



Modelling Group  
WATER NEW ZEALAND

# Modelling Symposium



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# VALIDATION OF THE WAIKATO R2R INFOWORKS MODEL:

A CRUCIAL TOOL FOR IMPROVING AUCKLAND'S DROUGHT RESILIENCE

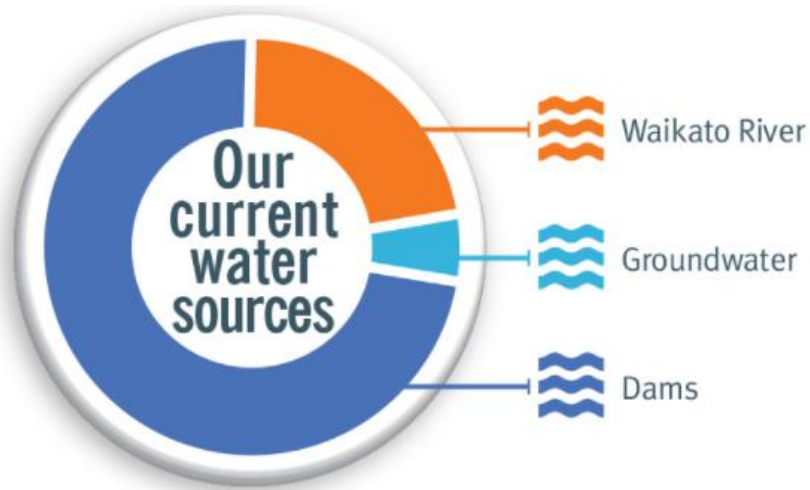
Presented by  
KIRWIN TAN | BRENDON HARKNESS

# Topics covered today

- Auckland's water supply
- Auckland's worst drought in recent times
- Watercare's transmission "bulk" water supply model
- The R2R system
- Validation of the R2R system
- Lessons learnt

# Auckland's Water Supply

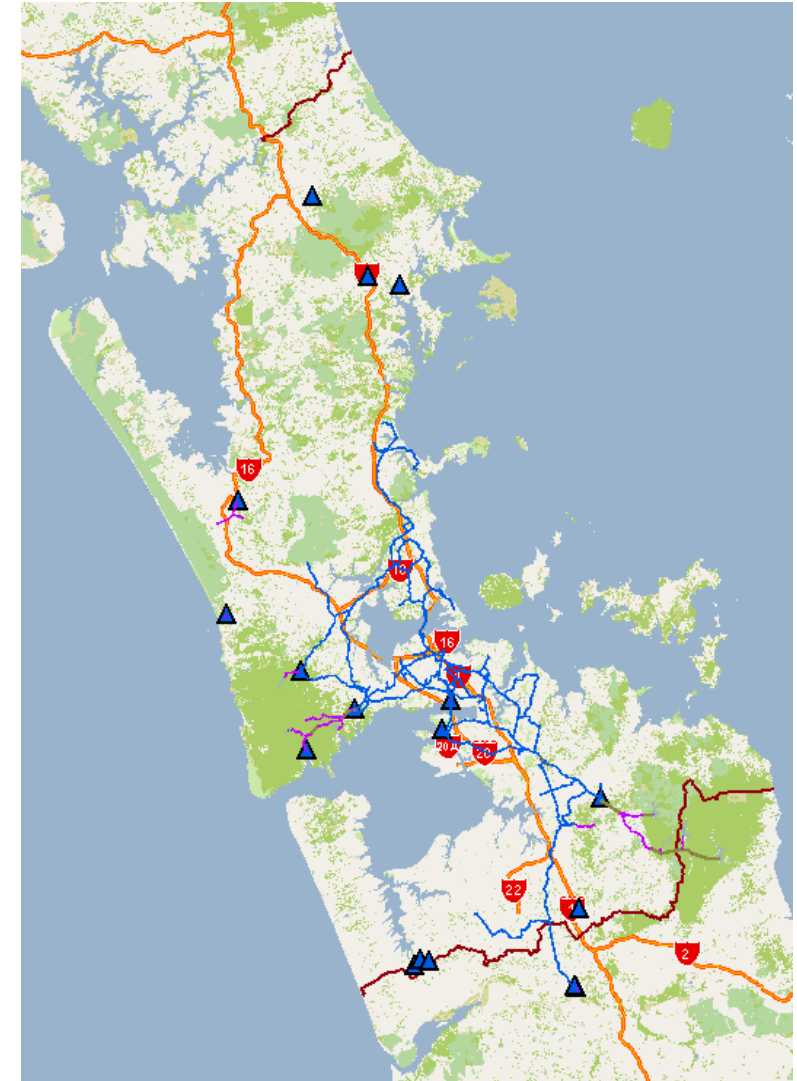
- Watercare supply water and wastewater services to approximately 1.7 million people – from Waiwera to Pokeno
- Auckland's water is drawn from dams, rivers, groundwater and springs



In the seven days to 27 February 2022, the proportion of water supplied by each source was:

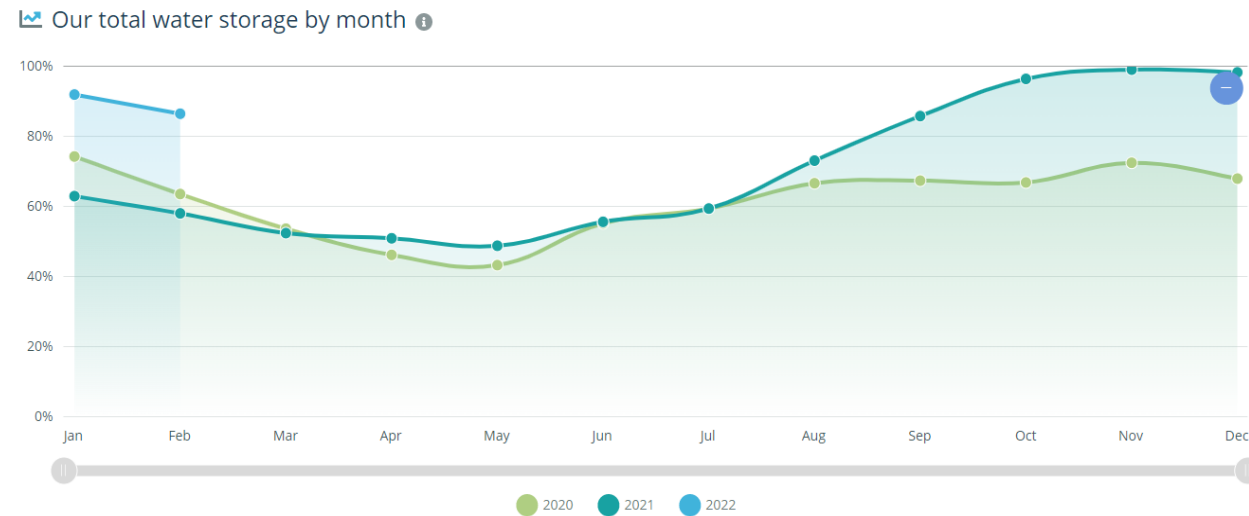
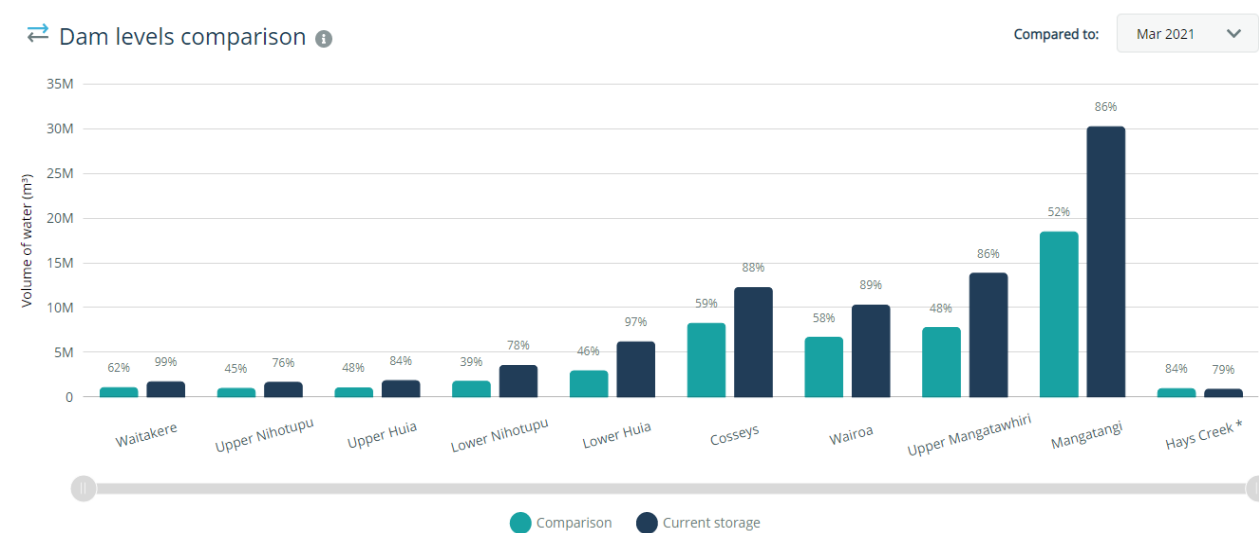
Dams = 72.80%  
Waikato River = 22.14%  
Groundwater = 5.06%

That % can vary due to the levels in the storage dams, forecast rainfall, treatment plant capacity, and the cost of transmitting water to the treatment plant.



