PODDS MODELLING in Synergi

CWMAG October 2022 – Lloyd Chikuruwo and Alan Maher

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Water for the North West

Contents

PODDS Modelling in Synergi

Introduction

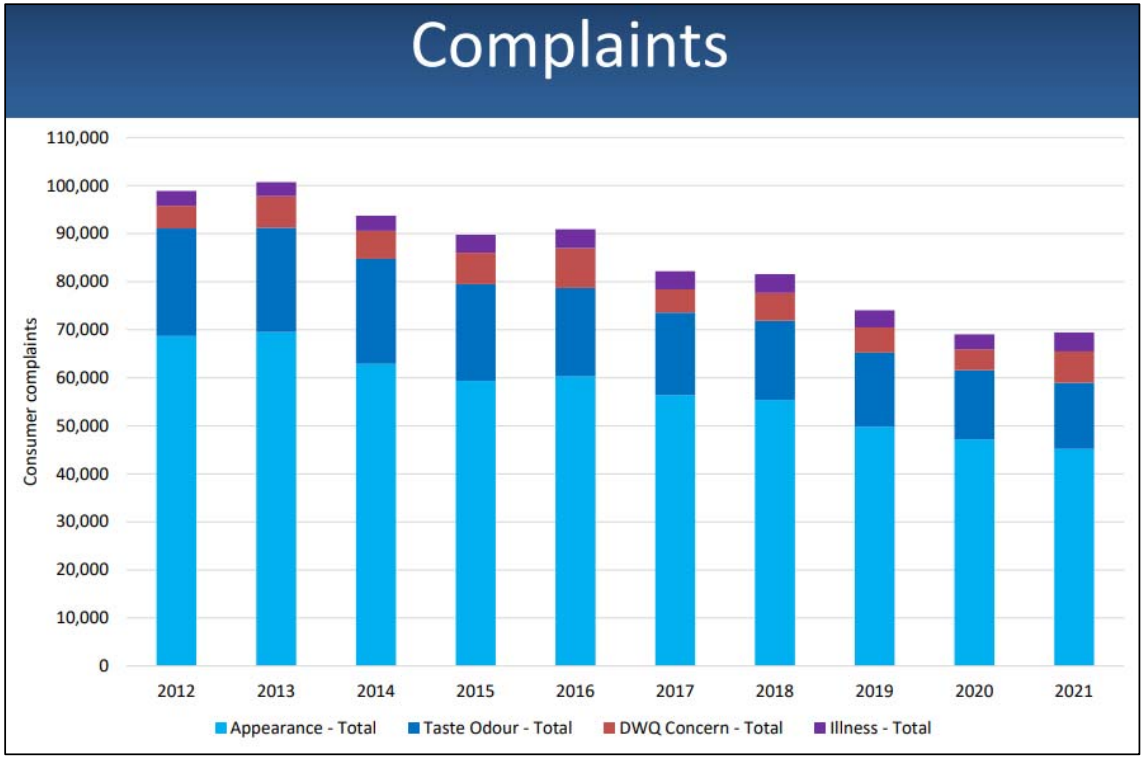
General

- I will start with a few questions related to this subject which some of us have asked at some point:
  - ❑ Is no water better than discoloured water? – 10years ago Vs today
  - ❑ How much resilience do we need to be able continue supplying our customers with wholesome (safe and clean) water?
  - ❑ Do we treat water as a food grade product?
- Imagine a scenario when you open your tap and the water is coloured like in the picture.

Introduction

General

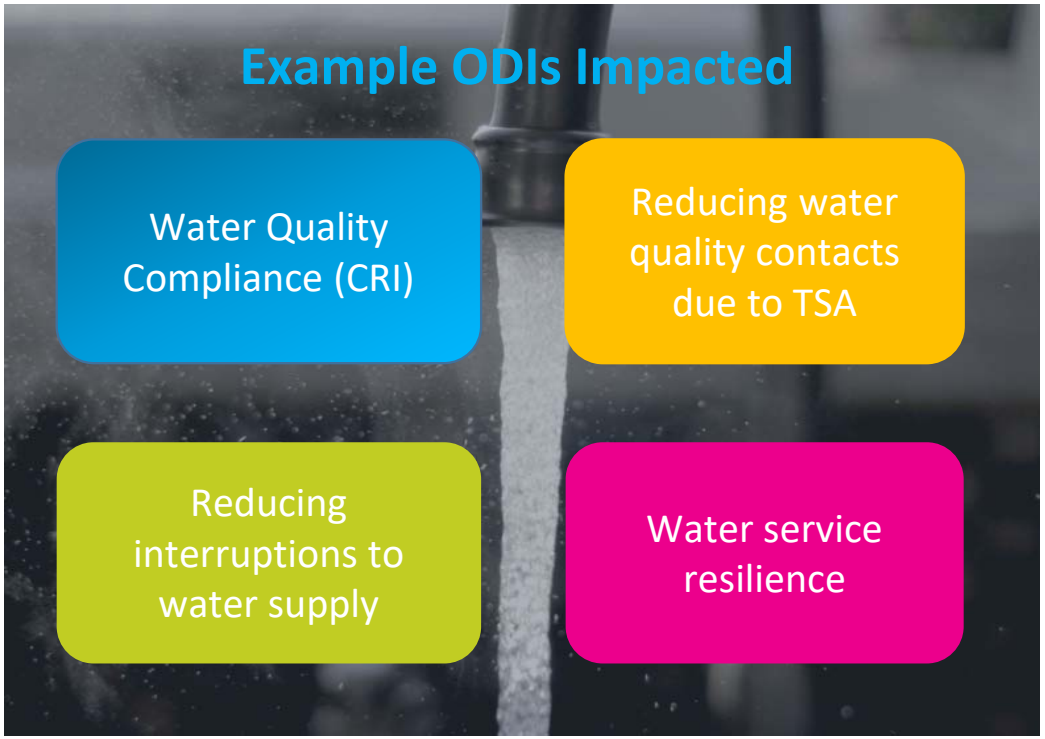
- When looking at customer complaints, the latest data suggests that appearance accounts for 60 -70% across the water industry.
- A significant % of these (*around 70%*) are black/brown and orange.
- Performance on these contacts has an impact on the *Outcome Delivery Incentives* (ODIs) set for water companies.



