Do you know where your water comes from?

Route and Source Tracing

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Scope

- Purpose of the study
- Model Set Up
- Source Percentage
- Route Tracing
- Customer Counts

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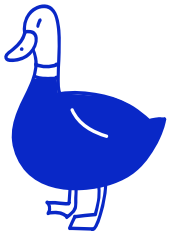
Purpose of the study

- To create a tool that can assess operational resilience of our sites and networks
- To map out all the sources and assets that serve each DMA
- To gain understanding of the redundancies, interdependencies and vulnerabilities at a system level
- To be able to link the site resilience to the network against different hazards and scenarios
- To calculate and compare operational resilience of each DMA, HDZ and Community
- To identify which hazards and assets represent the greatest risk to customer

Affinity Water



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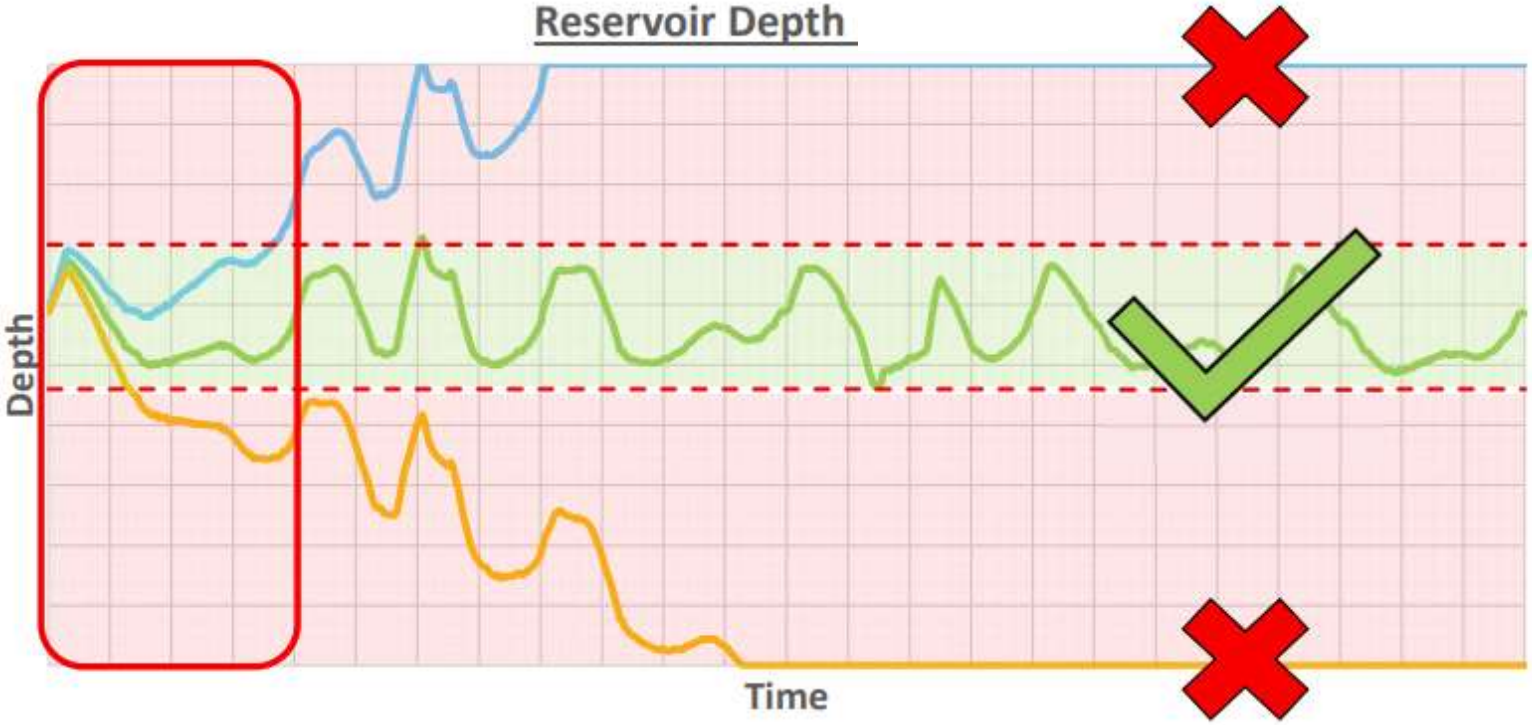
Model Set Up – Stage One

What do we consider?



