



25th world gas conference  
"Gas: Sustaining Future Global Growth"

# THE UK MAINS REPLACEMENT METHODOLOGY AND ITS ROLE IN REDUCING LEAKAGE REPAIRS

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Date: 5<sup>th</sup> June 2012  
Venue: Room 302/3



Patron



Host



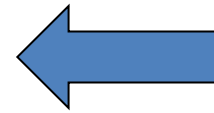
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## Issues with operating metallic distribution mains

- Significant population of metallic gas mains still in use around the world, particularly UK and USA
- Ageing population will increase leaks.
- Replacement of metallic main with PE virtually eliminates leaks from pipes
- Replacement of main will reduce number of leaks and incidents— **which mains to replace first?**

# Consequences of leakage from metallic mains



Fractures from cast iron or corrosion from ductile iron can lead to significant gas loss

Gas tracking into property can lead to ignition and explosion hazard

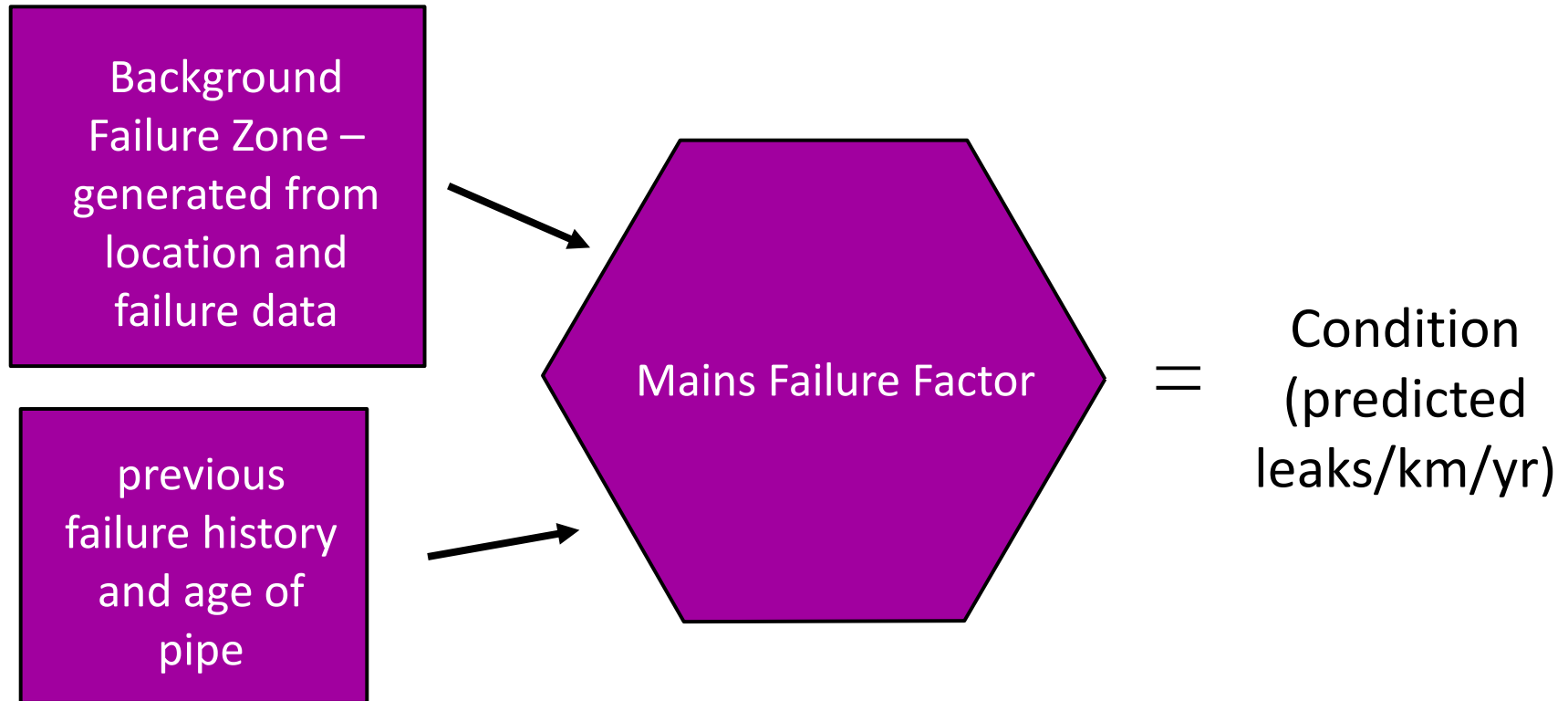


# Impact of mains replacement

- Replacement of metallic main with PE virtually eliminates leaks from pipes
- Most companies can manage about 1% replacement each year, so it will take **100 years** to replace all mains
- ***How does an asset manager decide which mains to replace first?***

# Development of Condition Model

- In 1999, GL Noble Denton developed a model which estimates the likelihood of a leak on a pipe segment in the following year



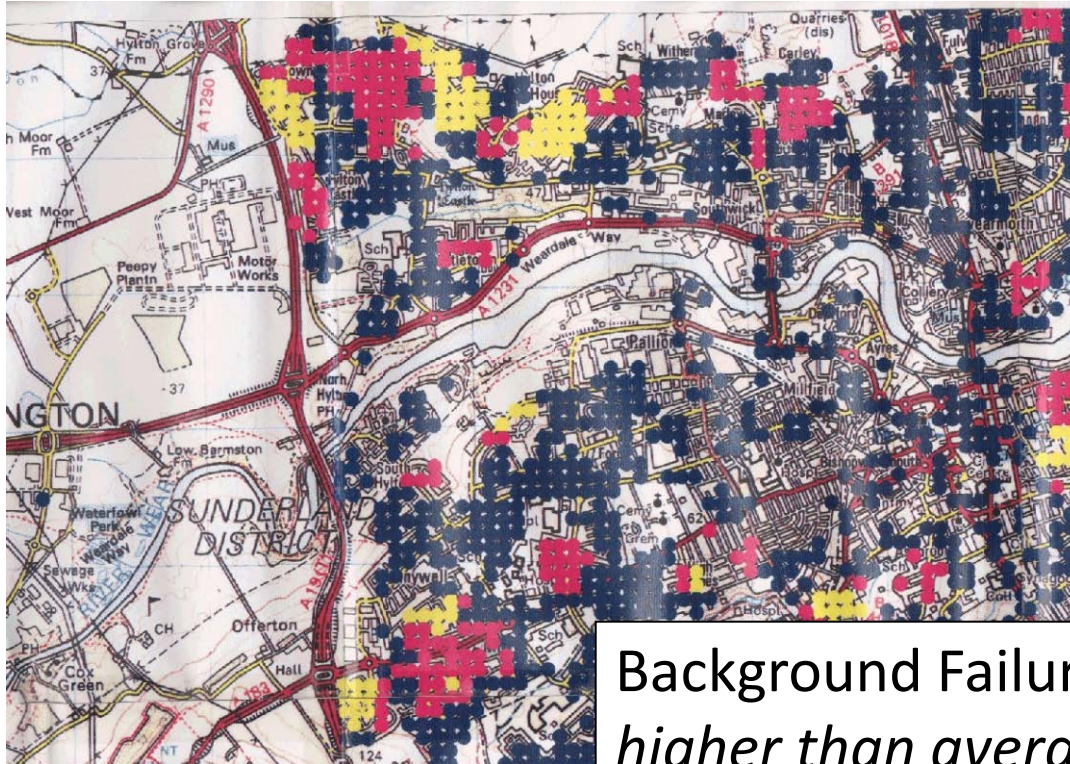
## Data used for development of model

National UK failure database on fractures, corrosion and joint leaks :-

Approximately

- 1,000,000 mains units,
- 20 years historical data,
- 300,000 fractures
- 500,000 joint leaks
- 200,000 corrosion leaks

