INFRASTRUCTURE REVIEW

EXPRESSION OF INTEREST

JULY 2016

INFRASTRUCTURE ASSESSMENT REPORT

GLENPANEL

Glenpanel – Special Housing Area
June 2016

CLARK FORTUNE MCDONALD & ASSOCIATES
REGISTERED LAND SURVEYORS, LAND DEVELOPMENT & PLANNING CONSULTANTS

GLENPANEL

CONTENTS

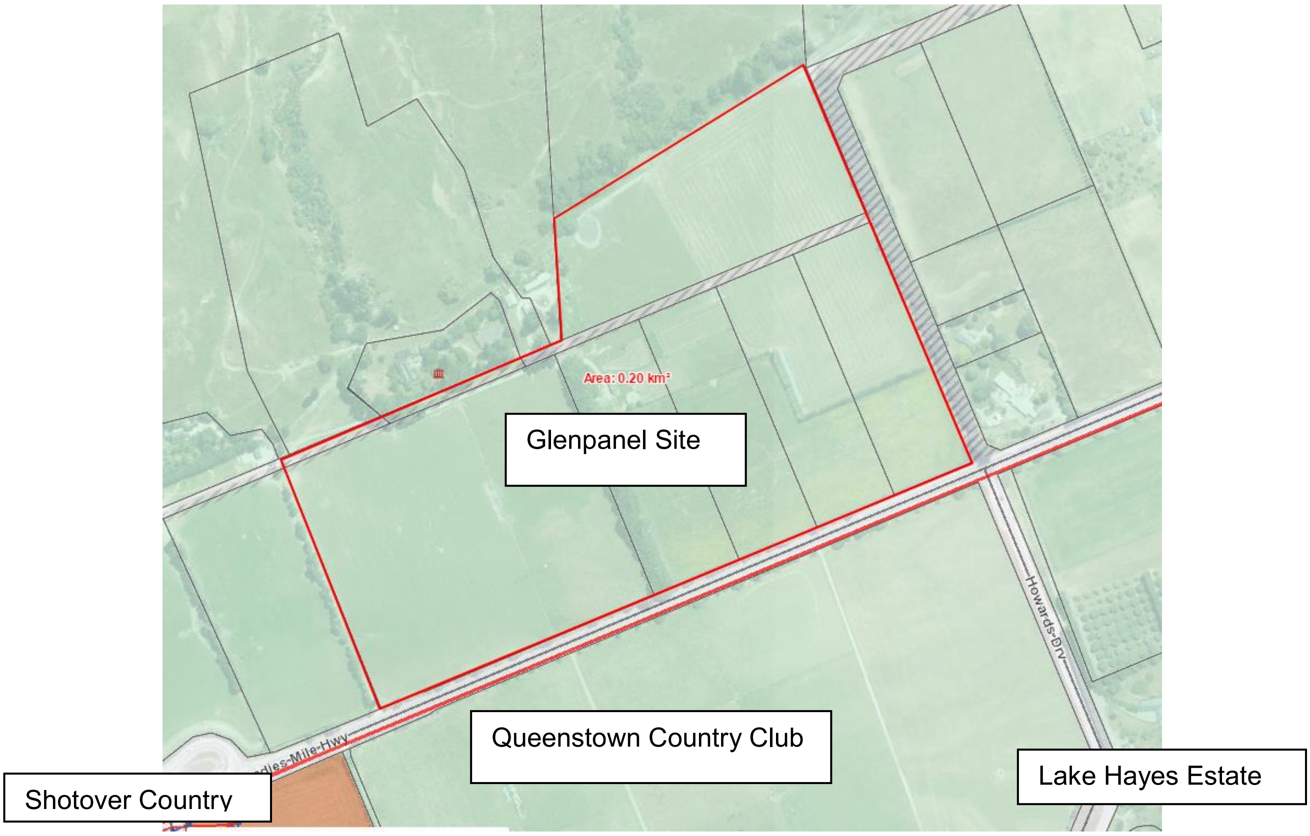
1 INTRODUCTION

Clark Fortune McDonald & Associates (CFM) has been engaged to assess 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 and worker accommodation.

The site is legally described as Lots 2, 4 & 7 D.P.463532 & Sections 42 – 44 Block III Shotover Survey District. The total site area comprises approx 20 ha and is contained in CT's 613707 & 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.

3 DESIGN STANDARDS

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

- QLDC Land Development and Subdivision Code of Practice adopted June 2015.
- 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 240 dwelling equivalent (DE) summarised as follows:

- 38 DE - Villas
- 65 DE – Low density lots
- 105 DE – Medium density lots or Multi Unit development (e.g. worker's accommodation)

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 Infrastructure code.