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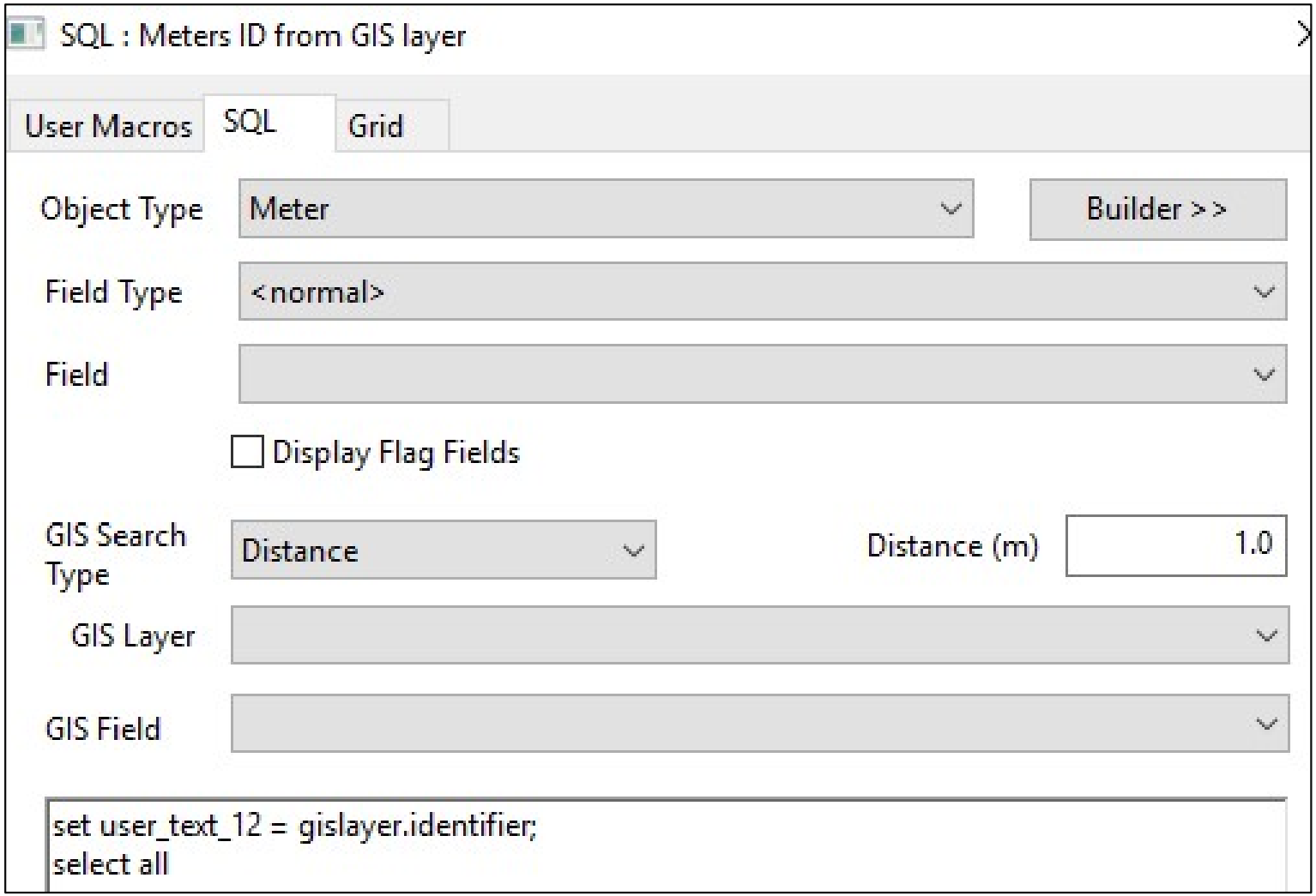
Model Set Up – Stage Two

We need to create a selection of all the specified assets, sources, trunk mains, meters. User texts were used to categorise this data.

How do we do this?



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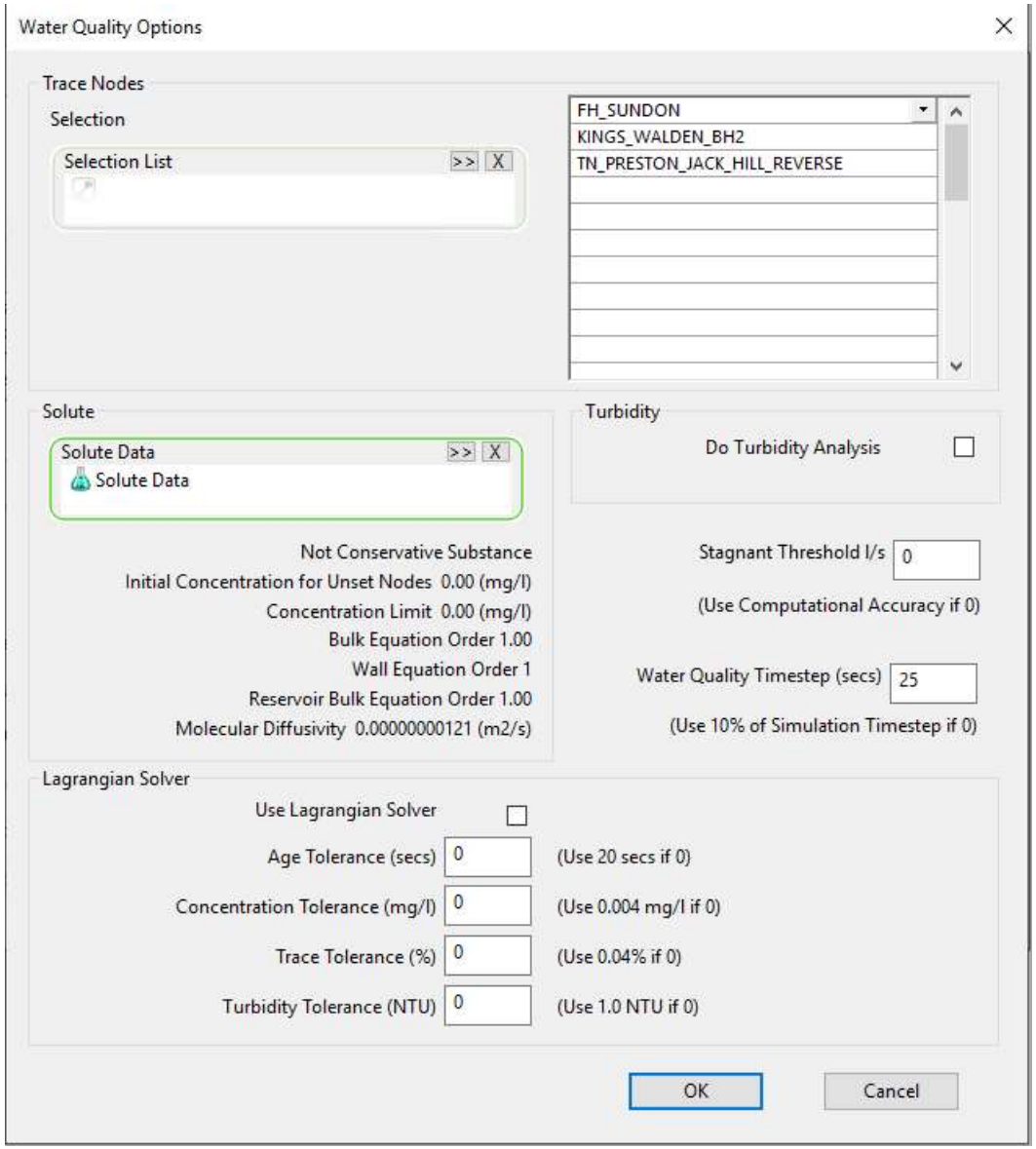
Model Set Up – Stage Three WQ Runs

