Construction and Commissioning of the Shotover Delta DAD System

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Environmental
Impact

QUEENSTOWN
LAKES DISTRICT
COUNCIL

Fluent
SOLUTIONS

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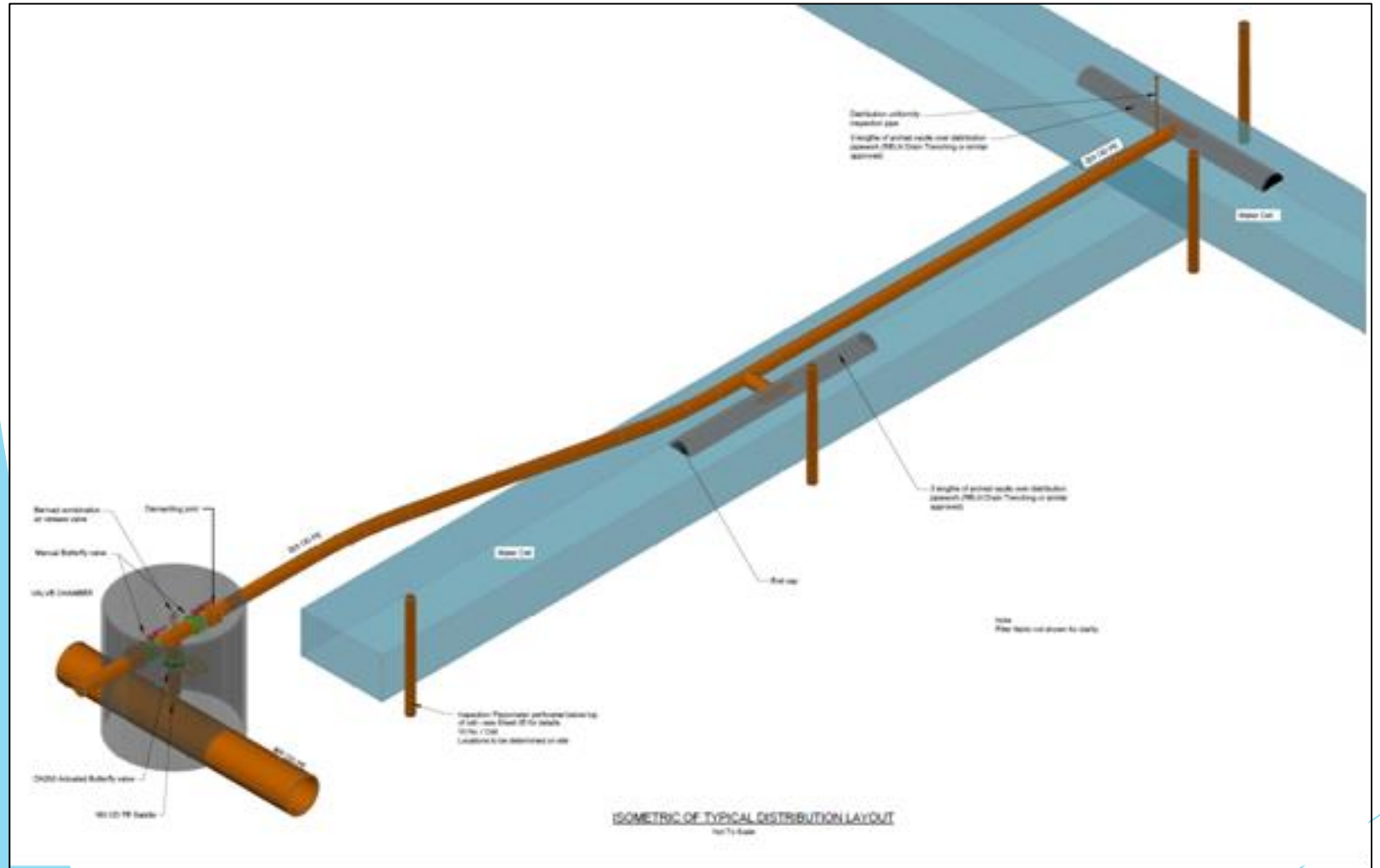
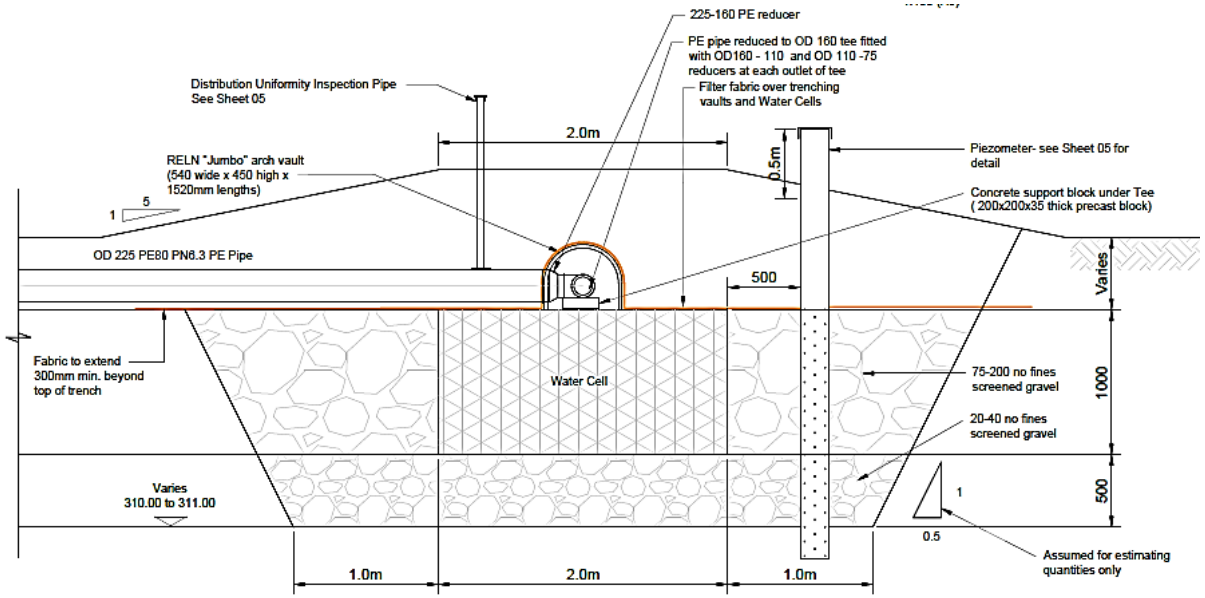
Cost Effective

