When is Reservoir Cleaning not just Cleaning? - following the evidence trail

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Reservoir Diving

- 17 years of jumping into storages
- Following the evidence trail
- Alert to Water Quality, OH&S and Structural issues

Condition Assessment

- Depends on how well you interpret the available evidence

- And how accurately and concisely you present the results

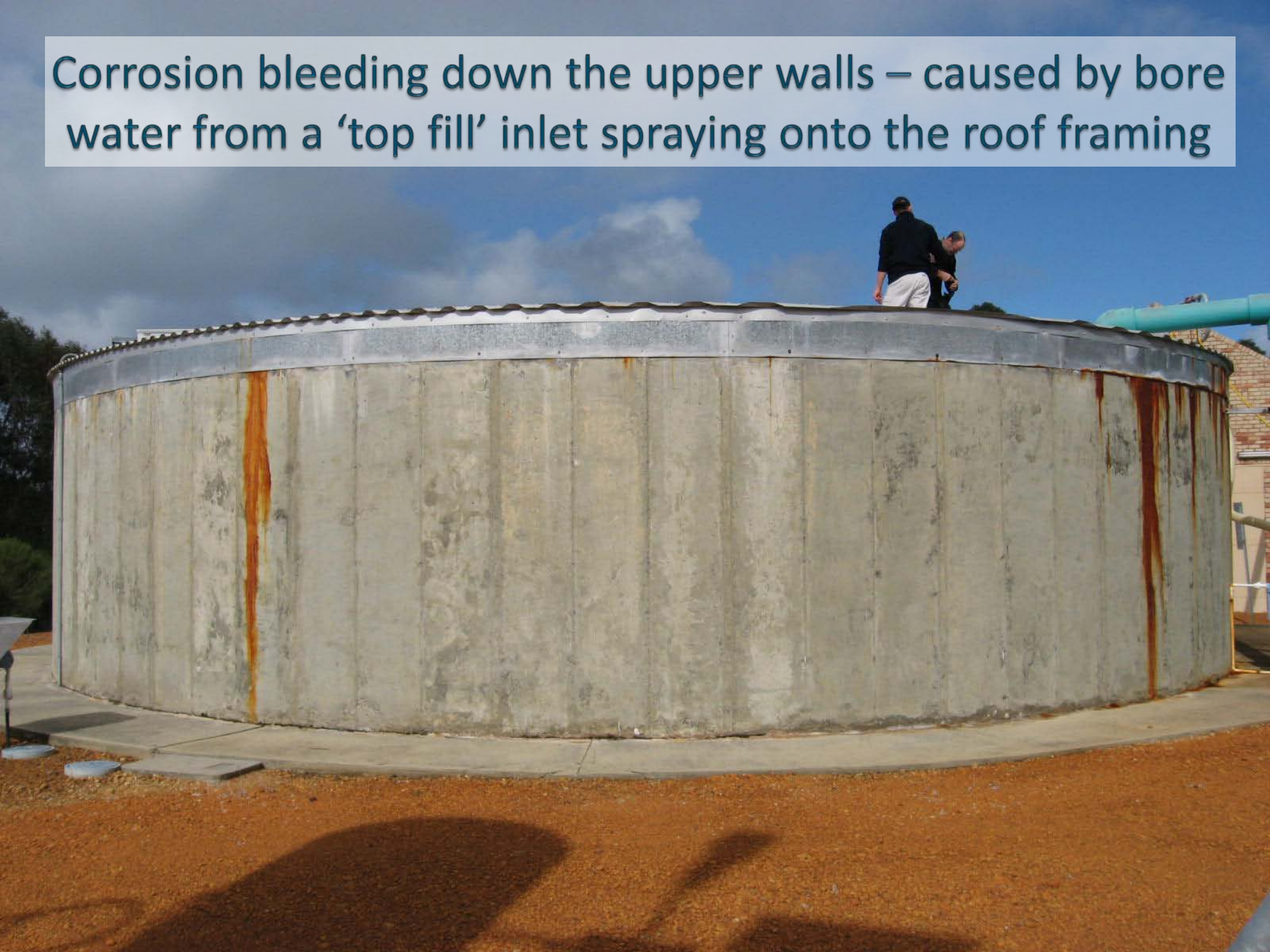
Opportunities

Maintenance review of the asset

- Check the tank in ‘real time’
- Using a ‘fresh eyes’ approach
- Technical training to recognize the issues and concerns
- Reporting on the findings

First Impressions……

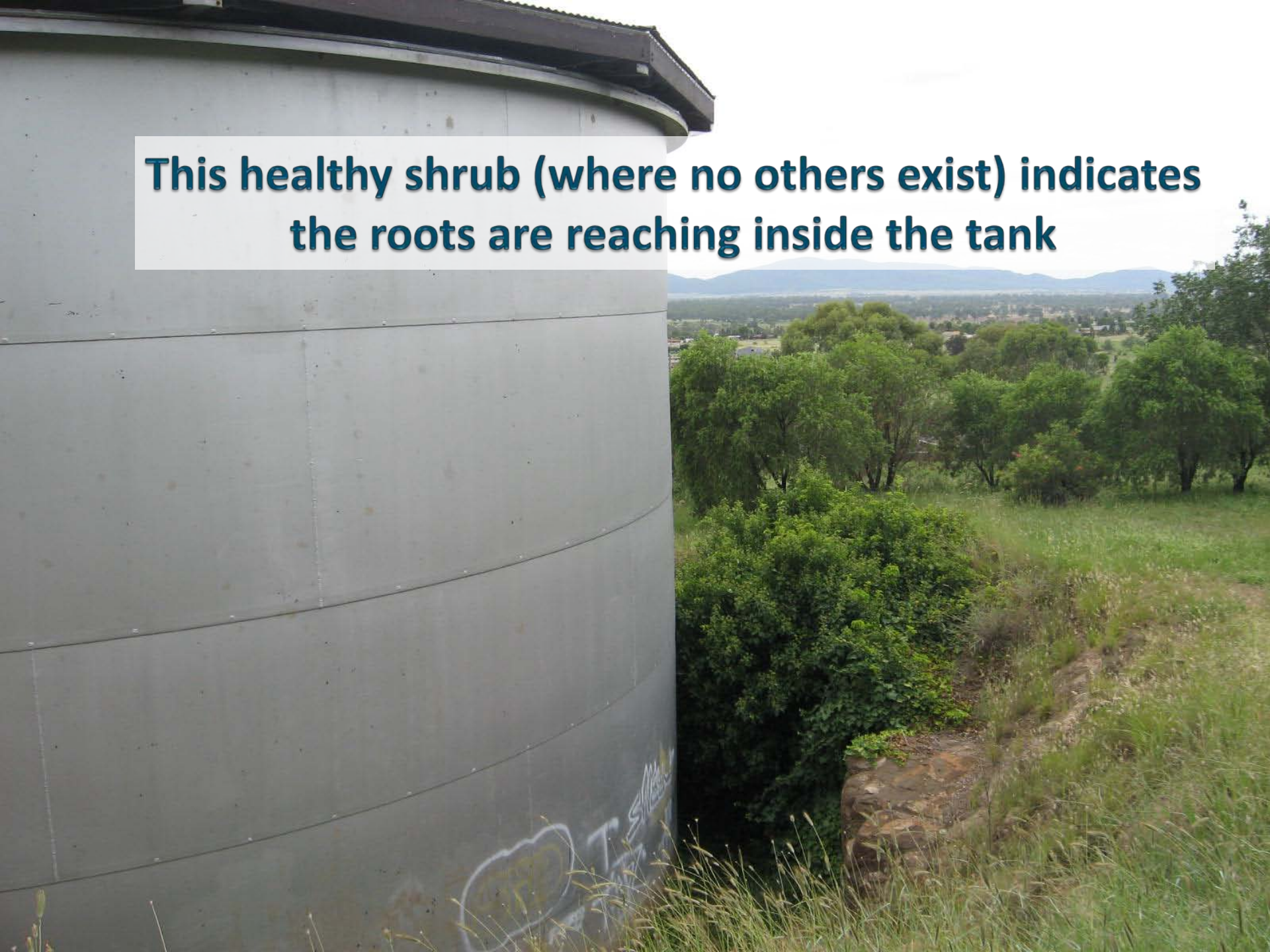
- Age, type of reservoir and construction materials used
  - commonality with previously identified issues…or…it seemed a good idea at the time!!
- Security fences and signs of vandalism
- Bird activity
- Trees and vegetation
- Entry hatch, platform and roof area


Corrosion bleeding down the upper walls – caused by bore water from a ‘top fill’ inlet spraying onto the roof framing


The inlet has a diffuser fitted to aerate the inlet water, but this system is damaging the roof framing

A birds nest in the rafters indicates an entry point close by

A birds nest inside the overflow pipe – they are often well hidden


This healthy shrub (where no others exist) indicates the roots are reaching inside the tank