No of residential units/DE:	208
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:	***156 m^3 / day.***
Peak hour flow:	***9.0 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.

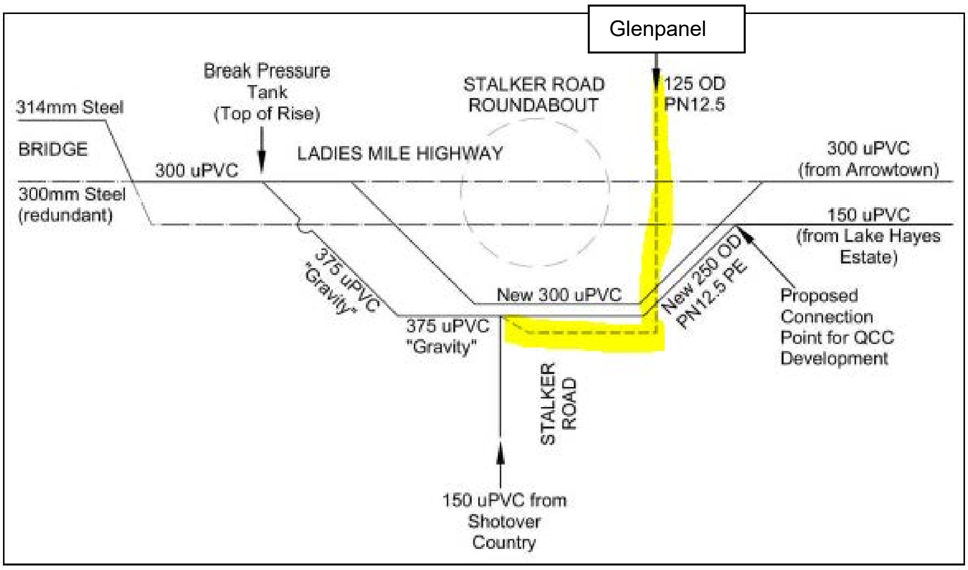


Figure 3.2: Schematic Diagram of Sewer Pipework at the Western End of Ladies Mile

(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	– 9 l/s
Total	- 71 l/s

This would leave a balance capacity of 79l/s available to service the greater Arrowtown/Lake Hayes area.

Modelling and capacity of the main across the Lower Shotover Bridge would need to be confirmed. It appears from previous reporting that this is sufficient. We anticipate that Rationale on behalf of QLDC would be able to confirm this.

It may be required to examine the storage capacities at each of the 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 would then be connected to the existing 125mm pressure connection at the Stalker Road roundabout.

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. It is assumed that the Glenpanel SHA would be levied the same as Shotover Country under the proposed 2016/2017 Development Contribution policy. This is assumed on the basis that the Shotover Country rate recognises that only the treatment component of infrastructure is utilised. The current figure being levied is $2,907 per residential unit. The additional 208 residential units under the current levy would net Council 208 x $2,903 = $603,824.00 ex GST.

Upgrades to the Shotover Waste Water Treatment Plant are currently under construction.

6 STORMWATER

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

6.1 Stormwater Catchment Management Plan (SCMP)

It is proposed that the Glenpanel SHA prepare and submit to QLDC a SCMP to be approved by QLDC prior to development of the site.

6.2 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. There are two main hillside catchments above the development with a combined area of approx. 45ha.

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.

6.3 Existing Reticulation

There is no existing storm water reticulation to service the property. There is some storm water infrastructure in the way of cut off drains/swales that deal with the hill side run-off.

6.4 Hydrological analysis

Runoff has been considered based on the Baxter Design Group draft concept plan dated 24 June 016, and calculated using the Rational Method. The development area is 20 ha and presently consists mainly of pasture and some trees. The soil drainage is moderate and the development area is quite flat, so a slope correction of -0.05 has been applied to the runoff coefficient for each surface type. Runoff coefficients have been obtained from Approved Document for New Zealand Building Code, Surface Water, Clause E1. Rainfall intensity has been determined from NIWA HIRDS V3 (http://hirds.niwa.co.nz/).

It is specified in the development code that pre-development runoff discharging to an existing network shall not exceed that which would have occurred for the undeveloped catchment during a 60 minute 5 year storm.

In this instance however as there is no existing network, we have considered the full discharge of the developed catchment for a 1% AEP or 100 year return period event. i.e. worst case scenario which is conservative. The following calculations and concept design show how the stormwater could be managed on site.