# Auckland's Worst Drought In 25 years

- There are 5 dams in the Hunua Ranges which combine to supply approximately 60% of Auckland's water.
- During the drought, the water level in these dams, along with the dams in the rest of the region, dropped to a concerning level – water restrictions were in place to temporarily manage the risk



# Auckland's Worst Drought In Recent Times



# So how do we solve this problem?

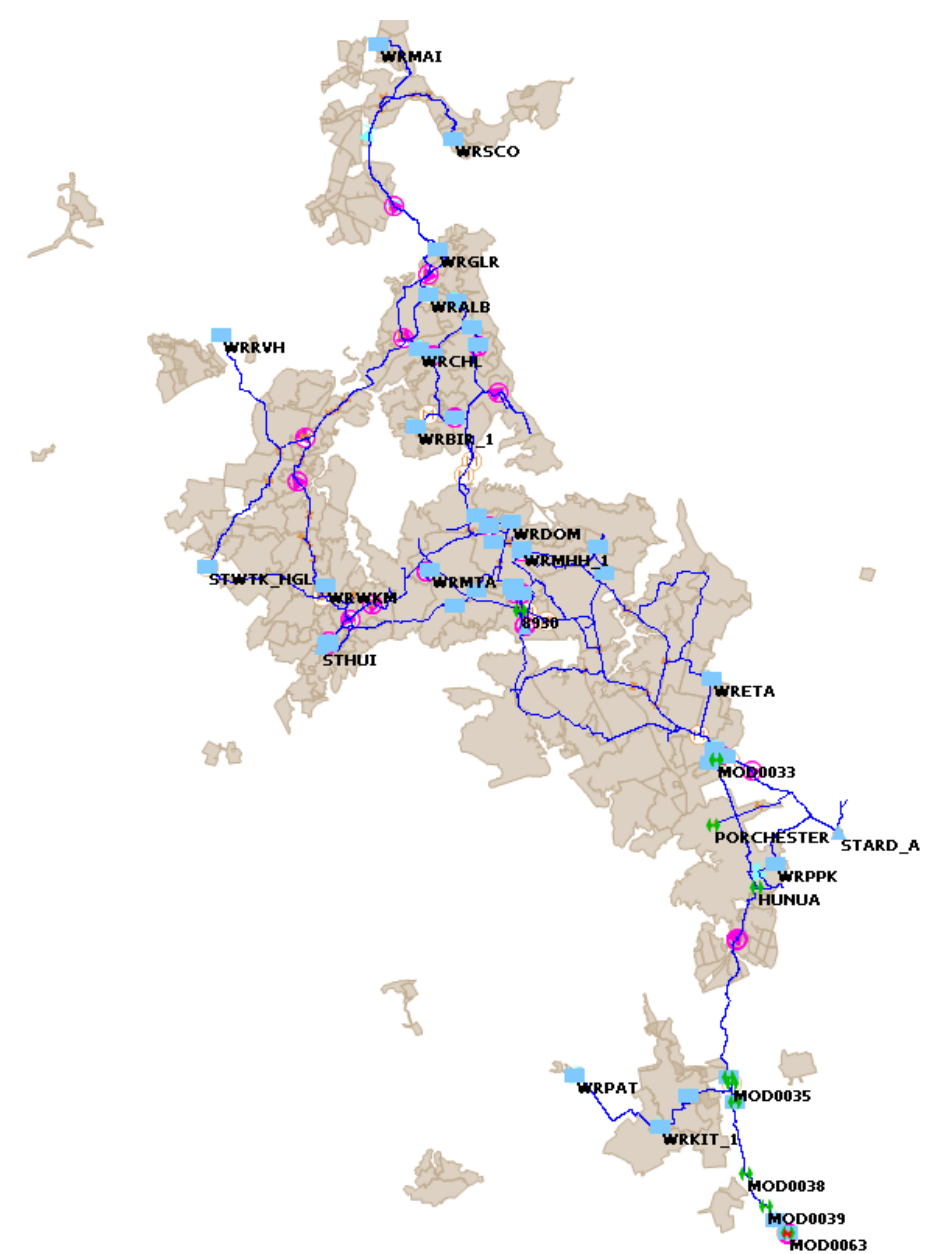
Over the last few years, a number of projects have been accelerated to provide greater resilience to Auckland's water supply including:

- Waikato WTP 175MLD upgrades
- Pukekohe East Reservoir (50ML)
- Waikato-50 WTP (50MLD)
- Waikato 1 Booster Pump Station (225+ MLD)
- Pukekohe WTP (5MLD)
- Papakura WTP (6MLD)
- Onehunga WTP (boosting treatment capacity by 4MLD)
- Leakage detection (estimated to save approx. 9MLD)



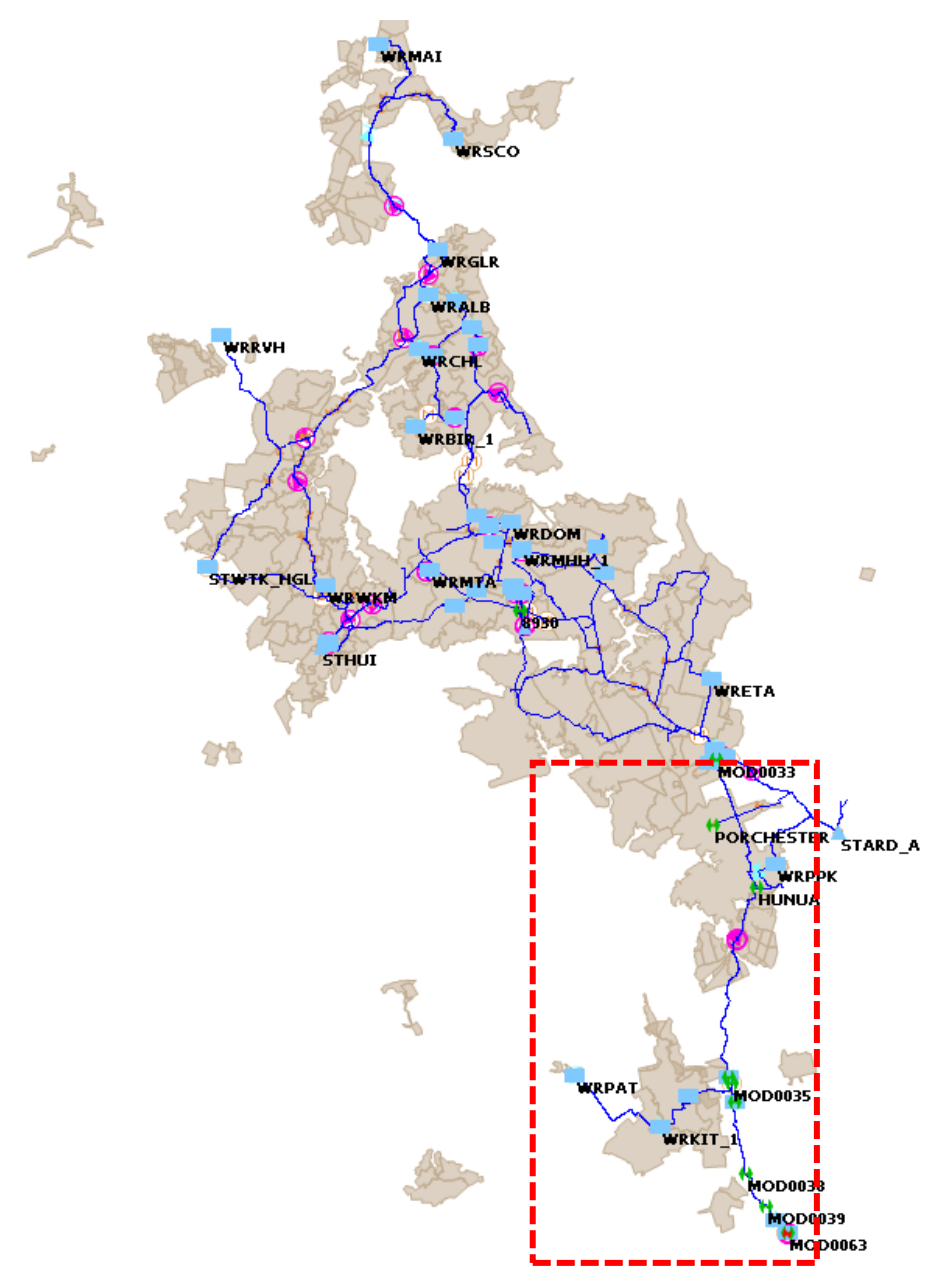
# Transmission Model

- Bulk network within the metropolitan area – from the Water Treatment Plant to Bulk Supply Points
- On-going rolling re-validation
- Needed to accelerate the operation of the system beyond 175MLD
- Focus on Waikato River to Redoubt Reservoir (R2R) system