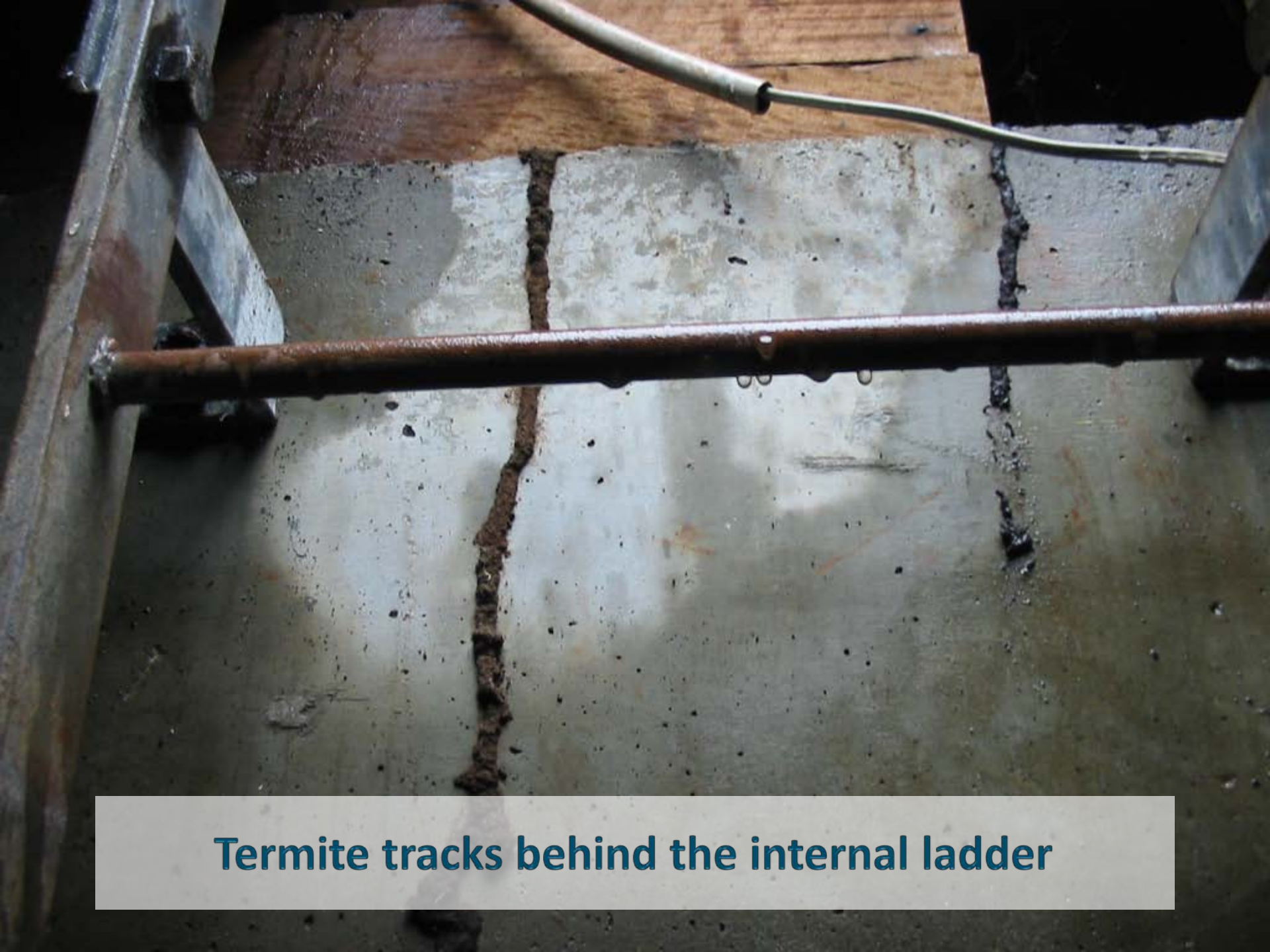
Root material pushing through the deteriorated floor seals

The roof area has subsided – the internal center post has most likely collapsed

Most galvanized posts are subject to severe corrosion on the water line area


The water line area has more available oxygen and significant corrosion is more prevalent here

Timber roof framing is subject to termite attacks – look for 'tracks' leading down to the water

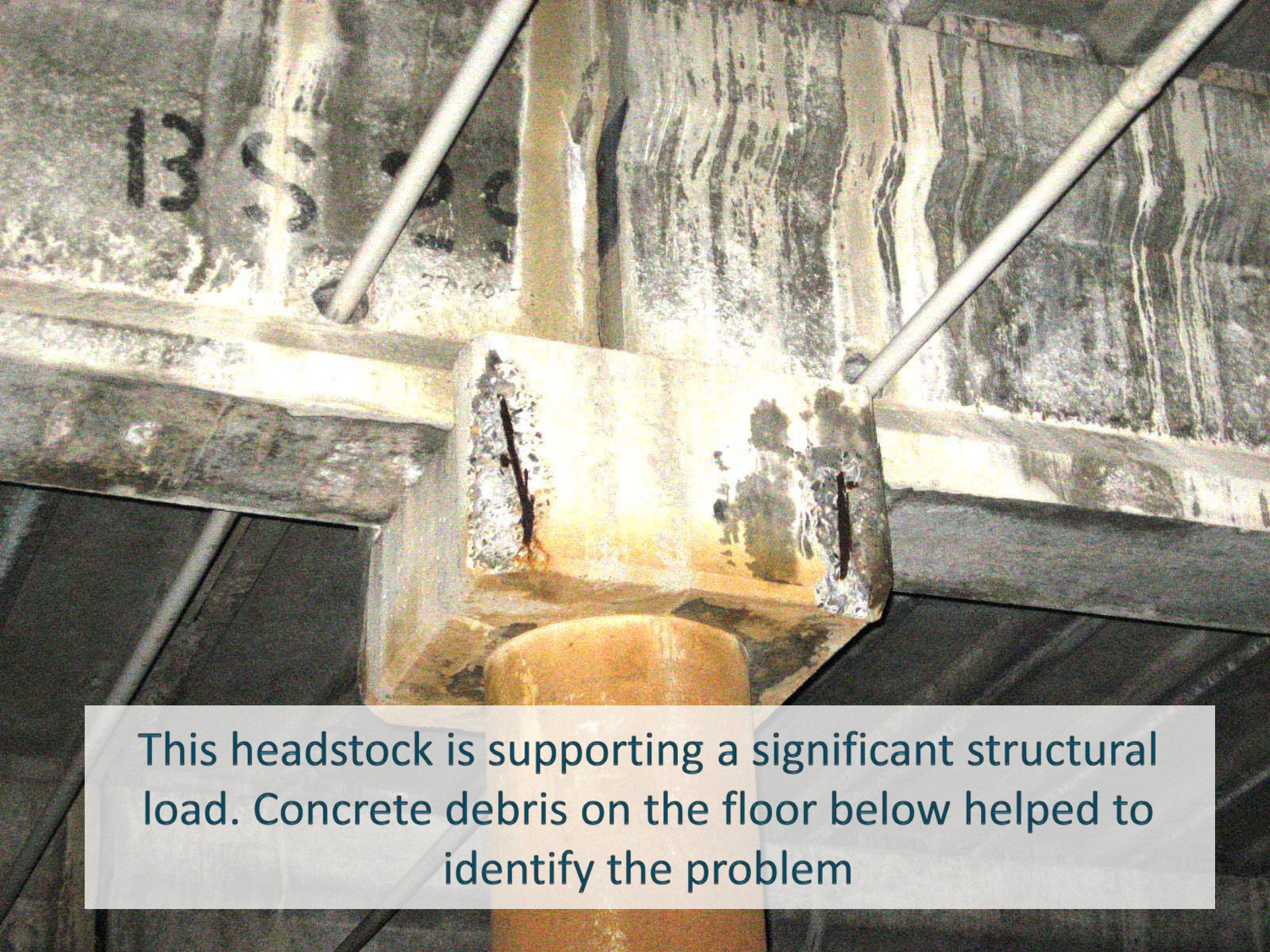


Termite tracks behind the internal ladder

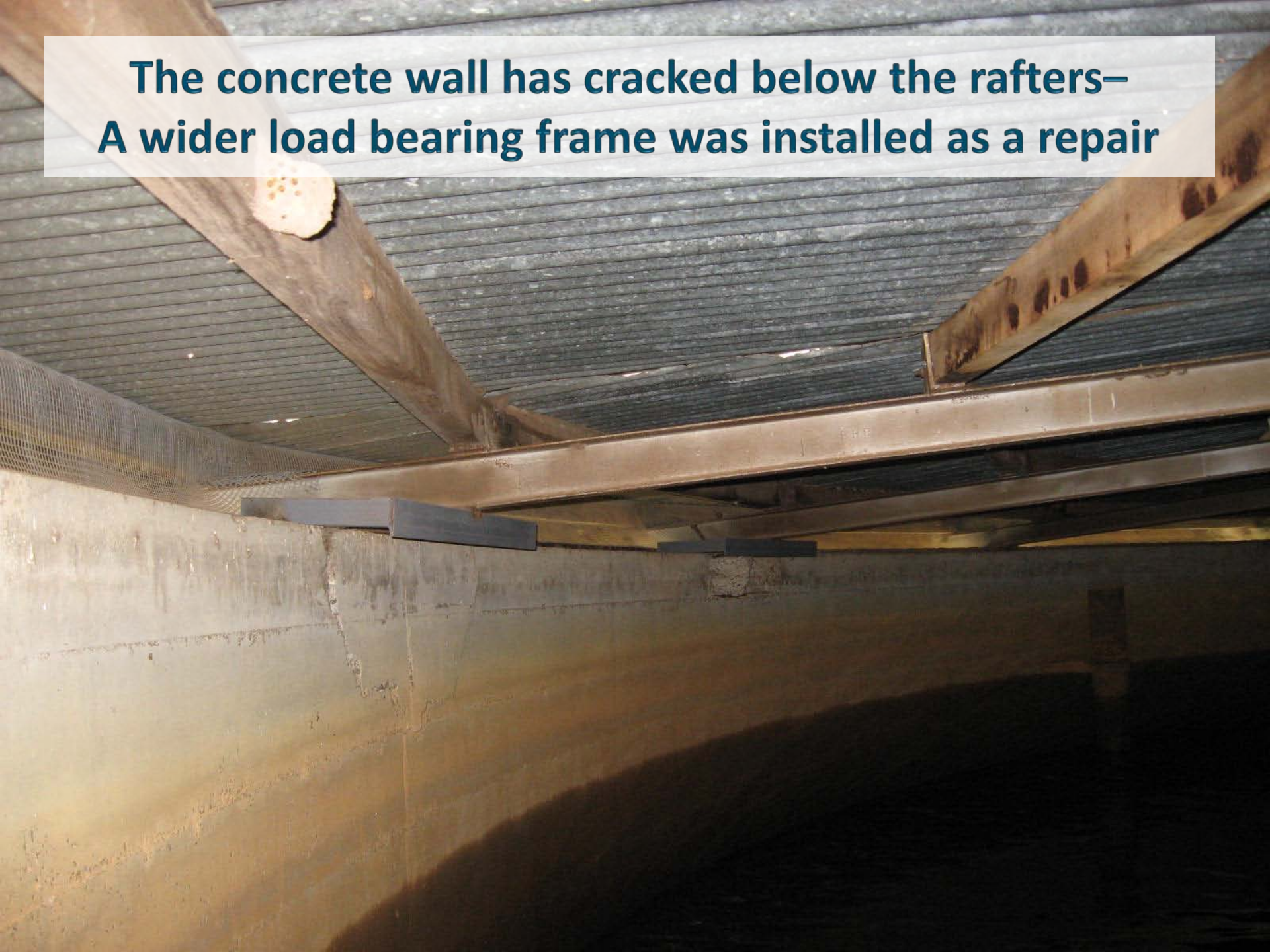
Structural Issues

- Spalled concrete debris on the floor
- Concrete cracking around load bearing beams
- Roof support posts corroded through


