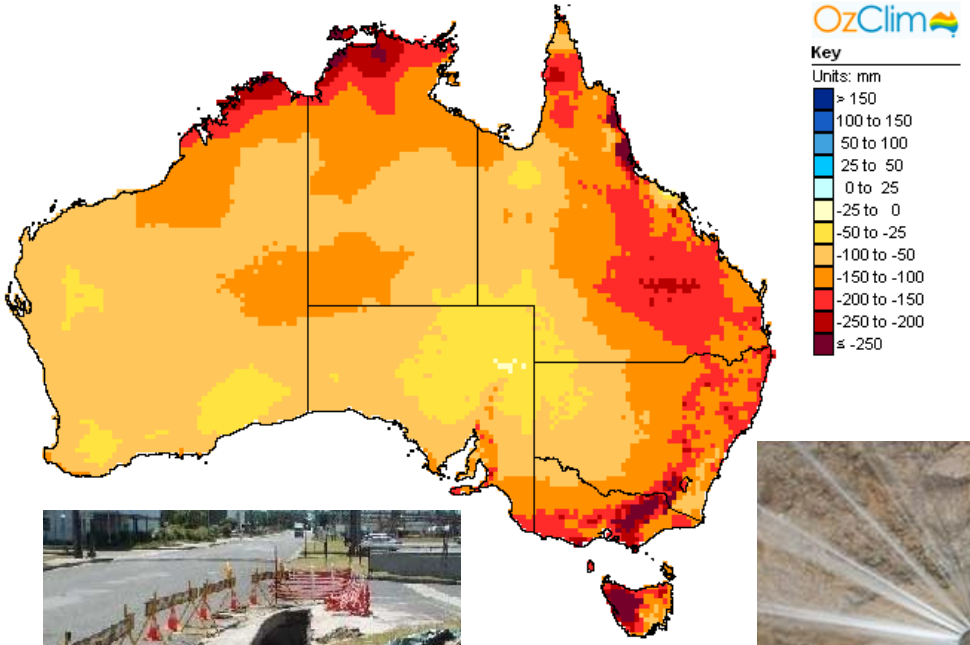

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# Water Pipe Failure Predictions under Different Climate Scenarios

**Water For a Healthy Country Flagship**

**F. Boulaire, S. Gould, D. Beale, J. Kodikara, S. Burn and D. Marlow**

**Presented by Scott Gould**

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# Presentation outline

- Background
  - Pipe failure modelling
    - Purpose of modelling
    - Factors which influence failure
- Enhanced model for predicting pipe failures
  - Does the enhanced model improve predictions?
  - Validation of model at cohort level, comparing
    - Predictions using the original model
    - Predictions with enhanced model (inclusion of climate factors)
- Quantifying the impact of climate change
  - Predictions on number of failures under three different scenarios