Source – DWI 2021 report

Water Quality (discolouration) and Network Resilience

- When we look at both water quality and network resilience we see how they are threaded in our ODIs
- Addressing the related issues brings some benefits in line with those ODIs.
- It is also right that we do so because that's what our customers want to see.



Water Quality (discolouration) and Network Resilience

The understanding

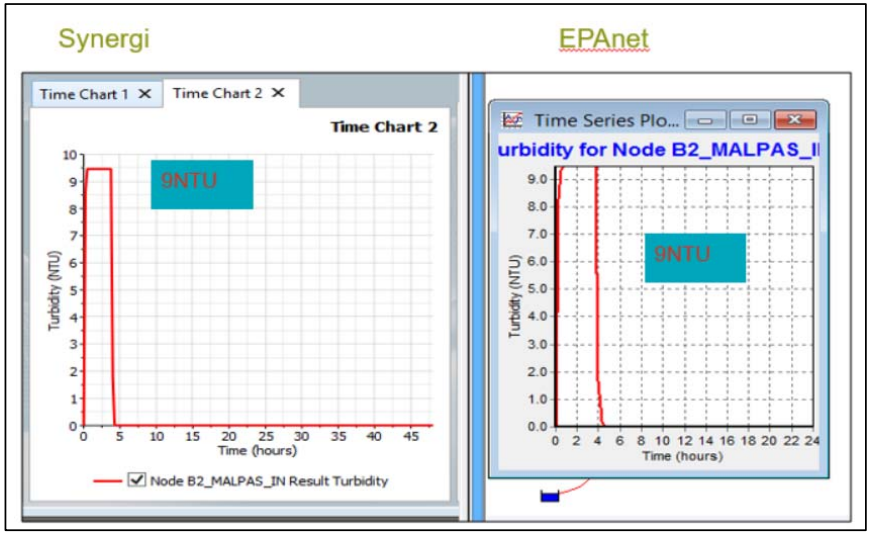
- Discolouration is linked to higher than normal flows in a network, often due to
  - bursts,
  - unusually high customer demand,
  - Operational changes
  - large draws for fire fighting etc.
- It is therefore important to understand how to manage our networks better to mitigate the persistent risk.
- Our knowledge of PODDS (Prediction of Discolouration in Distribution Systems) from Sheffield University research has helped us in the management of such risk.

The value of PODDS modelling

- We have applied the knowledge in a few streams of programmes that are part of our discolouration management strategy.
- These include
  - DMA robust flushing
  - Proactive conditioning
  - Operational contingency support
  - General network rezones
  - Night maintenance flushing

