TAC meeting Mar 2015
Activity 3 presentation

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Outline

- Background and aims
- Modelling approach
- Summary of progress to date
- Current overall goals
- Progress over last quarter
- Future work

Background and aims

- Aim - develop models for external corrosion depth as a function of time and soil environment
- Looking at old, large diameter cast iron cement lined pipes

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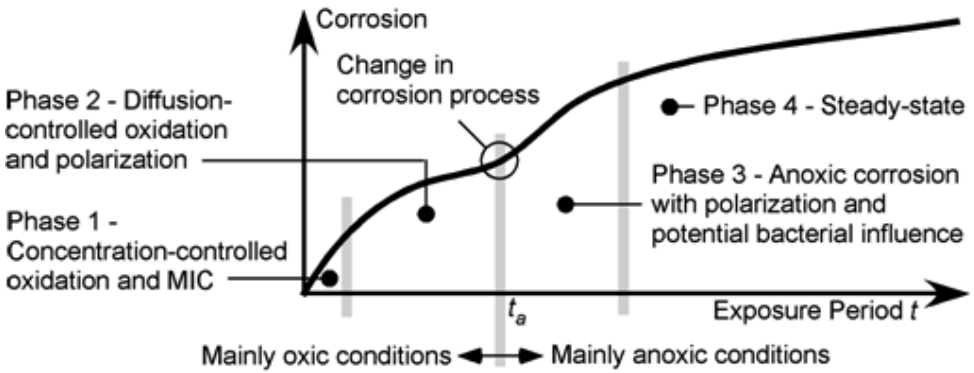
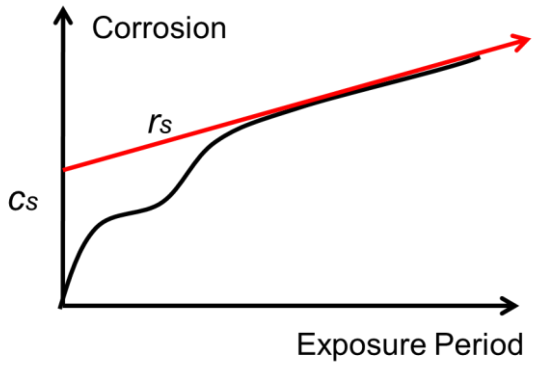
Modelling approach

- Long-term corrosion model
- Based on bimodal model
- Calibrated to real field data
- Corrosion loss is a function of time and soil parameters





Summary of progress to date

- Shown corrosion in a soil follows bi-model trend
- Long-term rate controlled by pit growth under rusts
- Identified parameters influencing growth of pits (incl. water and nutrient supply)
- Collected data for model calibration from the following:
- 1. Hunter Water field trials
- 2. SW breaks
- 3. Literature (Romanoff 1957 report)
- Calibrated model for pipes buried in native soils

Current overall goals

- Continue to investigate long-term corrosion behaviour and influencing factors
- Collect and analyse more data from field studies
- Further calibrate corrosion loss models

Progress over last quarter

Investigating the long-term corrosion processes

1. Re-examination of Romanoff (1957) data

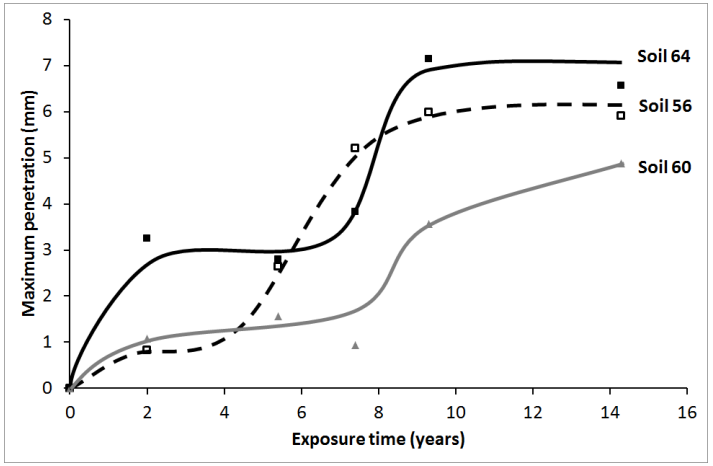
Data collection and model calibration

2. Model calibration using Hays (1980) data
3. Examination of Water Corporation CA reports
4. Test bed soil and pipe corrosion data collection

