Affinity Water

# Pressure Related Demand Modelling during Incidents

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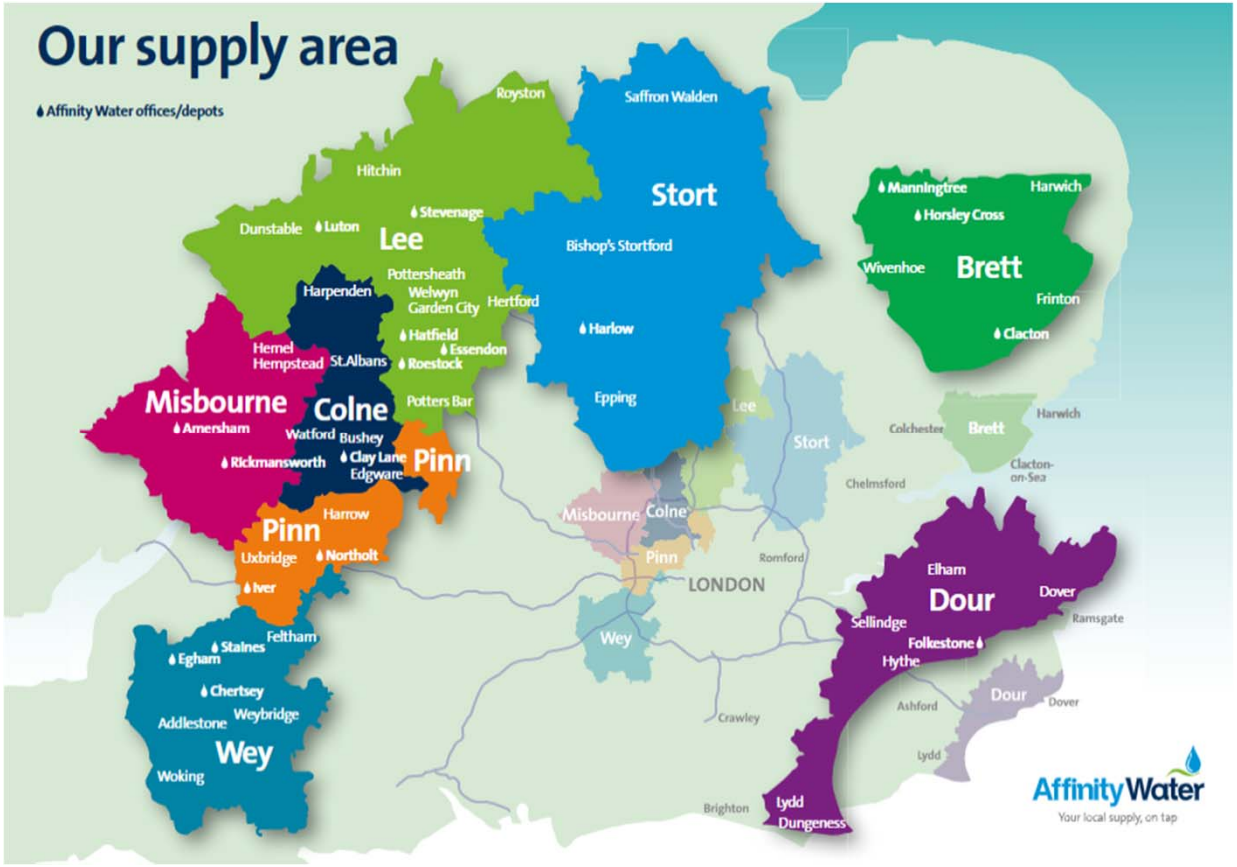