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# Background

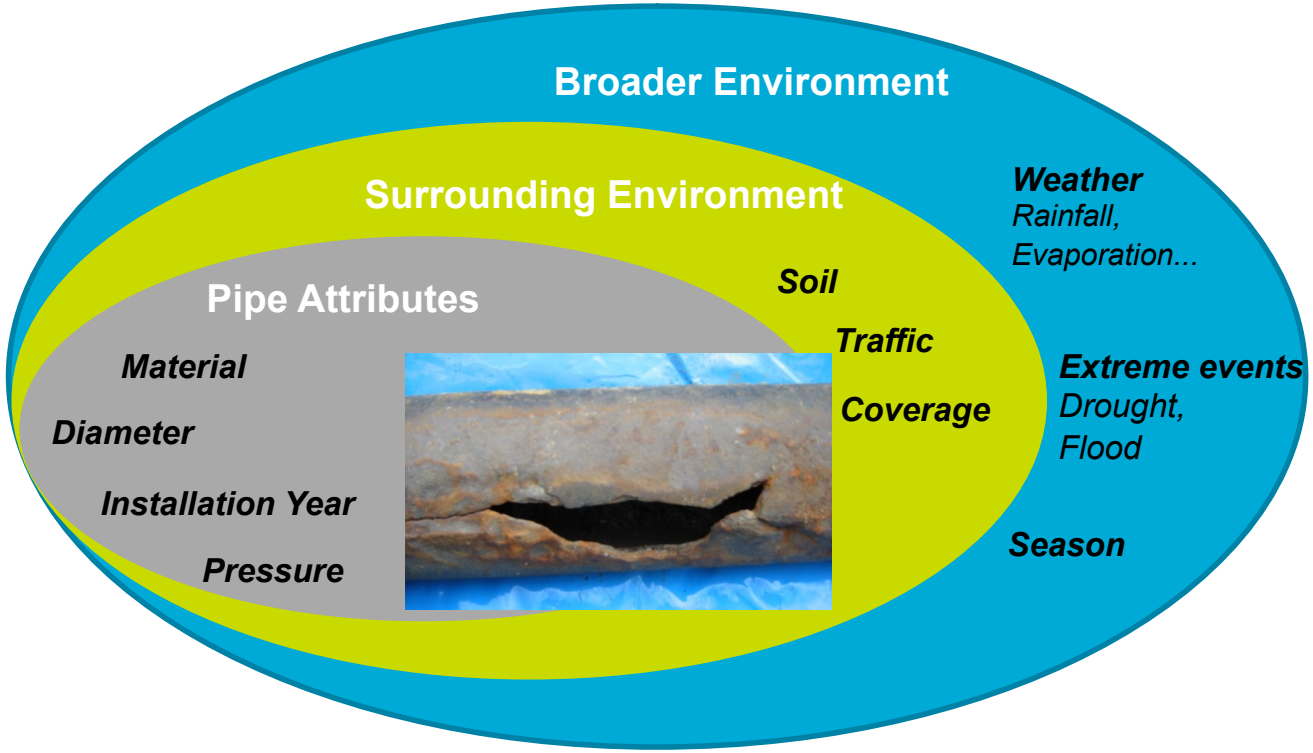
# Failure modelling

- Water asset managers use simulation tools to help make maintenance decisions

- Tools are based on failure predictions models
  - Physical
  - Statistical
  - Physical-probabilistic

# Causes of failures

- Failures are caused by a range of inter-related factors



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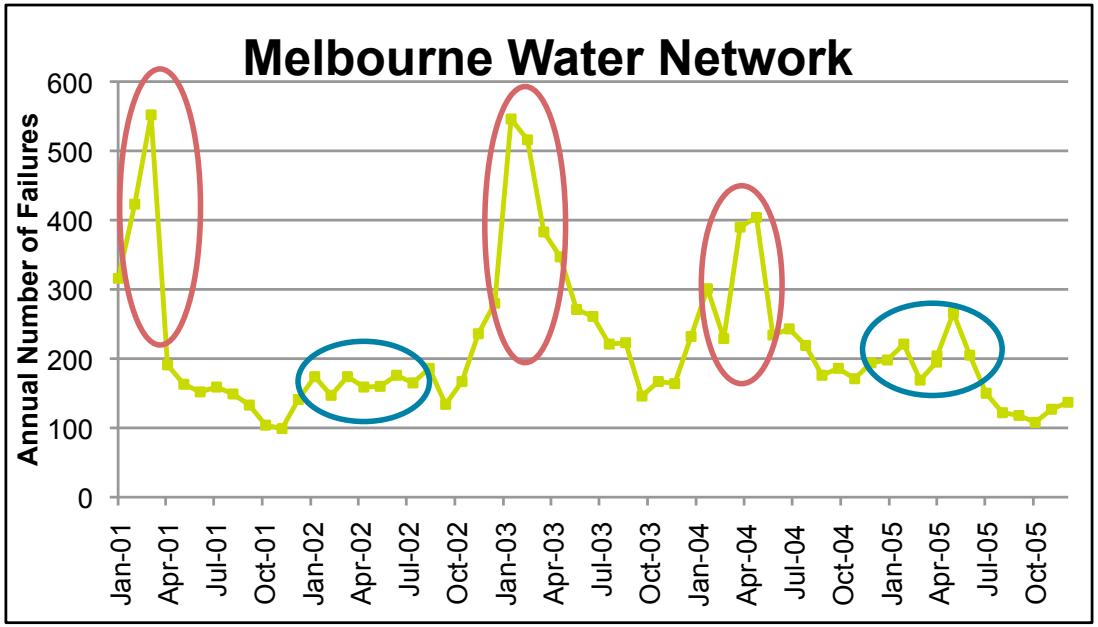
# Failure number variation

- Original model allows for Pipe Attributes and Surrounding Environment to be included




- Enhanced model also includes Broader environment (climate).