Re-examination of Romanoff (1957) data (1)

Background

- Observed corrosion of CI buried in soils follows bimodal trend
- Based on examination of plain and low-alloy CI buried in 14 soils for 14 years (Romanoff 1957)
- Above dataset represents only small subset of data in Romanoff (1957)



Re-examination of Romanoff (1957) data (2)

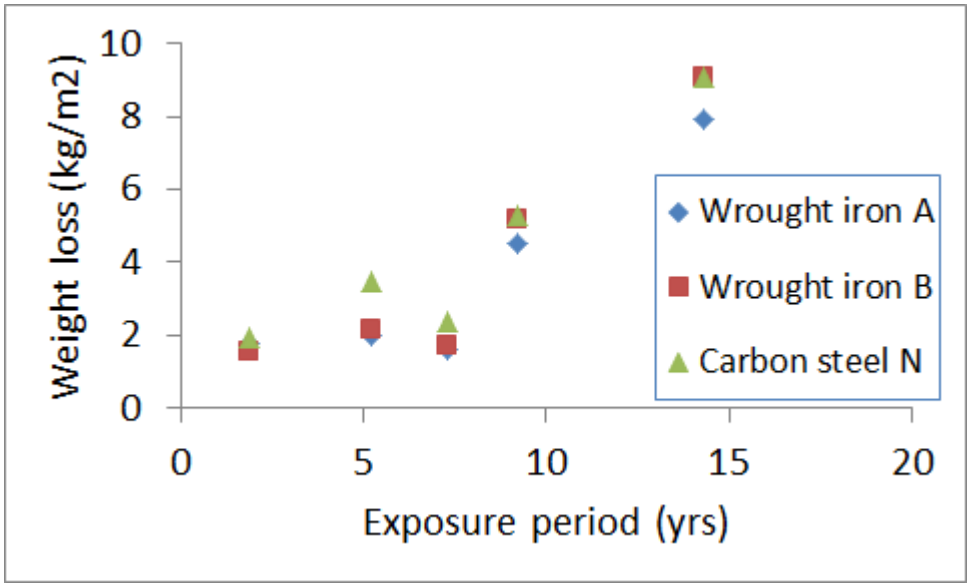
Aims of current analysis

- Expand original analysis to examine data for plain and low-alloy cast iron, wrought iron and steel pipes buried across all soils in report
- Assess to what extent the data follows the bimodal trend
- Determine whether corrosion is influenced more by soil conditions or pipe composition

Re-examination of Romanoff (1957) data (3)

Data overview

- Weight loss and maximum penetration
- Plain & low alloy cast iron, wrought iron and steel pipes
- Plain – 89 sites, low-alloy – 14 sites
- Buried for 12-17 years



Re-examination of Romanoff (1957) data (4)