Refer to the following calculations:

Post development runoff

Post-development						
Development area	High	Medium	Low	Reserve	Hillside	
Medium soakage pasture and scrub	Density	Density	Density			
Area (ha)	5.75	4.36	3.5	6.84	2.12	
C	0.65	0.60	0.55	0.30	0.30	
Slope correction	-0.05	-0.05	-0.05	-0.05	0.10	
Adjusted C	0.60	0.55	0.50	0.25	0.40	
CA	3.45	2.40	1.75	1.71	0.85	**10.16**

Infiltration pond routing computations

All ponds	100 year ARI storm								
Development area CA	9.310								
Hillside area CA	0.85								
∑CA (ha)	10.160								
Infiltration area (m2)	1700.000								
Infiltration rate (m/hr)	0.3								
			Infiltration to dispose of runoff from development area						
			Duration (hr)						
			0.33	1	2	6	12	24	48
Pond top area	13700	Rainfall (mm)	15.8	31.8	43.8	73.0	100.6	138.6	166.9
Pond base area	6400	Runoff (m3)	1605.3	3230.9	4450.1	7416.8	10221.0	14081.8	16957.0
Pond depth	0.7	Infiltration (m3)	168.3	510.0	1020.0	3060.0	6120.0	12240.0	24480.0
Storage (m3)	7035	Required storage (m3)	1437.0	2720.9	3430.1	4356.8	4101.0	1841.8	-7523.0
Infiltration (m3/hr)	510.0	Total storage (m3)	7035.0	7035.0	7035.0	7035.0	7035.0	7035.0	7035.0
		Surplus storage (m3)	5598.0	4314.1	3604.9	2678.2	2934.0	5193.2	14558.0

The runoff coefficient for the residential area of 0.65 has been used in the post development calculations. This is specified in the Approved Document for New Zealand Building Code, Surface Water, Clause E1, as being appropriate for shopping areas and townhouse developments.

Storage capacity has been provided for the 100 year ARI storm. The critical storm duration, as it relates to the storage required in the detention ponds, was determined by analysing storms of varying length: from 20 minutes through to 48 hours.

It is noted that it would be permitted to discharge the pre-development flows downstream.

6.5 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.

6.5.1 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	0.18-0.45	0.03-0.09
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

6.5.2 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.

The detention ponds will be designed generally in accordance with Auckland Regional Council TP10. Each pond will have a fore-bay and will be suitably vegetated. The detention ponds will provide stormwater treatment before it is discharged to ground. The primary contaminant removal mechanism of all pond systems is settling or sedimentation.

6.6 Stormwater Management Objectives

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

- Primary protection for 25 year ARI storms;
- Secondary protection (overland flowpaths) for 100 year ARI 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.

6.7 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.

6.7.1 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.

6.7.2 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.

6.8 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 watercourses.	(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.

6.9 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 will discharge to the same locations as the pre-development scenario.

The stormwater concept plan is shown in appendix A.

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:

<u>Refer QLDC code of practice 6.3.5.6</u>.

No of residential units:	208.
Average daily demand:	700 l / person / day.
Occupancy:	3.0 person / du.
Peak Day factor:	6.6.
Average Daily demand:	***437 m^3 / day.***
Peak day demand: (16 hour pumping)	***50.1 l/ sec.***

QLDC Code of practice also allows for a lower demand when supported by metering data approved by QLDC. Shotover Country has just completed a 12 month metering trial on 50 randomly selected houses. The trial results are still being analysed however early analysis of the results indicate that demands far closer to 4404:2010 have been found.

7.3 Design flows – Glenpanel SHA – 4404:2010

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

<u>Refer NZS4404:2010.</u>

No of residential units:	208.
Average daily demand:	250 l / person / day.
Occupancy:	3.0 person / du.
Peak day factor:	5.0.
Average Daily demand:	***156 m^3 / day.***
Peak hour demand:(16 hour pumping)	***13.5 l / sec.***

It can be seen above that applying the 4404 figures has approximately one quarter of the demand.

It is the opinion of the author that the demands from 4404 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.

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 has developed a new 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.