Most concrete spalling is caused by shallow steel cover combined with Carbonation



This headstock is supporting a significant structural load. Concrete debris on the floor below helped to identify the problem

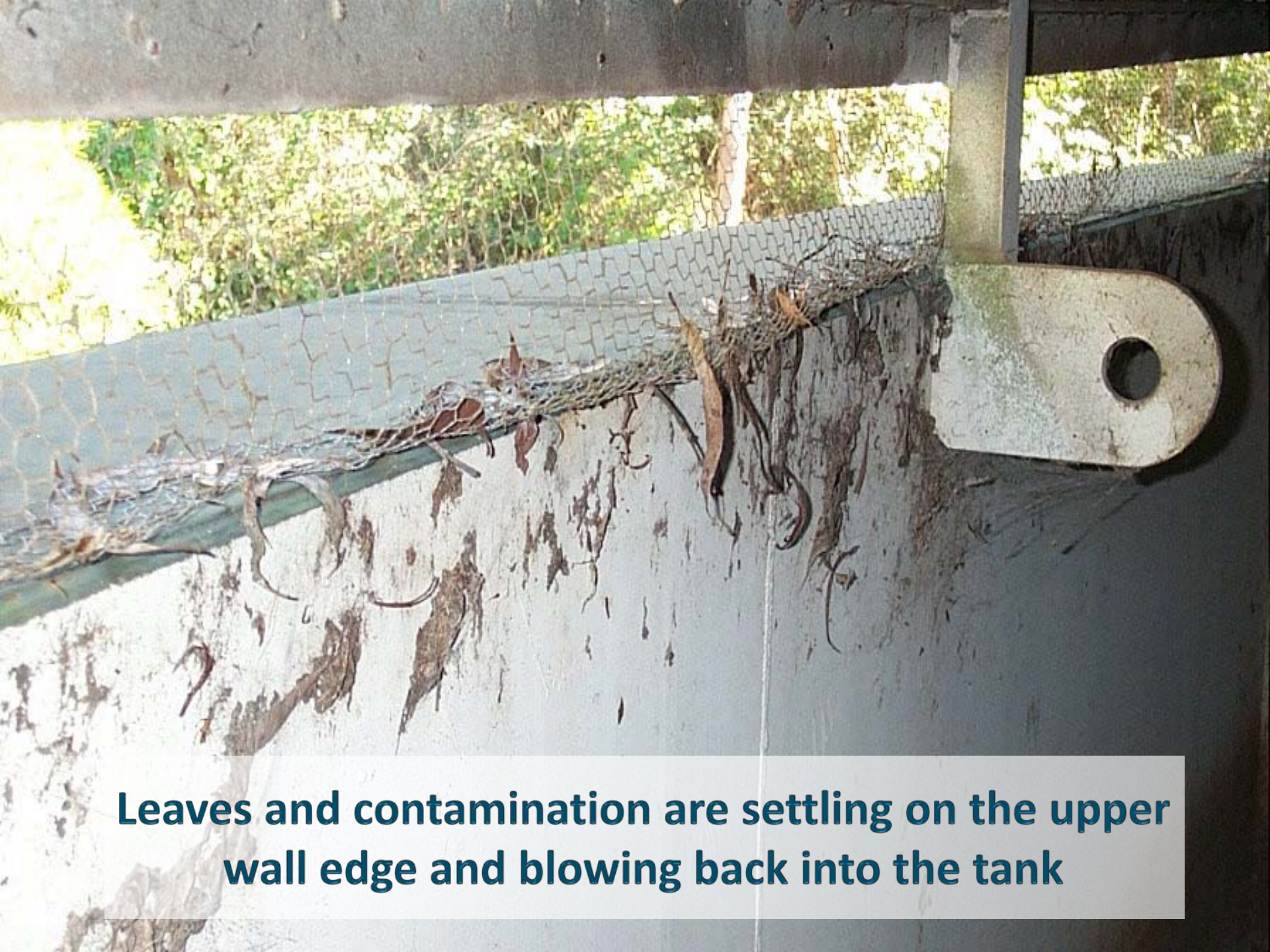

The concrete wall has cracked below the rafters–
A wider load bearing frame was installed as a repair

Sediment Profiles

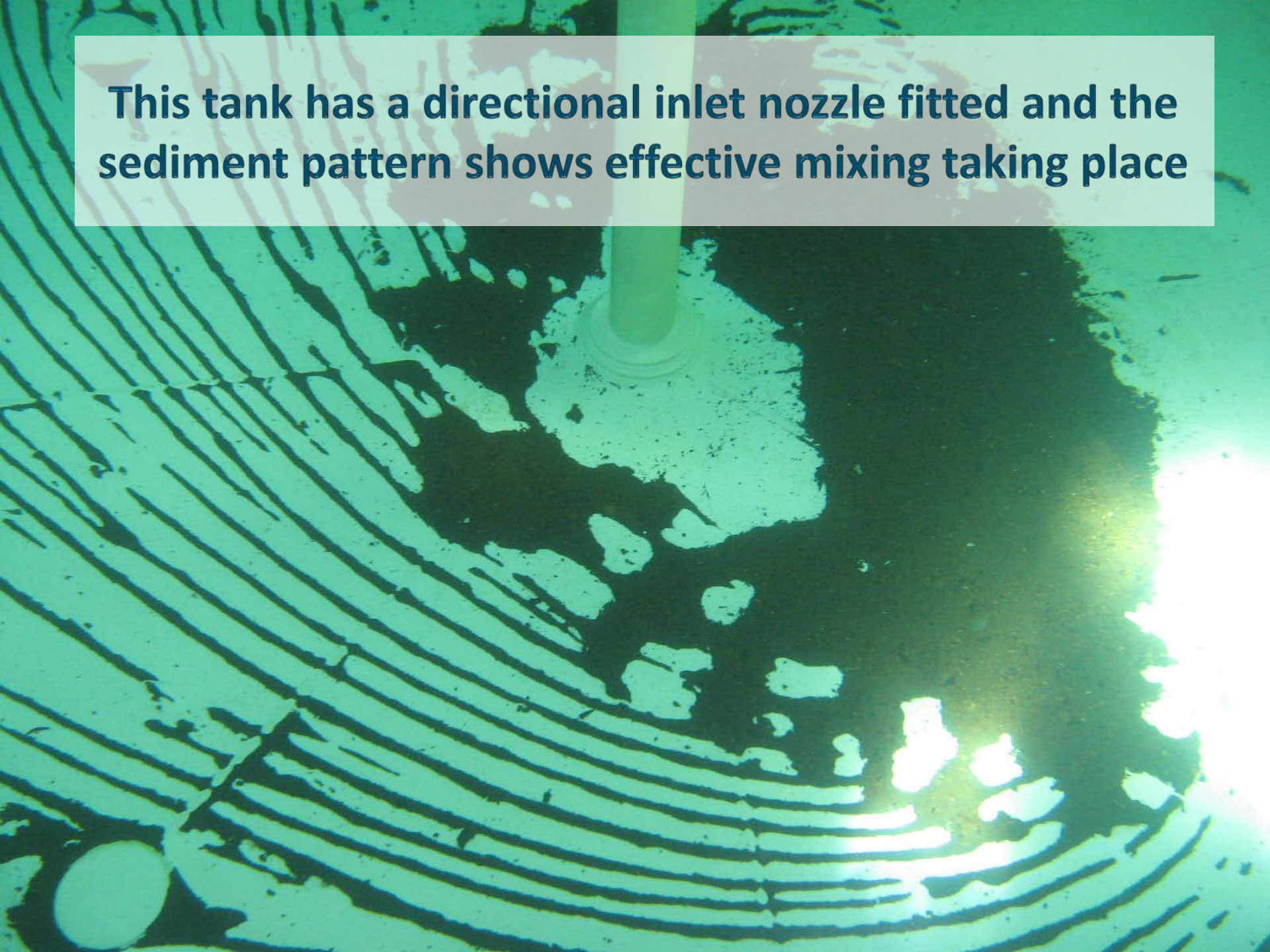
can identify performance of the water treatment process

Within a bore field collection tank - sand under the inlet area indicates bore casing failure


‘Dirty’ sediment indicates leaves and debris are entering the tank – the ventilation mesh proved to be defective


Leaves and contamination are settling on the upper wall edge and blowing back into the tank

The inlet on the RHS is directing water across to the outlet on the LHS - sediment pattern indicates a short circuit’