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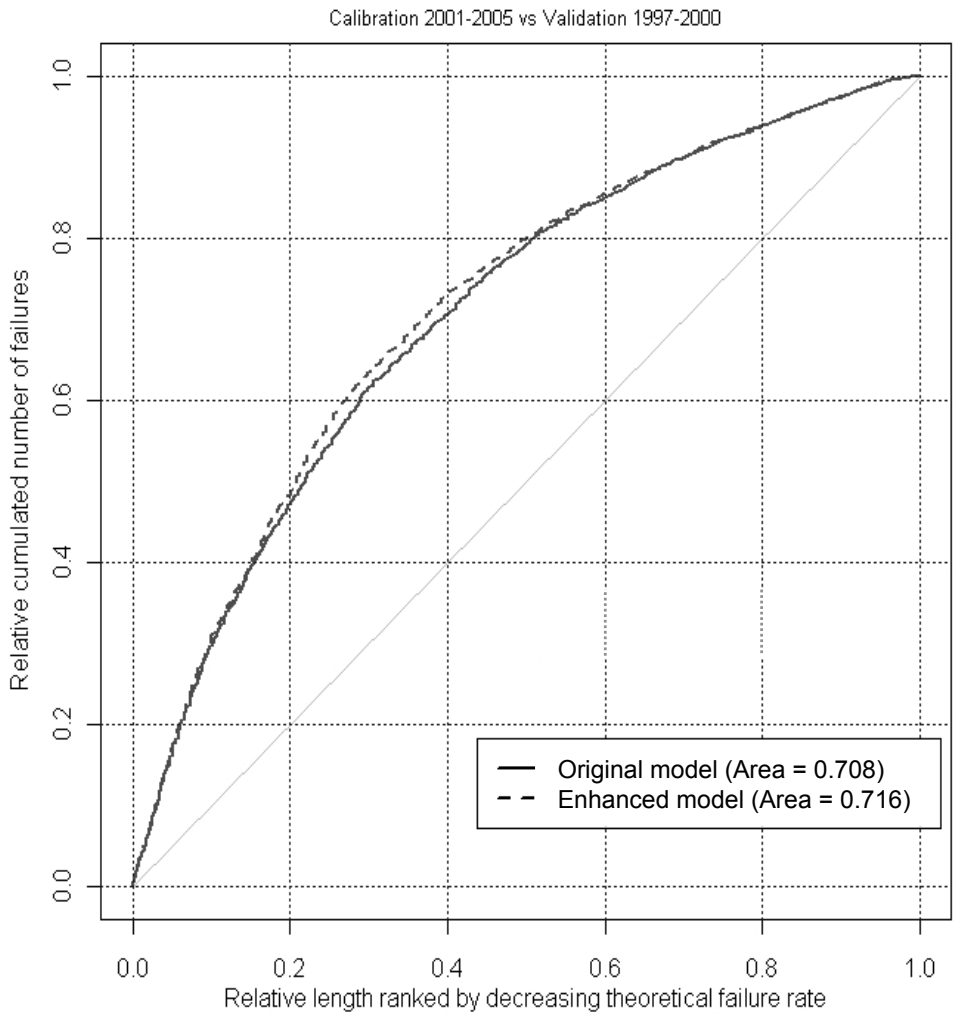
# Model Validation

# Can the model detect most at risk pipes?

- ROC (receiver operating characteristic) curves
  - x-axis: relative length of pipe ranked by decreasing predicted number of failures
  - y-axis: cumulative percentage of observed failures
  - Perfect prediction corresponds to an inversed L curve
  - Random guess corresponds to the diagonal line
- Area Under Curve
  - Measure of quality of predictions
  - Provides a way of comparing models