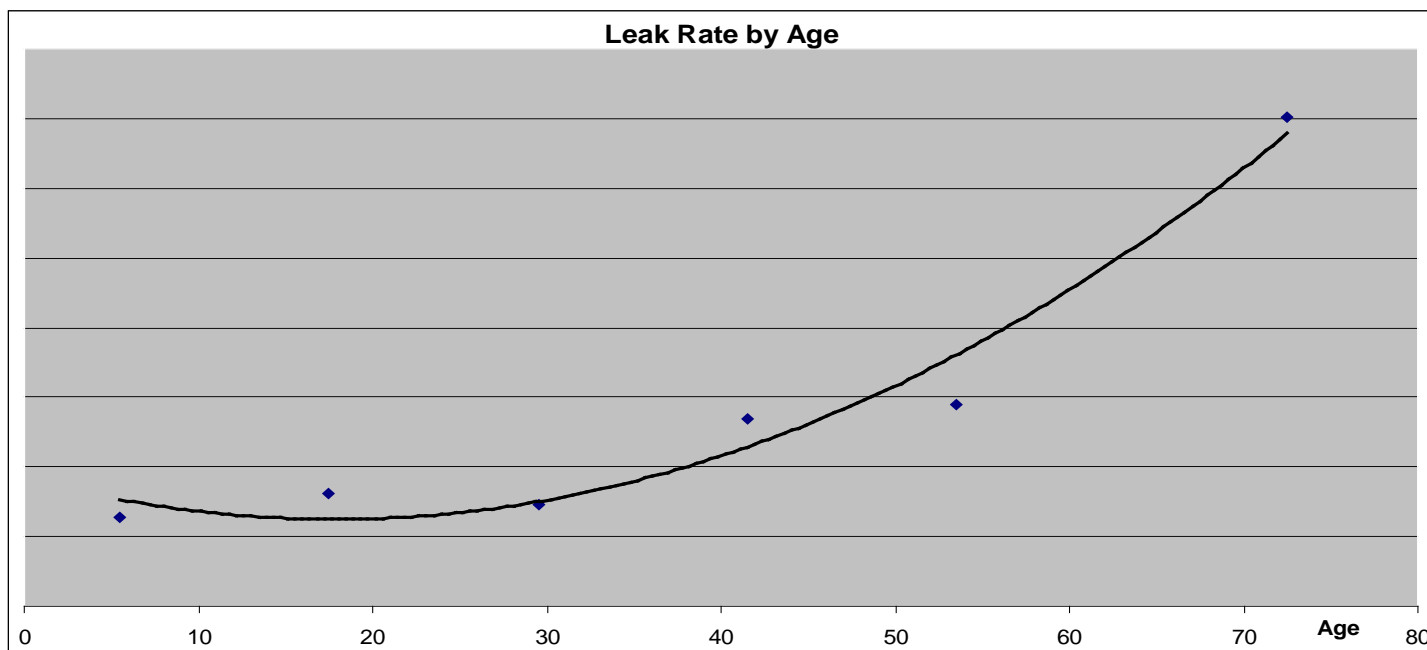
# Background Failure Zones



Background Failure Zones are areas of *higher than average* failure activity  
Approximately only 1% of mains will leak in any one year. A main lying in a high zone *which has not yet failed* has a much greater chance of failing in the future