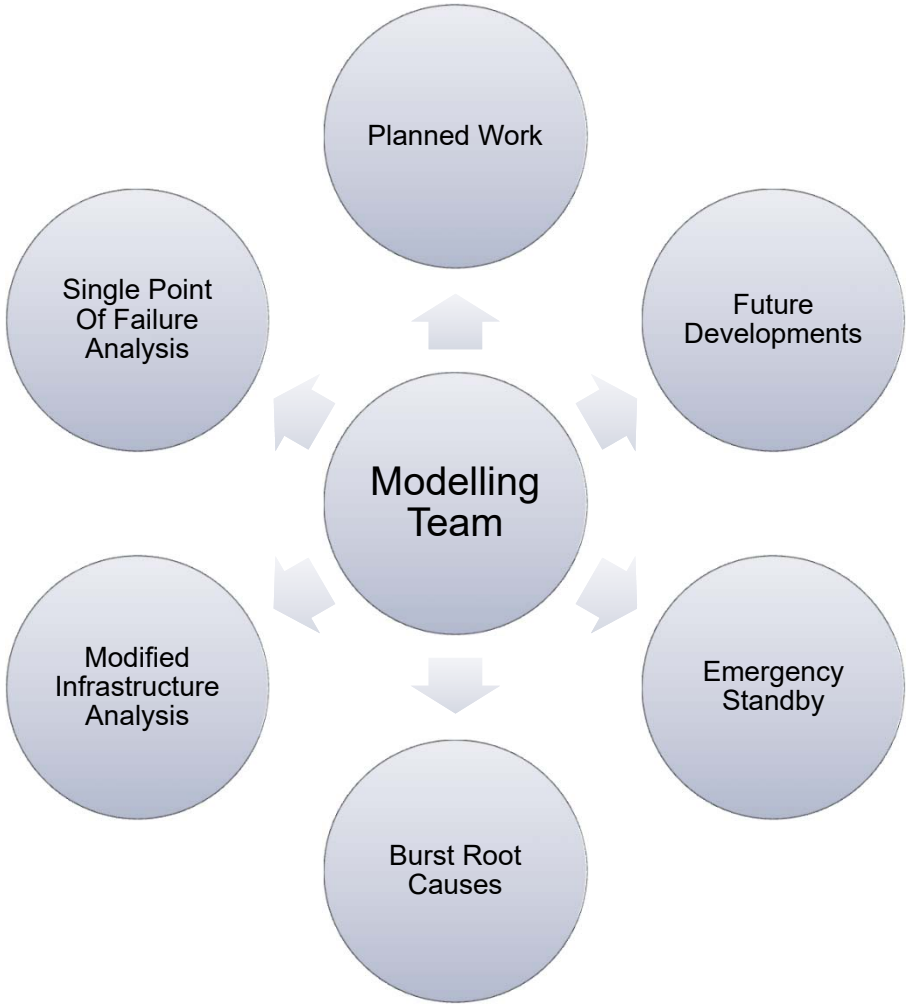
Be proactive, keep me informed · Make it easy for me · Show me you understand me · Do what you say you will · Show me you care