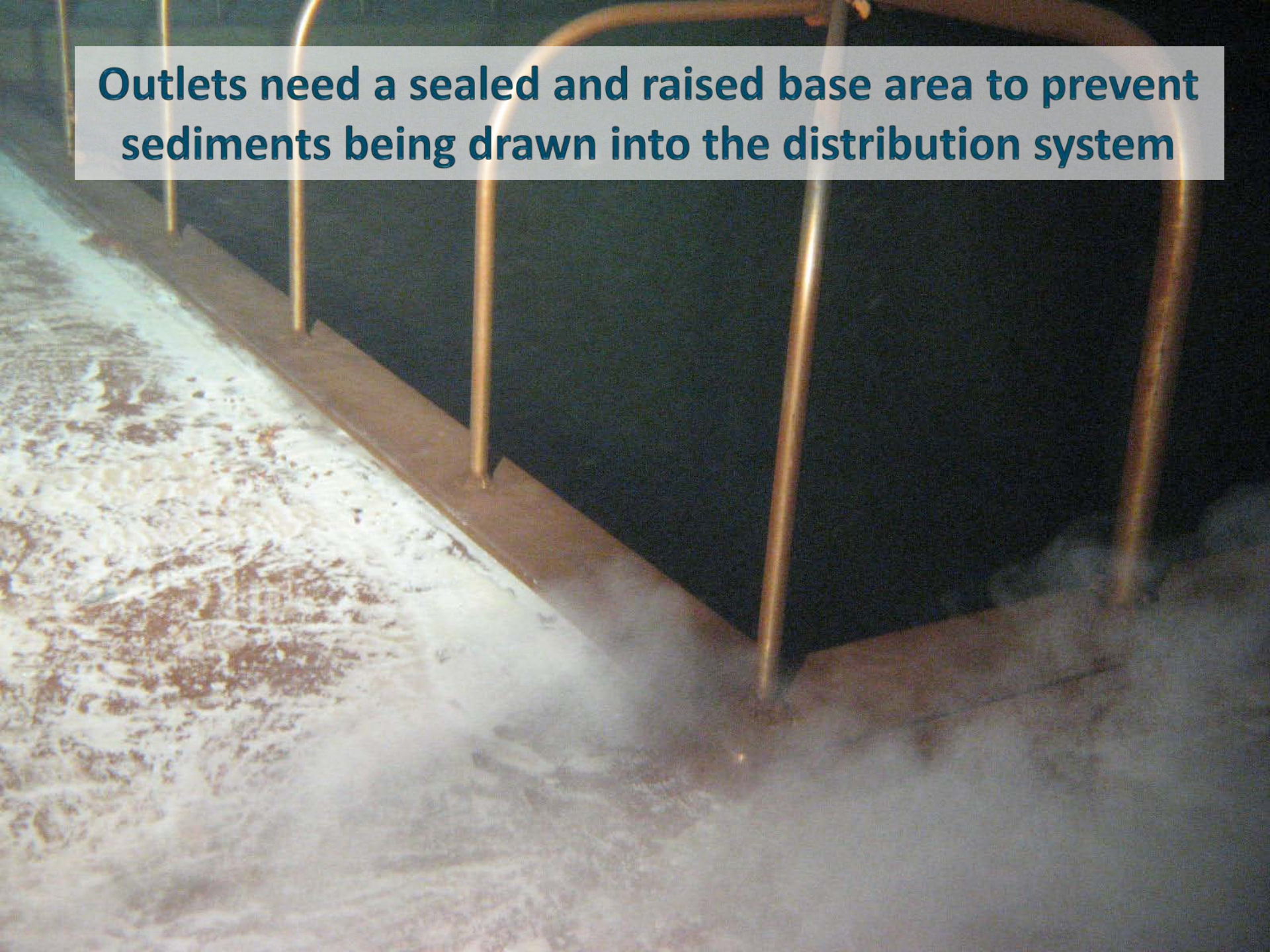

This tank has a directional inlet nozzle fitted and the sediment pattern shows effective mixing taking place

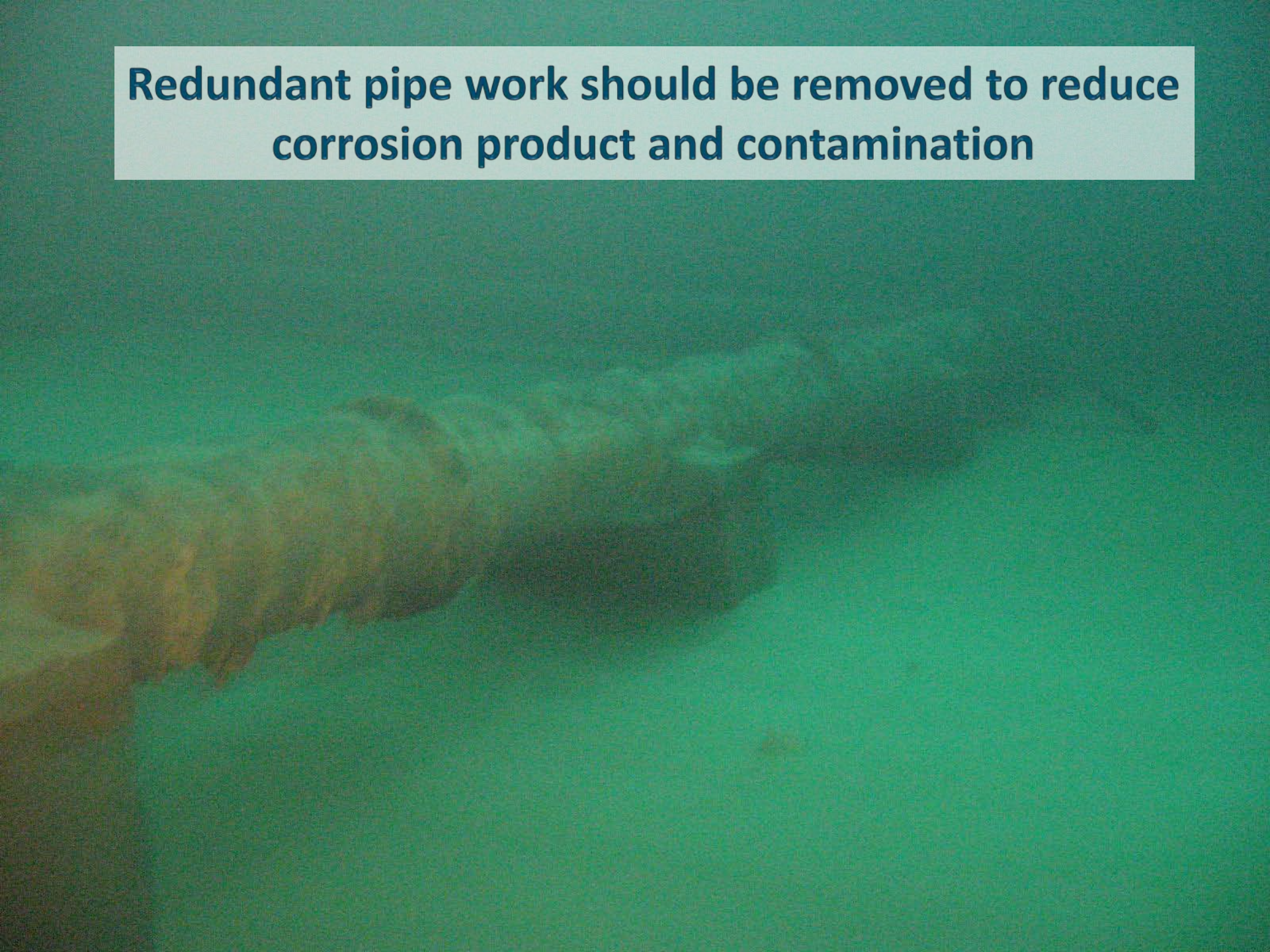
Pipe Work Configurations

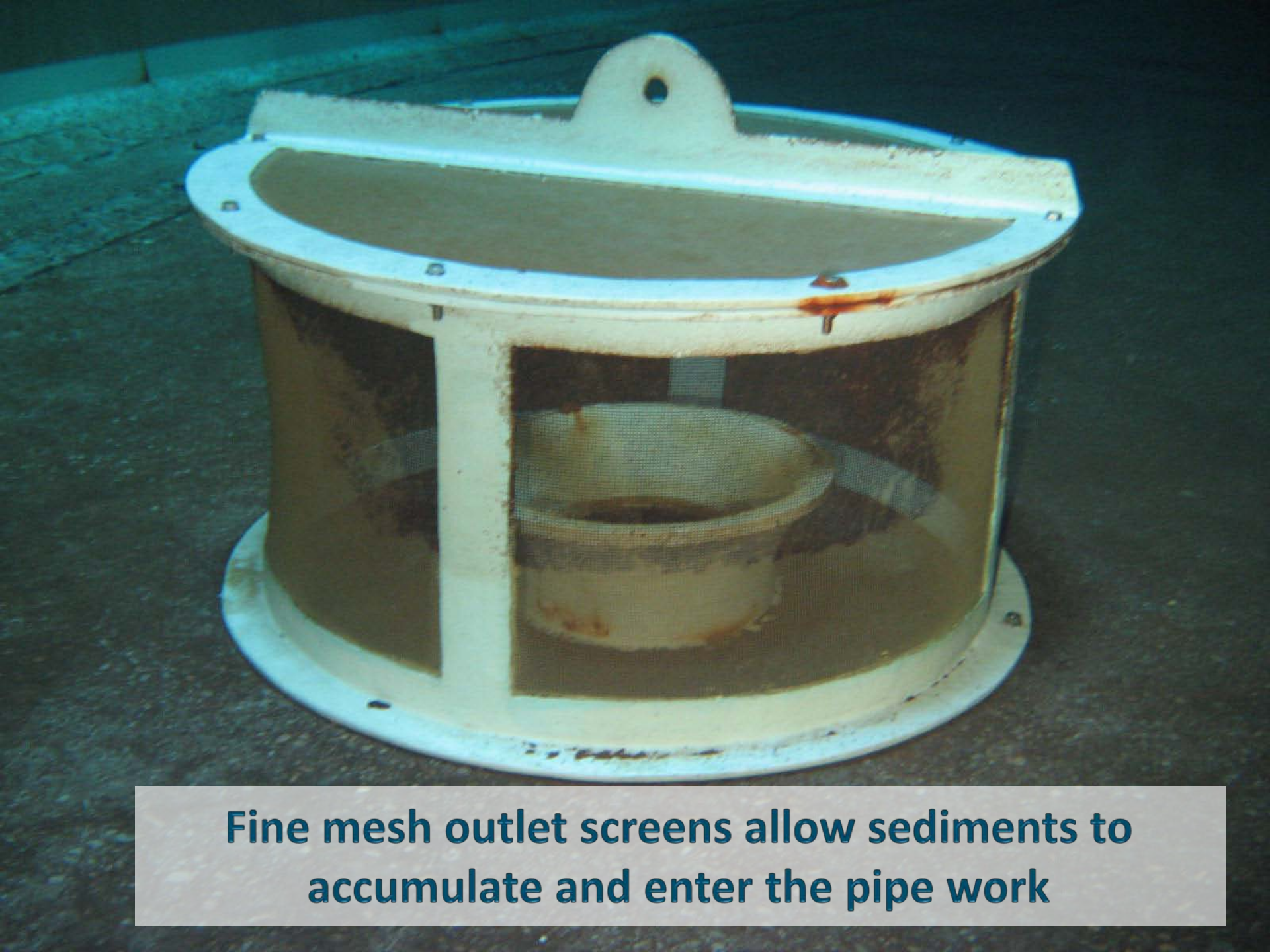
- Pipes connected incorrectly
- Top fill inlets disturbing the sediment or spraying the roof framing
- Inlets facing in the wrong direction
- Outlets positioned too close to inlets
- Redundant or unnecessary pipe work
- Incorrect usage of pipe valves and contradiction of operator knowledge

