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30 October 2015

Shane Fairmaid
C/- Armstrong & Associates
Box 109696
New Market
Auckland

ATTENTION: Shane Fairmaid

Dear Shane,

**RE: Arrowtown Retirement Village, McDonnell Road, Arrowtown**

Further to our feasibility report, delivered to Aurum Survey Consultants Ltd on 07/09/15, and as outlined in your e-mail dated 5 October 2015, we have completed the following assessments of the water and wastewater connections for the proposed Retirement Village development on McDonnell Road.

## Background

The proposed site (shown in green) for the retirement village is located along McDonnell Road, to the south of Arrowtown between The Hills golf course and the Mt Soho winery. This location is a significant distance from the existing water and wastewater infrastructure and is midway between the Arrowtown and Lake Hayes Schemes giving potential options to connect to either scheme.

## Wastewater

Two locations from the feasibility report have been investigated further for this report:

Option 3 - A pump station onsite with a rising main discharging into manhole SM14173 outside 100 Centennial Avenue. Conveying wastewater to Norfolk Street Pump Station via a 150 mm diameter gravity main.

Option 5 – A pump station onsite with the rising main injecting into the existing 300 mm main on Arrowtown – Lake Hayes Road at the junction with Hogan's Gully Road. Conveying wastewater to the Arrowtown – Lakes Hayes Road (Bendemeer) Pump Station via the 300 mm diameter main.

Some further investigation into the network infrastructure has been undertaken since our original report with the key points below:

- The connection point for option 3 is not a manhole. A cleaning eye is installed, but if connection to this point is the preferred option then a manhole would need to be constructed.

- There is little detail available on the Arrowtown – Lake Hayes Road trunk main from the top of McIntyre Hill to its discharge at the Arrowtown – Lake Hayes Road Pump Station. However, from available evidence it appears that it is a sealed construction from the receiving manhole at the top of McIntyre Hill. It is thought that injecting into this main at the junction with Hogan's Gully Road would be feasible as the main is essentially running under gravity at this point and would not be subject to significant pressure.

- The Norfolk Street Pump station was potentially thought to be controlled to a flow by VSDs. However, further discussions with Veolia have clarified that there is no control on these pumps and the current pump flow is the limit for the installed pumps.

- The current configuration at the junction with Shotover Country is unclear. A 'balance tank' was built, at QLDCs request, by the Shotover Country developers so that the three rising mains could discharge and then be conveyed by gravity from that point. However, it is understood that the Arrowtown – Lake Hayes Road Pump Station rising main was never reconfigured to flow into the tank. The future of the tank is also not known, as it has been moved due to a redesign of the roundabout at the junction with the highway. The model has this main configured as a dedicated main from the Arrowtown – Lake Hayes Road Pump Station to the treatment plant.

## Modelling - Wastewater

Wastewater modelling is based on the Wakatipu dynamic wastewater model (2012), calibrated to flow data January 2012 and June 2013. The modelling has been carried out on the current day scenario to assess the current impact of the development connecting to the scheme. As the development is outside of the current scheme boundary it is recommended that the future growth scenarios are also considered to ensure that the network has sufficient capacity allocated for developments that are compliant with the current district plan. It is recommended that this is carried out once updated models are available later in the 2015/16 financial year.

The objective of this work is to determine if the wastewater network has sufficient capacity with the addition of this development. It is noted that this development is outside of the current scheme boundary (shown as a dashed red line) and will increase the previous ultimate flow projection for the Arrowtown Scheme.

We have completed our investigations based on the development containing the following loads:

| Load Type | Units | Total Units | Load / Unit / Day (l/d) | PDWF (l/d) | Approx Peaking Factor | Rainfall Catchment Area (Ha) |
|---|---|---|---|---|---|---|
| Villas | People | 196 | 245 | 48,020 | 2.1 | |
| Apartments | People | 46 | 245 | 11,270 | 2.1 | |
| Aged Care | People | 60 | 245 | 14,700 | 2.1 | |
| **Total** | **People** | **302** | **245** | **73,990** | **2.1** | **11.4** |

The above wastewater generation rate has been calculated from the standard wastewater model load of 735/connection/day and an assumed average of 3 people/connection.

All other loads have been modelled as per the standard load from the calibrated model. Additional rainfall catchment area has been added to the model as per the above table. The same infiltration parameters as the neighbouring Arrowtown catchments have been applied.