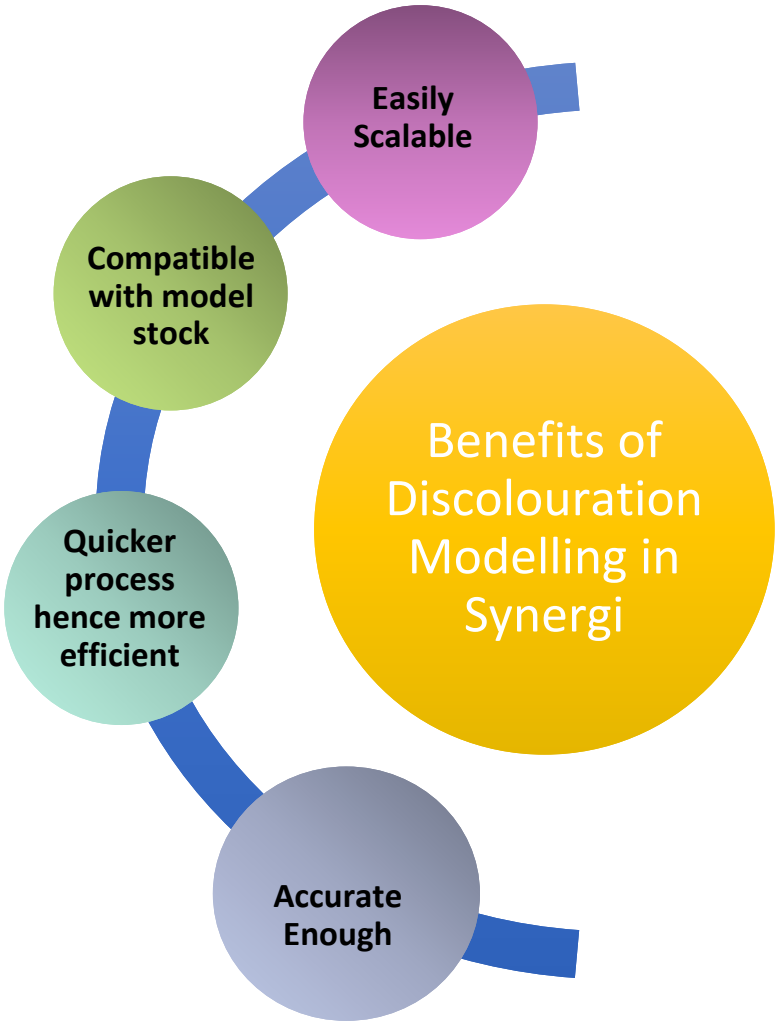
Advantages of using Synergi over EPANET

- EPAnet was the main software we used originally but it had limitations
- Our stock of models are maintained in Synergi.
- When DNV introduced turbidity modelling in Synergi, we took advantage of using the module which was more practical and economical than EPAnet.
- We undertook some testing of the Synergi comparing with EPAnet which allowed us to understand the differences in the coding.



		Enter into EPANET					Enter into Synergi					
Smooth or Rough	Diameter	Stored Turbidity Coefficient	Stored Turbidity Exponent (always=1 for EPANET or Synergi)	Excess Shear Rate Coefficient (EPANET)	Erosion Exponent	Cmax to enter into EPANET for 1.2N/m2 limit (gradient k is used with desired 1.2 X-axis limiting value to give Cmax)	Diameter	Roughness	Stored Turbidity Coefficient (α)	Excess Shear Rate Coefficient	Erosion Exponent	Max Layer Shear Strength (N/m2) (τmax) Gradient k is used with known Y-axis value (Cmax) to correspond to 1.2N/m2). Therefore Synergi just lets you enter 1.2
mm	mm	k	b	P	n	ntu metres	mm	k	α	βP	n	τmax
Smooth	150	-3.5	1	0.02	1.2	4.2	>120<160	<1	3.5	0.00571429	1.2	1.2
Smooth	100	-0.5	1	0.002	2.5	0.6	>70<120	<1	0.5	0.004	2.5	1.2
Smooth	50	-0.5	1	0.0002	3	0.6	>40<70	<1	0.5	0.00040000	3	1.2
Rough	3-4"	-0.5	1	0.00022	3	0.6	>70<110	>1	0.5	0.00044000	3	100