# Overview

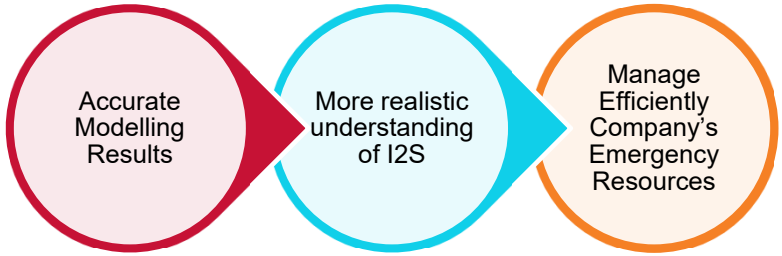
- Affinity Water is the UK's largest water-only supplier, providing more than 900 million litres of water each day to a population of more than 3.8 million people.
- It serves communities with some of the highest demand for water in the country.



# Modelling Team




Provide 24hrs standby hydraulic analysis support for unplanned incidents, such as bursts, production site outages, etc, evaluating the impact on our customers and the wider network, providing contingency plans and solutions using Infoworks Pro software.





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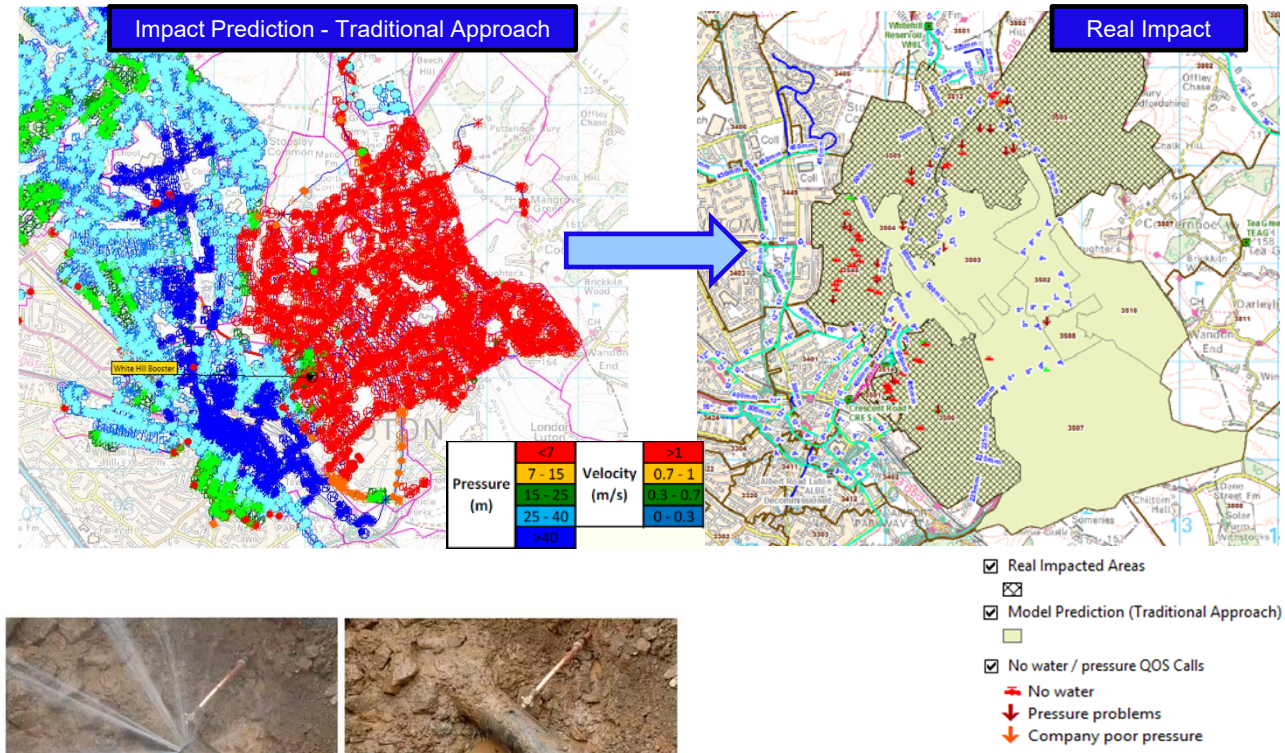
# Major Emergency Incidents

- In water networks, the domestic demand and the non-revenue water (NRW) depend on the available pressure across the different nodes in the system. Therefore, if due to unplanned works such as a burst or a pump failure, a significant pressure reduction happens in the system, the consumed flow will decrease due to insufficient pressure to fulfil the user's demand.







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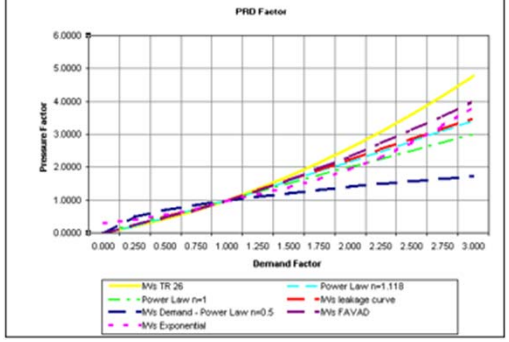
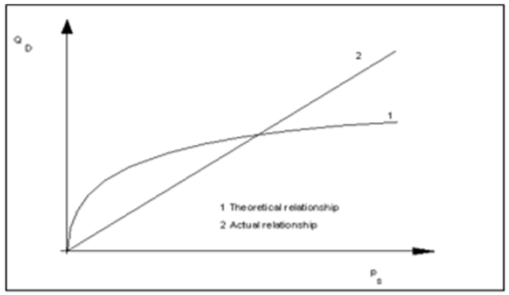
# Infoworks Pro- PRD Tool