### Assessment of Capacity

The relevant sections of the network have been checked for capacity using the following criteria:

- No overflows allowed at any network element.
- No pump station overflows based on the duty pump capacity.
- As per the infrastructure code (section 2.7.10.6), emergency storage of 8 hours of average daily dry weather flow is required or emergency generation.

It should be noted that the following calculations of emergency storage requirement are calculated assuming that 8 hours storage of average daily flow over the peak day flow is required. The use of peak day flows in this estimate is likely to be conservative and may overestimate the storage requirement comparted to the intended interpretation. The Infrastructure Code is now superseded by the QLDC Land Development and Subdivision Code of Practice, the Code of Practice does not stipulate any requirements for pump station design. The infrastructure code parameters have been retained as an indicator of emergency storage capacity / emergency management requirements.

### Results – SM14173 to Norfolk Street Pump Station (Option 3 Only).

- There are no related network elements overflowing. See attached map.
- Pump station inflow significantly exceeds outflow, but the level of storage is sufficient to avoid overflows. This is based on a single duty pump capacity of 52 l/s and a total storage volume of 247 $m^3$. See Figure 1.
- There is dedicated external emergency storage at this pump station of 220 $m^3$, plus the wet well storage of 27 $m^3$. There is no on-site backup generator. The storage requirement, as per the

infrastructure code, is estimated to be 353 $m^3$, increasing to 377 $m^3$ with the addition of this development.

**Results – Norfolk Street Pump Station / Hogan's Gully Road to Arrowtown - Lake Hayes Road Pump Station (Option 3 and 5).**

- This trunk main is believed to be a sealed construction and therefore no overflows can occur. The modelled flow is approximately 52% of the calculated capacity of this main, for both scenarios, indicating that sufficient capacity exists. It should be noted that the pipe lengths indicated in the map as having flow above the capacity of the pipe are actually the parallel main flows to Lake Hayes Pump Station 2 and not the trunk main from Norfolk Street Pump Station. See attached map.

- Pump station inflow does exceed outflow, but does not cause an overflow. This is based on a duty/assist pump capacity of 80 l/s and a total storage volume of 275 $m^3$. See Figure 2 and Figure 3.

- There is dedicated external emergency storage at this pump station of 224 $m^3$, plus the wet well storage of 50 $m^3$. Compliance with the infrastructure code is fulfilled by the use of an on-site backup generator. Without the generator the storage requirement, as per the infrastructure code, is estimated to be 455 $m^3$, increasing to 480 $m^3$ with the addition of this development. This does not include any potential upstream or network storage.

**Results – Arrowtown - Lake Hayes Road Pump Station to Shotover Treatment Plant (Option 3 and 5).**

- This trunk main has been modelled as a dedicated rising main through to the treatment plant and no overflows can occur. The original plan for the 'Balance Tank' at the junction with Shotover Country was that all downstream reticulation would be designed to convey at least the combined pump capacity of the three pump stations discharging to this point (Arrowtown – Lake Hayes Road Pump Station, Lake Hayes Estate Pump Station 4 and Shotover Country Pump Station). As the addition of this development would not trigger the requirement of an upgrade to any pump station it is assumed that the original design of the balance tank and downstream reticulation remains valid.

## Discussion - Wastewater

Modelling of the network from the proposed development through to the treatment plant indicates that the existing QLDC network, has sufficient capacity to handle the addition of this development, based on the above assumptions.

For option 3, the model indicates that the Norfolk Street Pump Station is nearing capacity and almost all of the emergency storage is used with the addition of this development. However, it should be noted that this does not result in an overflow, although the risk of overflow is significantly increased.

Option 5 would avoid using the spare capacity within the Arrowtown network and the Norfolk Street Pump Station. Modelling indicates that there would be no capacity issues in the network downstream of the connection point. However, it is noted that this connection point could be more costly and may be more technically difficult to complete.

It is noted that if a blockage occurred along the Arrowtown – Lake Hayes Road trunk main there is a risk of surcharging back up the proposed rising main. However, the highest point of the rising main will be higher than the discharge manhole at the top of McIntyre Hill which would be the first point of overflow.