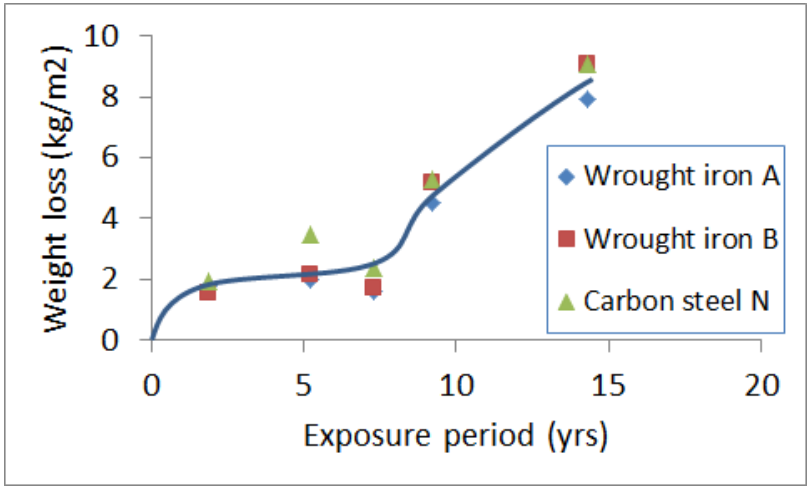
Variation analysis: method

- Variation due to soil:
  - Kept pipe type and exposure constant. Determined variation in corrosion due to variation in soil
  - Determined average COV across all pipe types and exposures
- Variation due to pipe type:
  - Kept soil type and exposure constant. Determined variation in corrosion due to variation in pipe type
  - Determined average COV across all soil types and exposures

Re-examination of Romanoff (1957) data (5)

Results and Outcomes – Assessment of bimodal fit

- Weight loss data – Fit in 87 % of 121 cases examined
- Maximum penetration data – Fit in 75 % of 449 cases examined
- Outcome for project – Work supports modelling approach



Re-examination of Romanoff (1957) data (6)

Results and Outcomes – Variation analysis

- Loss in weight determined more by soil conditions than by pipe type
  - (including plain & low-alloy cast irons, wrought irons, & steels)
- Maximum penetration determined more by soil conditions than by pipe type when considering the following groups
  - Plain & low alloy cast iron
  - Wrought iron & steel

  - But NOT when considering all pipe types

Re-examination of Romanoff (1957) data (7)

Results and Outcomes – Variation analysis

- Outcomes for project:
- This work shows that for cast iron, it appears that pipe composition/type is not as important as soil properties

Model calibration using Hays (1980) data (1)