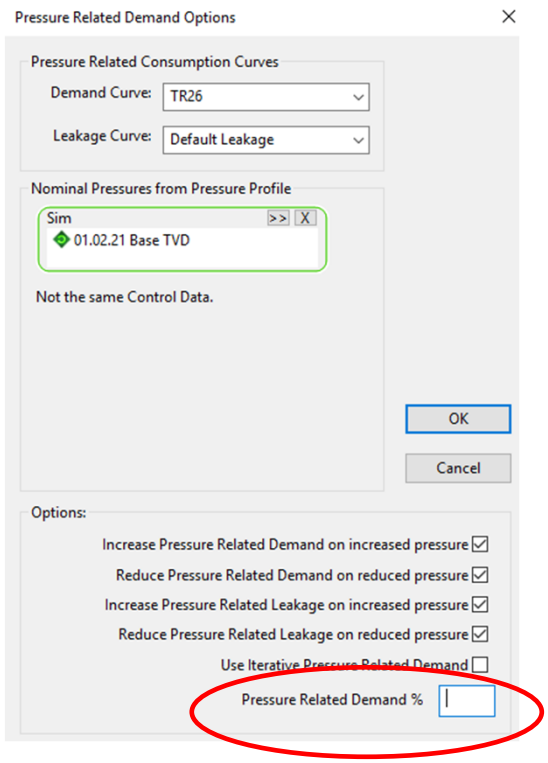
- While the correlation between pressure and leakage is well known in the industry; the relationship between the user's demand and pressure is still not fully understood during emergencies or temporary large reductions in pressures:

1. It is an emerging area for research
2. The demand variation does not depend only on the pressure (Human Factor)
3. Pessimistic view is preferred in an emergency event in the position of better safe than sorry.

| | Equation | Year | Coefficients |
|---|---|---|---|
| InfoWorks demand | $L = AZNP^{N1}$ | | N1=0.5 |
| TR26 – Leakage index curve | $L=0.5.AZNP+0.0042.AZNP^{2}$ | 1980 | |
| Power Law (high, low) | $L = AZNP^{N1}$ | 1979,1997 | N1=1.118 |
| FAVAD | $L=AZNP^{1.5}+(k1/k2)*AZNP^{0.5}$ | 1994 | (k1/k2) = 25.9 |
| Exponential X-C808 – WRC | $L=e^{S.AZNP}$ | 1996 | S=0.0135 (AZNP>50)<br>S=0.0240 (AZNP<50) |