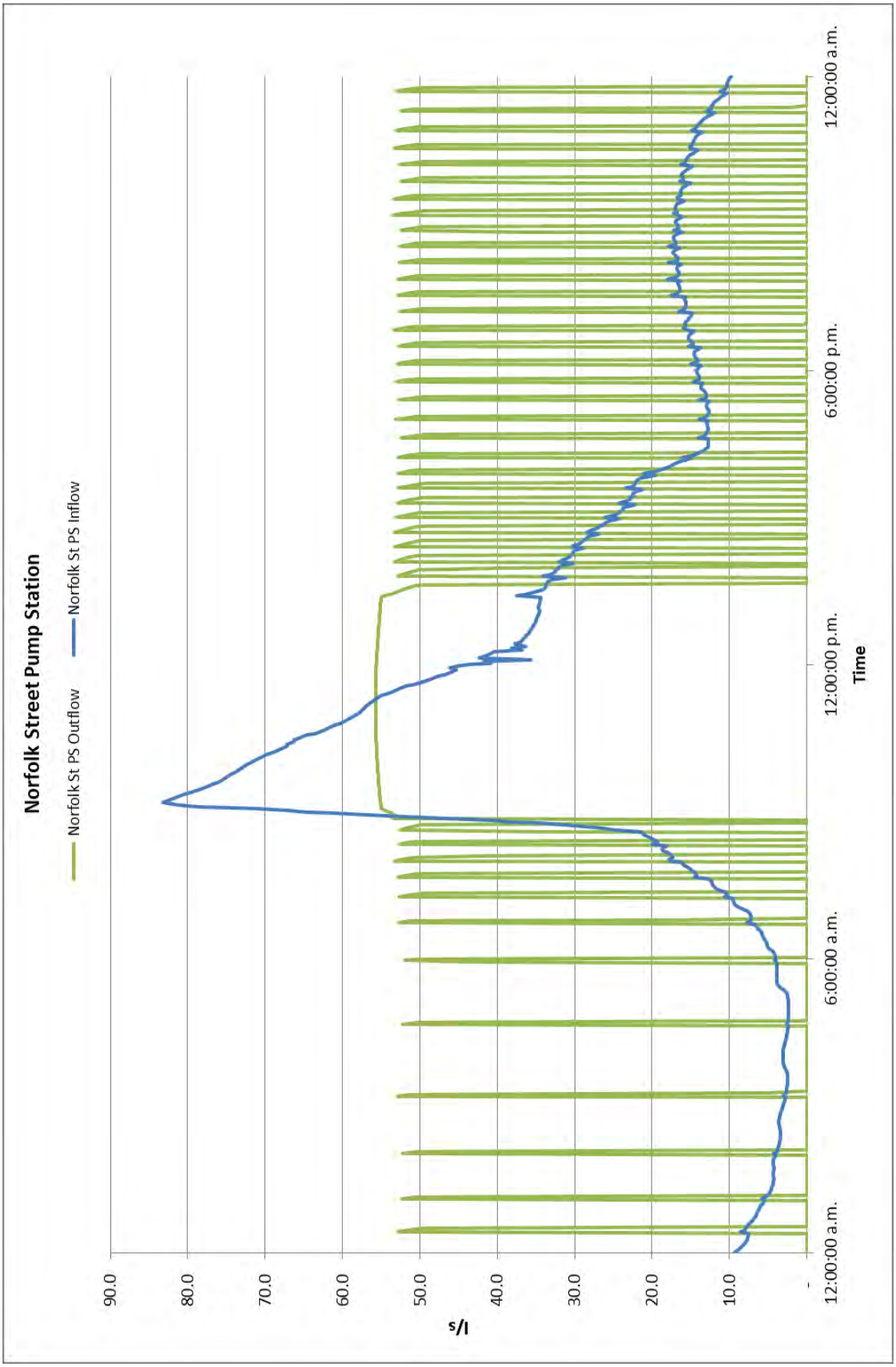


**Figure 1 - Option 1 - Norfolk Street Pump Station Inflow/Outflow**

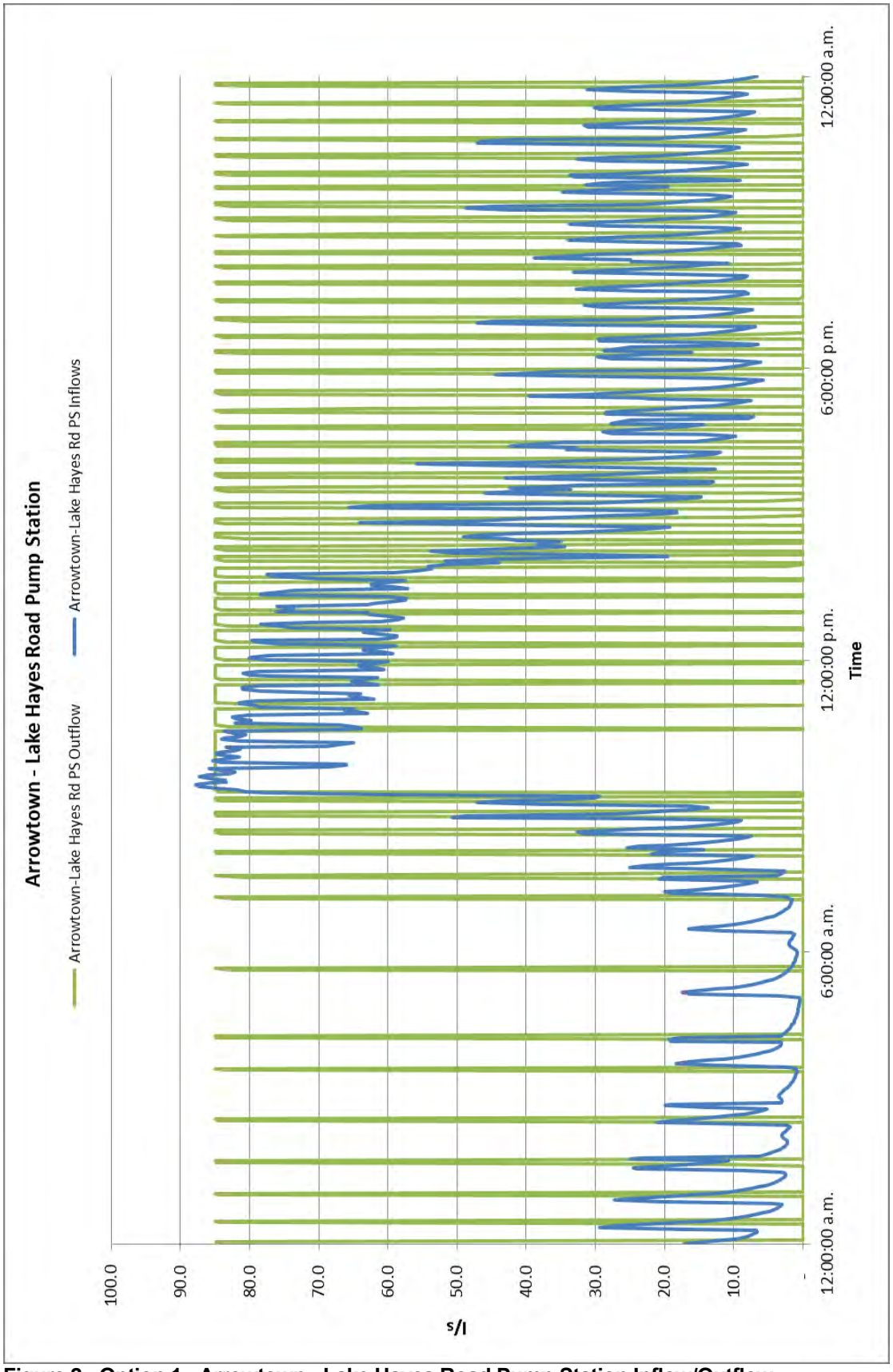


**Figure 2 - Option 1 - Arrowtown - Lake Hayes Road Pump Station Inflow/Outflow**

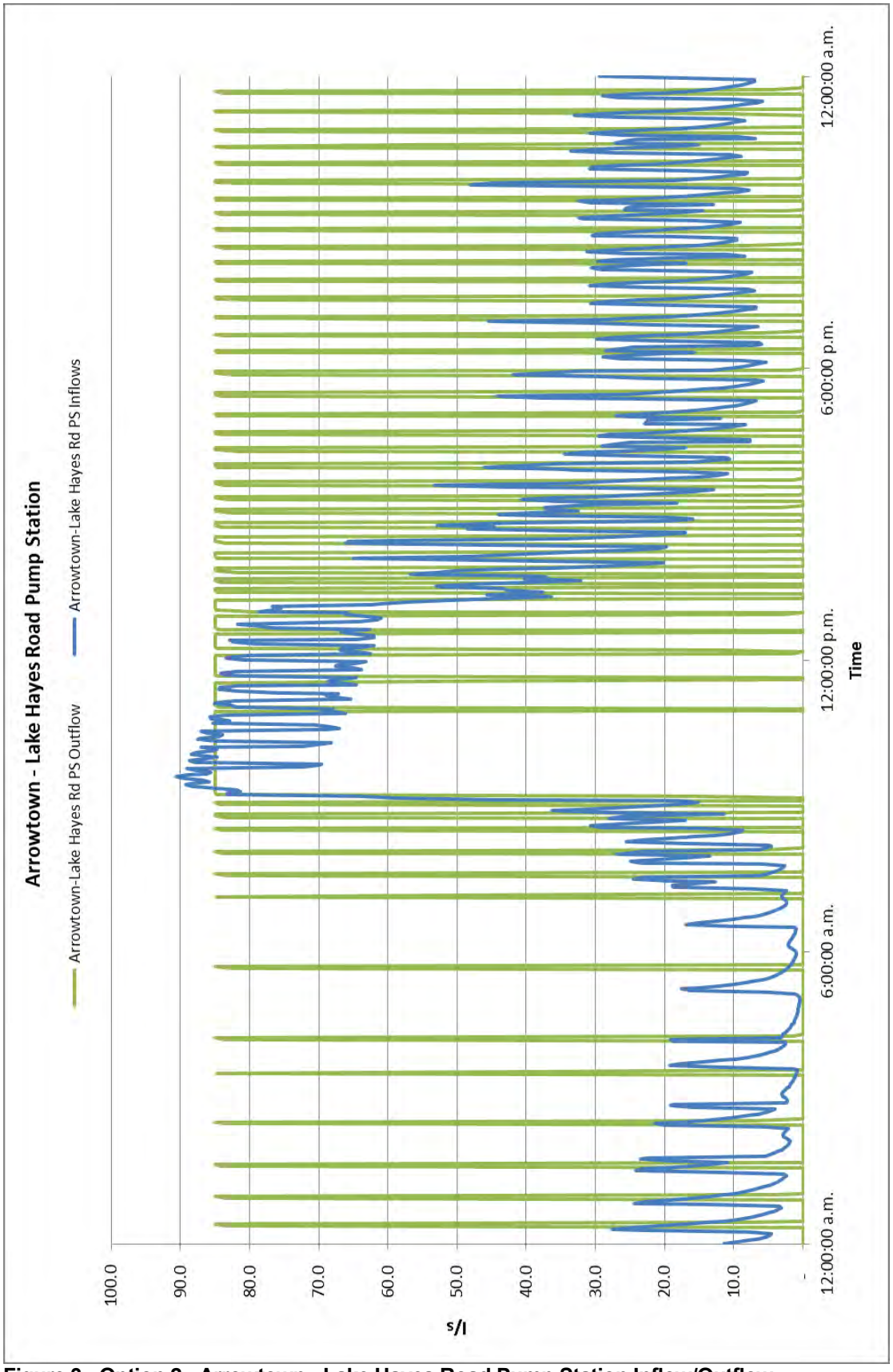


**Figure 3 - Option 2 - Arrowtown - Lake Hayes Road Pump Station Inflow/Outflow**

## Water Supply

Both options highlighted in the feasibility report have been investigated further:

1. Connection to the 200 mm main in McDonnell Road – Arrowtown Scheme.
2. Connection to the 100 mm main in Hogan's Gully Road – Lake Hayes Scheme. It is assumed that the 32mm pipe connecting the Mt Soho Winery is upgraded and extended to service the development. The modelling of a 200 mm diameter connection in this option assumes that the main is upgraded back to the main on Arrowtown - Lake Hayes Road.

Some further investigation into the network infrastructure has been undertaken since our original report with the key points below:

- The Arrowtown water source has been confirmed as to be approaching the total pump capacity and is likely to require to be upgraded in the near future.

- A significant upgrade to the Lake Hayes network is being undertaken with the addition of new bores at the Shotover Country development that is intended to supply Shotover Country and Lake Hayes Estate. A proposed operational change to the PRV located where the pipe enters Lake Hayes Estate will also restrict the flow to Lake Hayes Estate from the existing bores and reservoir which should free up sufficient capacity to supply the proposed development from the Lake Hayes scheme.

## Modelling – Water Supply

Water supply modelling is based on two dynamic water supply models (2012) built by Tonkin and Taylor. Both of these models have a low confidence in terms of the results, but will indicate if there will be significant issues with the addition of the proposed development. Updated and calibrated models will be available late in the 2015/16 financial year if more detailed investigation is required.