# Relationship between future leak rate and age

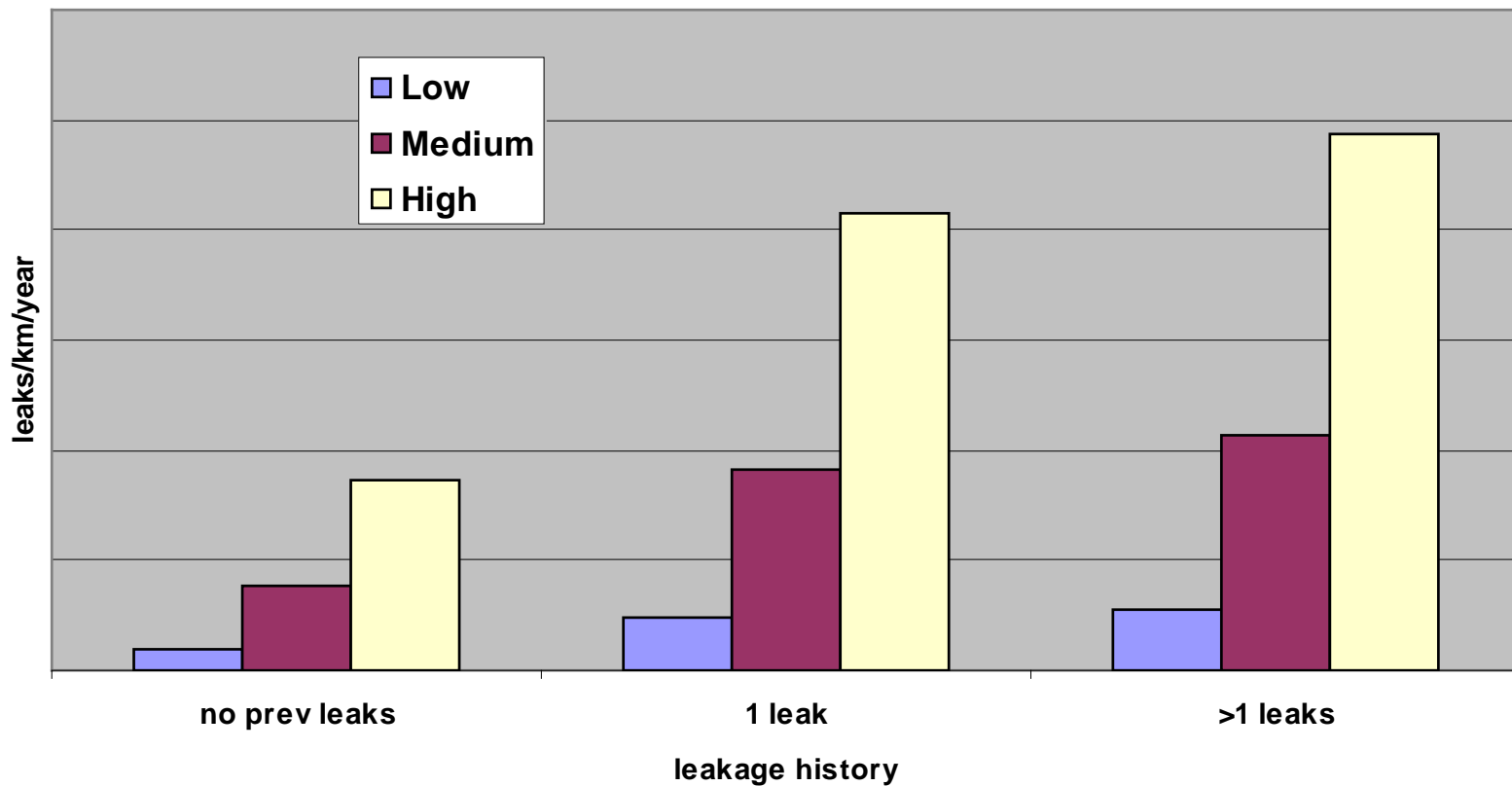
For mains with no previous failures, the age and Background Zone are the predominant factors which determine future behaviour





