns the land necessary for the establishment of a reservoir and is able to provide the land and access required for a new tank(s). Discussions between QLDC and the applicant are progressing. Necessary easements for rising/falling mains can also be provided as part of this development.

The WSP OPUS HIF report proposes 2 x 1,000m³ potable reservoirs to service the greater Ladies Mile Area. We understand that site selection and investigations are already underway for the proposed reservoir site.

The Slope Hill location is a centrally located position that could be connected to the Lake Hayes Scheme. This connectivity would augment the existing network and provide further security.



All new infrastructure constructed for this development would then be vested in Council ownership.

It is also proposed to utilise the existing Arrow Irrigation network to irrigate streetscapes, reserves and open spaces. By utilising the Arrow water would see a reduction to the overall demand on QLDC potable water supply.

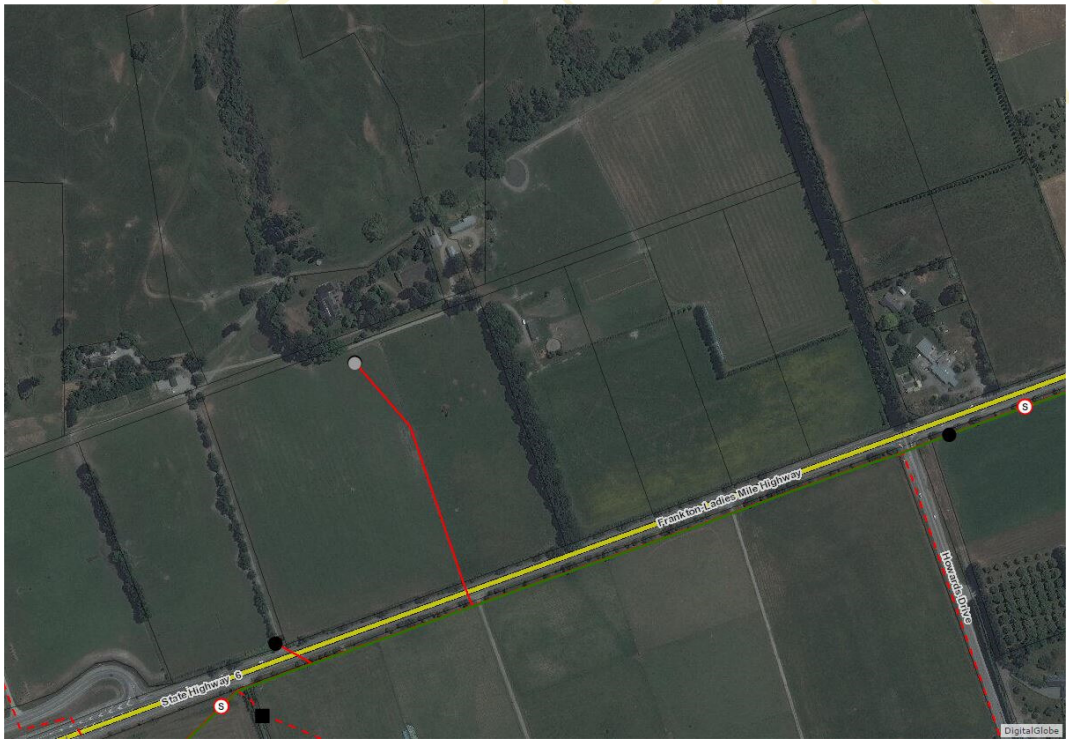
The further design and modelling of the infrastructure would need to be undertaken closely with the QLDC to confirm availability of supply.

7.7 Required upgrades

Any effects on the QLDC's wider infrastructure being the Shotover Country Bore Field and Water Treatment Plant will be mitigated by the imposition of headworks fees at the time of connection to Council's service. QLDC have included a Ladies Mile catchment in a new Development Contribution policy adopted at 1 Dec 2018. The current figure being levied is $5,683 per residential unit. The additional 150 residential units under the current levy would net Council 150 x $5,683 = $852,450.00 ex GST.

8 POWER, TELECOMMUNICATIONS AND GAS

Both local electrical networks, Aurora Energy and Powernet have high voltage network adjoining the subject site. Either network could supply suitable underground electrical supply to the proposed development. Below is a screen shot from Aurora's GIS showing the existing electrical infrastructure.



Chorus fibre optic telecommunications cables exist in the north side of the road corridor of State Highway 6. It is anticipated that connection to the network can be made and that the new development would be serviced with fibre to the door.

Rockgas have a 50t buried gas tank located off Jones Ave. There is an existing 200mm main that runs in Howards Drive to the State highway that is not currently being utilised. To connect the subject site to the existing underground reticulation would require a short length of new main being thrust under the highway carriageway to the site. Gas reticulation would then be available at the discretion of the developer.

All infrastructure is underground. All necessary mains will be extended to service the development area as development proceeds. Confirmation from the network owners will be obtained at each stage of development prior to proceeding.

It is not anticipated that there will be any supply or capacity issues for these services and connection will be made available from existing infrastructure at the time of development in accordance with the relevant service provider's specifications.

9 CONCLUSION

The inclusion of the Glenpanel Special Housing Area will not have any significant impacts on the infrastructure network. Infrastructure already exists that can be augmented as required to cater for additional demand.

The Business Case for the Ladies Mile area has been approved by central government and money is now available from the Housing Infrastructure Fund.

Any necessary infrastructure can be constructed and paid for the by the applicant as the development proceeds, equally the applicant can contribute its share of infrastructure costs for necessary QLDC capital works required to service the larger Ladies Mile area. It is possible that the construction of new infrastructure required for this development could also have a wider network or community benefit by augmenting or providing additional security to existing infrastructure.

The two main components of QLDC infrastructure that the development would rely upon on will be the Shotover Waste Water Treatment Plant and the Shotover Country water bore field and water treatment plant. Appropriate headworks fees can be levied to mitigate the effects of the additional demand.

Stormwater would be managed for the development on site and is not expected to have any effects on existing infrastructure. Overflow events can discharge to the existing Stormwater main in Howards Drive.

Other non-Council infrastructure and network utilities exist and have capacity to supply this development. Should additional capacity to accommodate the cumulative demand of the SHA on the non-Council infrastructure be required, it can readily be provided.