The modelling has been carried out on the current day scenario to assess the current impact of the development connecting to the scheme. As the development is outside of the current scheme boundary it is recommended that the future growth scenarios are also considered to ensure that the network has sufficient capacity allocated for developments that are compliant with the current district plan. It is recommended that this is carried out once the updated models are available.

### Arrowtown

The Arrowtown model is not fully calibrated, but is balanced to recorded flows from 2011. The 2016 growth scenario (3983 $m^3$/day) has been used as the basis of this exercise and matches recorded peak demand from 2014/15 (4040 $m^3$/day) well.

### Lake Hayes

The Lake Hayes model is uncalibrated but the model does include the final design for the new Shotover Country infrastructure and the new bore. However, the demand for the 2012 scenario was approximately double the recorded flow for the peak day for 2014/15. The model had demand of 10,082 $m^3$/day, of which 4,416 $m^3$/day was for the existing Lake Hayes scheme. The highest recorded flow for the 2014/15 year was 2,204 $m^3$/day, which included supplying water to a small part of Shotover Country that was already developed.

Therefore the overall model demand has been scaled back to 5,041 m3/day to achieve a more suitable level of demand. It is acknowledged that water restrictions were in place at the time of the recorded peak, but the model demand of 5,041 m3/day results in demands in excess of 2,500 l/d/connection which is thought to be more representative of the scheme moving forward given that the scheme connections are moving towards a smaller proportion of rural residential connections that have historically been the large users of water. This also aligns well with the demands as outlined in the QLDC Land Development and Subdivision Code of Practice.

### Objective

The objective of this work is to determine if the water supply network has sufficient capacity with the addition of this development. It is noted that this development is outside of the current scheme boundary (shown as a dashed red line) and will increase the previous ultimate flow projection for the Lake Hayes Scheme.

We have completed our investigations based on the development containing the following loads:

| Load Type | Total People | Water Demand per Person (l/d) | Average Day to Peak Day Factor | Load (l/d) | Max Diurnal Peaking Factor |
|---|---|---|---|---|---|
| Villas | 196 | 250 | 3.3 | 161.7 | 2.0 |
| Apartments | 46 | 250 | 3.3 | 38.0 | 2.0 |
| Aged Care | 60 | 250 | 3.3 | 49.5 | 2.0 |
| **Total** | **302** | **250** | **3.3** | **249.2** | **2.0** |

The above assumptions result in an average flow, over the peak day, of 2.88 l/s and a peak demand of 5.77 l/s.

The water demand used for this assessment is from the QLDC Land Development and Subdivision Code of Practice and is likely to be conservative for this type of development. It could be argued that this type of development has the potential to be significantly more efficient in its use of potable water for the following reasons:

- The centralised landscaping that will be in place would result in less water demand than a typical garden of a residential development.
- The developer also has a water take that could be used for irrigation to save potable water being used.

It is noted that some centralised facilities are planned for the site. These will be for the residents of the development and are unlikely to create significant extra demand. With the demand already deemed to be conservative no demand has been added for the central facilities.

**Assessment of Capacity**

Each connection option has been modelled at two connecting pipe sizes to test if the required pipe size can be optimised. Each option has also been assessed for the following scenarios:

- Restricted Supply - a restricted connection whereby onsite tanks would be used to buffer the diurnal peak and to supply firefighting requirements.
- On Demand – the network (including the existing reservoirs) is required to supply water 'on-demand' throughout the day to the required flow and pressure.
- FW2 Firefighting – 25 l/s for 30 minutes. This is in addition to the 'normal' demand above.
- FW3 Firefighting – 50 l/s for 60 minutes. This is in addition to the 'normal' demand above

The actual firefighting requirement is not known at this point in time, although it is thought to be at least FW2 plus any sprinkler system requirement. It is thought that testing the system to FW3 would indicate sufficient capacity for this minimum requirement.

The relevant sections of the network have been checked for capacity using the following criteria:

- A minimum pressure of 300 kpa or 30.6 m under normal peak data demand.
- A maximum pressure of 900 kpa or 91.8 m under normal peak data demand.
- Firefighting capacity has been assessed in addition to the peak day flows with the requirement for a residual pressure of 100 kpa or 10.2 m.