# Relationship between future leak rate, previous leaks and Background Zone

Relative weightings between previous leaks, Background Zone and future leak rate



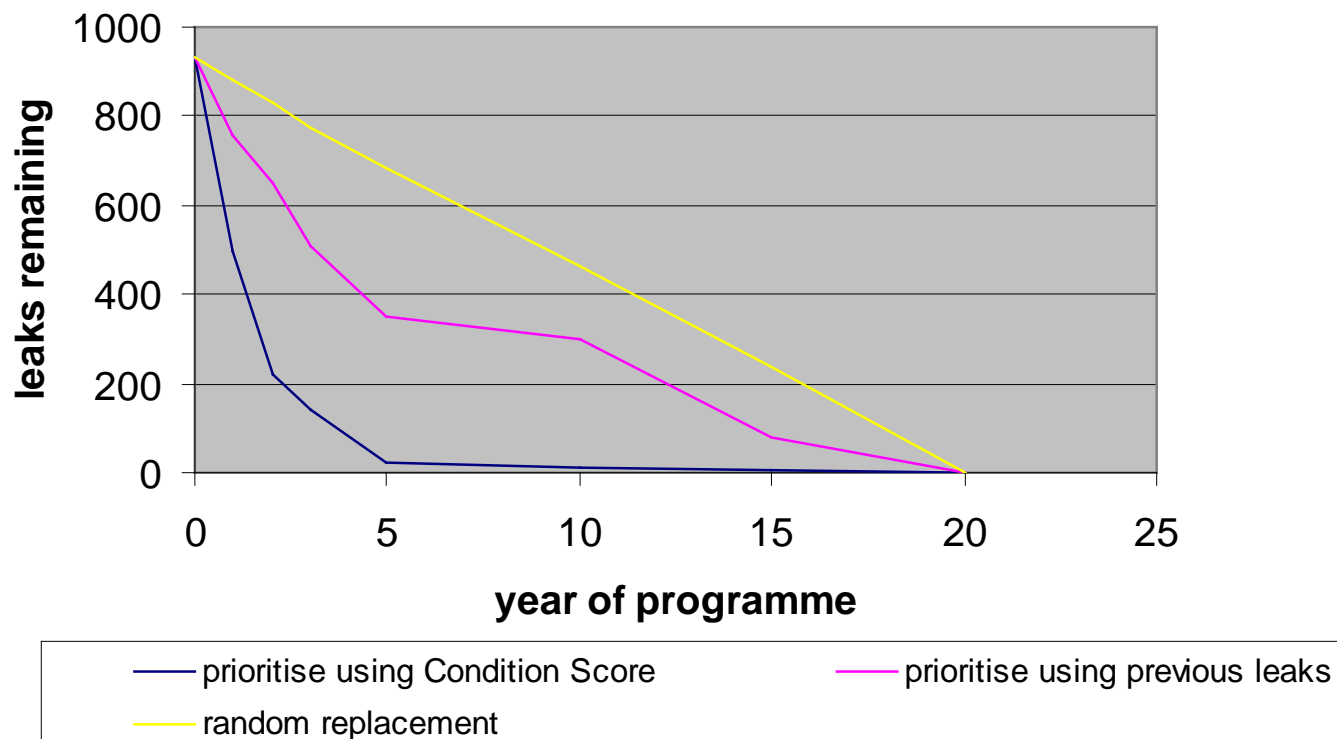
# Application of Condition Model

Every metallic distribution main in the UK within 30m of property has been assessed to determine its Condition Score

The future impact of prioritising on Condition Score has been simulated.

- If 5% of mains are replaced at random, **5%** of leaks in the following year would be avoided
- If 5% of mains with the highest number of previous leaks are replaced, **20%** of leaks in the following year would be avoided
- If 5% of mains with the highest Condition Score are replaced, **50%** of leaks in the following year would be avoided