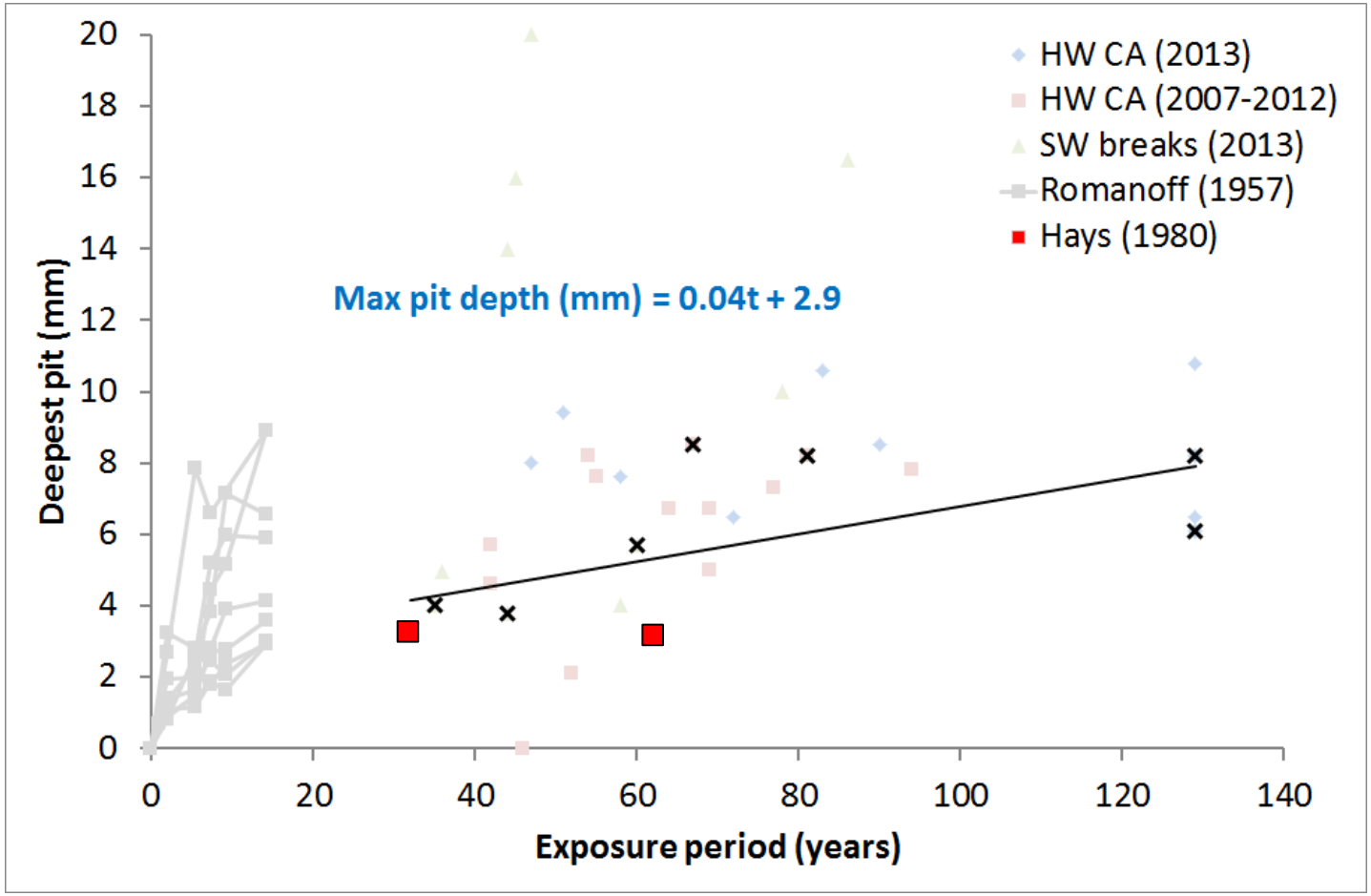
- 19 pipes
- Cast iron pipes 100 – 300 mm diameter
- Sampled from sites in Newcastle & Sydney
- Corrosion measured on removed pipe sections
- Site details recorded + multiple soil properties determined
- Soils: predominantly loams and sands
- Some cases rubbish, bricks & rocks in backfill

Model calibration using Hays (1980) data (2)

- For model calibration considered only pipes buried in native soils
- Estimated long-term average moisture content using climate-soil moisture model developed previously
- Moisture value converted to degree of saturation for model calibration
- 5 data points with certainty about moisture condition
- Consistent with previous data from HW CA
- Model fits shown in next 3 slides

Model calibration using Hays (1980) data (3)