This was normally run over 15+ days, with all DMA inlets in the system reaching to 100% source saturation.



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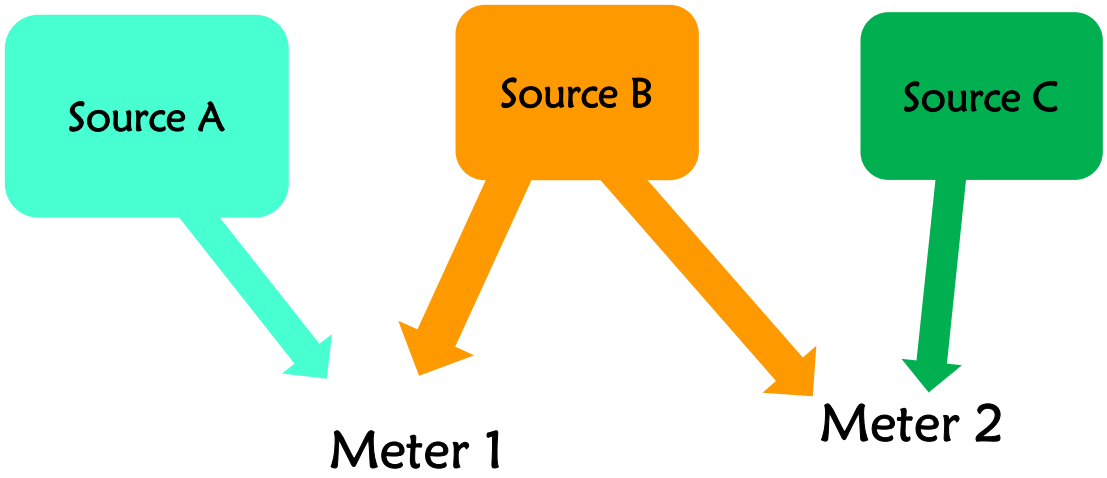
What is Source Percentage Tracing?

The percentage split between the sources in a zone supplying each asset, meter and trunk main in the area.



What was considered a source?

- All ground water and surface water sources
- Imports from neighbouring water companies

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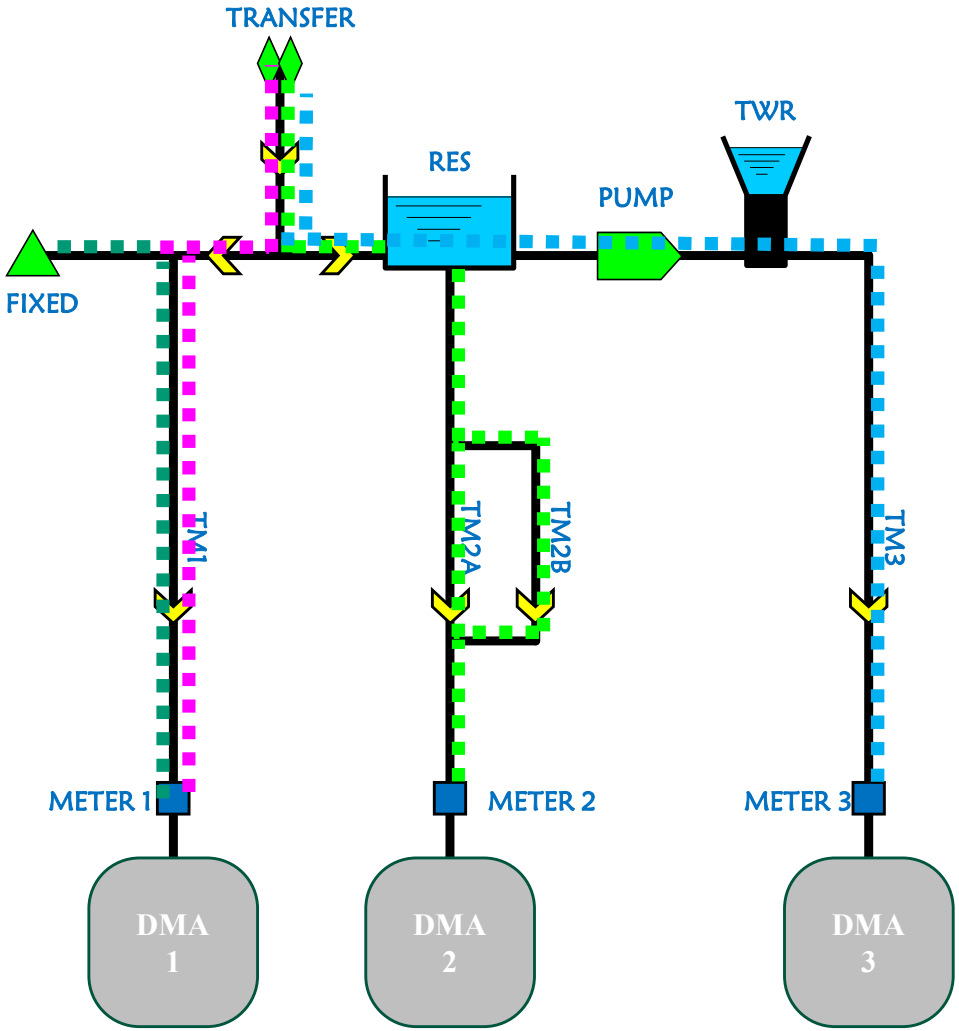
Source Percentages