## Reduction in leaks by prioritising mains replacement

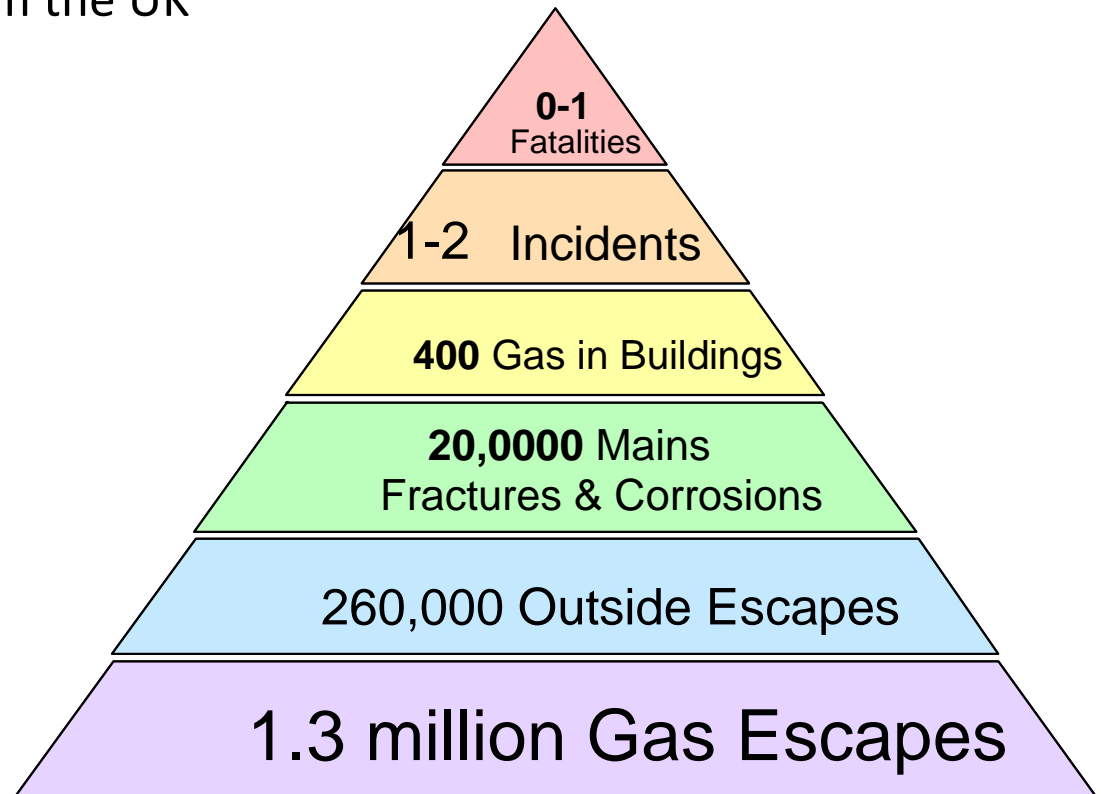


## Benefits of Condition Model

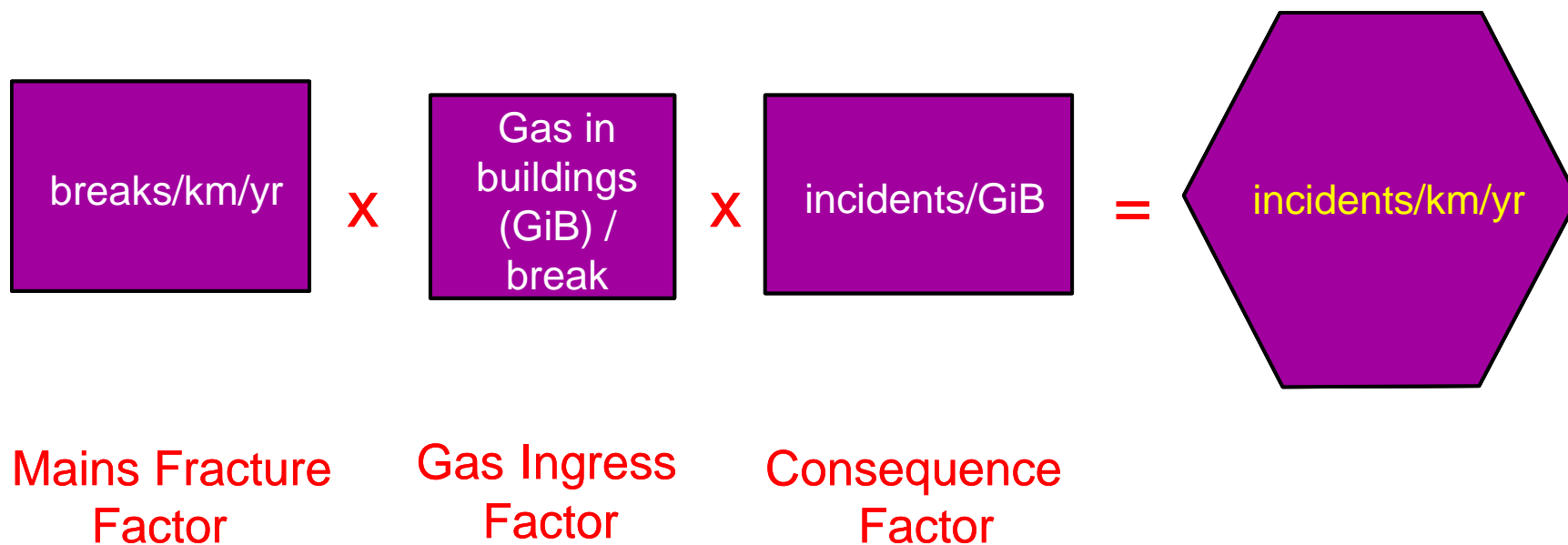
- Same level of replacement can achieve a greater reduction in leaks
- A lower level of replacement can achieve the same reduction in leaks
- Process is auditable and objective so can be used to justify expenditure to senior management, shareholders, and regulators