# Transmission Model

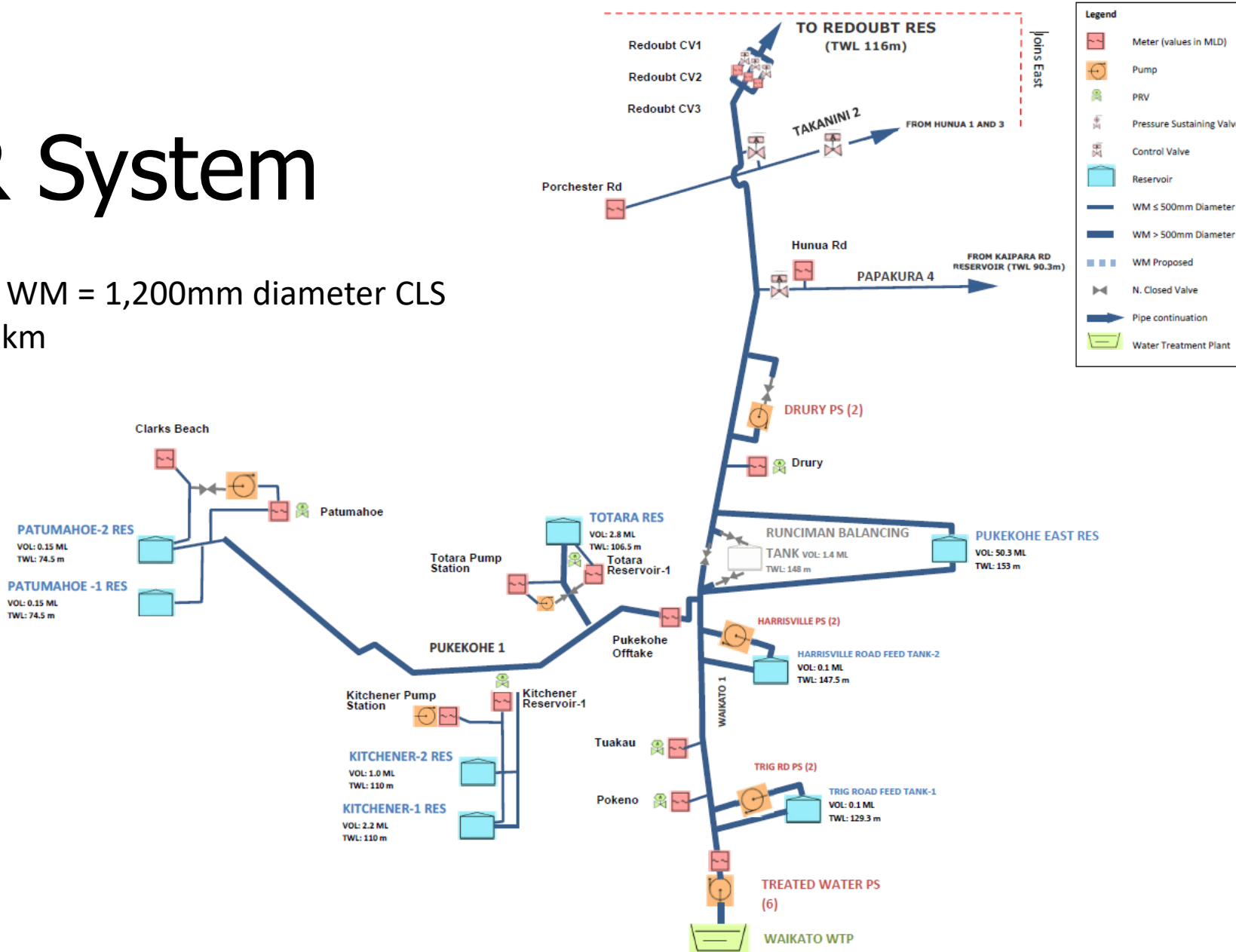
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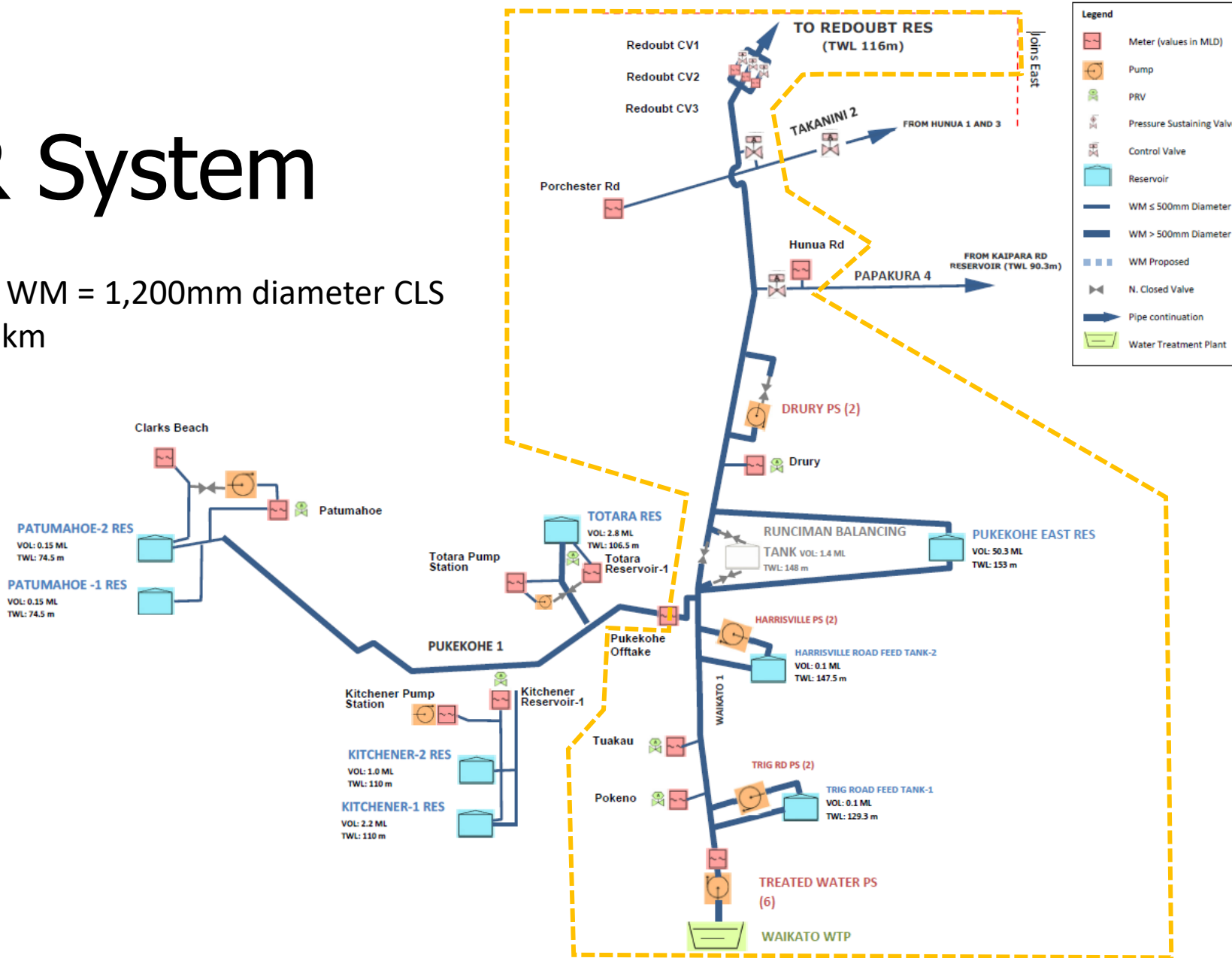
# R2R System

Waikato 1 WM = 1,200mm diameter CLS  
Approx 35km



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Approx 35km



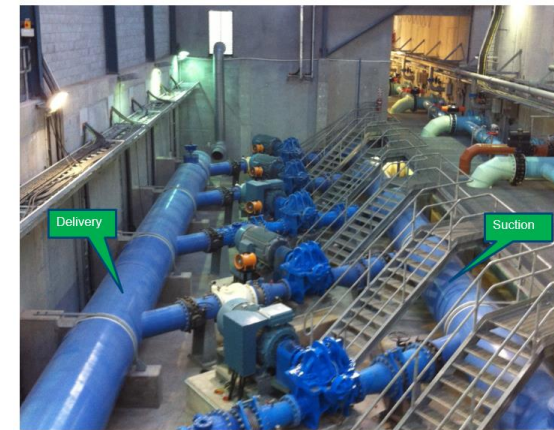
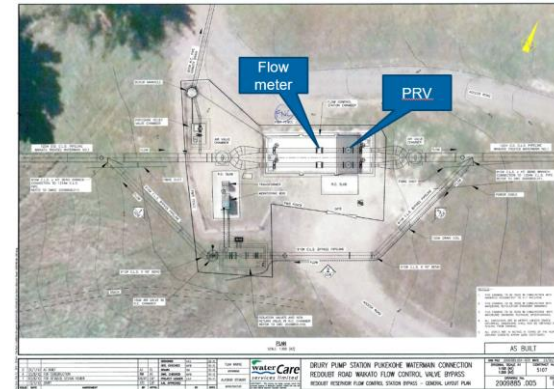
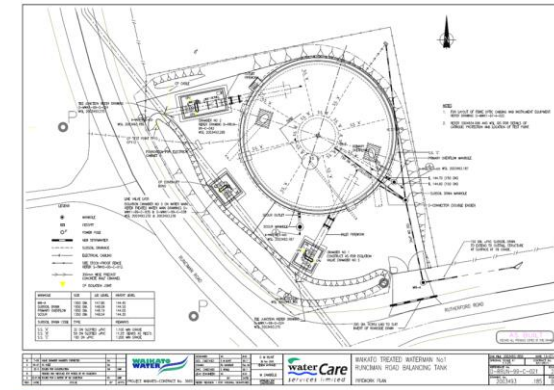
# Validation

- Model setup / update
- Field monitoring
- Flow / trunk balances
- Model validation



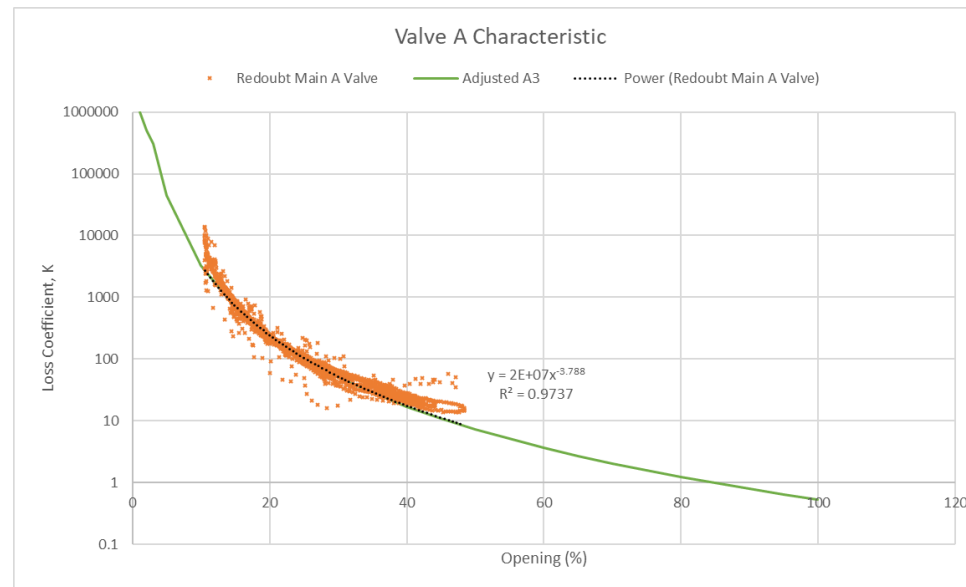
# Model Setup / Update

- Collaboration with Operators, Control Engineers, and Design Partners
- Local losses applied to the model based on as-builts
  - Waikato WTP pump station
  - Runciman Reservoir
  - Redoubt Reservoir Inlet Valve Complex
- Apply default pipe roughness ( $k = 0.036\text{mm}$  – from other studies)
- Model controls updated to reflect operational controls
  - Waikato WTP pumps operating to maintain upstream clean water tank
  - 2 pumps operating during low flow with additional pumps trigger at set points
  - Redoubt Control Valves operating to maintain Runciman Reservoir level (upstream)