‘Top fill’ inlets can cause significant sediment disturbances when water levels are low

‘Top fill’ turbulence can disturb sediments on the floor area


Outlets need a sealed and raised base area to prevent sediments being drawn into the distribution system


Redundant pipe work should be removed to reduce corrosion product and contamination



Fine mesh outlet screens allow sediments to accumulate and enter the pipe work

This screen was clogged with sediments and then collapsed following a high flow event

Poor Tank Design

- Roof downpipes not connected
- Unsealed hatches and platform areas
- Roof gutters back flowing
- Ventilation – too much or too little
  - Should suit the surrounding environment
  - Corrosion issues caused by too little air flow
  - Dust, debris and vermin ingress
  - Unsecured mesh or vent structures

The roof gutter pipework is not connected into the overflow, allowing contamination to directly enter the tank

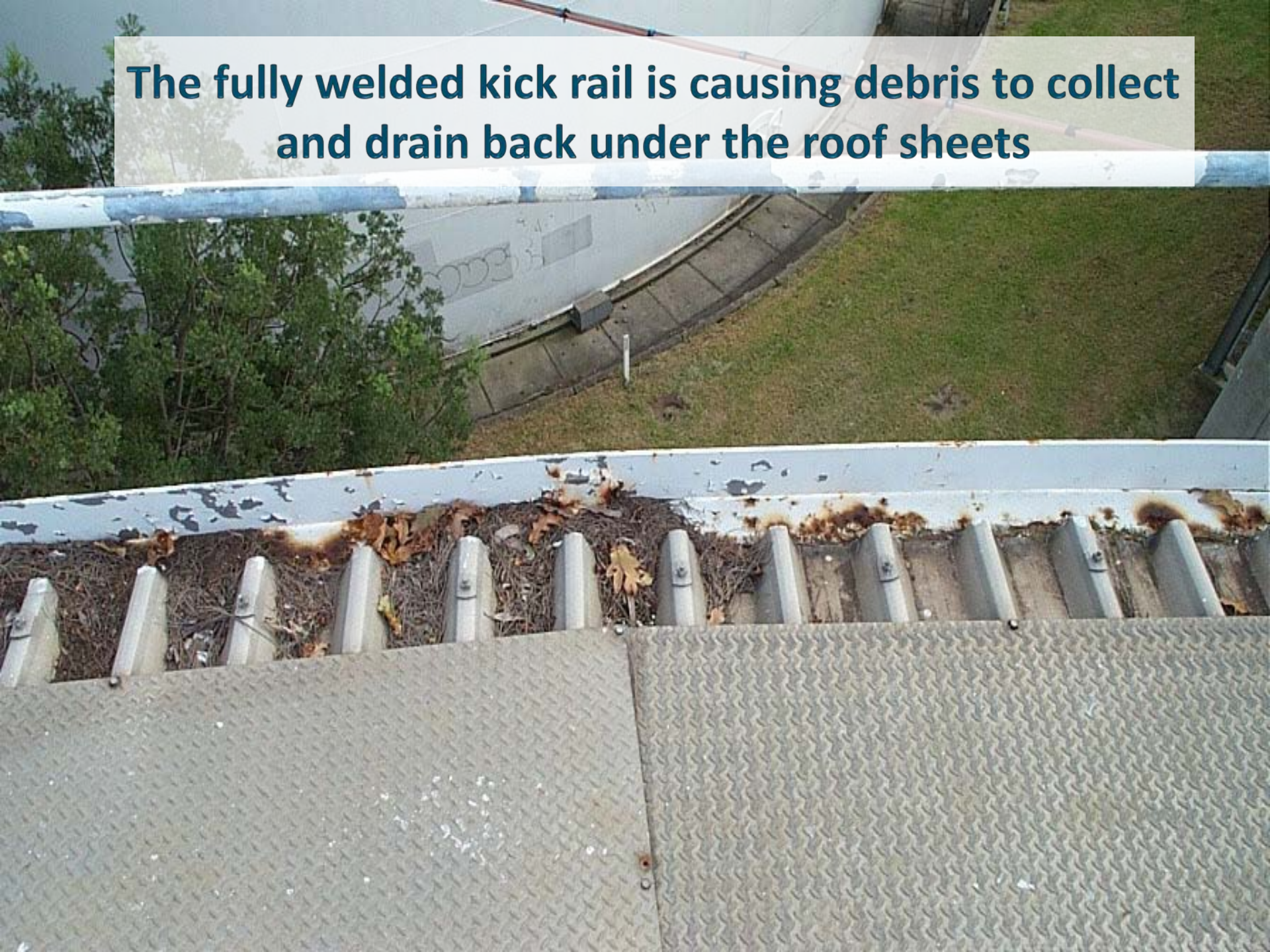

These penetrations appear to have a large capacity – but where are they draining to??


A 90mm pipe does not seal into a 150mm drain very effectively!!


No trip hazards…. but external contaminates drain back into the tank

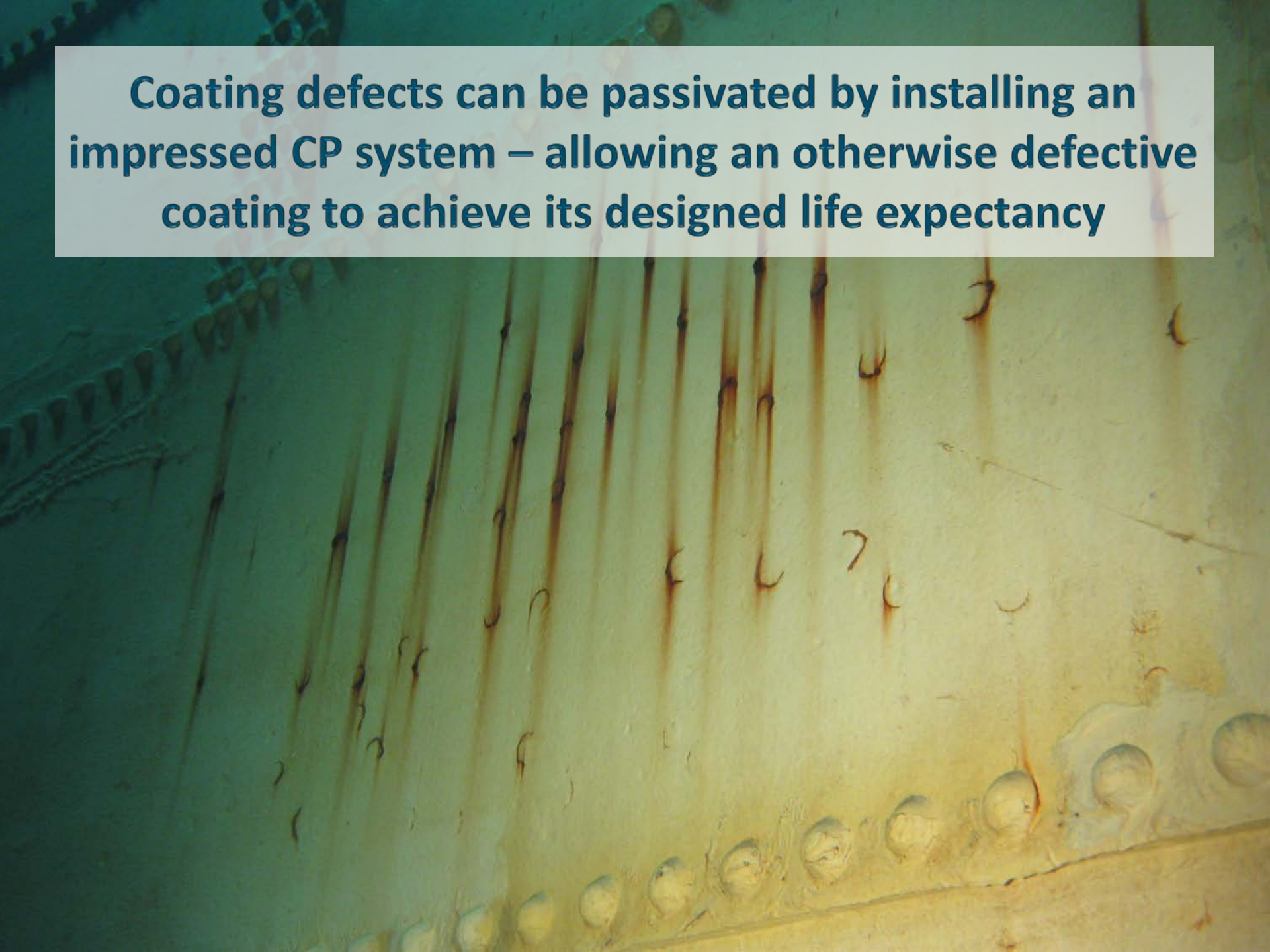
The roof gutter beam is leaking in the joint area above the headstock – external roof water is draining back into the tank