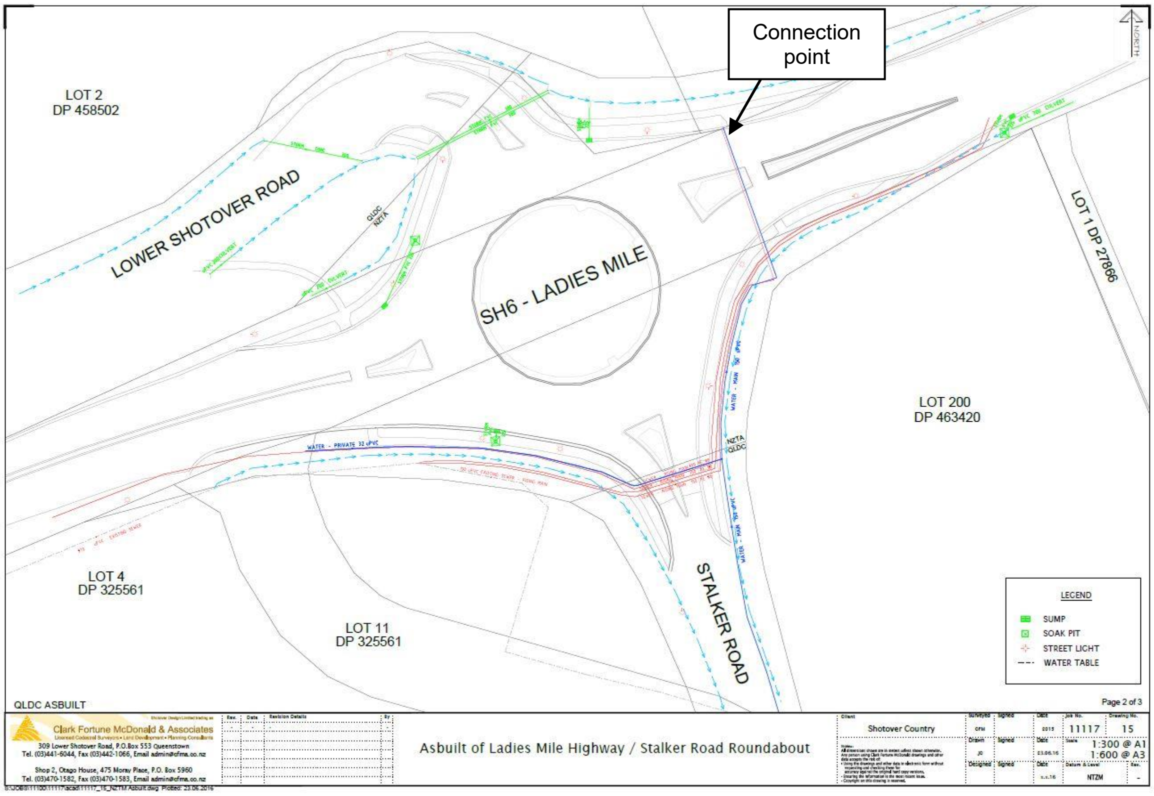
A 150mm water main was extended to the Stalker Road roundabout and across the highway in early 2016. This main adjoins the subject site. The static water pressure in the pipe is approx. 150kPa given its relative elevation to the Shotover Country water reservoir.

QLDC are currently designing an upgrade to this water supply scheme which involves the construction of a bore field with several new bores capable of taking 395 l/s (subject to consent). This new "on-demand" system will also include a new water treatment plant that will treat the water at the source and be pumped to areas of future development including the Frankton Flats. Works on the first stage of the water upgrade a proposed to commence from July this year.

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 15l/s would be required. The connection point would be the existing 150mmØ water main on the north side of the State highway.