## Extension of Condition Model to Risk

- A proportion of leaks will lead to gas ingress into property (gas in building (GiB) occurrences)
- A proportion of GiBs will lead to gas ignition and explosion
- Indicative annual data from the UK is shown below

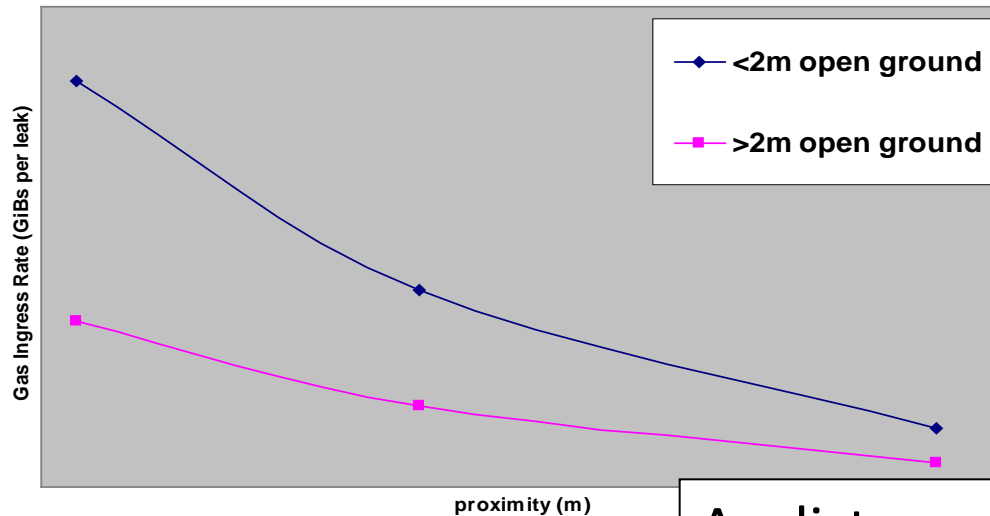


# Structure of Risk Model for Cast Iron Mains



# Relationship between proximity, open ground and gas ingress

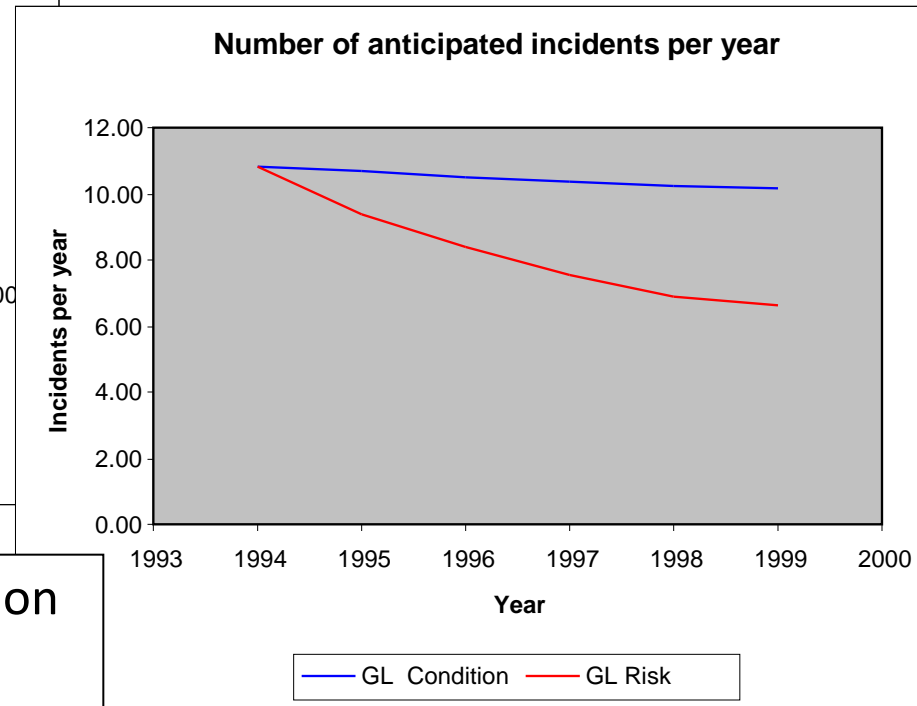
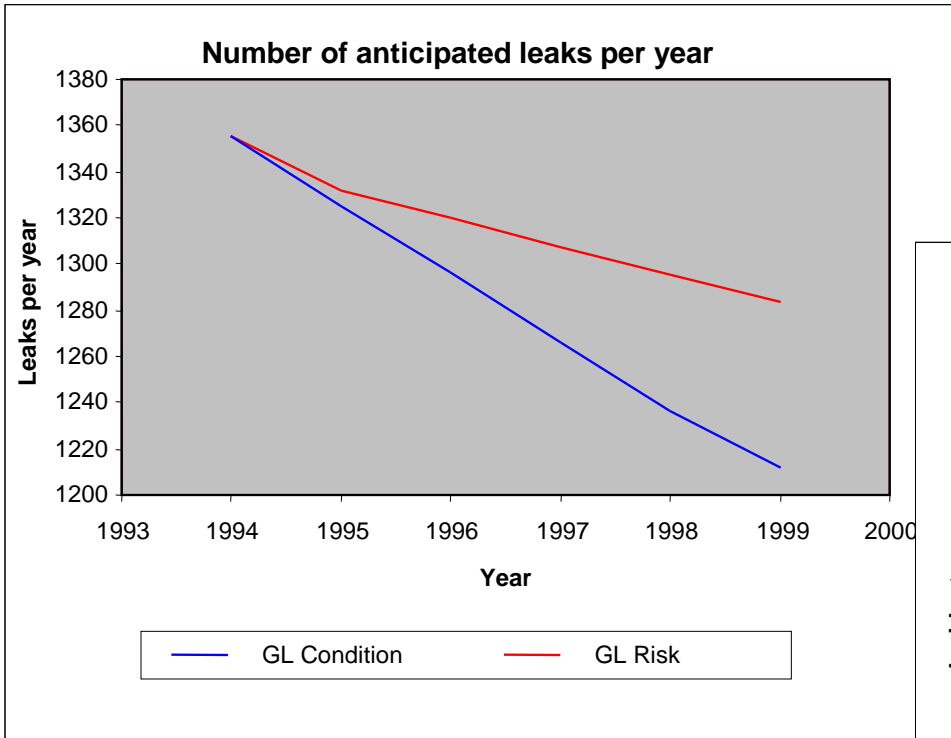
Proximity and open ground vs Gas Ingress rate



As distance from main to property increases, probability of gas ingress reduces

As amount of open ground increases, probability of gas ingress reduces

# Impact of prioritising by Condition or Risk Score



Prioritising by Risk Score will reduce explosion incidents more quickly than leaks  
Prioritising by Condition Score will reduce leaks more quickly than explosion incidents



## Summary and conclusions

- The benefits of mains replacement can be enhanced by targeting those pipes most likely to leak or those most likely to generate ignition incidents
- Statistical models based upon large quantities of historical data have delivered an effective targeting mechanism
- Models can be used to reduce replacement expenditure while delivering the same reduction in leaks or risk
- Models can be used to increase the reduction in leaks or risk, whilst maintaining the same level of expenditure.

**Better performance, delivered by smart analysis, need not cost more!!**