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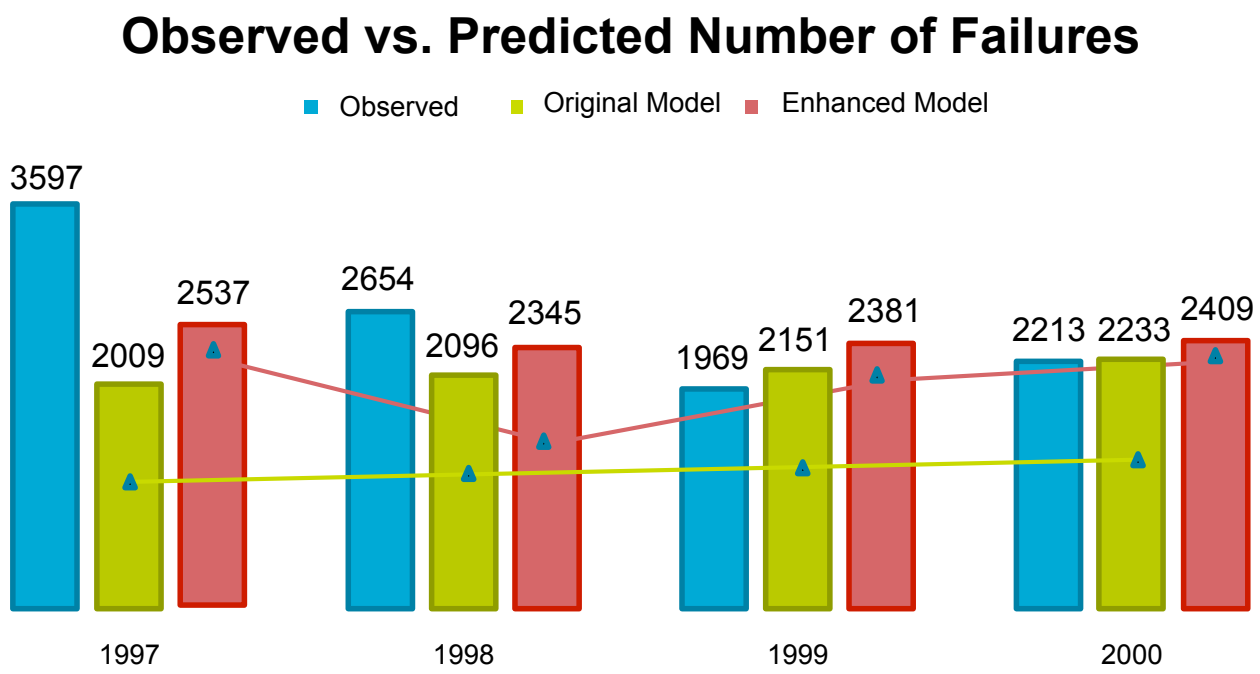
# Are the yearly variations better captured?




- Enhanced model captures some yearly variations
- Overall predictions
  - Enhanced model under predicted by 7%
  - Original model under predicted by 19%



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# Long term predictions

# 2001 - 2100

# Predictions under various climate scenarios

- Without the inclusion of climate factors
  - Original model
- Using current climate conditions
  - Enhanced model assuming current average conditions continue without change
- Using projections from the A2 climate change scenario
  - Enhanced model using data from the CSIRO 3.5mk model