Advantages of using Synergi over EPANET

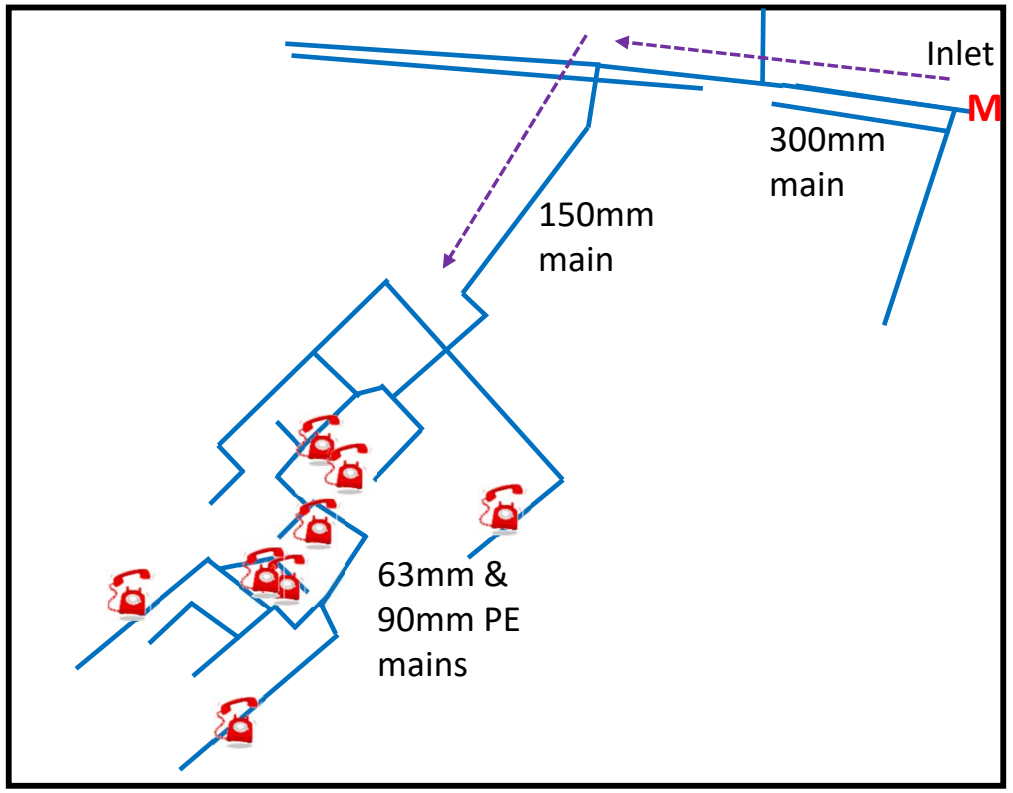


Case Study 1 - “Targeted Conditioning” (DMA scale)

- Discolouration data
- Step 1 - Condition the inlet main
- Step 2 – Condition downstream mains
- Conditioning assessment
- Benefits

Discolouration data

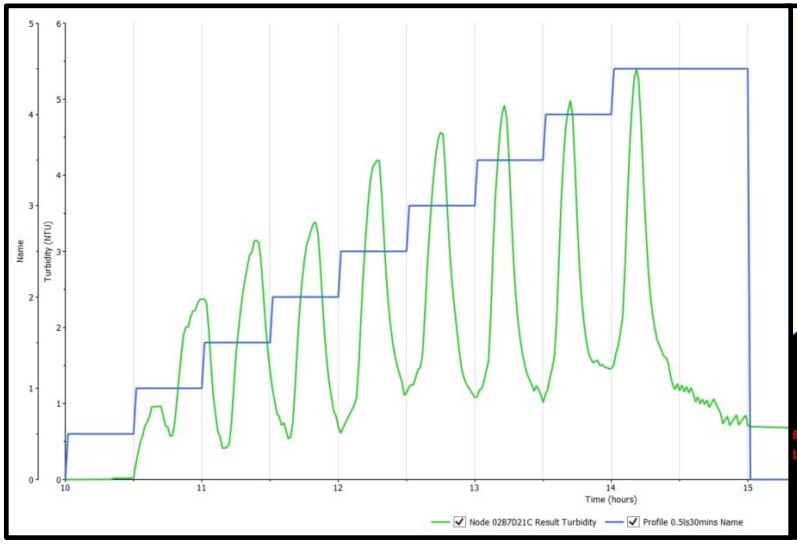
- Problem on the network with regular discolouration contacts
- Regular but small number of calls (2-3 a month)
- Local level, calls not reported in other parts of the DMA just at the locality shown
- Analyse the database to find similar examples
  - How do we remove material maximally without causing discolouration?

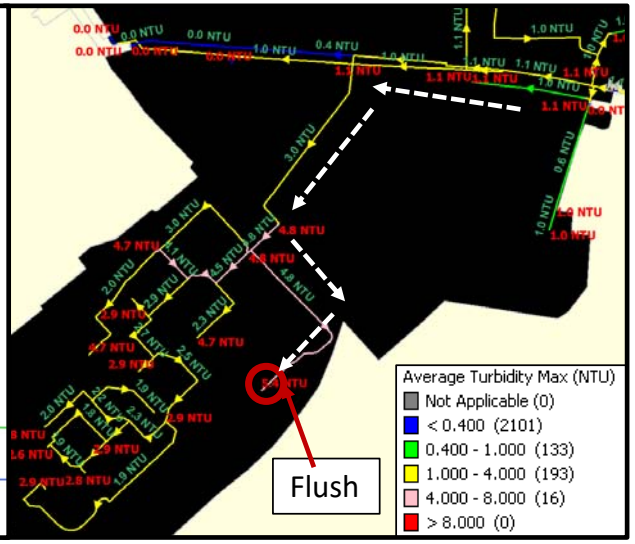


Step 1 – Condition the inlet main using Synergi

➢ At what rate do we flush? for how long? what is within standards?