- The innovative design cost approximately $4 million - reduced from estimated $19 million for a traditional LPED system on platform



- Each cell is 35 long with a 35 m long T, with 2 cells/zone
- Distributed at centre of each cell

Design



Typical Section through the DAD System

- 4 m wide trench, battered
- 1 m of open gravels under cells
- 1 m depth x 2 m wide water cells
- 5 ops piezos/zone + monitoring

Plan of the 11 DAD zones with 800 mm distribution pipe

Design Details

- Effluent 30/30/23/260 Stage 1 to 10/10/10/10 Stage 3 after N trigger
- Underlying soils K of 5 to 80 m/d
- Relationship between particle size and K developed
- Site significantly test pitted to arrive at design hydraulic loading
- Variability required flow to each cell to be able to be tweaked
- FOS of 50% used in sizing system to allow degradation from TSS & BOD
- Groundwater 1.5 m depth and direction parallel to Shotover towards Kawarau - Shotover mainly losing to groundwater
- Relatively flat gradient giving ~ 2 - 10 m/d travel – up to 10 – 50 days to reach Kawarau River
- Mounding due to DAD likely to change direction more towards Shotover River – 2 – 5 days travel

Exceeding Expectations

- Commissioning data indicates the capacity of the field is approximately twice the original design – as per 50% FOS
- This may result in the benefit of delayed future expansion of the field and further significant cost savings to QLDC
- The DAD system is designed for peak flow of 440 L/s (45,000 m^3/d) but is currently operating at between 77 and 330 L/s and an average of 162 L/s (14,000 m^3/d)
- Each zone originally designed to take 50 L/s, with multiple operating as required based on flow – pressure sensors
- High rate system – peak design hydraulic load is 1.6 m/d over entire 2.8 ha area, or 7 m/d over 1,600 m^2 bottom area only
- Average design hydraulic load is 0.9 m/d over entire area, 4.2 m bottom area only

Construction

800 mm diameter distribution pipe from UV chamber

Construction

Bed of gravel at base of trench, water cells tied together and installed. Monitoring piezometers installed. Manholes installed in centre of each field with control valves

Construction

Trenches backfilled with gravels

Construction

Geofabric installed above water cells. 200 mm distribution pipes to each ‘T’ from central pipe with distribution nozzles on top of cells - incomplete

Construction

Butterfly valve with electrical actuator on off-take riser to each zone. Manual valves installed on 200 mm distribution pipe to each cell

Construction

DAD Dispersal field backfilled to finished levels and planted with native species

Key Learnings

Willow Trees

- Significant concern re potential for the willow roots to clog the HDPE water cells
- Mitigation the risk of willow growth included:
  - All roots in the trenches cut neatly
  - Herbicide applied to roots
  - Almost all willow trees within the DAD dispersal field felled
- Willow growth will be closely managed as part of the ongoing DAD dispersal field maintenance

Key Learnings

Actuated Valves

- Electrical actuators opening and close each zone based on pressure
- Problems encountered with the torque required to close valves tripping the actuators. Rectified by re-seating the butterfly valves

Key Learnings

Control System

- Requires little operator intervention
- Considers:

  - Flow rate from the UV chamber

  - Required average flow per field

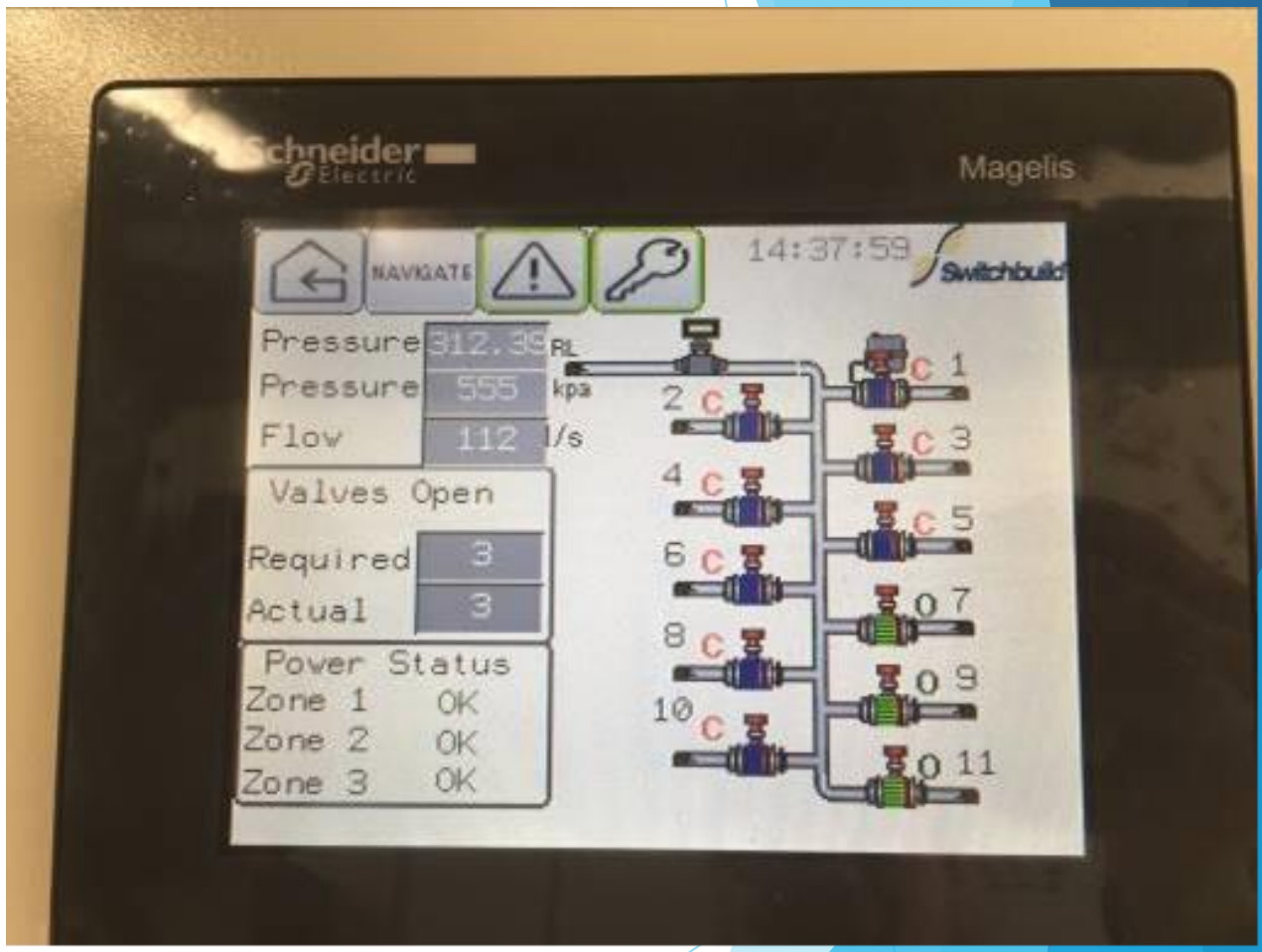
  - Sequence of fields opening

  - Lag time in opening new field

  - Max number of field continuous run hours

  - Run time of fields to ensure even distribution

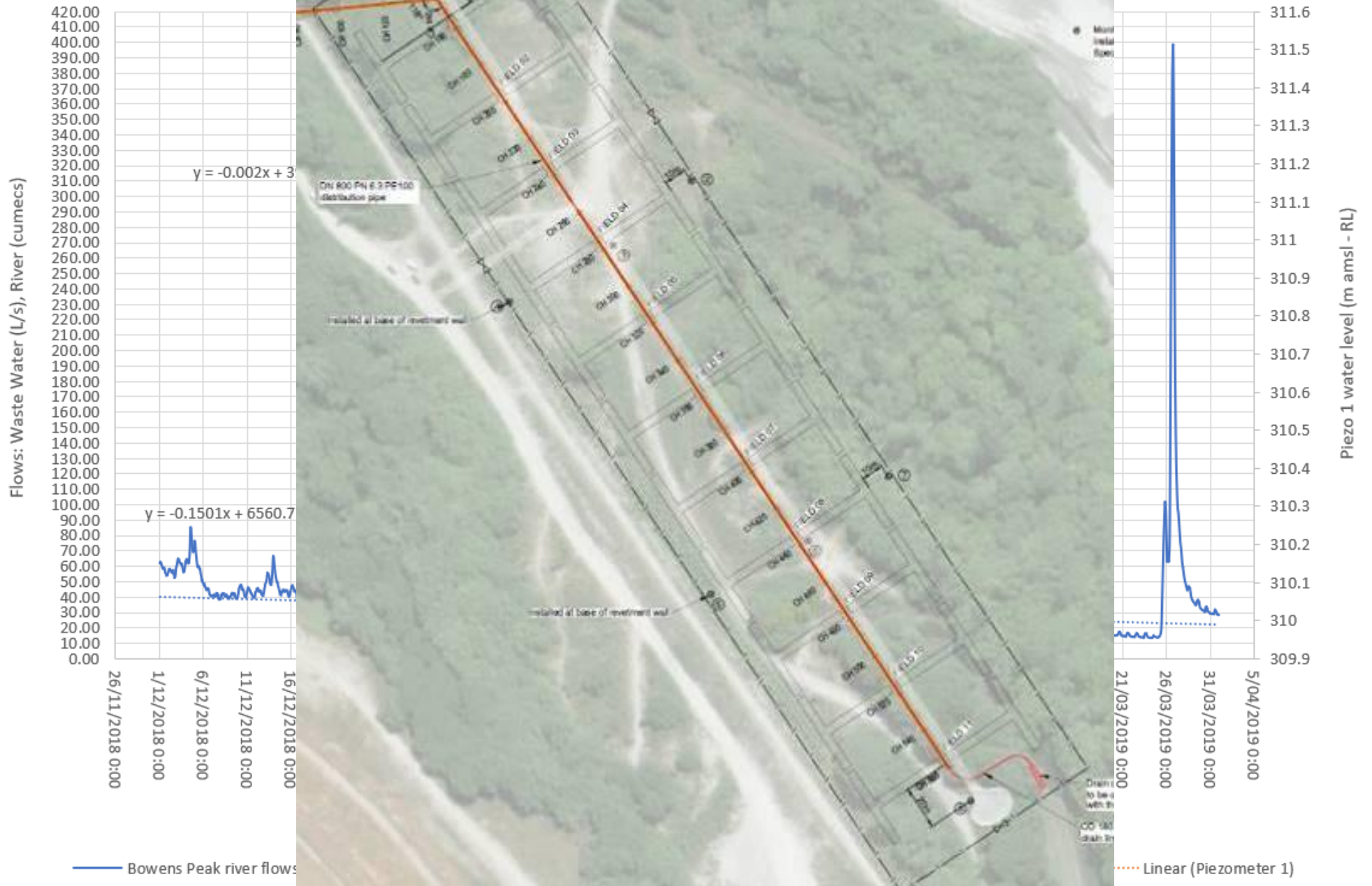
  - Pressure build up in 800 mm pipe



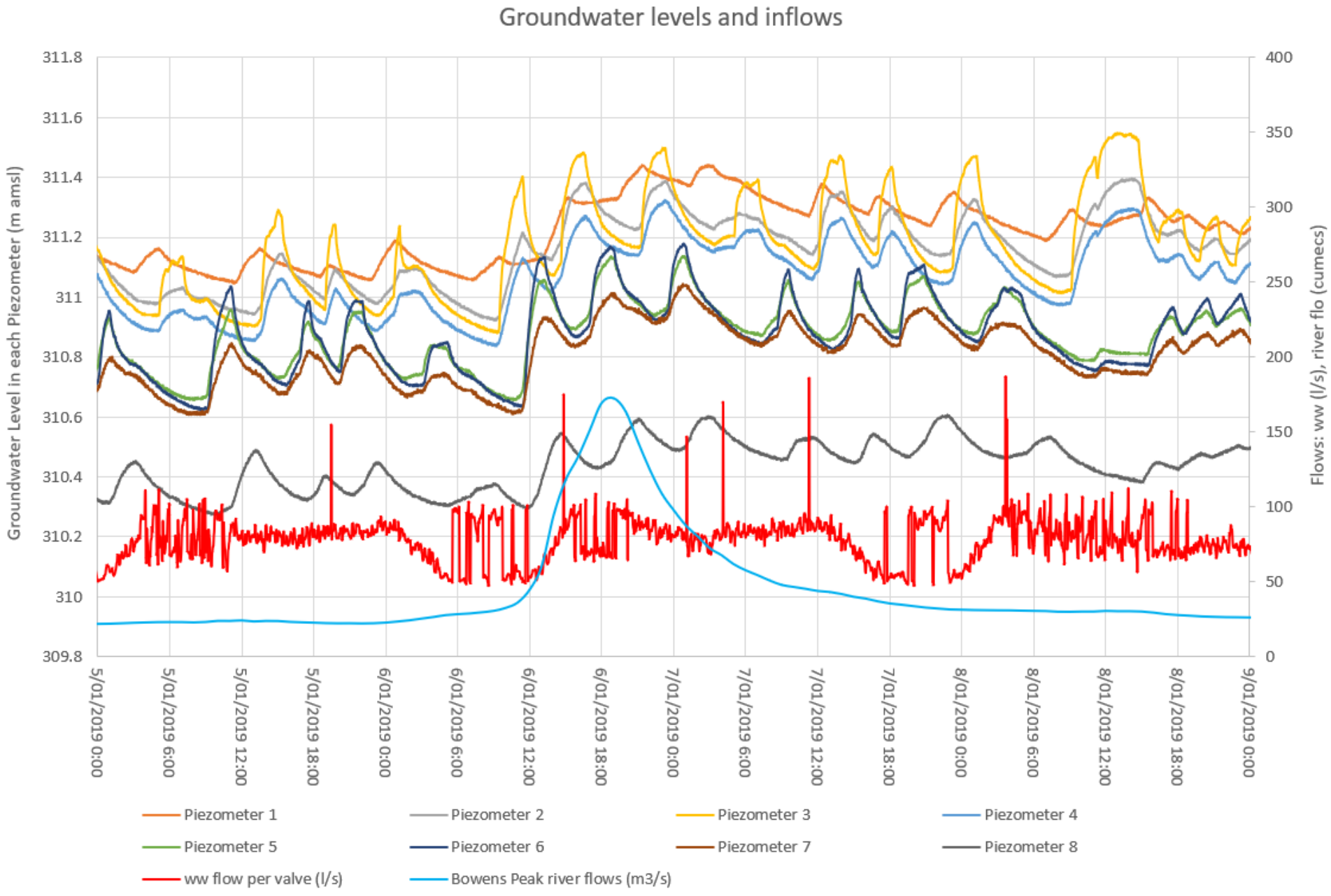
First Three Months of Operation

- Data just received – still being evaluated
- Found a few unexplained anomalies
- Some data loggers eroded off cables
- Some stopped working - have full information for some piezometers
- Difficult to know flow to each zone when more than one operating
- System performing very well regarding rise in water levels during operation - ~200 mm rise from dose