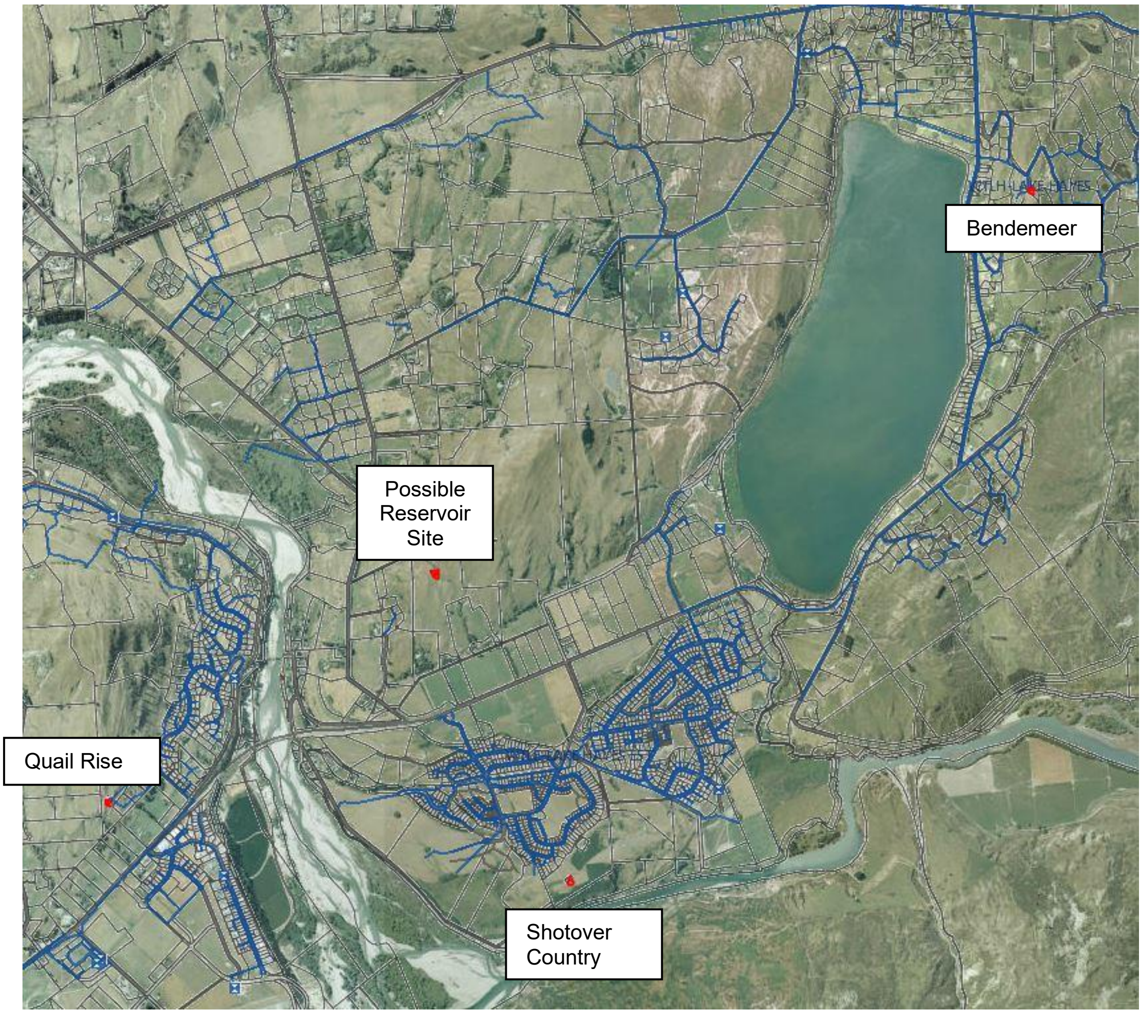


This water would then need to be pumped via booster pump to a higher level water reservoir. A reservoir would be sited at a suitable elevation to provide the suitable domestic pressures of between 300kPa & 900kPa to the development. From the reservoir, gravity reticulation would be installed to service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

It is proposed that a new reservoir could be established on Slope Hill at a suitable elevation to service the development. 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.

Given the current proposed re-zoning of land surrounding Slope Hill under the District Plan Review a new tank cold also service additional demand generated from any re-zoning.

Equally Slope Hill 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.



Sizing of the reservoir should also be carefully considered as this could help eliminate peaks in the demand. This would then allow for a lower peak flow of water to be taken from the existing QLDC system.

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.

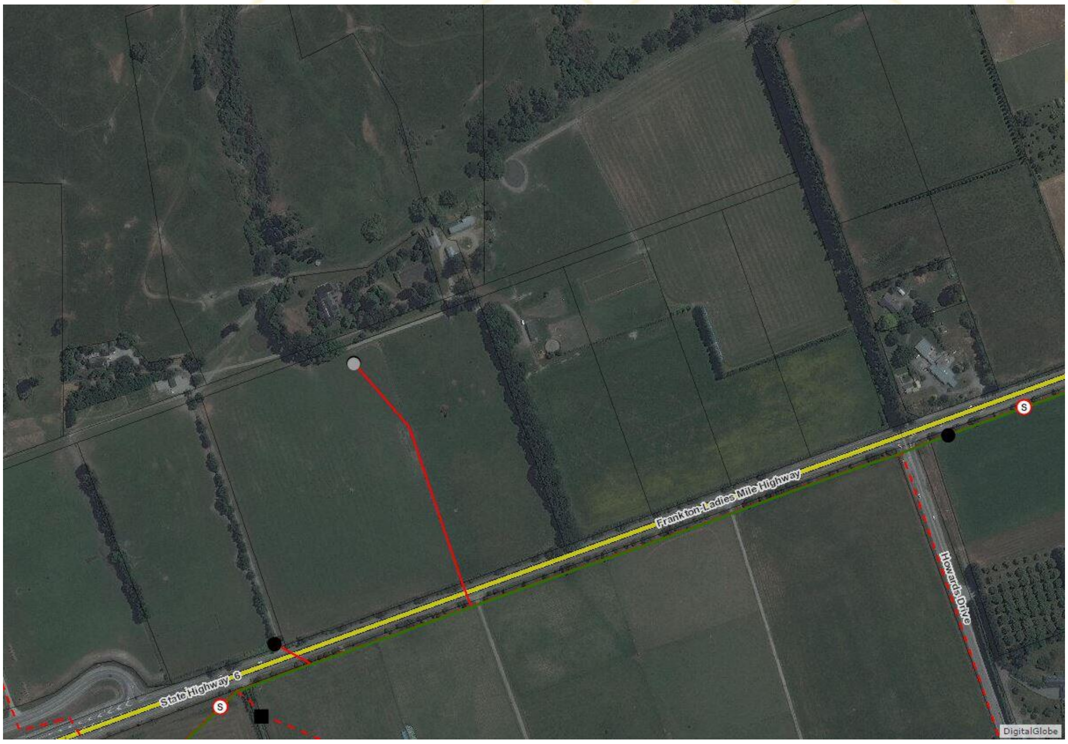
The further design and modelling of the infrastructure would need to be undertaken closely with the QLDC to confirm availability of supply. It is anticipated that water modelling consultants Tonkin and Taylor will be need to carry out this modelling at the next phase of design.