**BUT WHAT FACTOR TO APPLY?**

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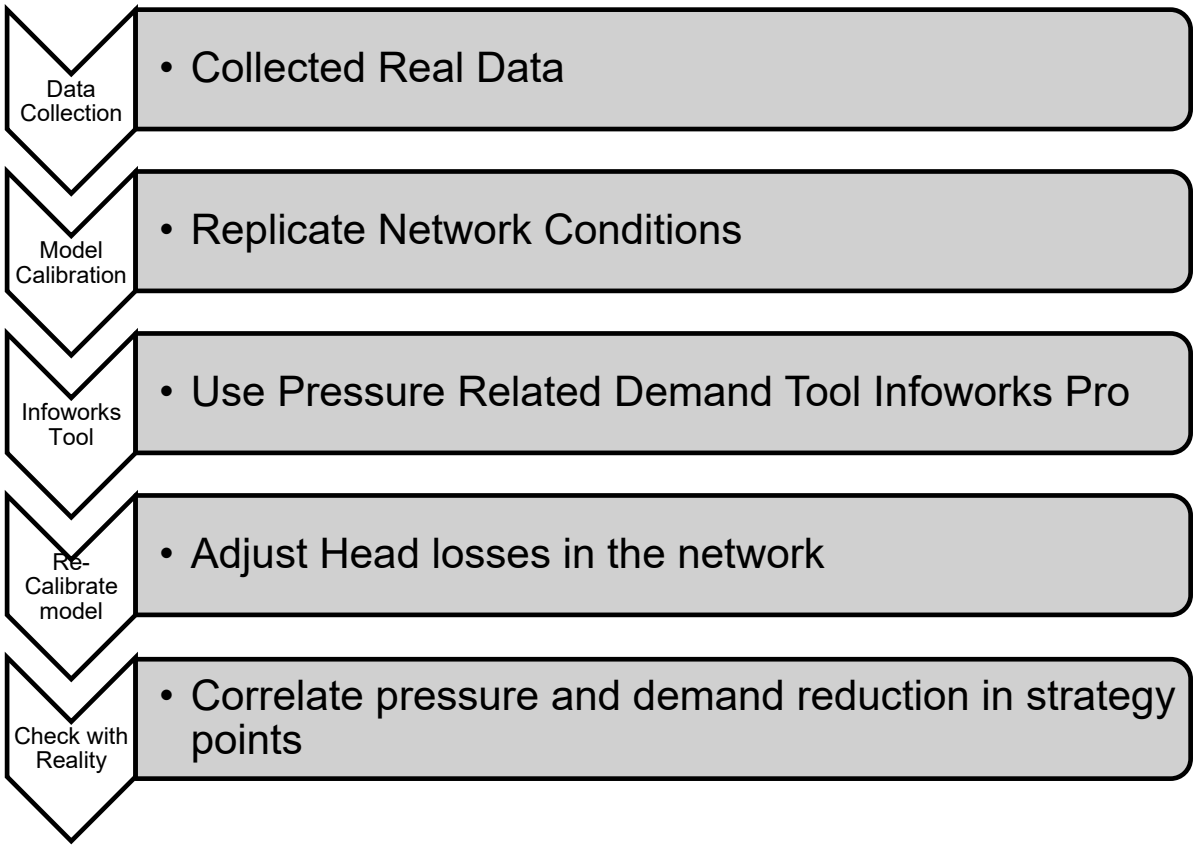
# Incidents Aftermath




The final objective is to understand the pressure demand reduction relationship and be able to identify a factor in PRD curves

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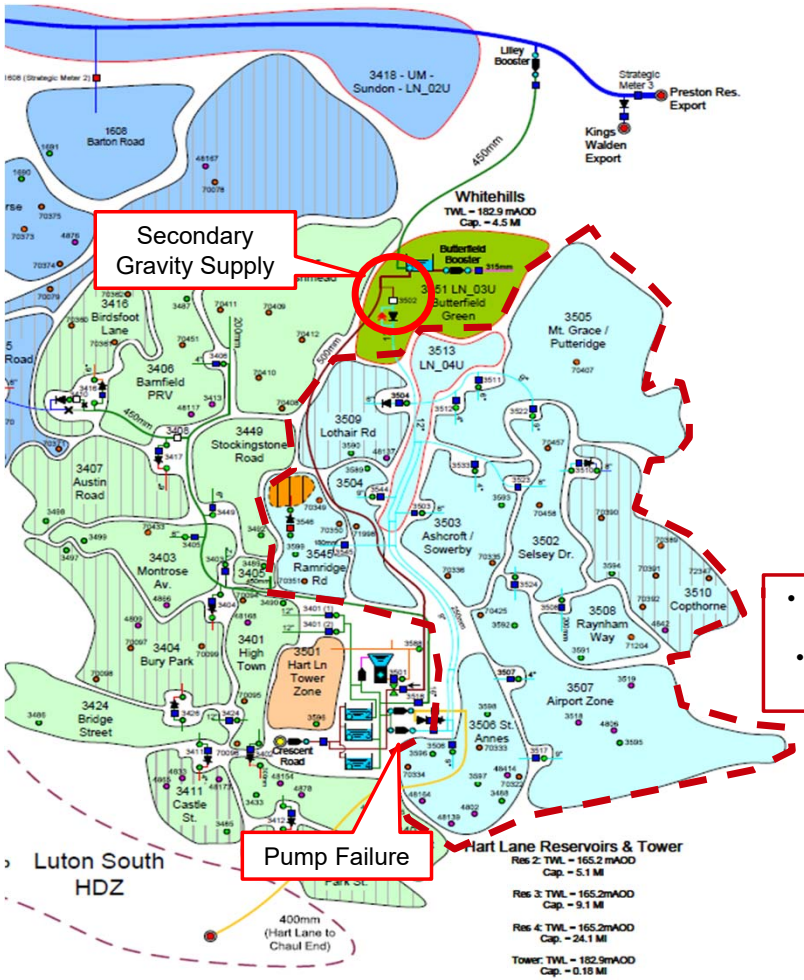
# Case Study