Calculated using a bespoke SQL for the meter inlets and assets



METER 1 =
80% Fixed Head
20% Transfer Node

METER 2 and RESERVOIR =
100% Transfer Node

METER 3 and TWR =
100% Transfer Node

The source % results at each timestep are then averaged out over the 96 timestep model run using the SQL

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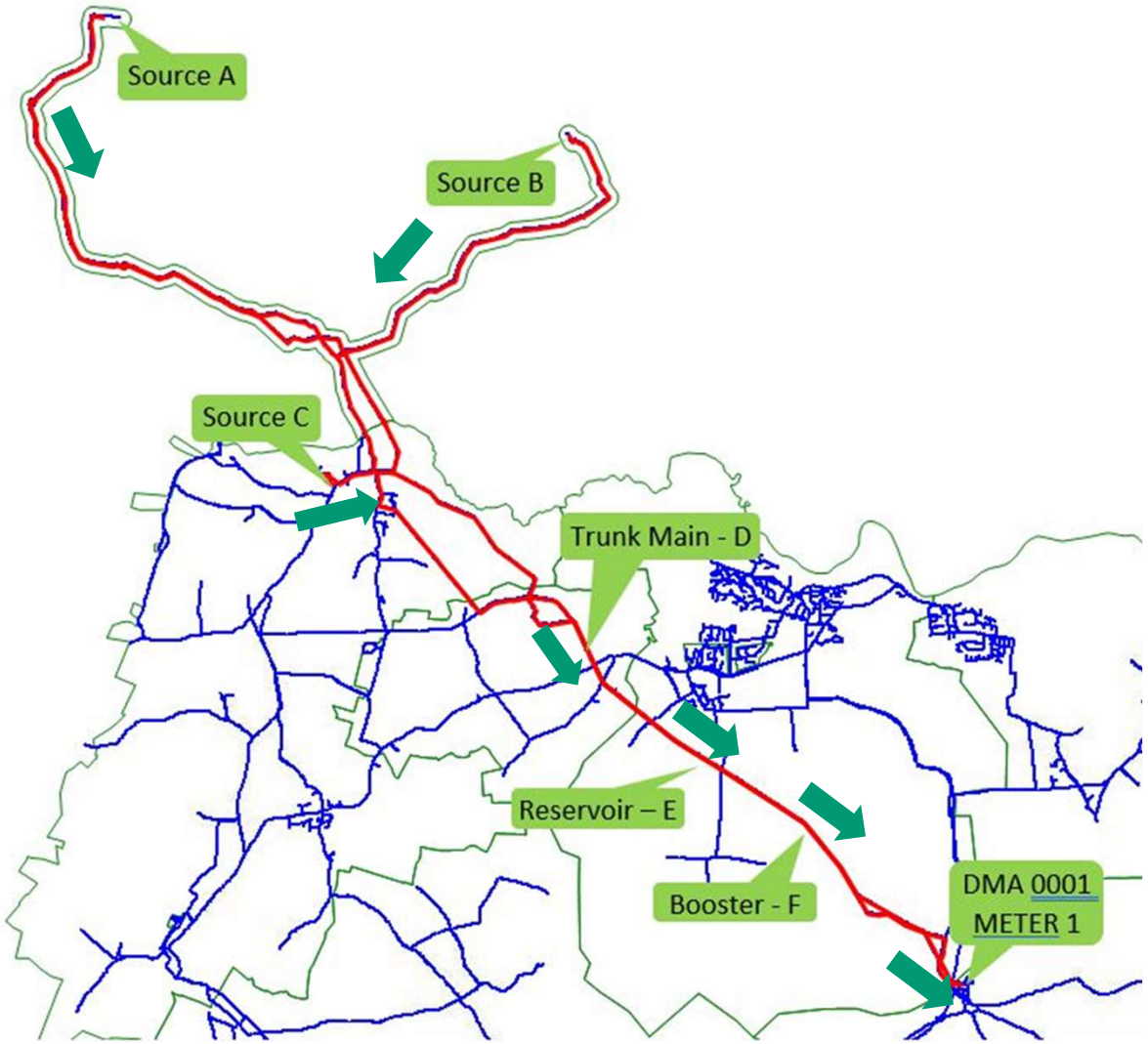
Route tracing?

To identify all routes from source to meter, along with any key trunk mains and assets along the way.