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. It is assumed that the Glenpanel SHA would be levied the same as Shotover Country under the proposed 2016/2017 Development Contribution policy. The current figure being levied is $2,628 per residential unit. The additional 208 residential units under the current levy would net Council 208 x $2,628 = $546,624.00 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.

Contact/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. New infrastructure already exists that can be augmented as required to cater for additional demand.

The infrastructure will be constructed and paid for the by the applicant as the development proceeds. It is anticipated that new infrastructure required would be constructed at little or no cost to QLDC. 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.

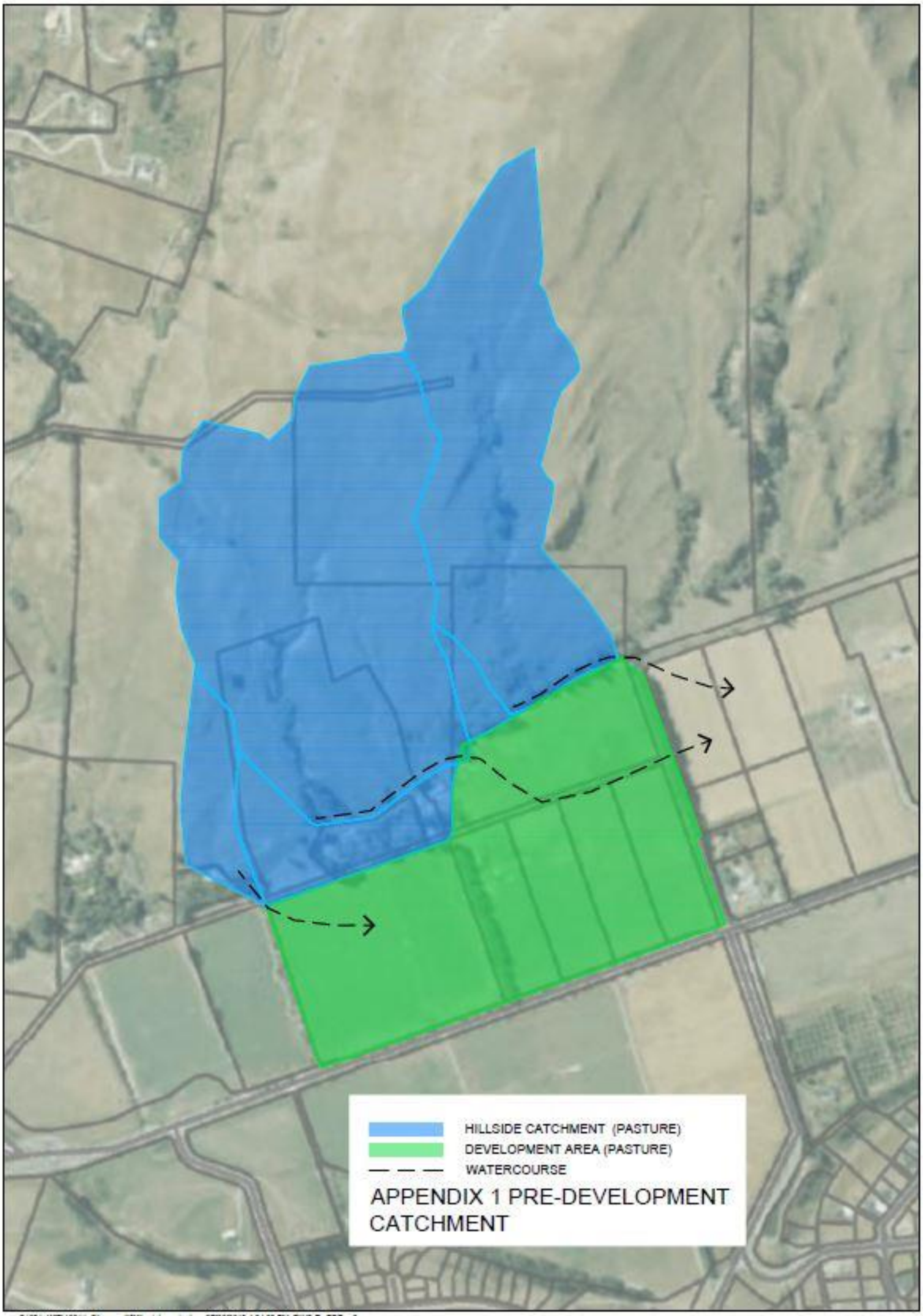
The two components of QLDC infrastructure that the development would rely upon on will be the Shotover Waste Water Treatment Plant and the Shotover Country water bore field and treatment plant. Appropriate headworks fees can be levied to mitigate the effects of the additional demand.