**Results – Network Capacity**

| Option | Pipe Size | Delivery Pressure * | Restricted Supply | On Demand | FW2 | FW3 |
|---|---|---|---|---|---|---|
| **1.1** | 200 mm | **68-84 m** | ✓ | ✓ | ✓ | ✓ |
| **1.1** | 100 mm | **67-84 m** | ✓ | ✓ | × | × |
| **2.1** | 200 mm | **18-39 m** | ✓ | × | × | × |
| **2.2** | 100 mm | **2-38 m** | ✓ | × | × | × |

* Delivery pressure is dependent on time of day and location on the site and is taken from the on-demand scenario.

Maps indicating the results for the cells shaded in blue are attached to this letter.

In regards to firefighting the following should be noted:

- There has been no historical provision for firefighting requirements beyond FW3 in Arrowtown.
- Firefighting requirements could also be provided (or supplemented) in compliance with SNZ PAS 4509:2008 (the New Zealand Fire Service Firefighting Water Supplies Code of Practice) by the use of onsite tanks. These tanks could be filled with a non-potable water supply, such as the irrigation supply discussed previously.

**Results – Storage Requirements**

The requirements for storage are not clear at this time. The existing reservoirs provide 1,350 $m^3$ of storage, but utilising the previous Infrastructure Code requirements indicates that there would be a 730$m^3$ shortfall following the addition of this development, of which 543m3 is generated by this development.

| Storage Element | Requirement | Volume ($m^3$) |
|---|---|---|
| **Firefighting** | FW3 | 180 |
| **Emergency** | 4 hours of peak day flow (44 l/s) | 636 |
| **Operational** | 8 hours of average flow (25 l/s) | 720 |
| **Current Requirement** | | 1,536 |
| | | |
| **Proposed Development** | 4 hours of peak day (2.9 l/s) | 418 |
| | 8 hours of peak day (0.9 l/s) | 125 |
| **Proposed Total** | | 2,079 |

It is advised that discussions are entered into with QLDC as to the level of storage that would be required and how it may be attained.

## Discussion – Water Supply

The current consent limit of 7,800m3 /day for Arrowtown will not be exceeded with the addition of this development and is expected to be sufficient for the foreseeable future compared to the modelled demand of 4286 $m^3$/day including the proposed development.

The bore capacity issue (as discussed earlier in this letter) has been acknowledged by QLDC but at this point it is not programmed within the current Long Term Plan. This development or other significant growth is likely to be the trigger for bringing this upgrade forward. As there is likely to be a wider benefit to the community it is recommended that QLDC complete this project.

It is not known at this point if the treatment plant capacity is significantly higher than the pump capacity. Therefore, at this time, no comment can be made on the treatment plant would also require to be upgraded.

Confirmation of storage requirements will be required from QLDC, the desktop assessment outlined above indicates that there may be insufficient storage available and onsite storage (or other solution) may be required.

The simplest, and likely the most cost effective way, for this development to connect to the water supply network is likely to be option 1 (connecting by a 200 mm pipe along McDonnell Road) as this will provide the required level of service without any additional upgrades.

The level of service that would be provided by connecting to the Lake Hayes Scheme, even if Hogan's Gully Road is upgraded to 200 mm diameter, will be limited due to the lower elevation of the reservoirs. This option is only likely to be viable if the connection is either boosted or a restricted connection with onsite tanks is chosen.

Providing firefighting capacity through the irrigation supply is likely to increase costs as the irrigation network would require significant upgrades in terms of storage / reticulation capacity and redundancy. It is unlikely that there would be a similar drop in costs for the potable water supply. However, tanks located close to the larger centralised facilities (e.g. Aged Care centre) could be used to supplement the firefighting provision beyond FW2 for those buildings without any need to upgrade the reticulation.

There are two points that may change the decision on the preferred option:

- The connection via approximately 1.3km of single pipe does result in a low level of resilience. Given the type of development, it may be beneficial to have some storage on-site to retain a lower level of service if the pipe did fail or a shutdown was required.

- The requirement for reservoir storage will need to be confirmed and the discussion entered into as to how any shortfall in storage could be addressed. If it is decided that storage would be constructed onsite for this development then a restricted supply may become a more economical option.

## Recommendations

It is our recommendation that the development is allowed to connect to the water and wastewater schemes as per the following options:

- Wastewater – Option 5
- Water Supply – Option 1, utilising a 200 mm pipe.