- Max.pit depth. Pipe buried in native soil. S_w =0.3-0.5



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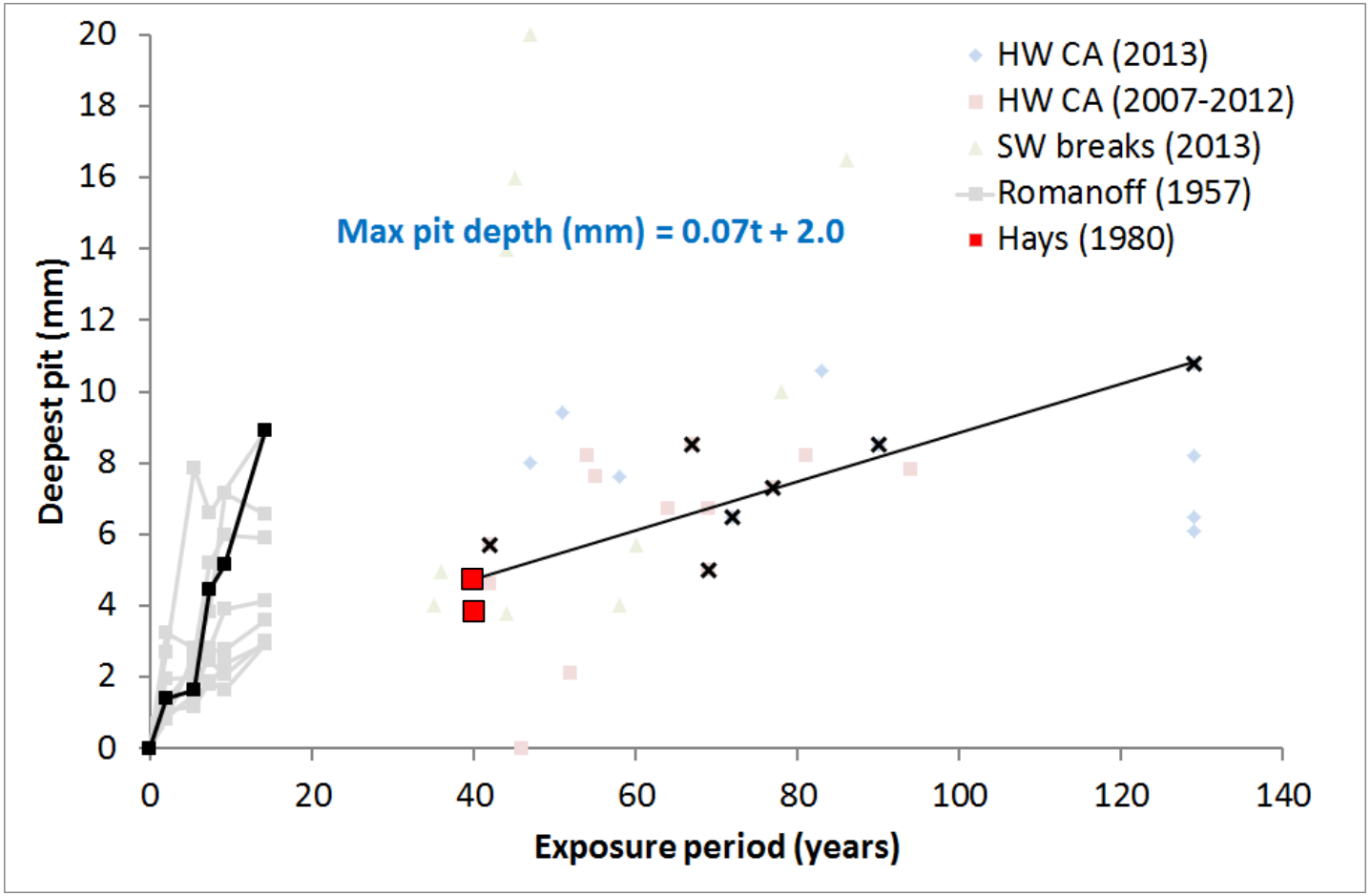
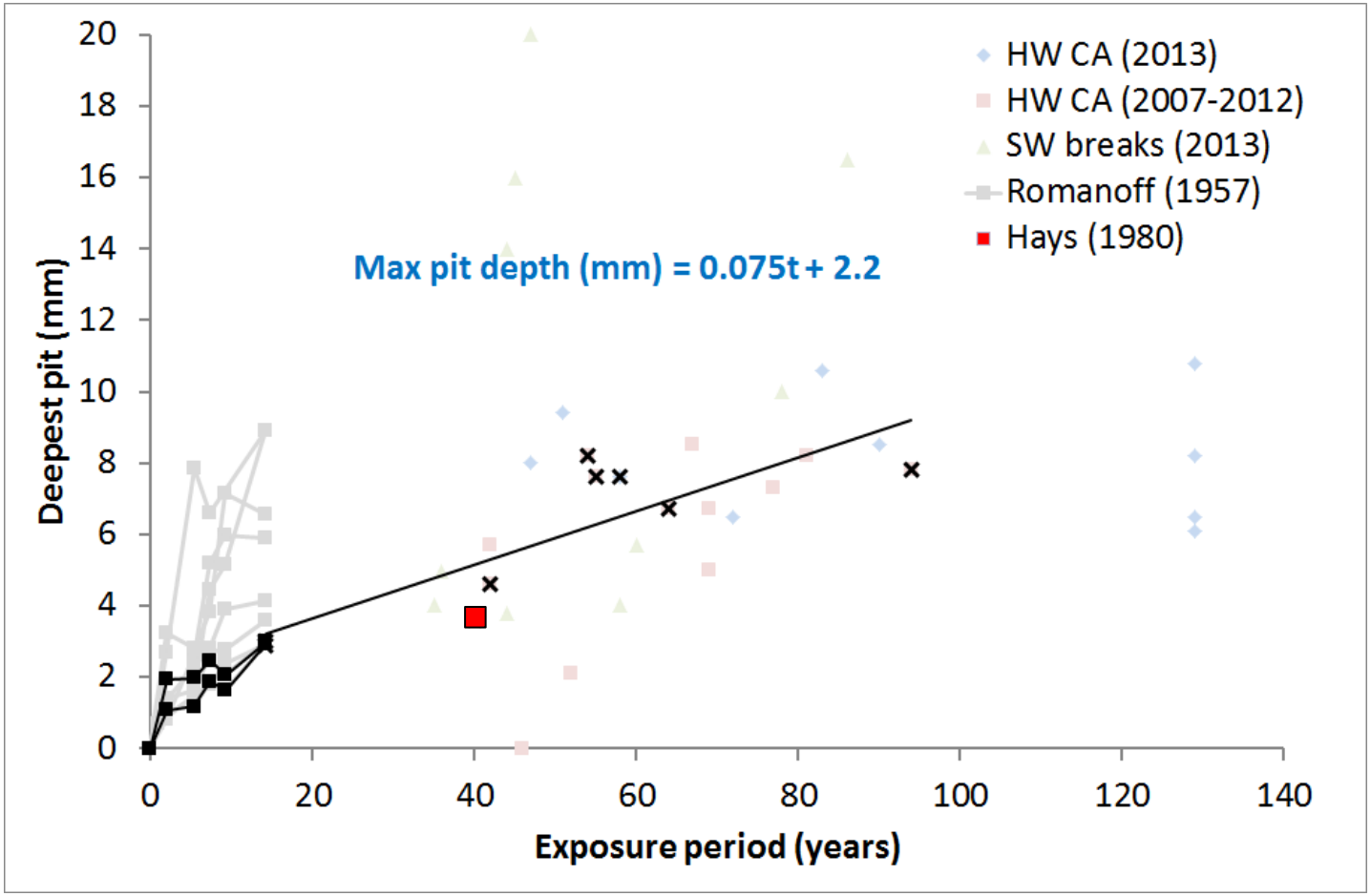
Model calibration using Hays (1980) data (4)