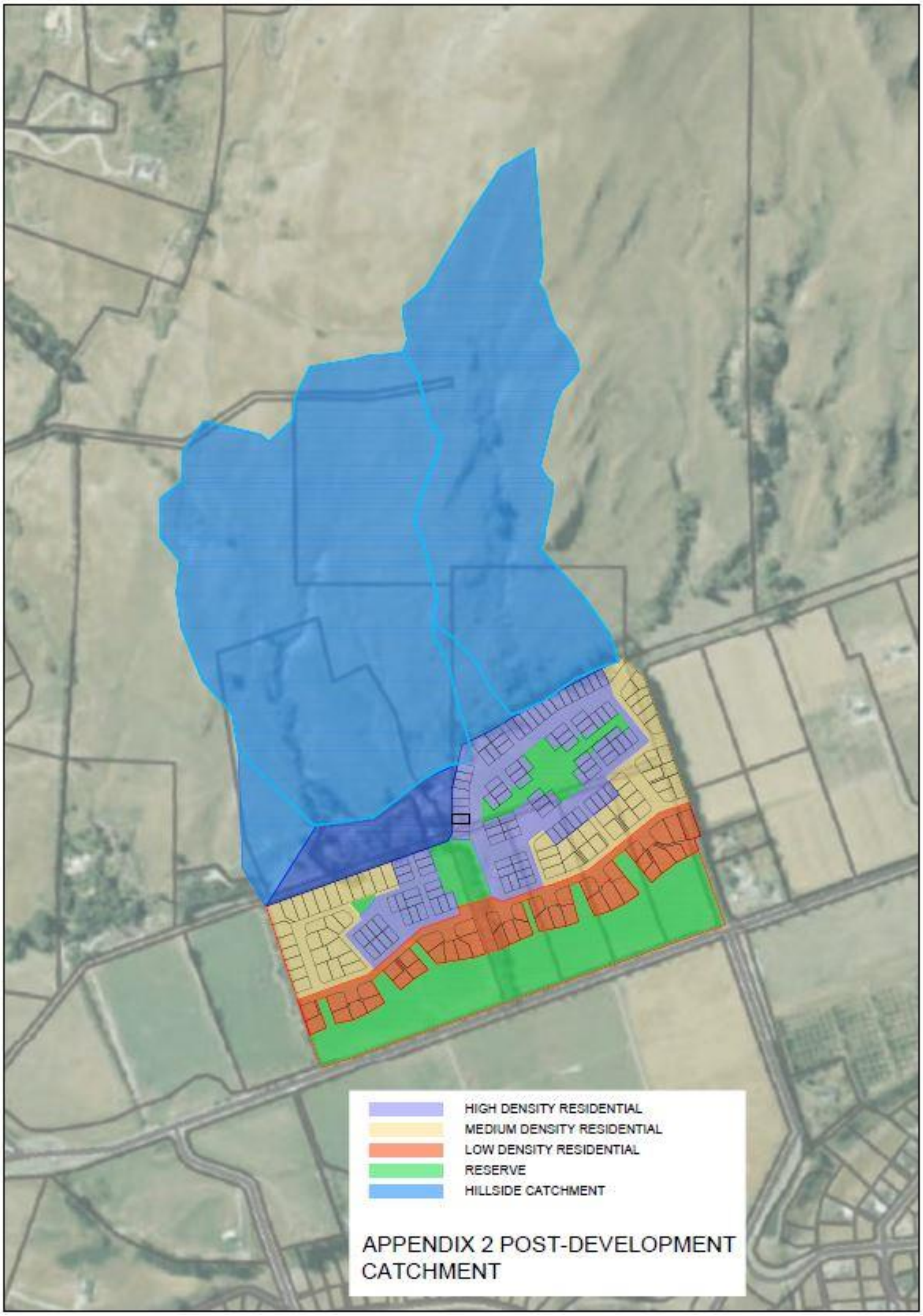
Upgrades to the Shotover Waste Water Treatment Plant are under construction and upgrades to the Shotover Country water bore and treatment plant are planned and programmed in Council's Long Term Plan. Work is expected to start in the second half of 2016.