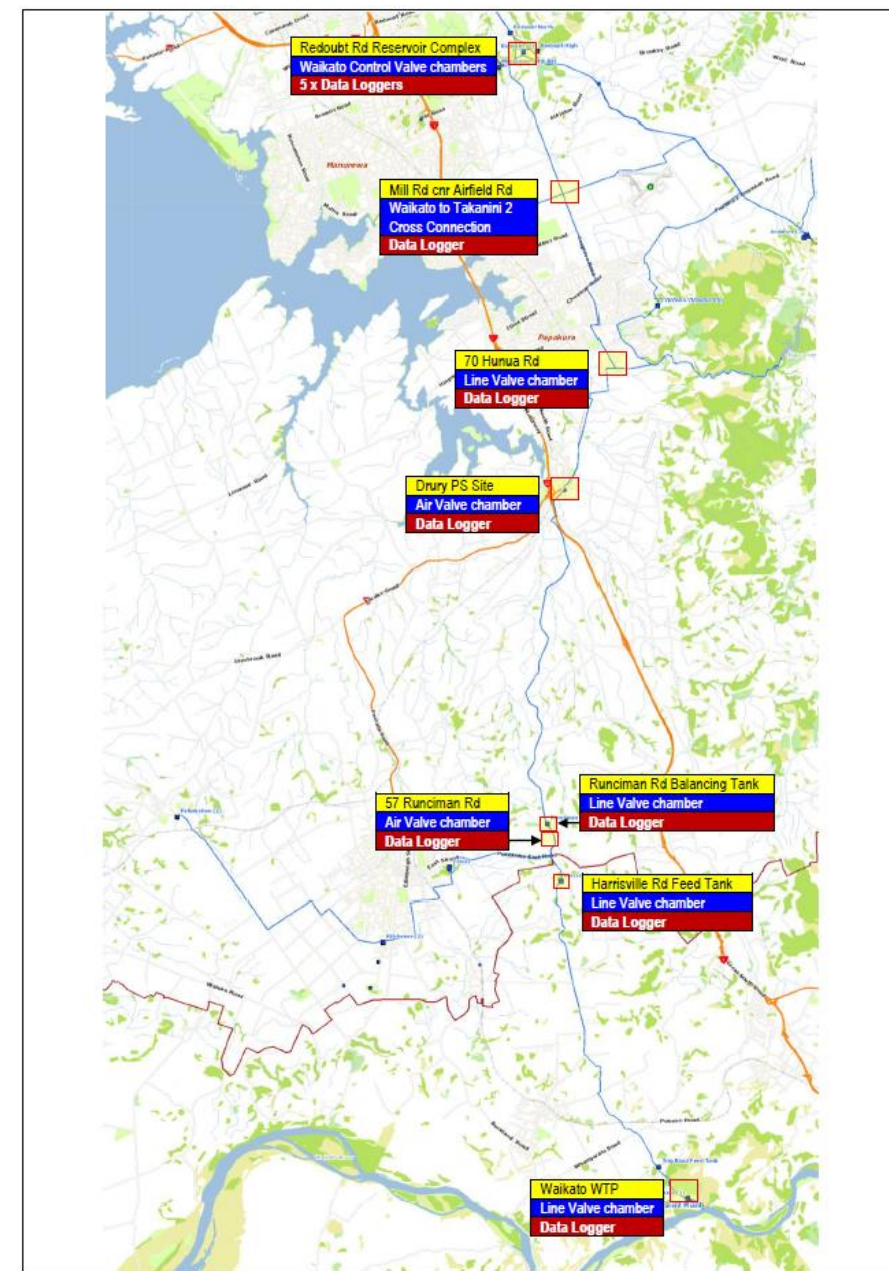
# Model Setup / Update

- Waikato Pump curves - manufacturer
- Redoubt Control Valve curves (original 2) – performance tests

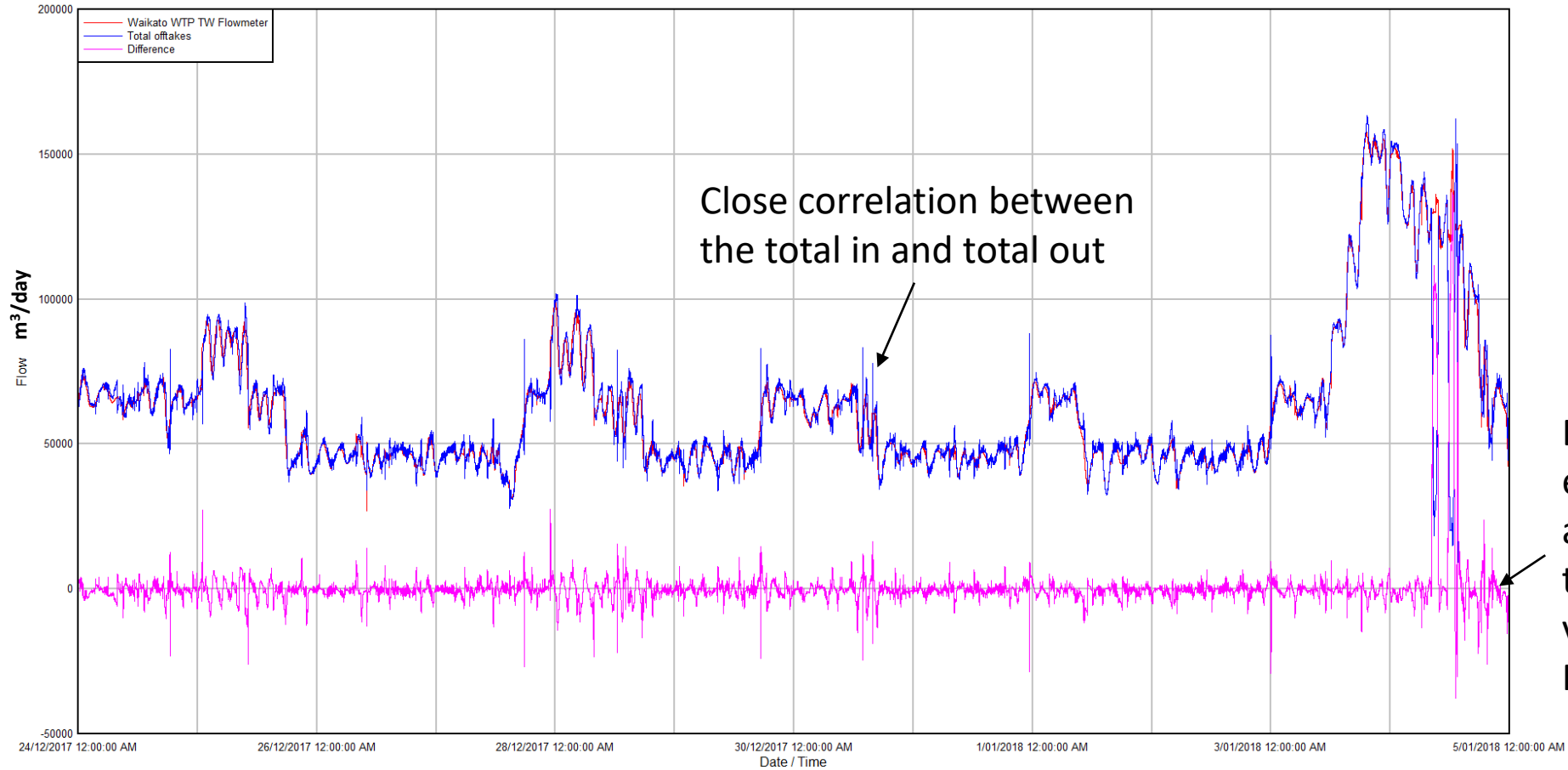


# Field Monitoring

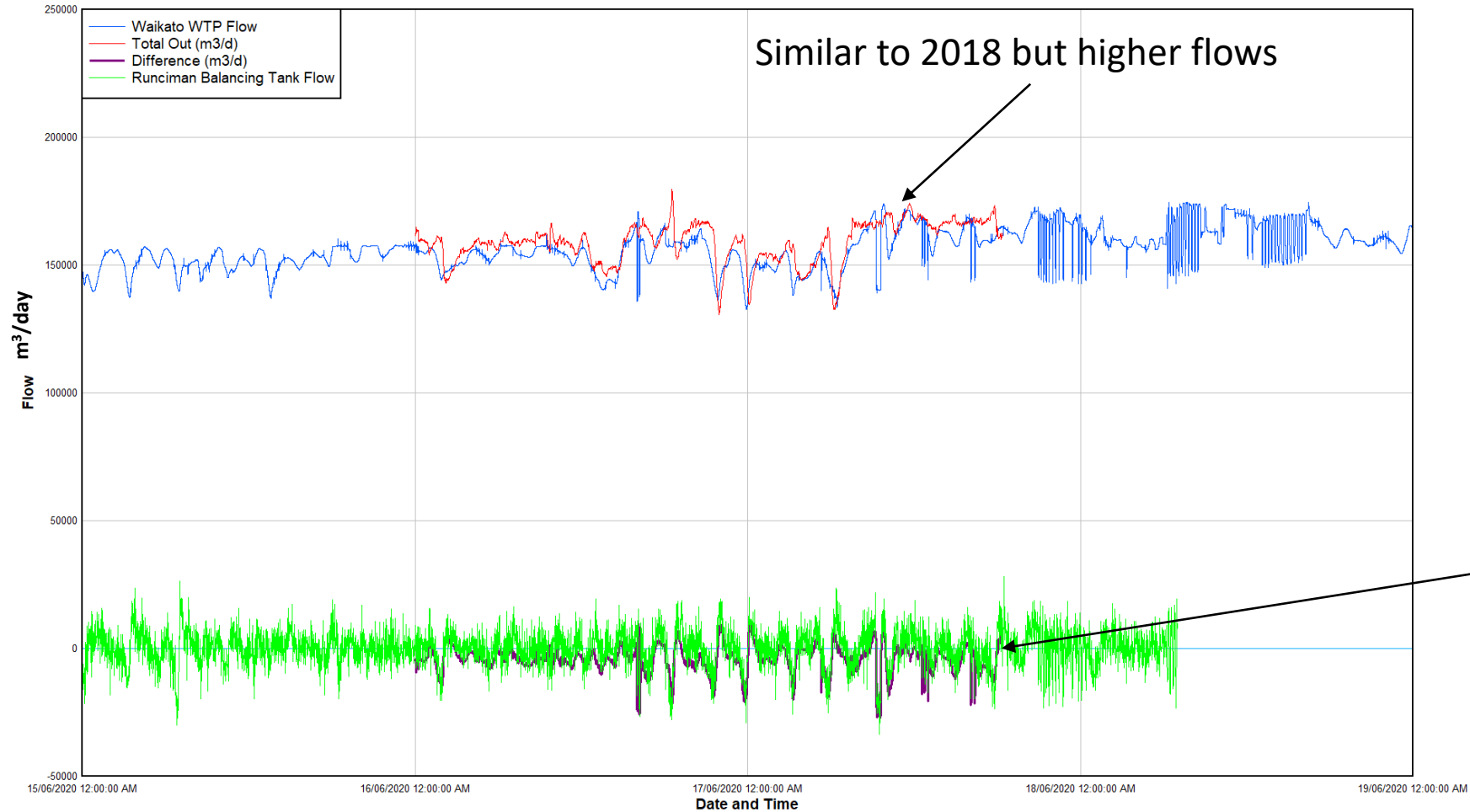
- 13 pressure loggers were installed in 2018
- 12 pressure loggers were installed in 2020
  - Inflowmatix – enabled live monitoring of the pressures recorded