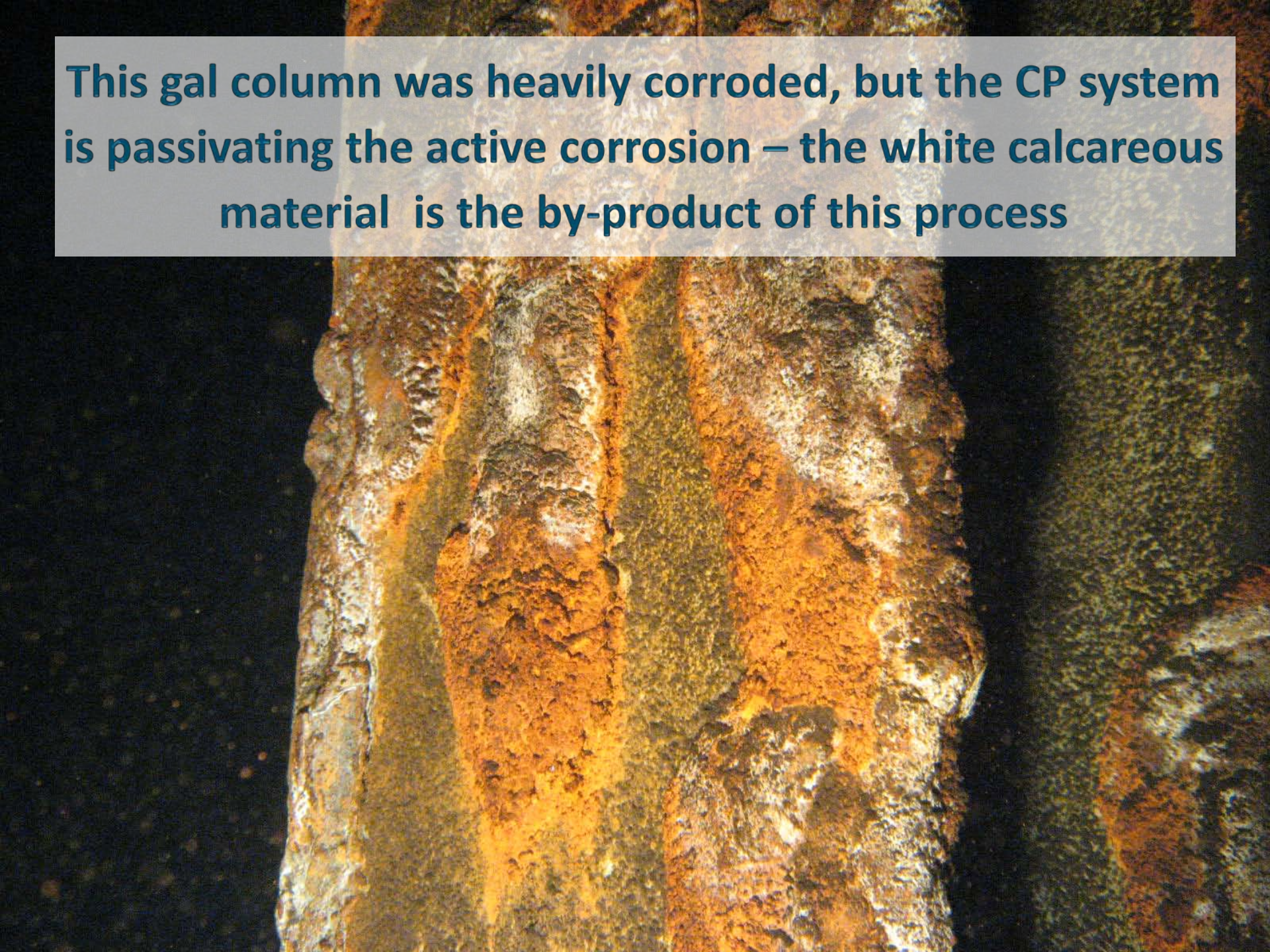
The roof gutter has no flashings fitted along the edges – allowing birds and vermin to enter the tank

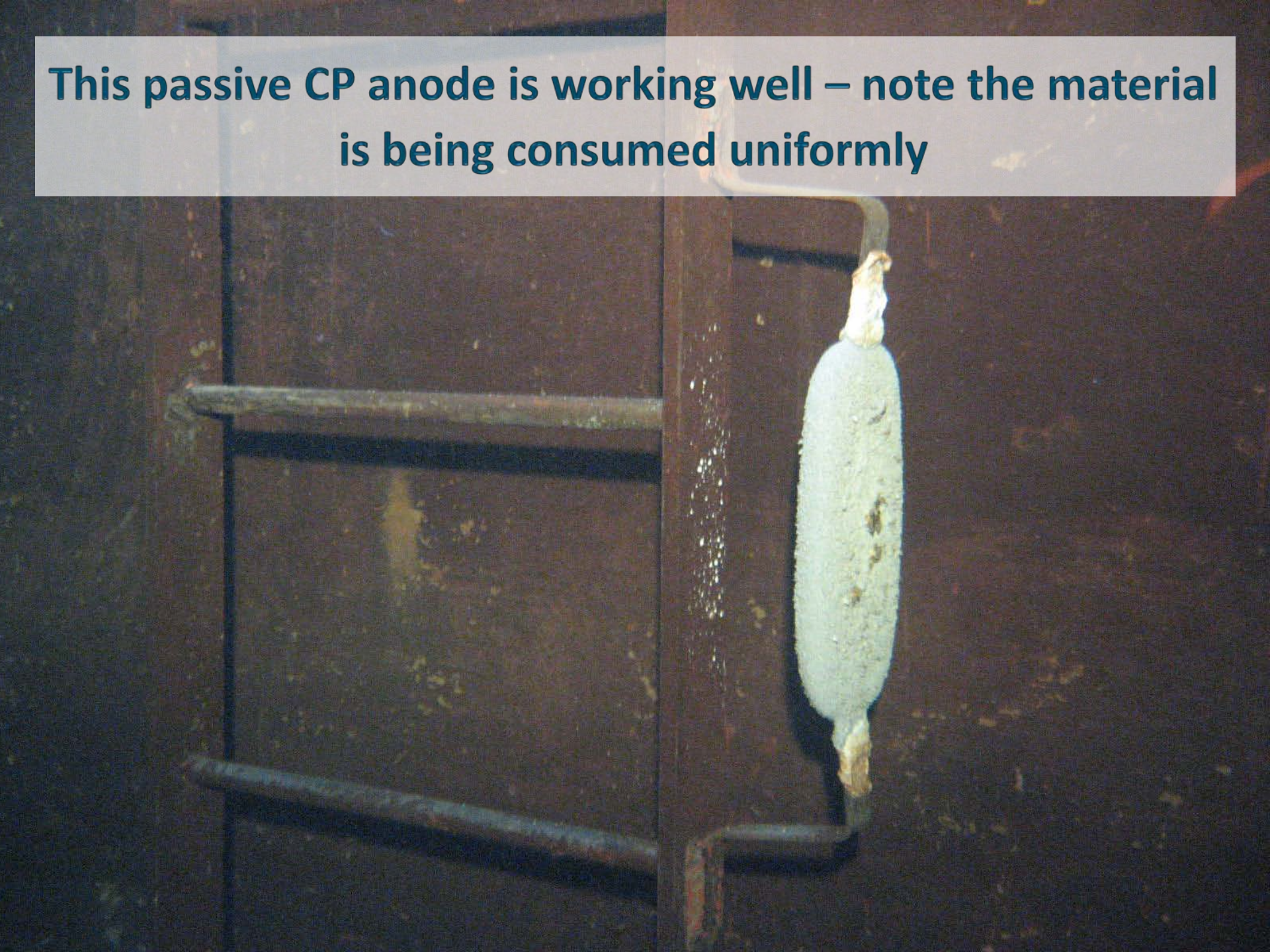

The fully welded kick rail is causing debris to collect and drain back under the roof sheets

Cathodic Protection

- Is it needed?
- Is it working?
- Visual evidence of it controlling corrosion
- Sacrificial anodes maintained


Coating defects can be passivated by installing an impressed CP system – allowing an otherwise defective coating to achieve its designed life expectancy


This gal column was heavily corroded, but the CP system is passivating the active corrosion – the white calcareous material is the by-product of this process