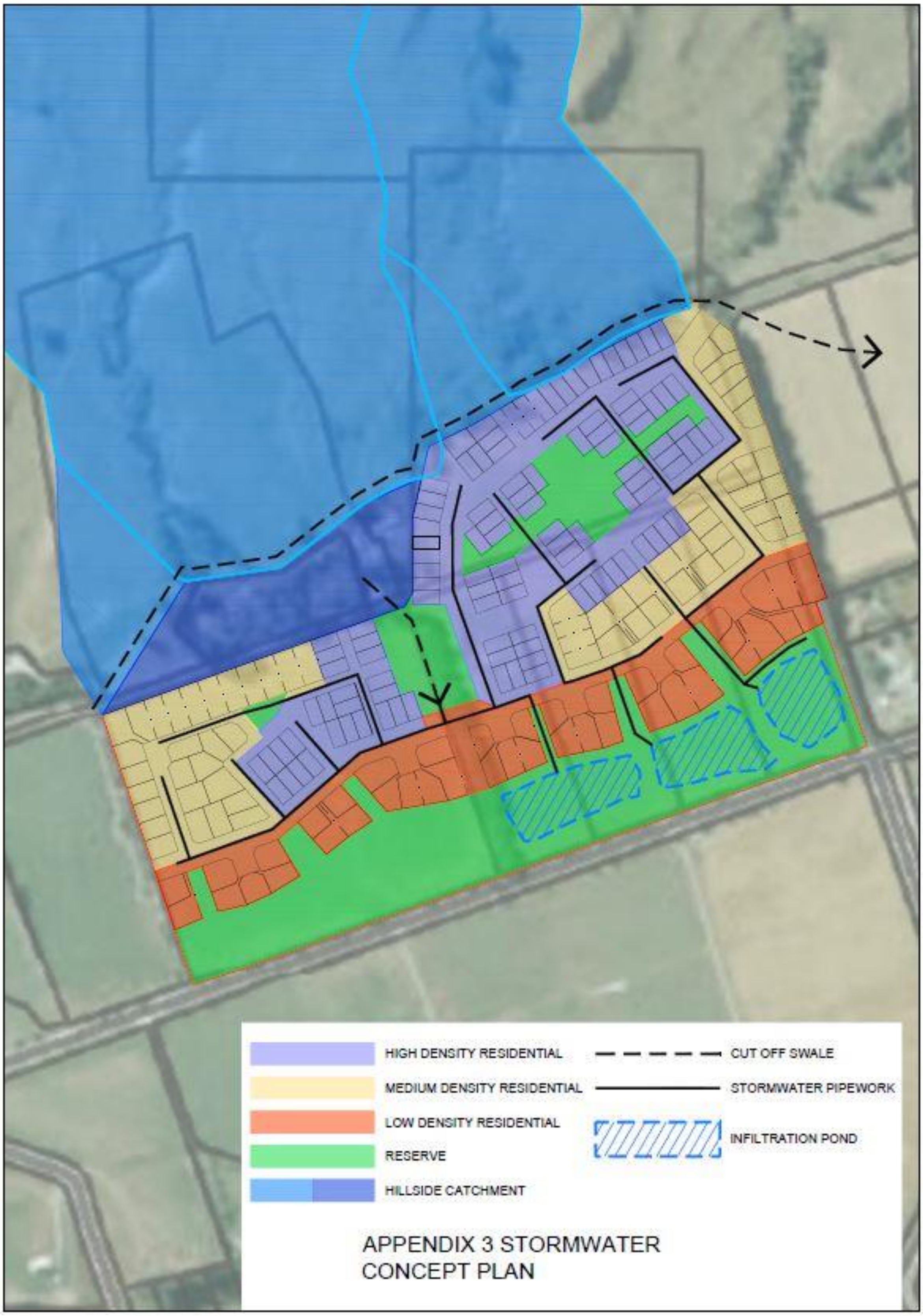
Stormwater would be managed for the development on site and is not expected to have any effects on existing infrastructure.

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.

10 APPENDICES


HILLSIDE CATCHMENT (PASTURE)
DEVELOPMENT AREA (PASTURE)
WATERCOURSE
APPENDIX 1 PRE-DEVELOPMENT CATCHMENT


HIGH DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
RESERVE
HILLSIDE CATCHMENT
APPENDIX 2 POST-DEVELOPMENT CATCHMENT


HIGH DENSITY RESIDENTIAL
MEDIUM DENSITY RESIDENTIAL
LOW DENSITY RESIDENTIAL
RESERVE
HILLSIDE CATCHMENT
CUT OFF SWALE
STORMWATER PIPEWORK
INFILTRATION POND
APPENDIX 3 STORMWATER
CONCEPT PLAN