- Pump is the mainly support for the area.
- 17192 customers within the area
- Luton Airport- Large User

- Pump Failure at 07:30hrs – Impact during morning peak
- Secondary gravity supply. Up to 20m drop in pressure during morning peak
- Traditional Approach scenario, constant demand regardless pressure variation, approximately 12.8k properties affected wit no water during peak times

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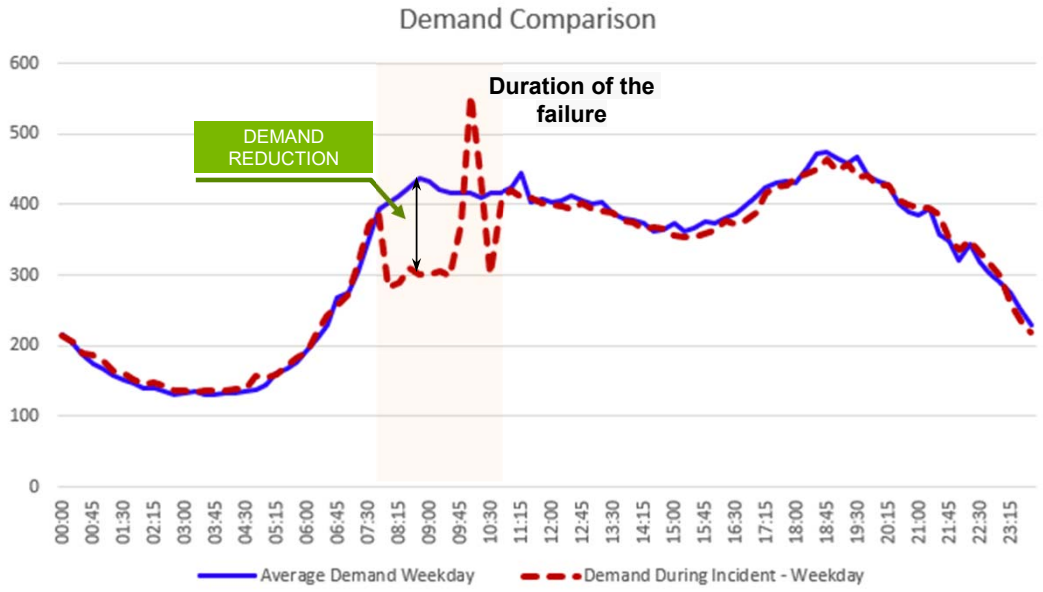
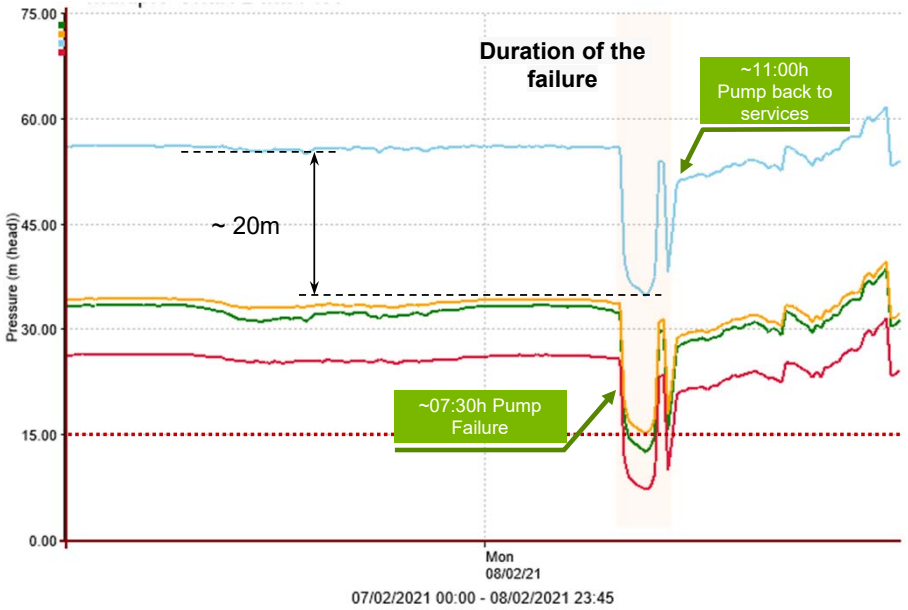
# Understanding the incident (Telemetry)