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Route Tracing

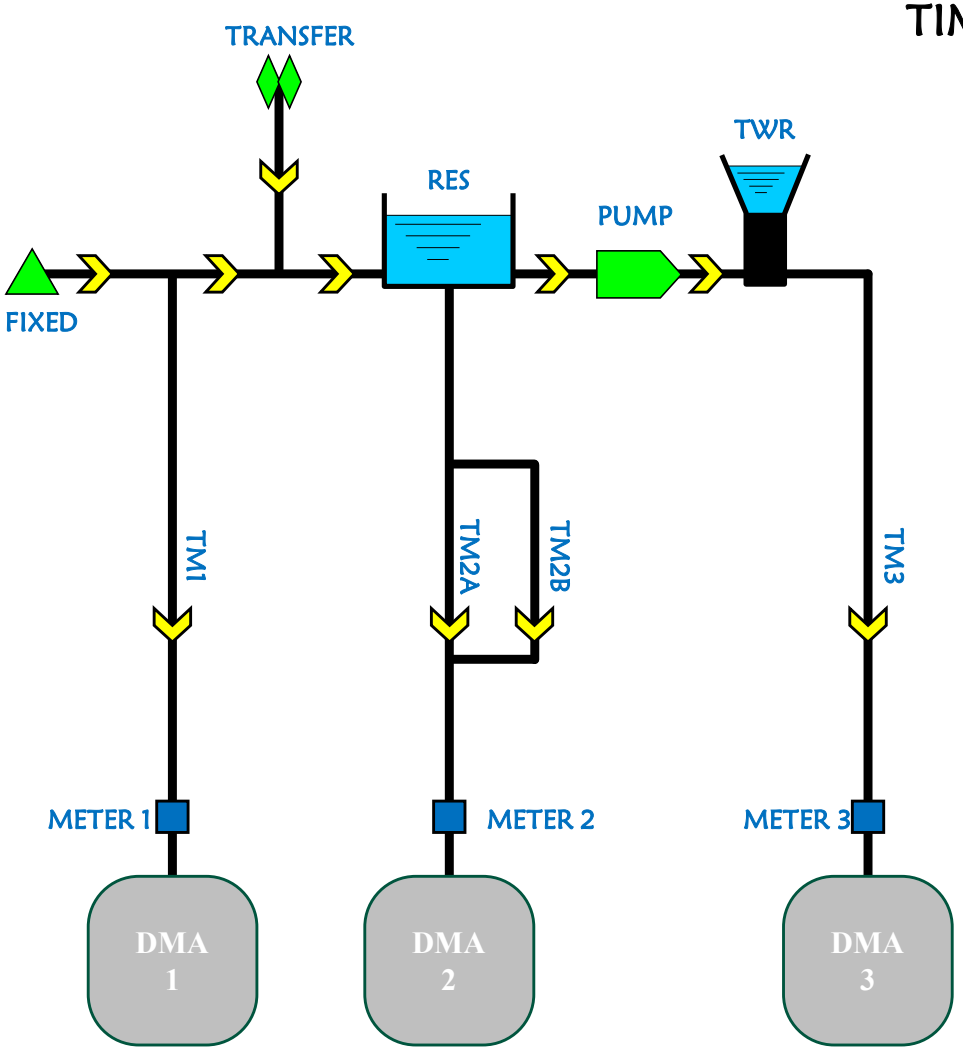
- A complex ruby script has been created for this process, set to run on the same day as the Source Tracing results.

- The route for each meter at each timestep for the period specified is recorded

- The ruby script results were used in two ways:
  - Raw route data – how many times a route was used to get to a meter
  - Sorted route data - duplicate routes removed

Route Tracing

STEP 1: SET FLOW DIRECTION AT CURRENT TIMESTEP



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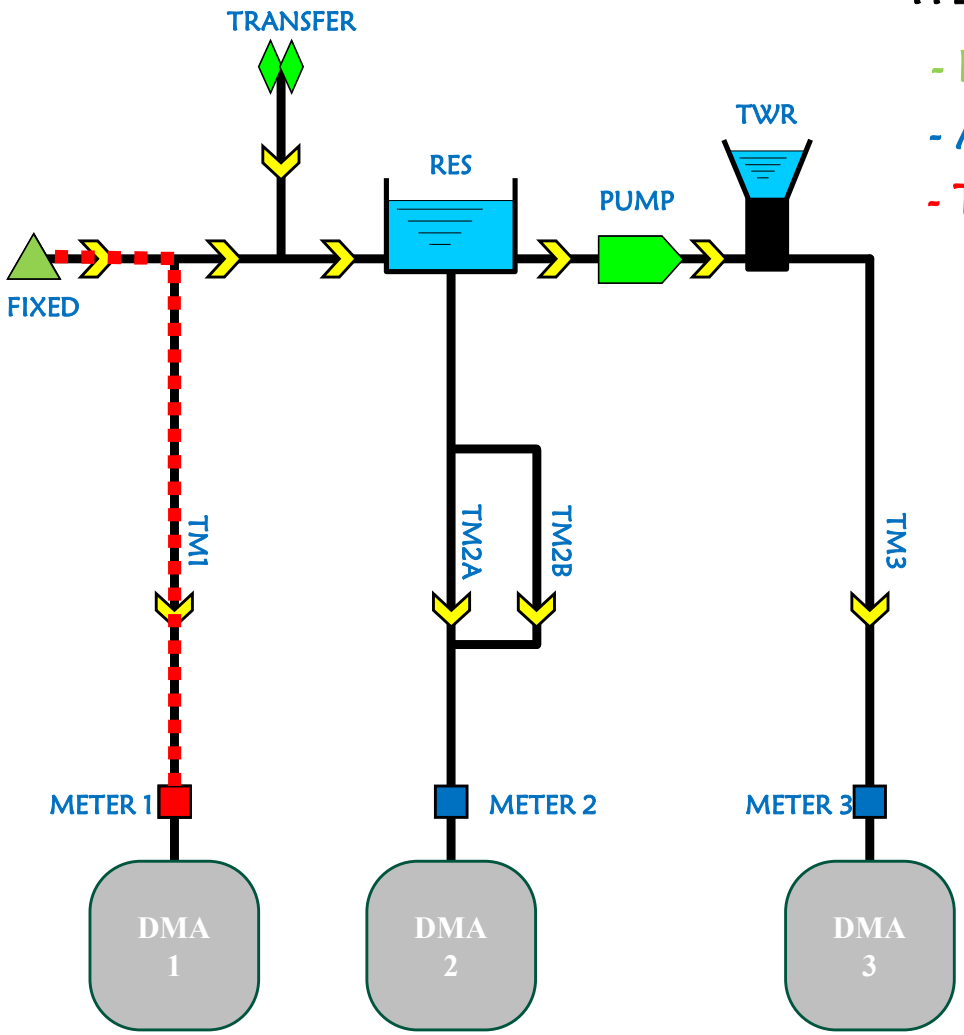
Route Tracing