- System seems to recover quickly after each dose - long-term mounding predicted in modelling not yet evident
- Levels in piezos more sensitive to flows in Shotover River - ~ 300 mm

Relationship



Relationship with River – 5 days



What Next

- **Establishing Baseline and Optimising Design**
  - Each cell set operated for a period to measure the water level in the piezometers and to gain Scada data to benchmark hydraulic performance of each cell at varying flow rates.
  - Provide baseline to check against in future to see if reducing hydraulics
- **Operation at High Flows**
  - Once relationship established above, push 2 – 3 cells to limit and then corelated to the data obtained above to understand limit of all cells
- **Optimising Distribution**
  - Altering manual valves even distribution/water levels in cell sets
- **Slug Tests**
  - Establish aquifer parameters for better mounding modelling

Conclusions

- The use of stormwater storage cells for receiving a large dose of effluent is a first in NZ, possibly anywhere
- It has allowed a high rate dispersal system to be used while allowing drainage at natural rates through underlying soils under gravity
- A DAD system on river side of the revetment has saved the community a significant sum
- The DAD system appears more sensitive to river levels than the dose itself. River braid location may therefore also be important and may need controlling in future if groundwater mounds
- Design rates have to date been shown to be conservative but benchmarking is required to see if this will be the long term conclusion
- The system needs pushing in order to optimise future design

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Thank you for your attention