# Flow Balance - 2018



# Flow Balance - 2020

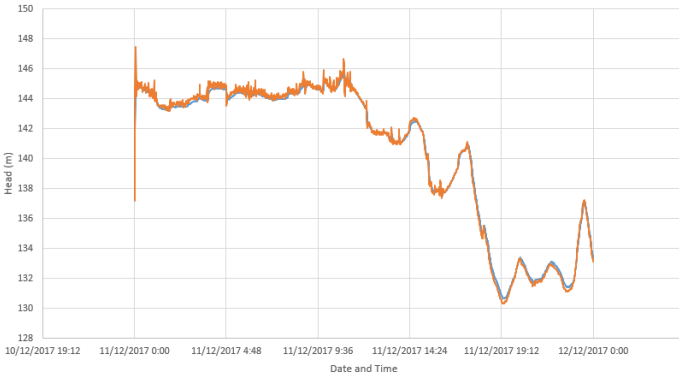




# Model Validation 2018

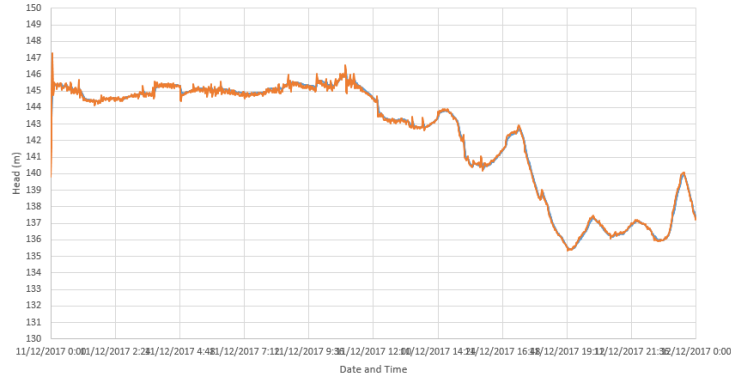
Papakura Xcon Head

— Model — Pressure Data



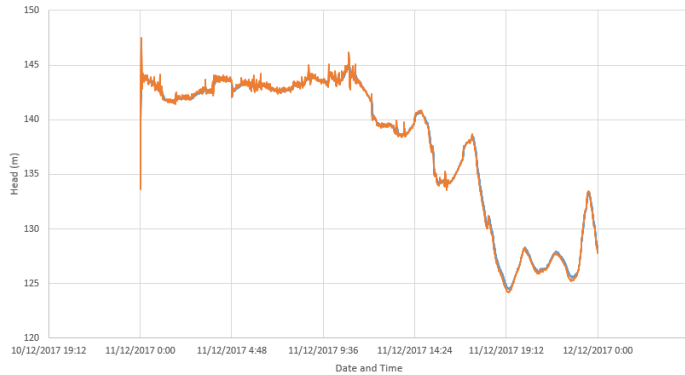
Drury PS Head

— Model — Pressure Data



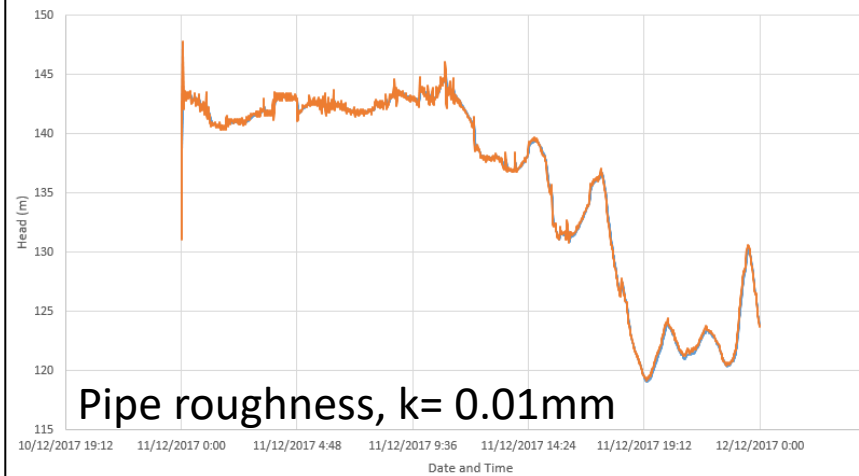
Takanini Xcon Head

— Model — Pressure Data



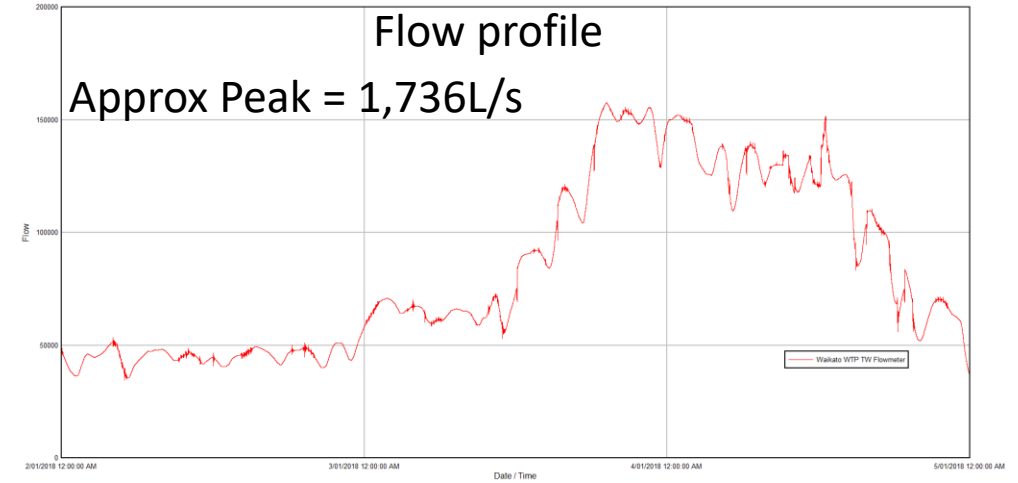
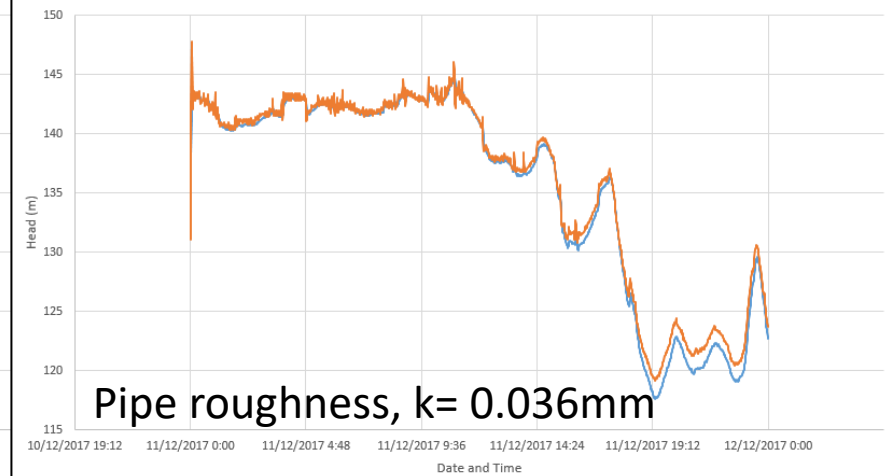
Redoubt Rd Valve A Upstream