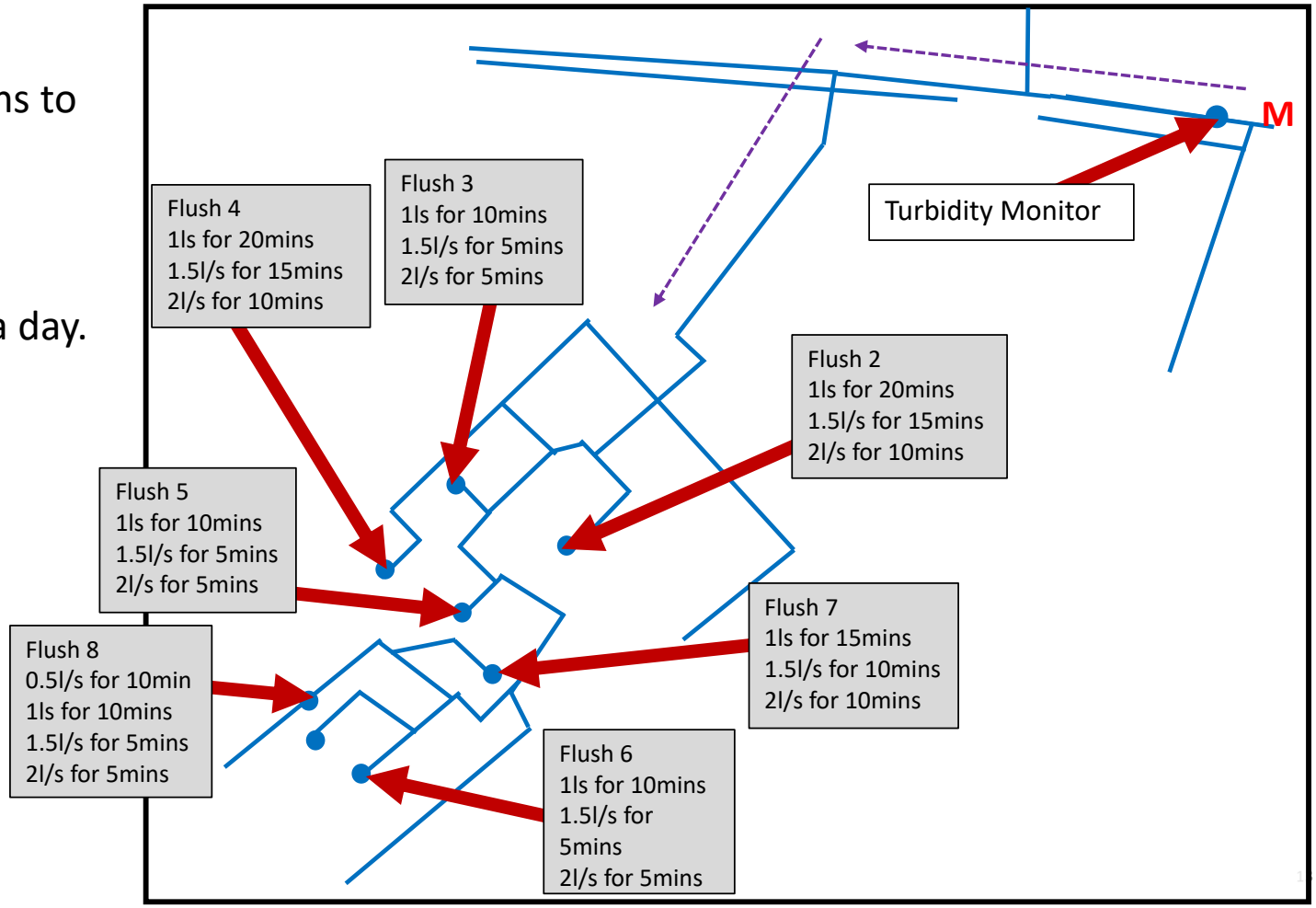
- Choose a hydrant to flush.
- Model the proposed increase in flows to keep turbidity manageable (<4ntu on site).
- Provide a flushing schedule to site team.
- This method targets a main to be conditioned, a maximum flow and a rough duration for the flushing. In addition it protects the upstream system from discolouration as a result of the exercise.