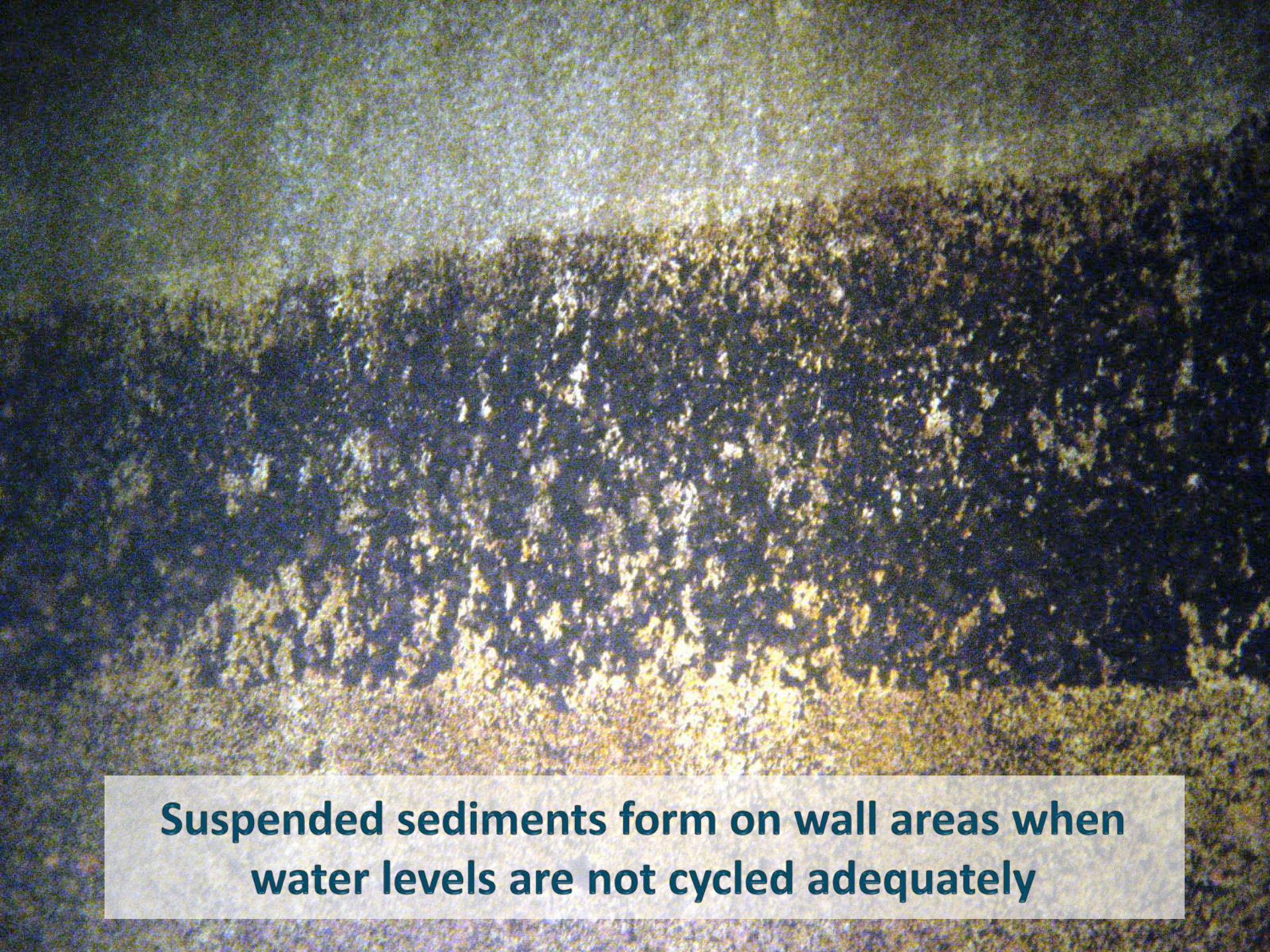

This passive CP anode is working well – note the material is being consumed uniformly

Storage Level Operation

- Level sensors not set correctly
  - corroded roof framing
- Water levels not cycled sufficiently
  - suspended sediments on the walls

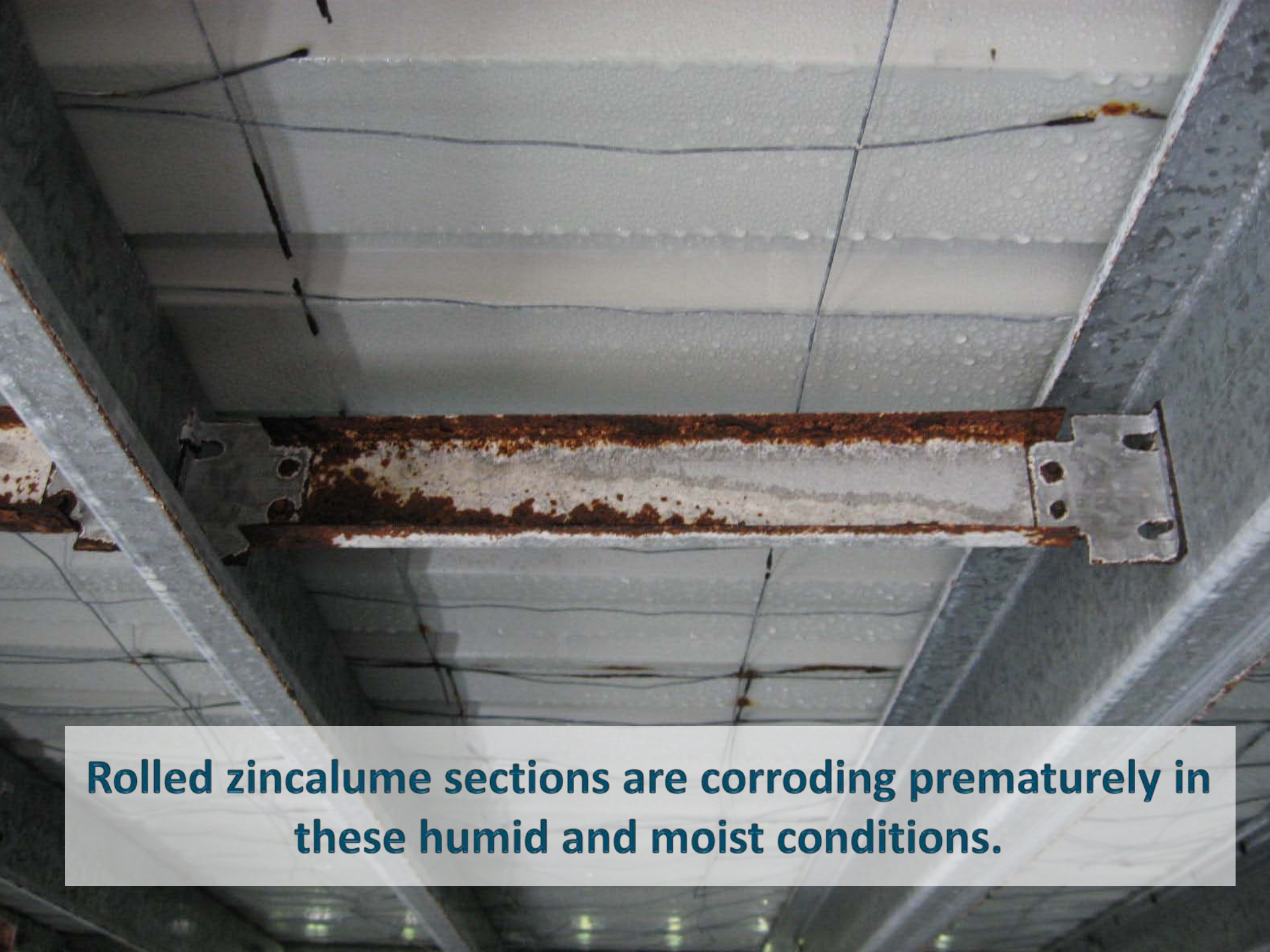

The water level has been set too high
- causing corrosion on the roof beam

The water levels were not re-set after a new roof was installed – corrosion is forming around the SS joining bolts

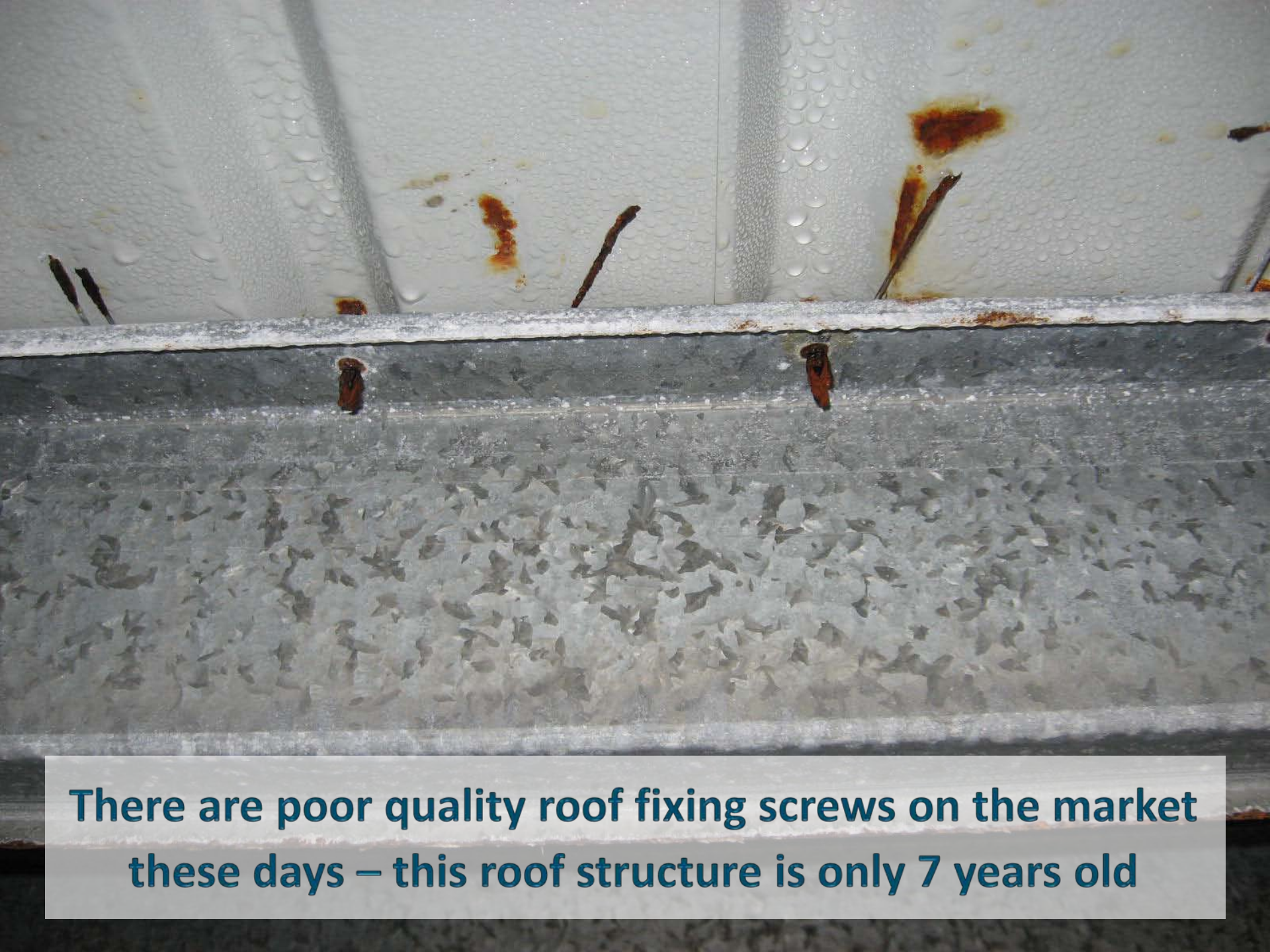

Suspended sediments form on wall areas when water levels are not cycled adequately