STEP 2: TRACE UPSTREAM FROM 1st SELECTED ITEM

- FIXED HEAD IDENTIFIED AS SOURCE
- ANY MORE SOURCES FOR DMA 1?
- TRACED ITEMS TEMPORARILY 'TAGGED'

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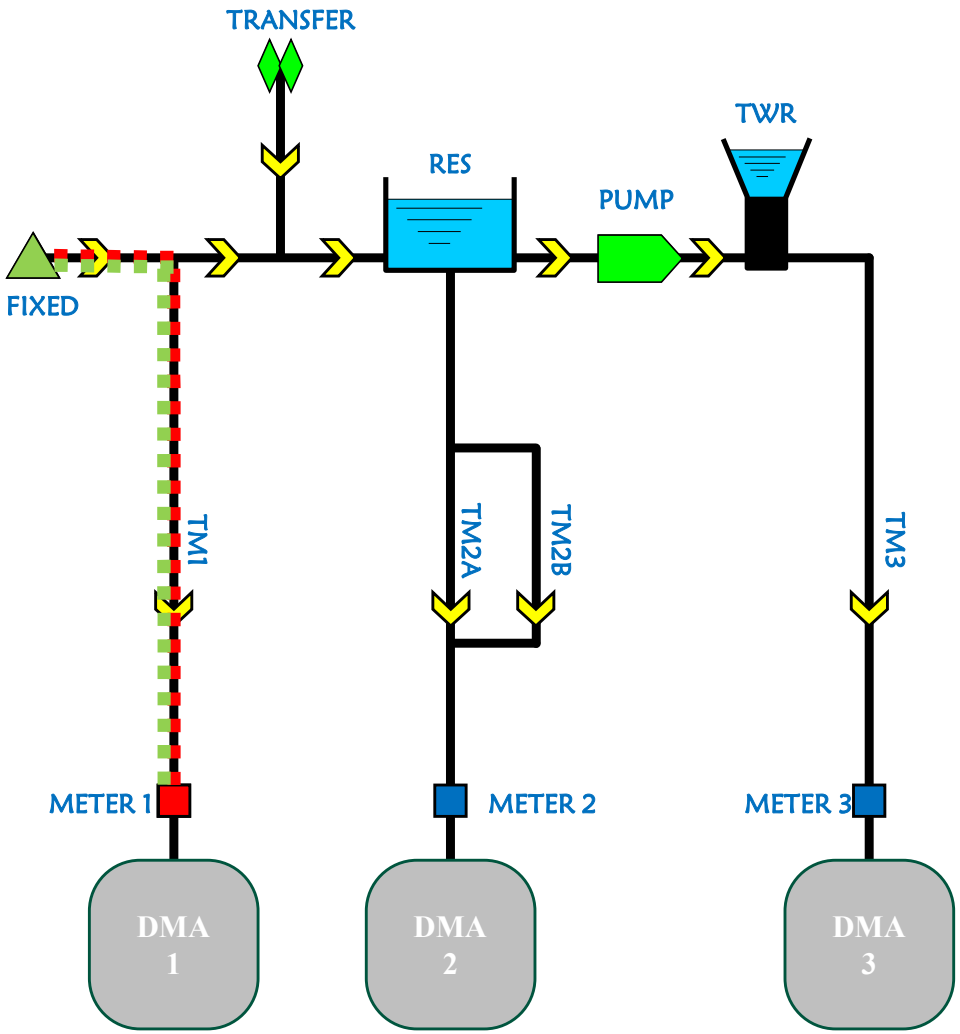
Route Tracing