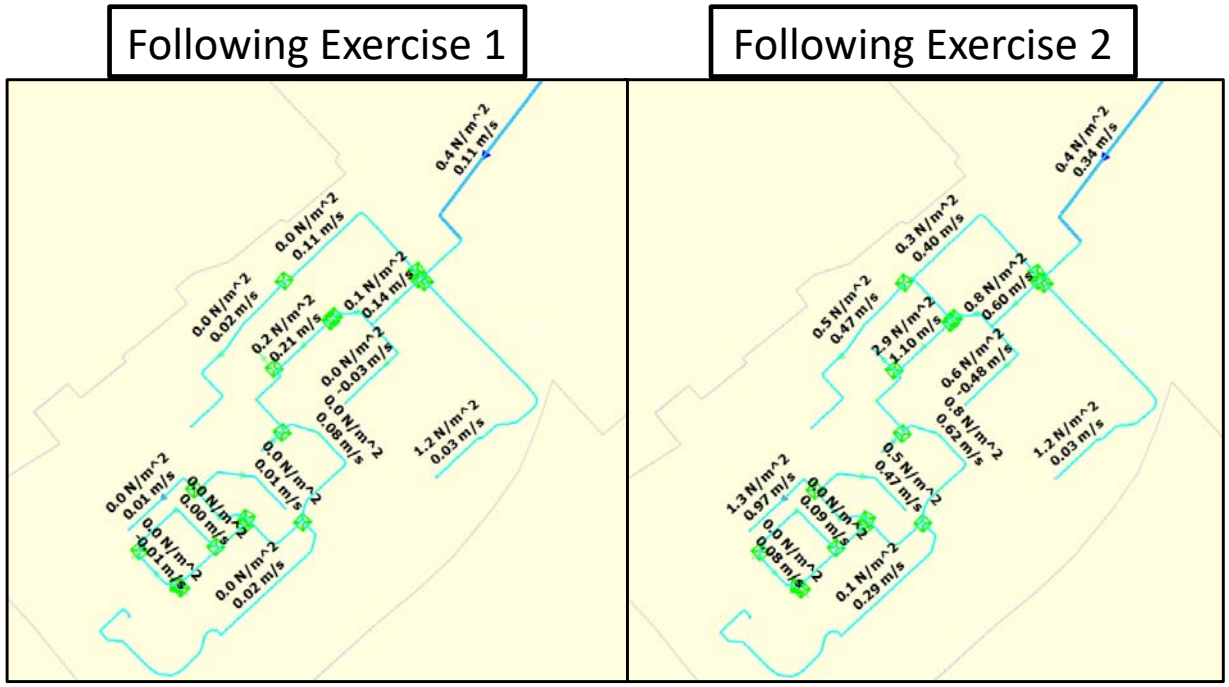
Step 2 – Condition downstream mains

- Condition the smaller mains downstream for short durations to complete the targeted conditioning exercise.
- Exercise can be completed in a day.



Benefits

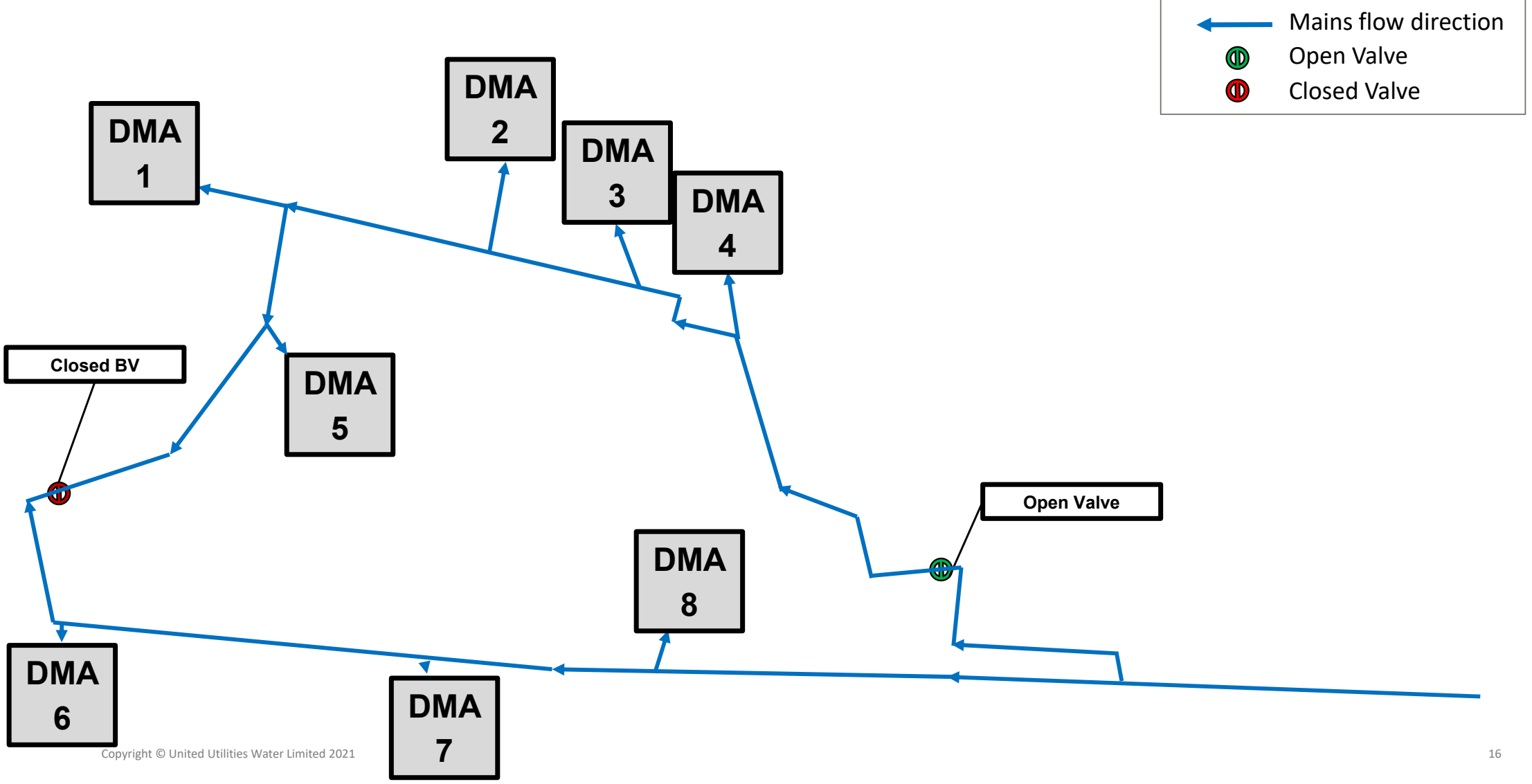
- Conditioning Shear (N/m²) of the pipe wall and peak velocity (m/s) are labelled on the diagram
- Compare conditioning before and after
- Using Synergi to condition mains at the end of the system while also protecting against the risk of discolouration further upstream.
- Field test data validated the turbidities predicted in the designs.
- Most small scale exercises involve hydrant flushing