— Model - Valve A upstream — Pressure Data - Valve A upstream



Redoubt Rd Valve A Upstream

— Model - Valve A upstream — Pressure Data - Valve A upstream

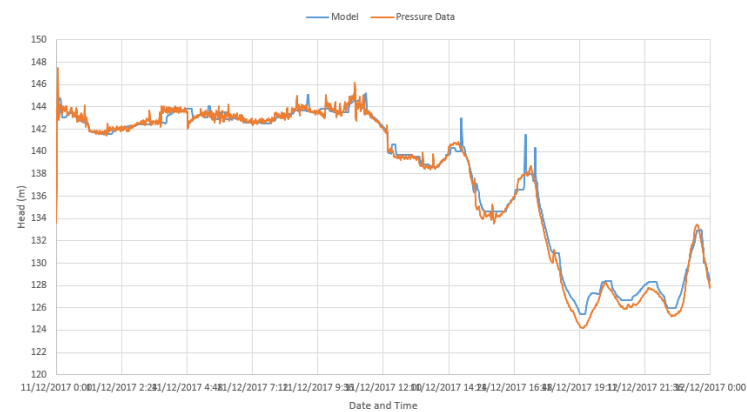


# Model Validation 2018

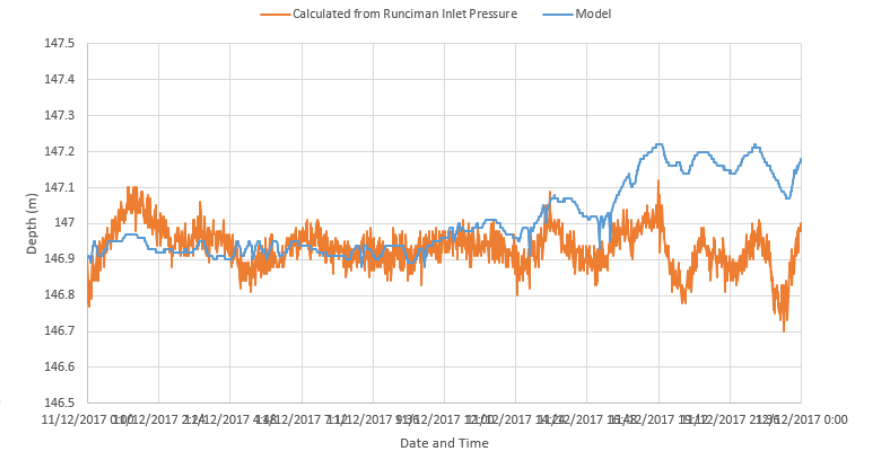
Flow Comparison



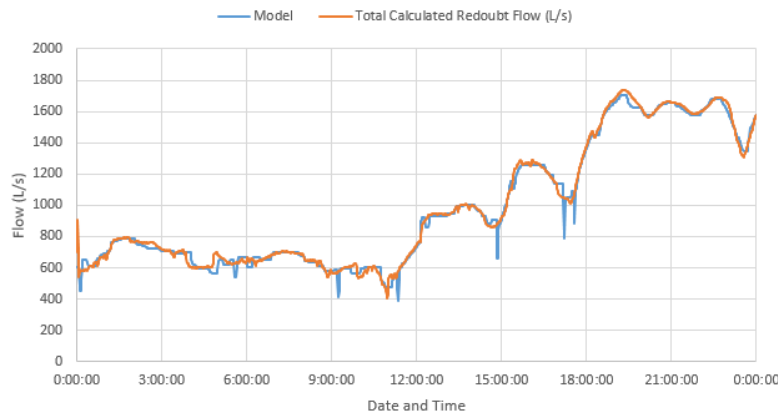
Takanini Xcon Head



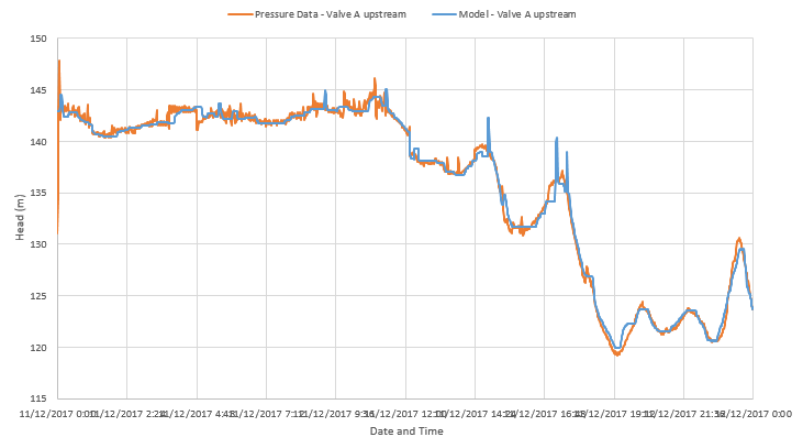
Runciman Reservoir Level



Redoubt CV Flow



Redoubt Rd Valve A Upstream

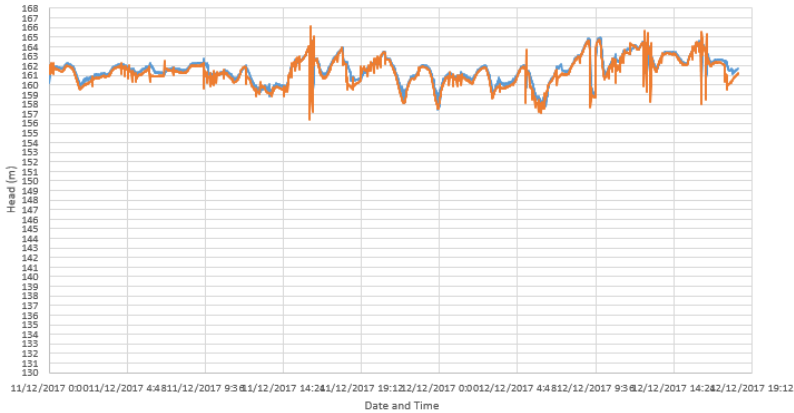


- Flow matched – in and out
- Pressures aligned
- Runciman reservoir – model appeared to react faster than observed data