STEP 3: TRACE DOWNSTREAM FROM SOURCE

- ONLY RETURNS TAGGED ITEMS
- COLLECTS ASSET NAMES IN ORDER TRACED
- ORDER THEN REVERSED & ADDED TO LIST

FIXED	TM1	METER 1	DMA 1
DMA 1	METER 1	TM1	FIXED

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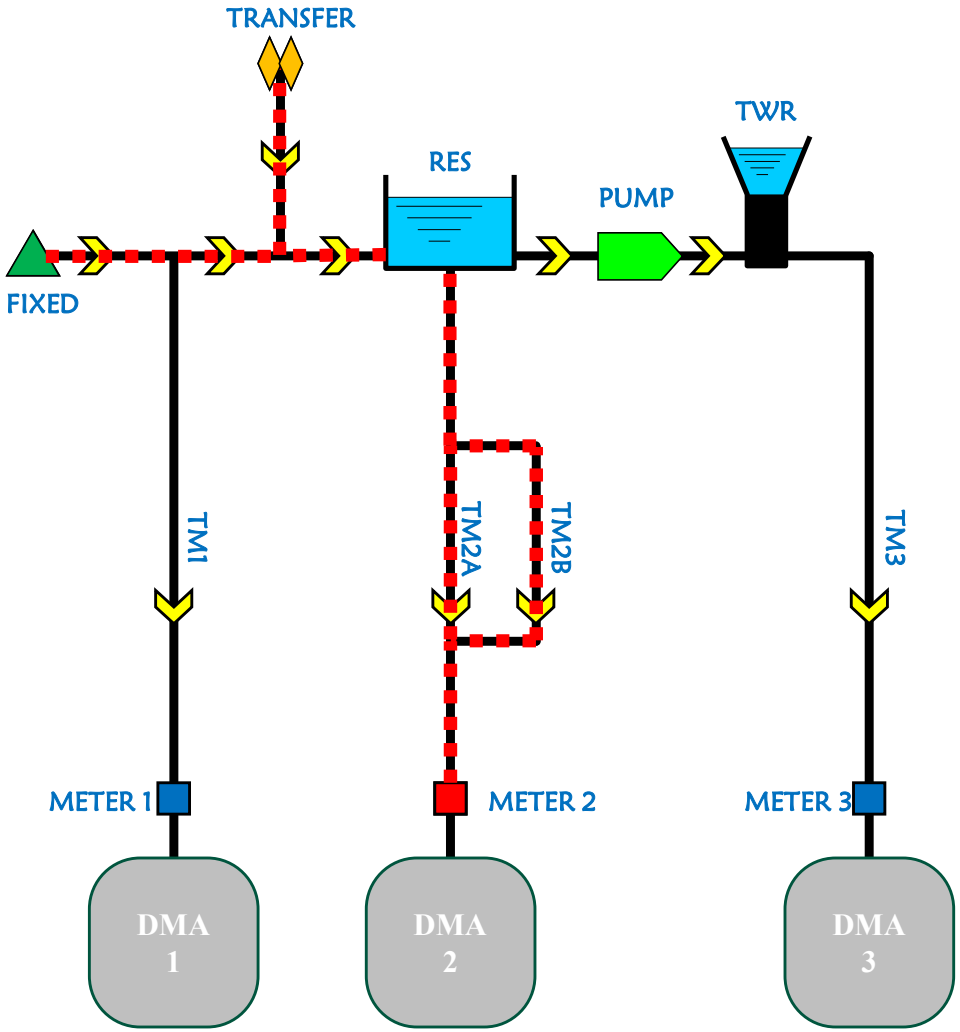
Route Tracing



STEP 4: TRACE UPSTREAM FROM 2nd SELECTED ITEM

- FIXED HEAD IDENTIFIED AS SOURCE 1
- TRANSFER NODE IDENTIFIED AS SOURCE 2
- TRACED ITEMS TEMPORARILY 'TAGGED'

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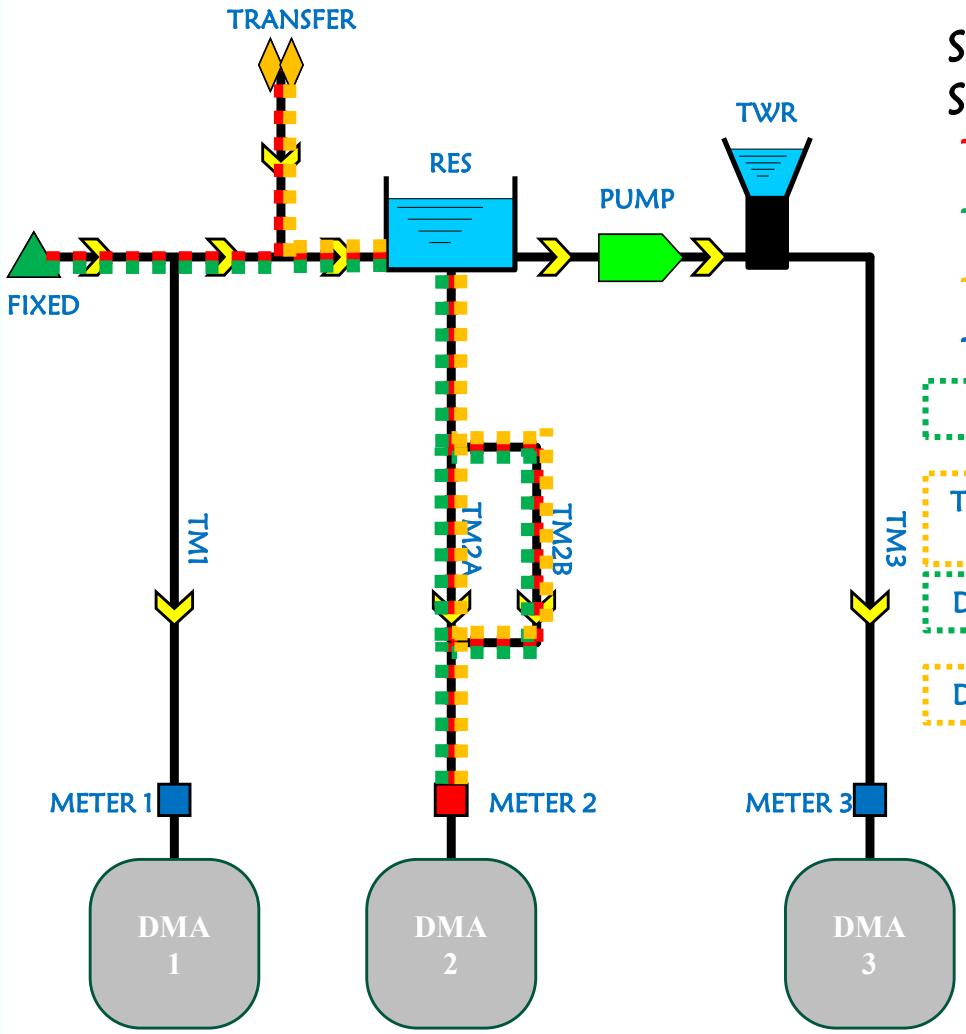
Route Tracing