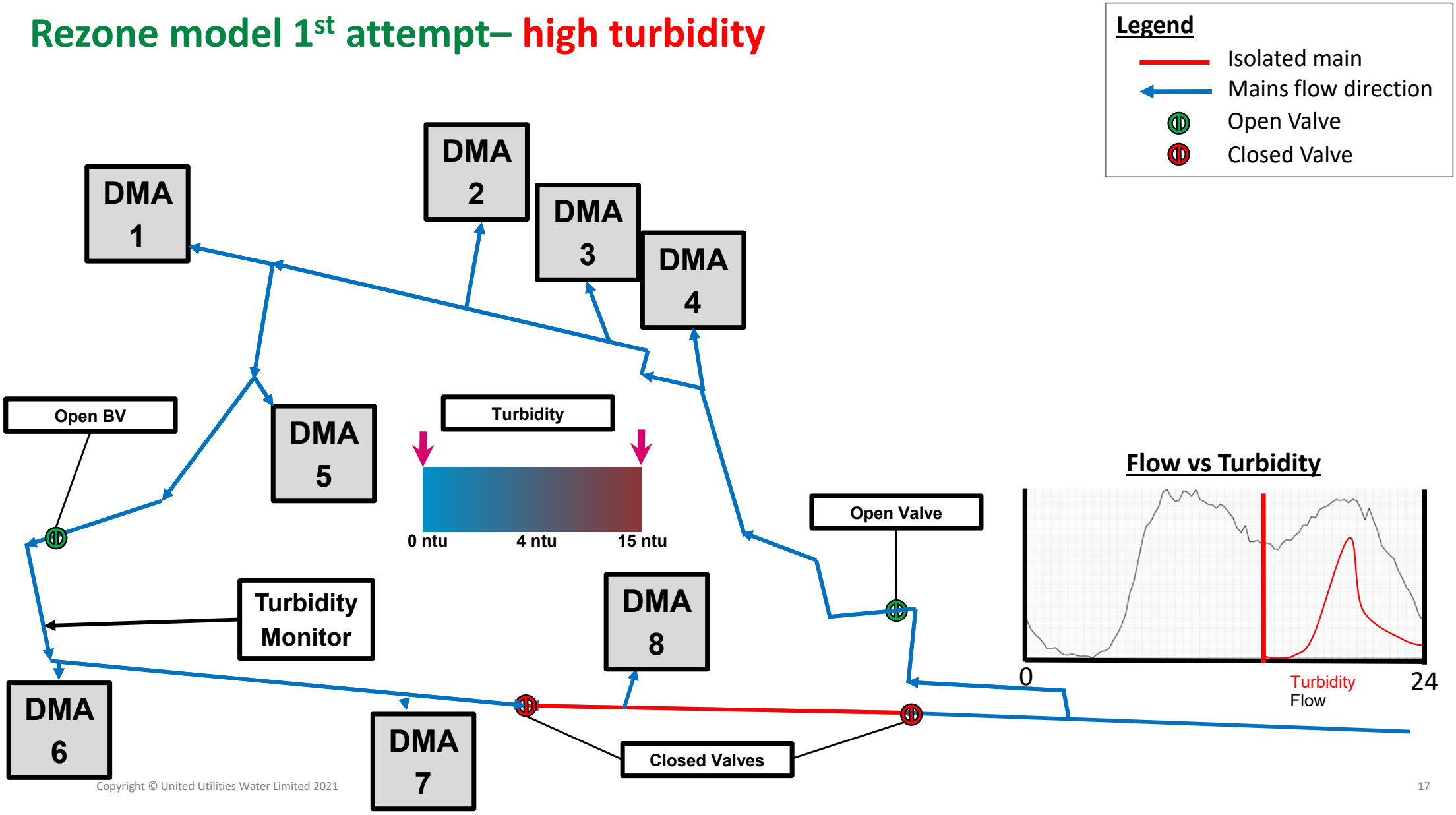
Case Study 2 - Trunk Main Conditioning, medium scale (WSZ Level)

- Demand Monitoring Zone (DMZ) scale
- Normal network configuration
- Rezone model 1st attempt – high turbidity
- Partial rezone model 2nd attempt – low turbidity
- Benefits