However the following considerations would be required to be raised with QLDC:

- Timing of the programmed upgrade to the Arrowtown water source.
- Confirm the requirement for storage and how to address any shortfall.
- Confirming the ability to connect to the existing wastewater trunk main on Arrowtown – Lake Hayes Road.

Due to the rapid growth occurring in this area, the validity of this letter should be checked any time it is used as supporting evidence in a consent application.

It should be noted that the wastewater and water supply models are an attempt to simulate a physical system using hydraulic equations and various assumptions, hence it bears some uncertainty. QLDC's GIS data was used to develop the models and we can offer no guarantee on the accuracy of this information. The sanitary loads / water demands and diurnal patterns are an approximation of the patterns in the townships which have been agreed with QLDC. It should also be noted that the water models are not fully calibrated and will, hence, provide a lower level of confidence in the results.

Yours Sincerely,

**Mark Baker**
Infrastructure Analyst

**Tom Lucas**
Director / Infrastructure Analyst

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W
E
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**Legend**

**Opt 1-Pressure at Min Press-FW3**

- -4.071302 - 10.200000
- 10.200001 - 30.600000
- 30.600001 - 50.000000
- 50.000001 - 70.000000
- 70.000001 - 91.800000
- 91.800001 - 468.928711

**Opt 1-Velocity at Min Press-FW3**

- 0.000000 - 0.250000
- 0.250001 - 0.500000
- 0.500001 - 0.750000
- 0.750001 - 1.000000
- 1.000001 - 1.250000
- 1.250001 - 1.500000
- 1.500001 - 12.301056

0 95 190 380 570 760
Meters

QLDC Water Supply - Arrowtown Retirement Village - Option 1, 200 mm Main, FW3 Results

N
W
E
S

**Legend**

**Pressure (m)**

- -4.071302 - 10.200000
- 10.200001 - 30.600000
- 30.600001 - 50.000000
- 50.000001 - 70.000000
- 70.000001 - 91.800000
- 91.800001 - 468.928711

**Velocity (m/s)**

- 0.000000 - 0.250000
- 0.250001 - 0.500000
- 0.500001 - 0.750000
- 0.750001 - 1.000000
- 1.000001 - 1.250000
- 1.250001 - 1.500000
- 1.500001 - 12.301056

0 95 190 380 570 760 Meters

QLDC Water Supply - Arrowtown Retirement Village - Option 1, 200 mm Main, Peak Day Normal Demand Results

N
W
E
S

**Legend**

**Results**

- -4.071302 - 10.200000
- 10.200001 - 30.600000
- 30.600001 - 50.000000
- 50.000001 - 70.000000
- 70.000001 - 91.800000
- 91.800001 - 468.928711

**Results**

- 0.000000 - 0.250000
- 0.250001 - 0.500000
- 0.500001 - 0.750000
- 0.750001 - 1.000000
- 1.000001 - 1.250000
- 1.250001 - 1.500000
- 1.500001 - 12.301056

0 95 190 380 570 760
Meters

QLDC Water Supply - Arrowtown Retirement Village - Option 2, 200 mm Main, Normal Peak Day Demand Results

N
W
E
S

0 220 440 880 1,320 1,760
Meters

**Legend**

**Overflow Volume (m3)**

- 0.000000 - 0.001000
- 0.001001 - 100.000000
- 100.000001 - 200.000000
- 200.000001 - 300.000000
- 300.000001 - 727.667765

**Gravity Pipe (Flow/Capacity)**

- 0.00000000 - 0.250000000
- 0.250000001 - 0.500000000
- 0.500000001 - 0.750000000
- 0.750000001 - 1.00000000
- 1.00000001 - 6.26196933

**Model Pipes**

- Gravity
- Pressure

QLDC Wastewater Network Capacity - Arrowtown Retirement Village - Option 3

N
W
E
S

**Legend**

**Overflow Volume (m3)**

- 0.000000 - 0.001000
- 0.001001 - 100.000000
- 100.000001 - 200.000000
- 200.000001 - 300.000000
- 300.000001 - 727.667765

**Gravity Pipe (Flow/Capacity)**

- 0.00000000 - 0.250000000
- 0.250000001 - 0.500000000
- 0.500000001 - 0.750000000
- 0.750000001 - 1.00000000
- 1.00000001 - 6.26196933

**Model Pipes**

- Gravity
- Pressure

0 220 440 880 1,320 1,760
Meters

QLDC Wastewater Network Capacity - Arrowtown Retirement Village - Option 5