# Model Validation 2020

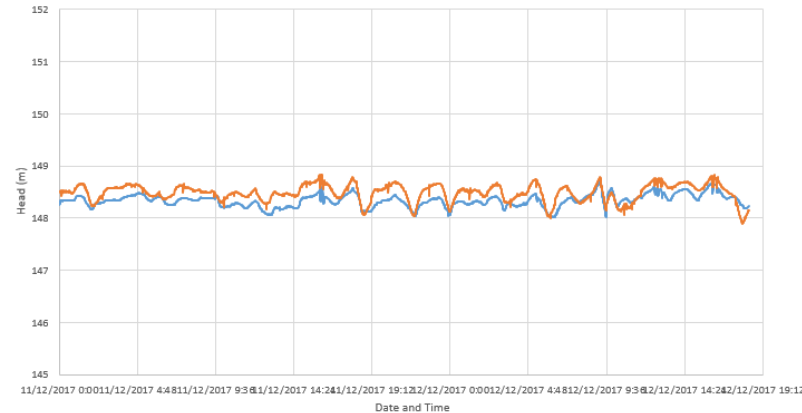
Waikato Head

— Model — Pressure Data



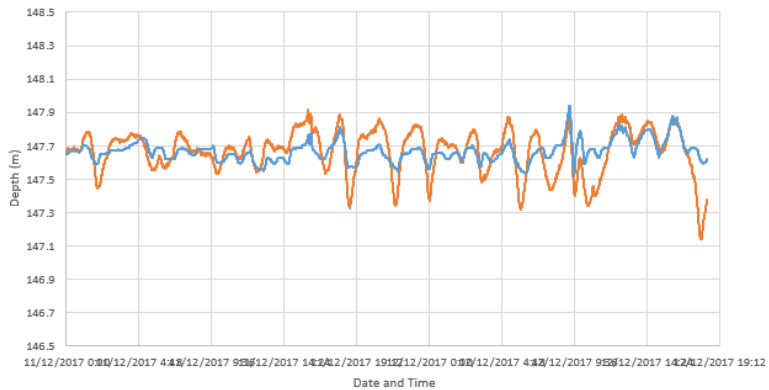
Pukekohe Offtake Head

— Model — Pressure Data



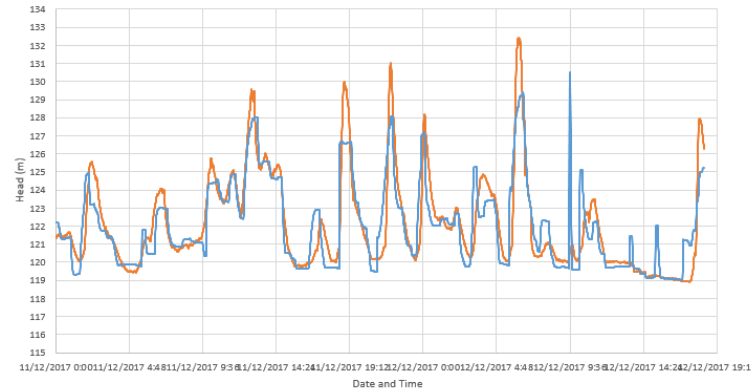
Runciman Reservoir Level

— Calculated from Runciman Inlet Pressure — Model



Redoubt Rd Valve A Upstream

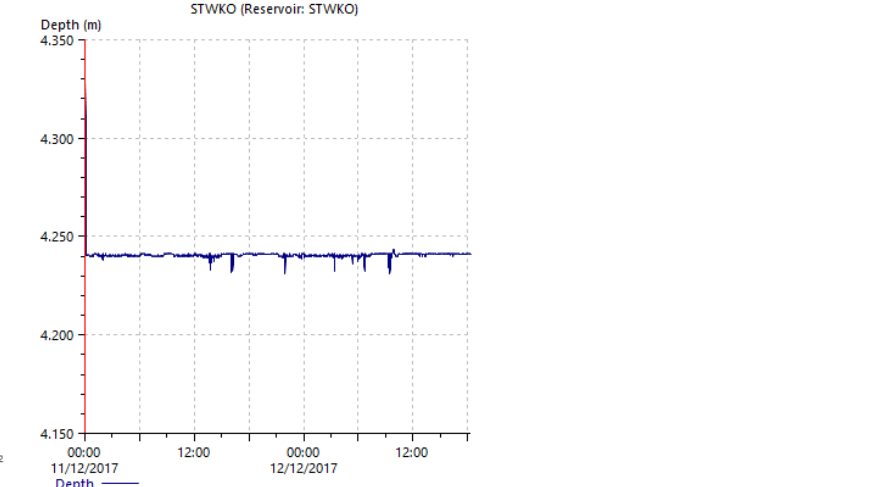
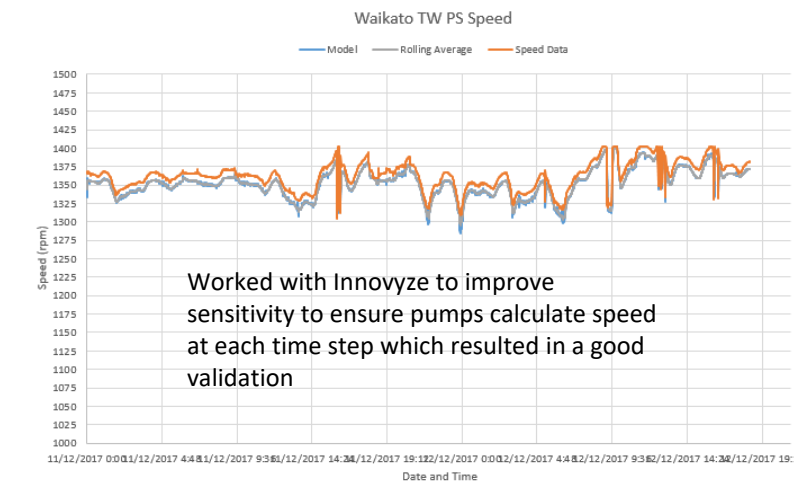
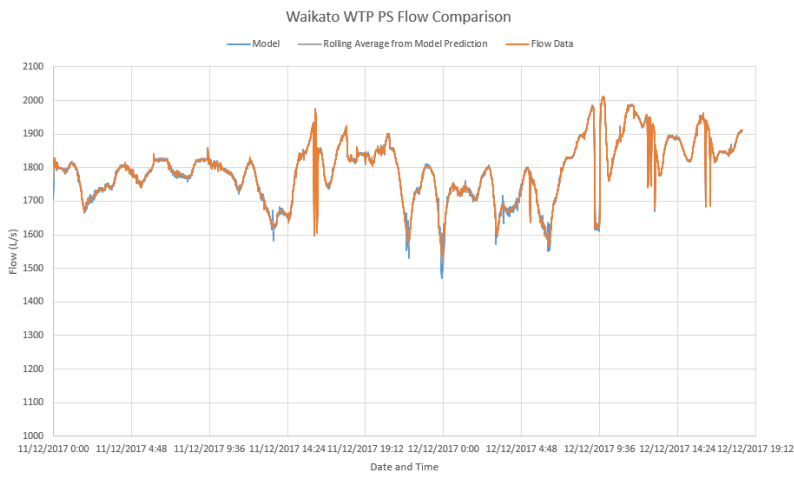
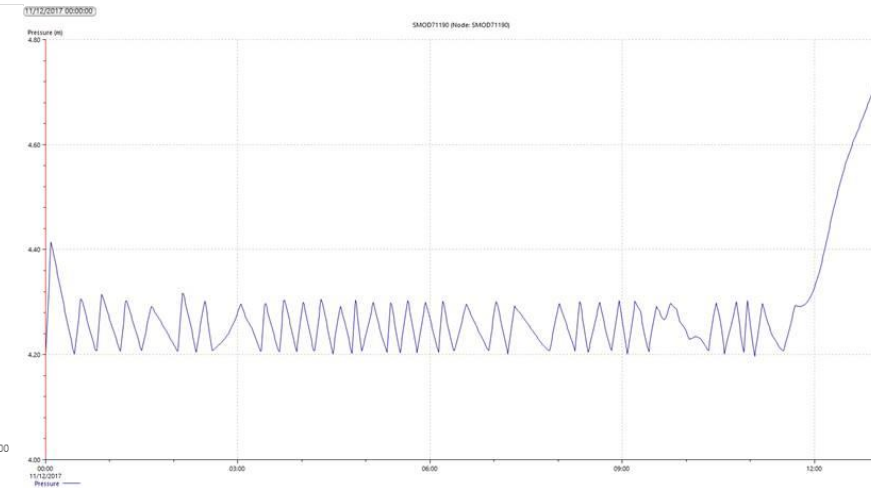
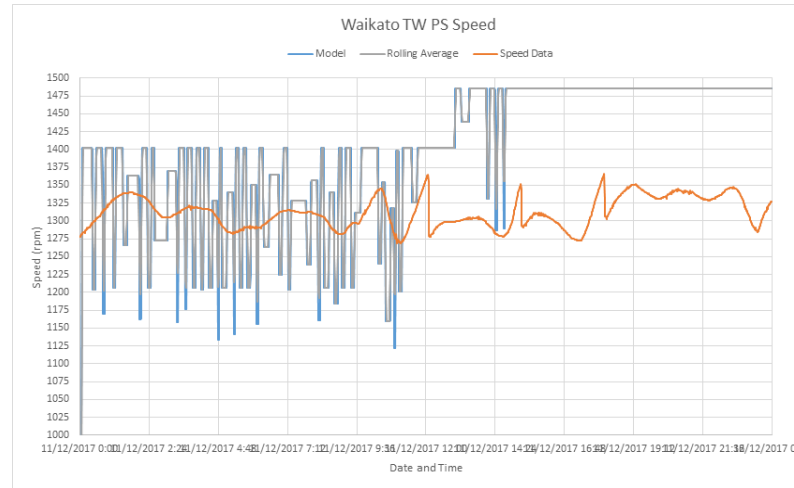
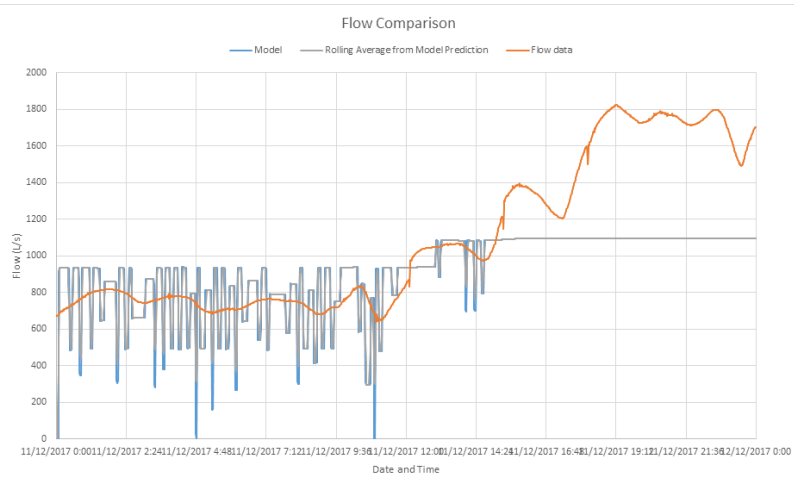
— Pressure Data - Valve A upstream — Model - Valve A upstream



- Results similar to 2018
- Runciman Reservoir – model appears to react faster than observed data

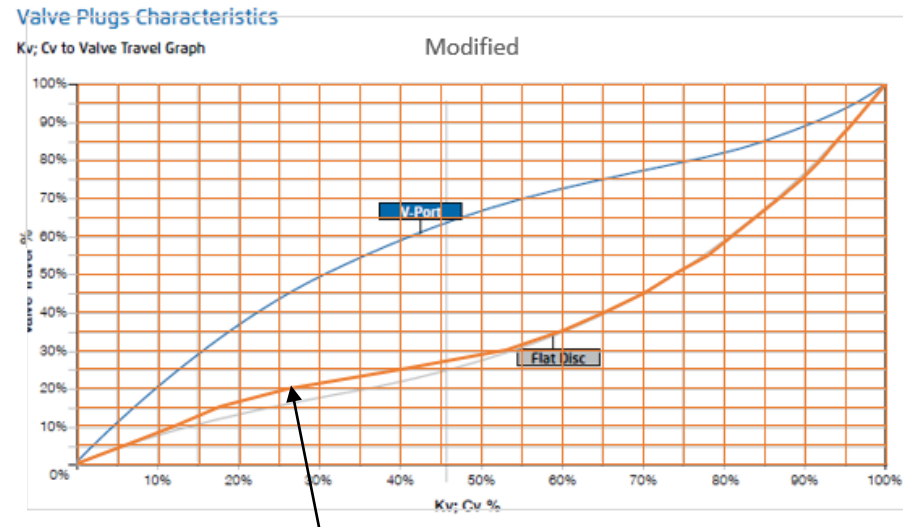
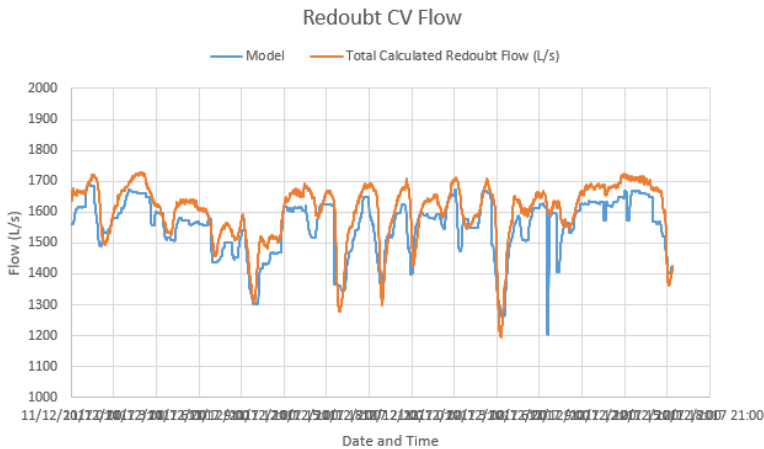
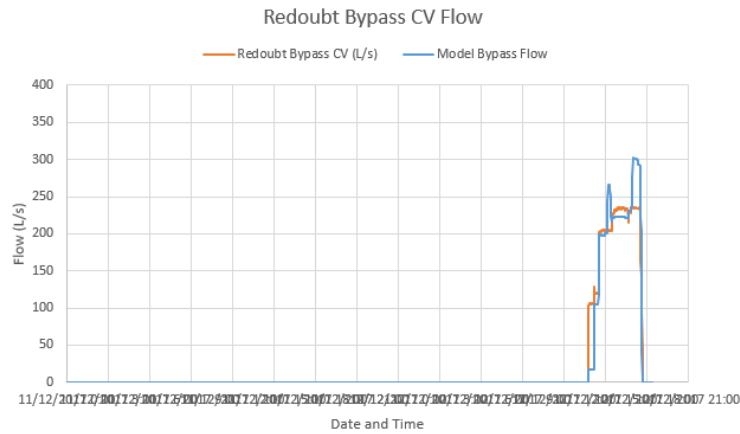
# Challenges