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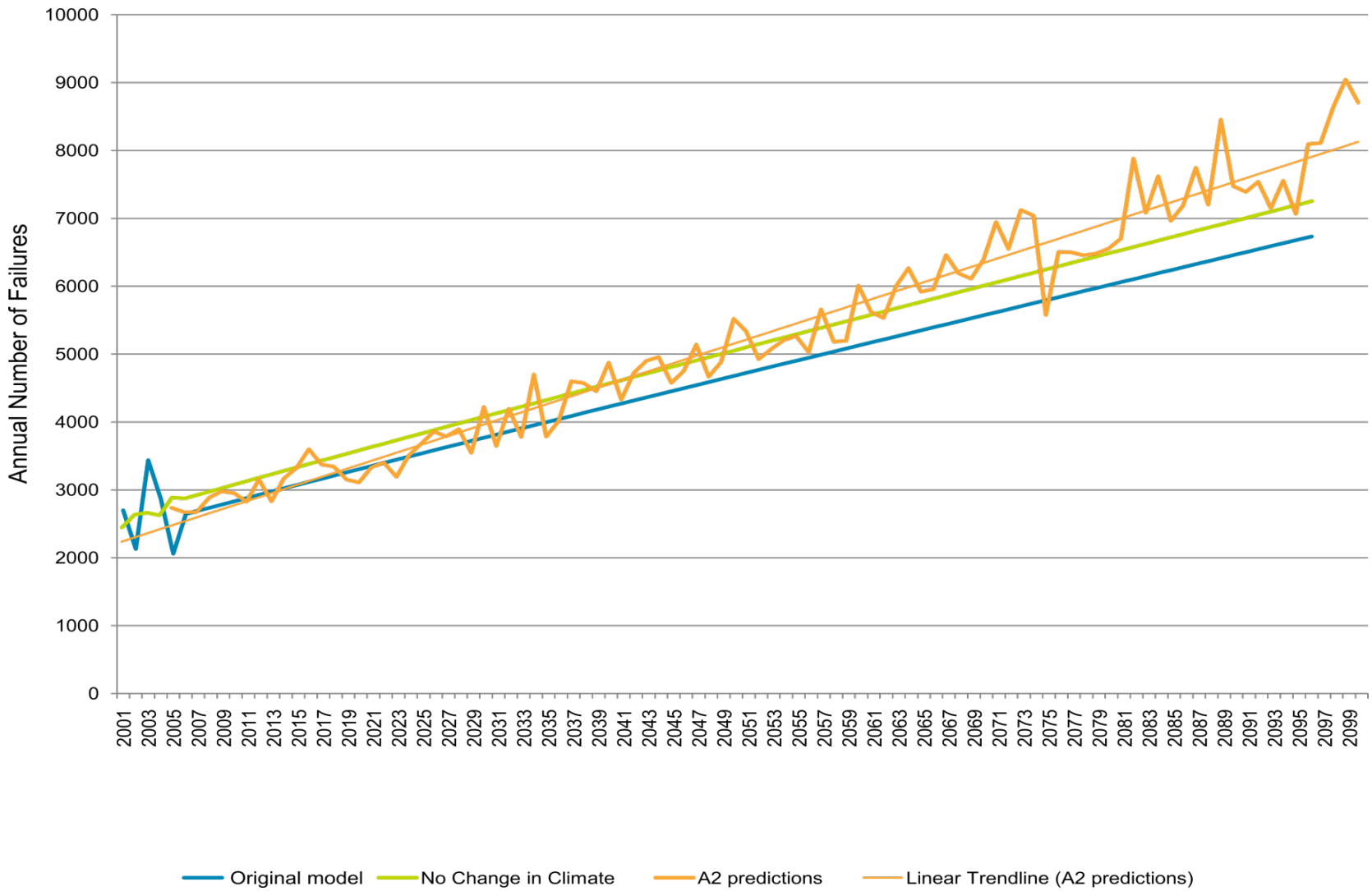
# Predictions on number of failures 2001-2100