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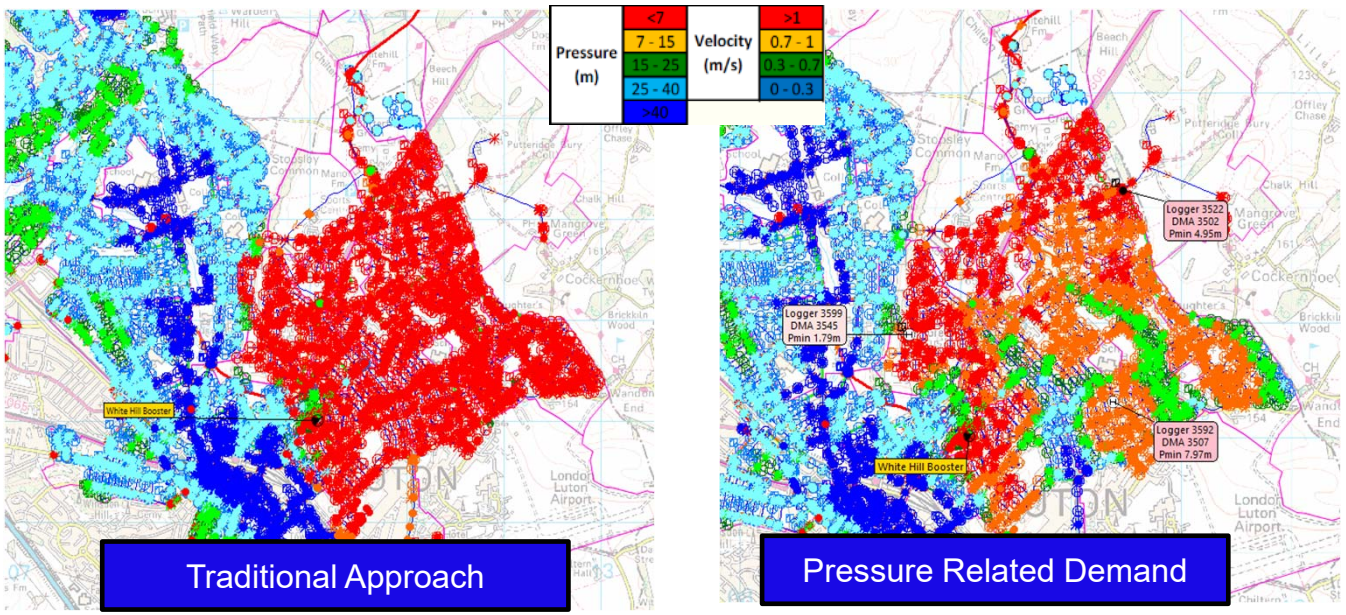
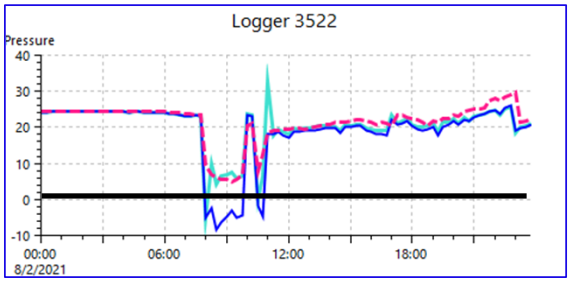
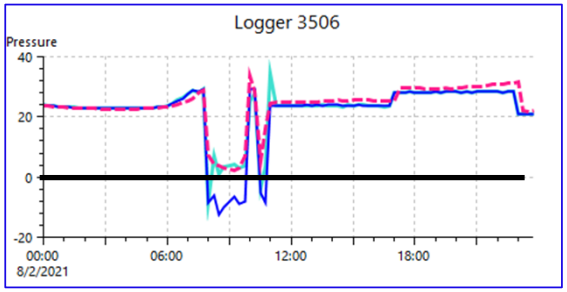
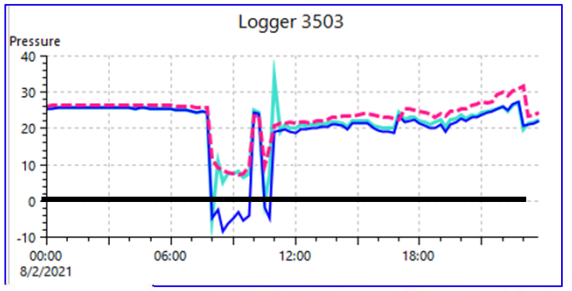
# Pressure Comparison