- Profile pump setting did not achieve the required level of accuracy
- UPC script allowed pump speed to be calculated every time step providing greater accuracy

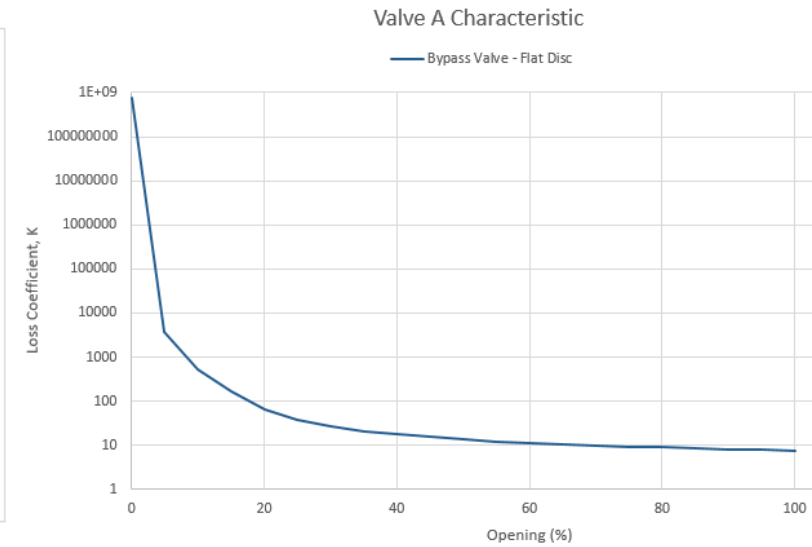


Worked with Innovyze to improve sensitivity to ensure pumps calculate speed at each time step which resulted in a good validation

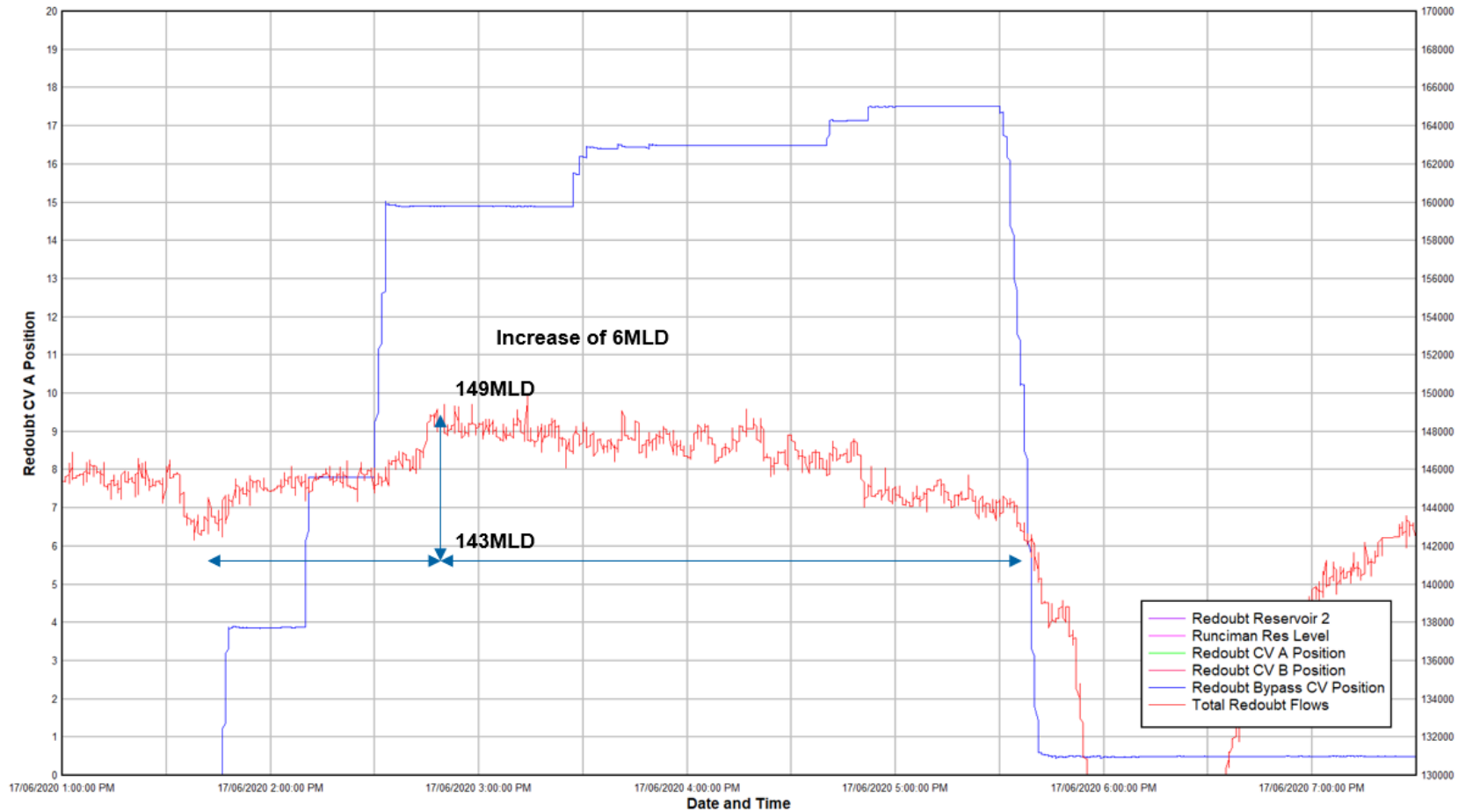
# Redoubt Valve – 3<sup>rd</sup> (new) valve



Slight modification to the valve characteristics achieved good validation



# Redoubt Valve – 3<sup>rd</sup> (new) valve



# Putting the Validated Model to use!

- Control philosophy for the 3<sup>rd</sup> Redoubt Valve while Runciman Reservoir (1ML) in service
- Control philosophy for the 3<sup>rd</sup> Redoubt Valve - Runciman Reservoir replaced with Pukekohe East 50ML Reservoir
- Confirming ability to sustainably distribute 175MLD from the Waikato WTP
- Confirm impact of wider augmentation (Pukekohe WTP + Papakura WTP)
- Provide confidence in the pipe roughness / condition of 20+ year old Waikato 1 watermain
- Supported batch running of the Waikato WTP to provide supply to Pokeno / Tuakau offtakes
- Supporting upgrades including Waikato 1 Booster Pump Station, increasing the Waikato source capacity to 225MLD

# Auckland's water supply today

WSL Metro Water Balance

Sep '21 - Oct '21\* (2 months)

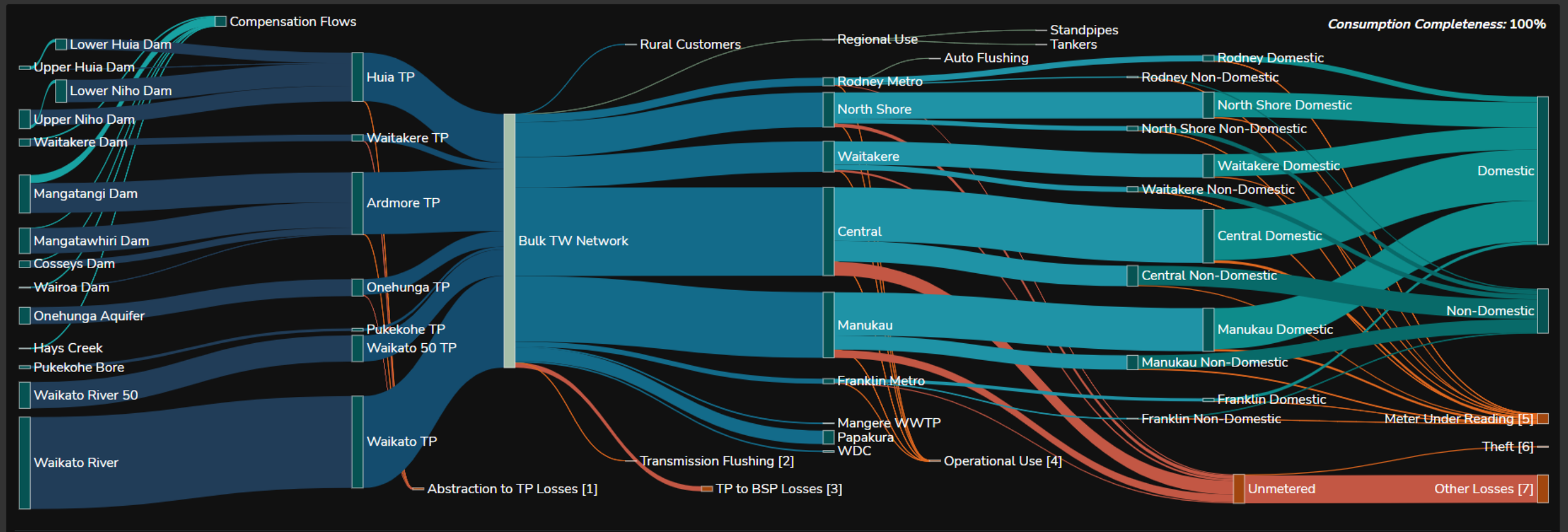
PERIOD:

Jul '17

Jul '18

Jul '19

Sep '21 — Oct





# Conclusion

- Successful collaboration between multiple groups under urgency
- Use of UPC scripts to manage “less” conventional operational controls
- A validated model is a crucial tool to support design and operational decisions
- The validation enabled the fine adjustment of the roughness value of the Waikato 1 watermain
- Improved R2R performance assisted in mitigating drought impacts
- Supports business benefits gained from model investment

# Acknowledgements

- Watercare – Network Operators, Planning, Commissioning Engineers
- GHD
- Detection Services
- Innovyze Support Team
- Dave Rooke



# Modelling Symposium



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Thank you!  
Questions? Patai?