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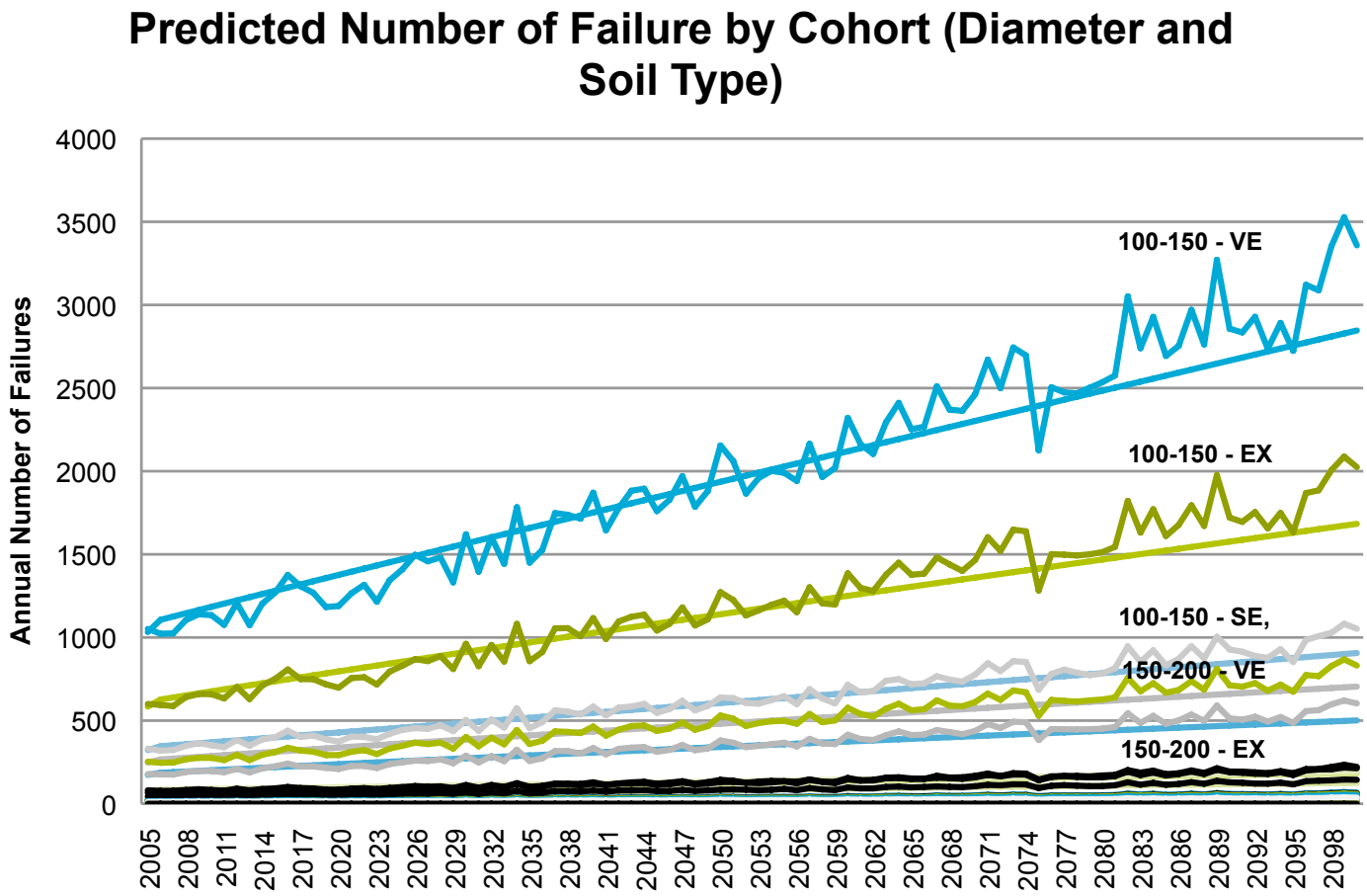
# At risk cohorts

- Asset managers look at the most at risk cohorts when budgeting



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# Cost estimations

- Different types of costs associated with failures
  - Repair costs depending on
    - Type of repair or replacement
    - Location of pipe
    - Diameter
  - Social costs (depending on location of pipe and time of day)
  - Penalty costs (depending on outage length)

- A2 scenario costs are
  - overall 5% higher than when compared to a scenario of no climate change
  - with peaks up to 20% in some years

- Other climate change scenarios are expected to show more dramatic differences

# Conclusion

- Enhanced failure prediction model
  - Assess long term performance of the networks
  - Determine the direct economic cost of various climate change scenarios on network maintenance
- Identify at risk pipe cohorts
  - Optimising maintenance
  - Supporting management strategies.
- Failure number variation
  - Identify potential peaks in failure numbers
  - Supporting advanced planning to reduce stress on resources (budgets and labour)

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# Thank you

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