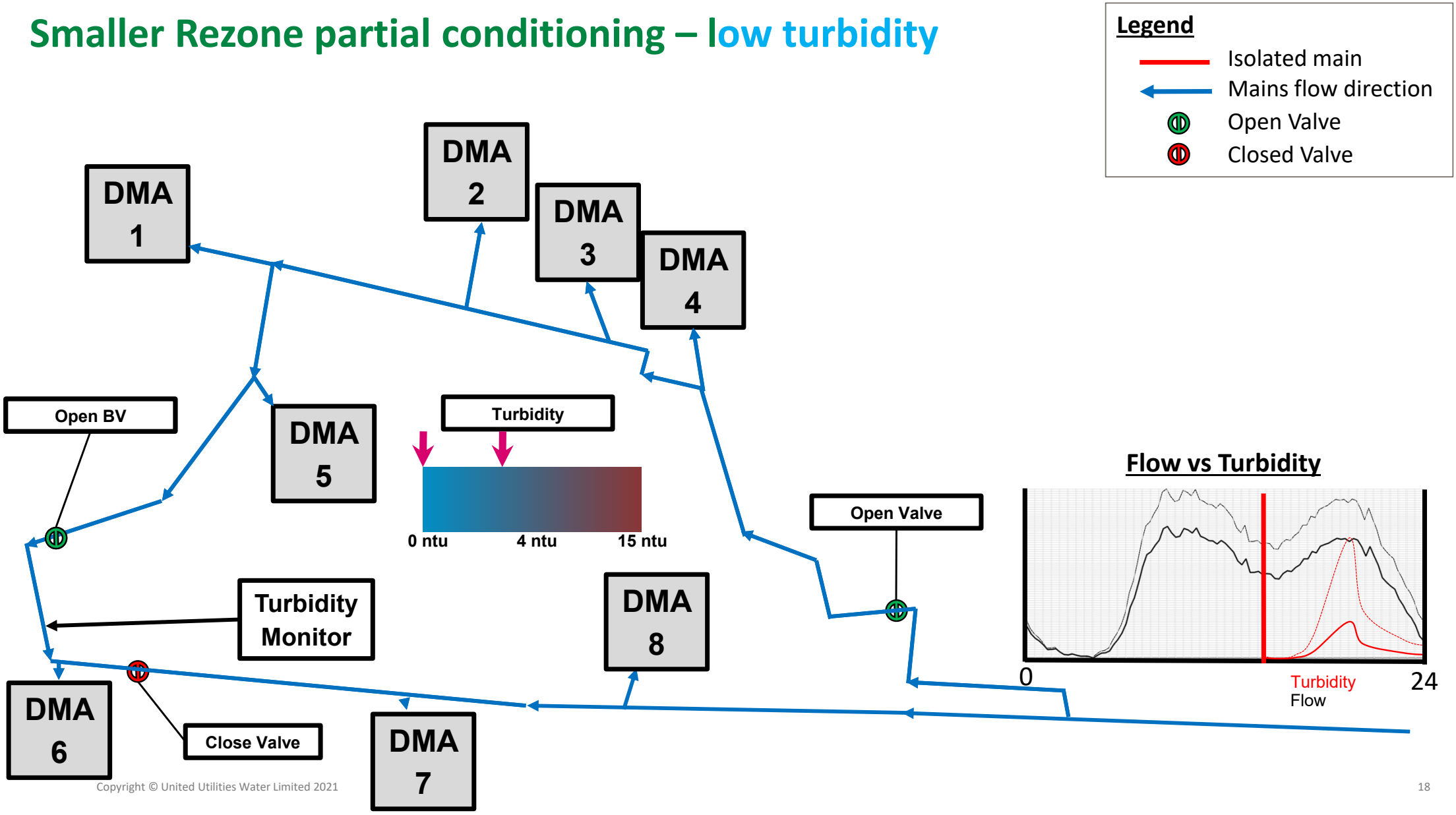
Normal network configuration



Rezone model 1st attempt– high turbidity



Smaller Rezone partial conditioning – low turbidity



Benefits

- The medium scale solutions are mostly:

  pre-emptive rezone solutions for contingency plans to be used during reactive scenarios such as bursts.

  Planned rezones to be carried out for normal network maintenance.

- Synergi quickly allows turbidity analysis of complex networks
- It is flexible and easy to run a number of simulations
- Even though models are not calibrated for turbidity, it provides operations with “ball park” figures with regards to sensible flow increases and durations.
- Most medium scale solutions are a combination of hydrant flushing and rezoning.
- Synergi’s turbidity module is standard while modelling rezones.

Case Study 3 - Aquaduct scale (LDTMs)

- EPANET has long been used for Aqueduct PODDS conditioning which tends to be less complex (number of pipes and nodes),
- Modelling work currently underway for conditioning lines 1 & 2 so that line 3 can be taken out.
- Most large scale conditioning operations involve the use of pumps and valve operations.

Summary and Conclusions

- Talked about different use cases at all scales
- Might want to also think about when is appropriate PODDS modelling and when to use different methods or more invasive cleaning:
    - Robust flushing
    - Air scouring
    - Swabbing
    - Ice pigging


TIME FOR QUESTIONS

United Utilities

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Appendix A - Preferred equipment

- United Utilities “Proactive Conditioning Team” carry out the flushing work.
- Equipment is installed in a vehicle for manual handling purposes and for efficiency.