STEP 5: TRACE DOWNSTREAM FROM SOURCES

- ONLY TRACE TAGGED ITEMS
- TRACE FROM FIXED HEAD SOURCE
- TRACE FROM TRANSFER NODE SOURCE
- ORDER THEN REVERSED & ADDED TO LIST

FIXED	RES	TM2A	TM2B	METER 2	DMA 2
TRANSFER	RES	TM2A	TM2B	METER 2	DMA 2
DMA 2	METER 2	TM2B	TM2A	RES	FIXED
DMA 2	METER 2	TM2B	TM2A	RES	TRANSFER

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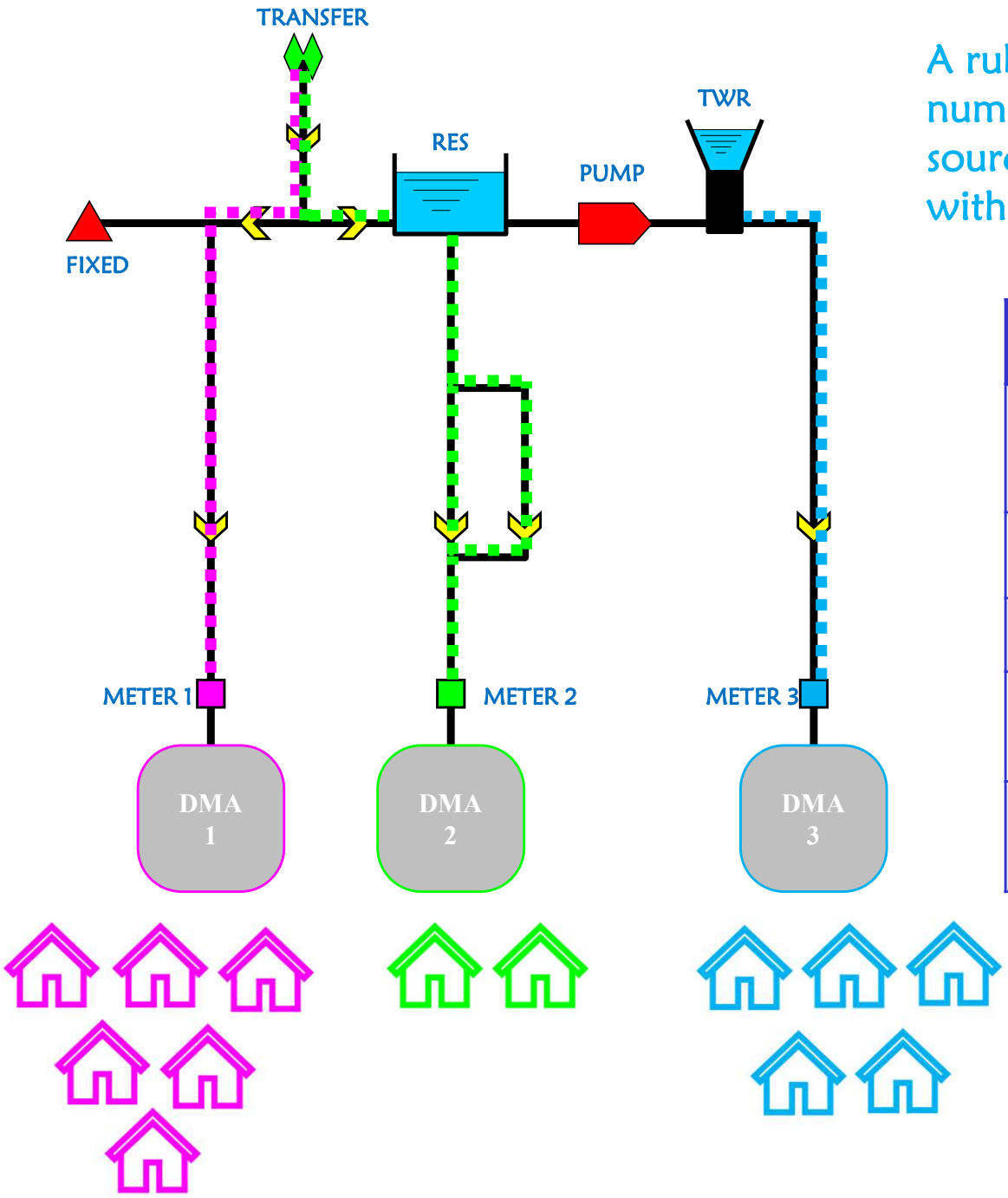
Customer Counts



A ruby script is used to count the number of customers supplied via the source, asset, trunk main and meter within the HDZ.

Asset	Customers
Fixed Head and Pump	0
Transfer Node	8
Meter 1	6
Meter 2 and Res	2
Meter 3 and Tower	5

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Summary

By using sophisticated SQLs and Ruby Scripts it is possible to efficiently calculate the

- Source of water
- Source percentage
- Number of properties downstream of strategic assets

For the whole of Affinity Water system (3.6 million customers (2018/19))

This took a team of people about a year to complete

We estimate it would've taken 10x longer without the use of the SQLs and Ruby Scripts.

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Questions?

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