| Strategic Loggers | Min. Pressure at morning peak | | |
|---|---|---|---|
| | Traditional Approach Scenario (Model) | PRD Scenario Factor 50% (Model) | Reality (Telemetry) |
| Logger 3522 | -6.79m | 6.3m | 5m |
| Logger 3506 | -12.26m | 3.8m | 3.1m |
| Logger 3503 | -6.79m | 8.2m | 7.6m |
| Logger 3523 | 2.41m | 18.7m | 17.7m |
| Logger 3524 | -2.98m | 14.2m | 13.1m |




PRD Scenario
Traditional Approach
Live Data

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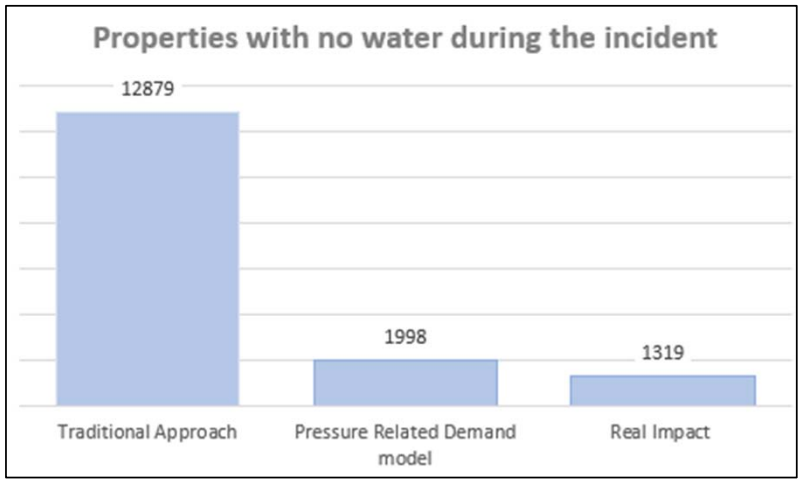
# Results Comparison

- Significant Customer Impact reduction (No water) after applied Pressure Related Demand, more realistic scenario in comparison to reality
- Sensitive Customers (Tiers 1 & 2) need to be handle delivery - Better planning
- Reduce standby resources
- Reduce unnecessary stress on our customers and our employees
- Reduce costs associated with mobilising resources




| | Traditional approach Scenario | PRD Scenario |
|---|---|---|
| Sensitive Customers with predicted no water (Properties) | 1930 | 198 |
| Emergency Resources to deliver water (people Needed) | ~97 people | ~10 people |
| Cost Associated with Standby | £9700 | £1000 |

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# Conclusions - What we learnt so far

1. Challenges
   - Pressure management depend on the model accuracy and headlosses in the network
   - Few case studies to find a trend and identify the right factor in PRD curves

2. Advantages
   1. Be Able to predict more accurately impact
   2. Realistic impact helps to manage efficiently the company's emergency planning resources during incidents
   3. More accurate understanding of Interruption to Supply (I2S).

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# Questions

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