- Max.pit depth. Pipe buried in native soil. S_w =0.5-0.6



Model calibration using Hays (1980) data (5)

- Max.pit depth. Pipe buried in native soil. S_w =0.6-0.7

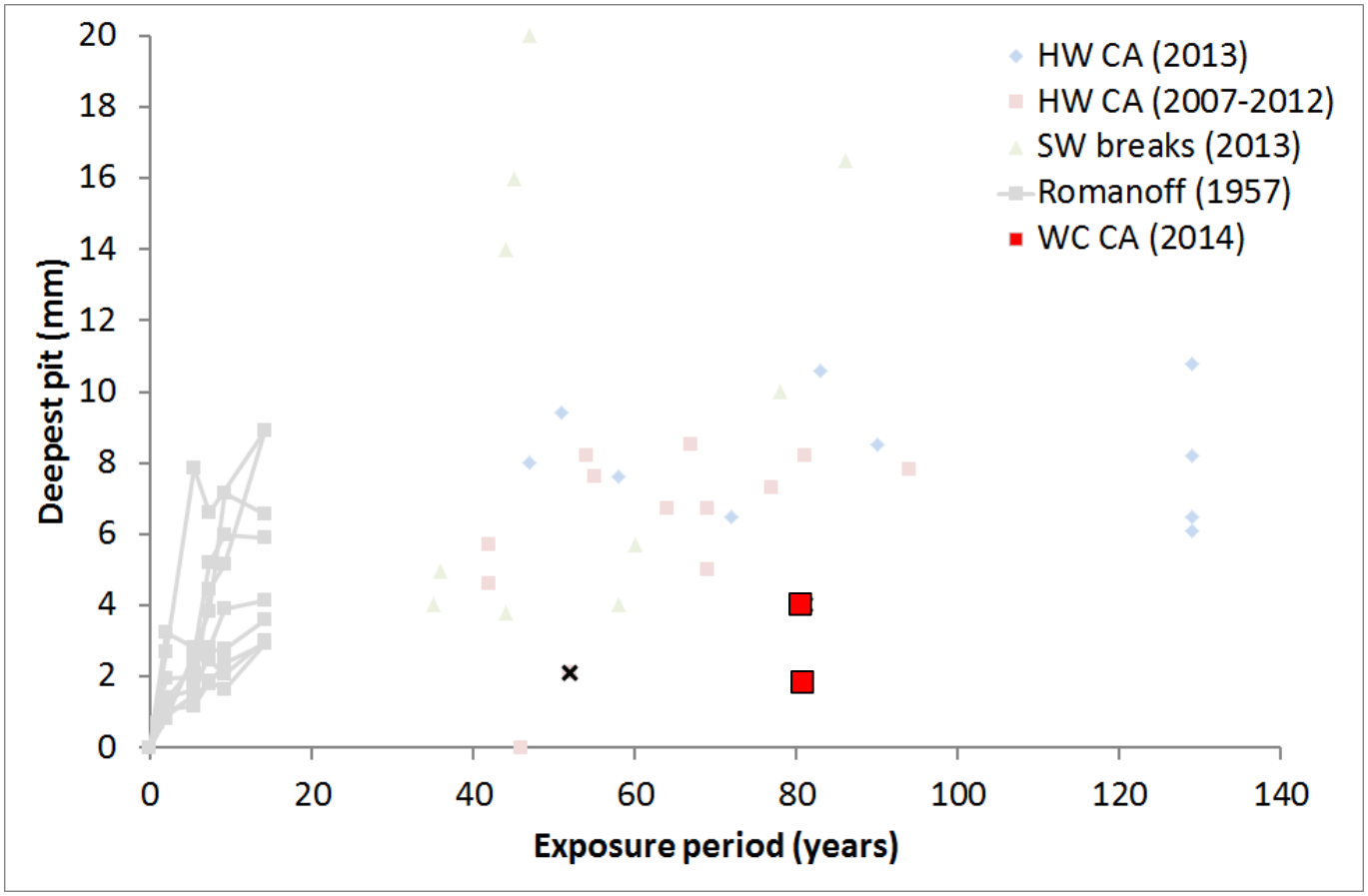


Examination of Water Corp. CA reports (1)

- WC provided 27 CA reports
- Majority BEM, but more recently physical exams
- Considered those with physical exams for incorporation into model
- 2 cases, dry sandy soils, under pavement
- Very low external corrosion
- From field data Sw ≈ 0.1
- Data consistent with previous observations for pipes buried under grassed easements

Examination of Water Corp. CA reports (2)

- Max pit depth. Sw = 0-0.2.



Test bed data collection

- Soil data collected along test bed main at previous pipe exhumation locations by SW and UTS
- Collected at 15 locations close to CA trial locations
- UTS laser scanned pipe surfaces at locations
- Currently quantifying corrosion loss from laser scan data
- Aim to use soil and corrosion loss data for model calibration

Future work

- Quantify corrosion losses on test bed pipes and use with collected soil data to further calibrate model
- Investigate the influence of nutrients on corrosion loss using data collected from the project
- Continue re-examination of Romanoff (1957) data focusing on determining the relationship between model parameters and soil properties
- Examine any additional corrosion loss data provided by industry partners