Roof Framing Condition

- Debris from purlins, rafters or connections in sediment
- Incorrect materials used in construction
  - eg. rolled zincalume purlins with unprotected raw edges
  - premature corrosion of fixing screws



Rolled zincalume sections are corroding prematurely in these humid and moist conditions.

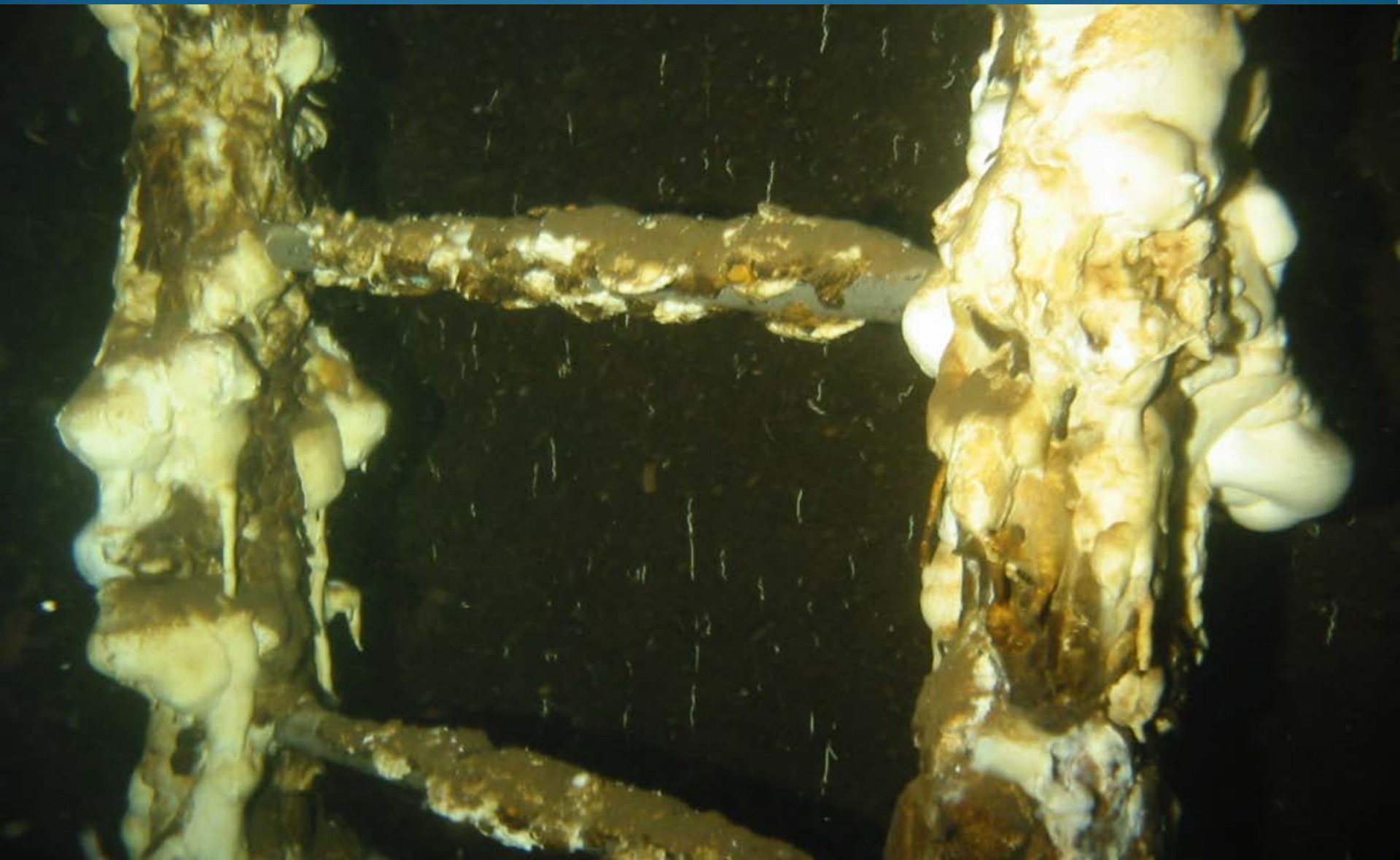


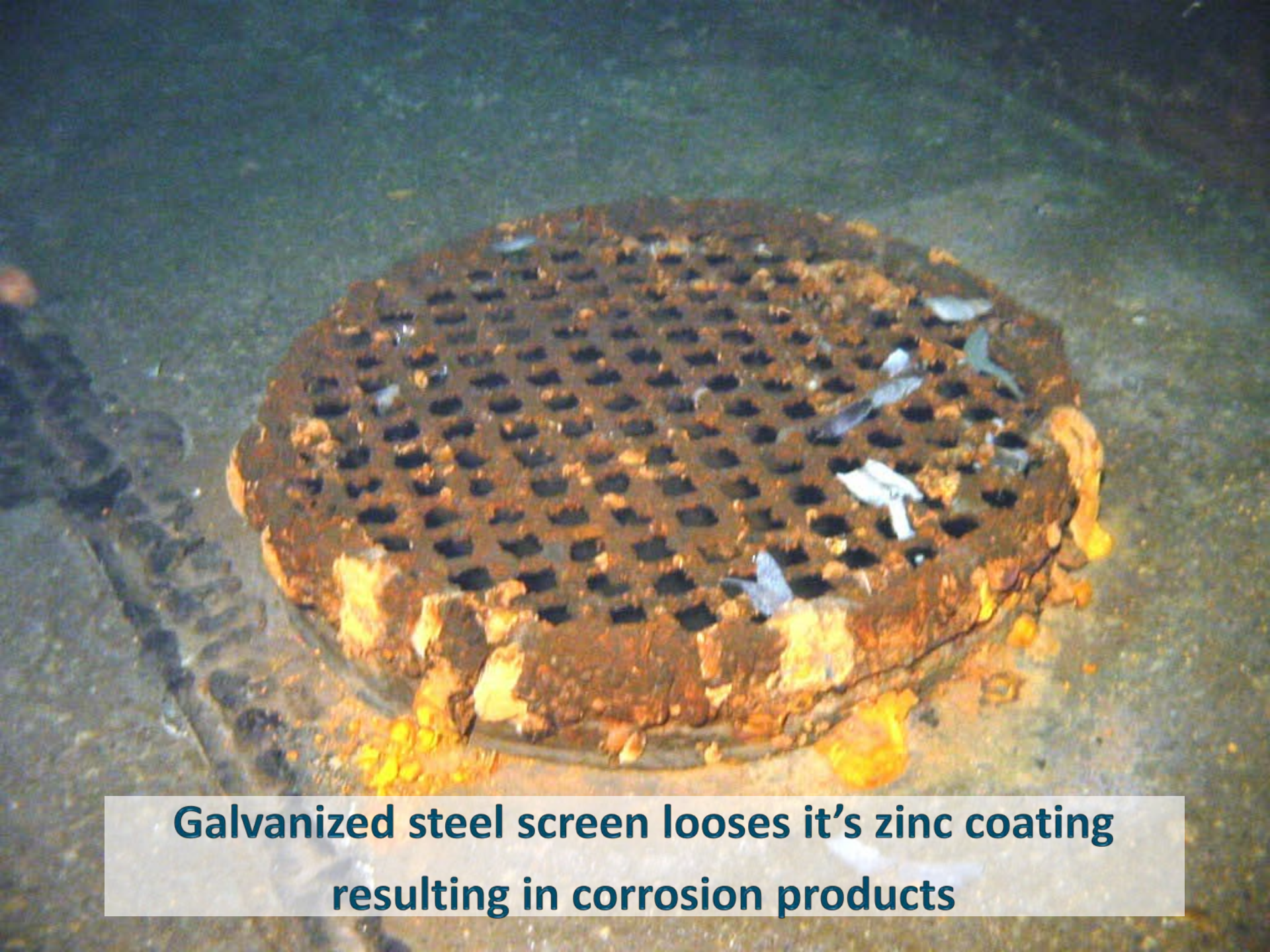
There are poor quality roof fixing screws on the market these days – this roof structure is only 7 years old

Condition of Internal Metal Work

- Corrosion byproducts from
  - Ladders
  - Overflow risers
  - Platforms
  - Cages
- Chlorine Demand increased

Aluminum corrodes when submerged - also entrapping sediments and affecting the water quality





Galvanized steel screen looses it’s zinc coating resulting in corrosion products

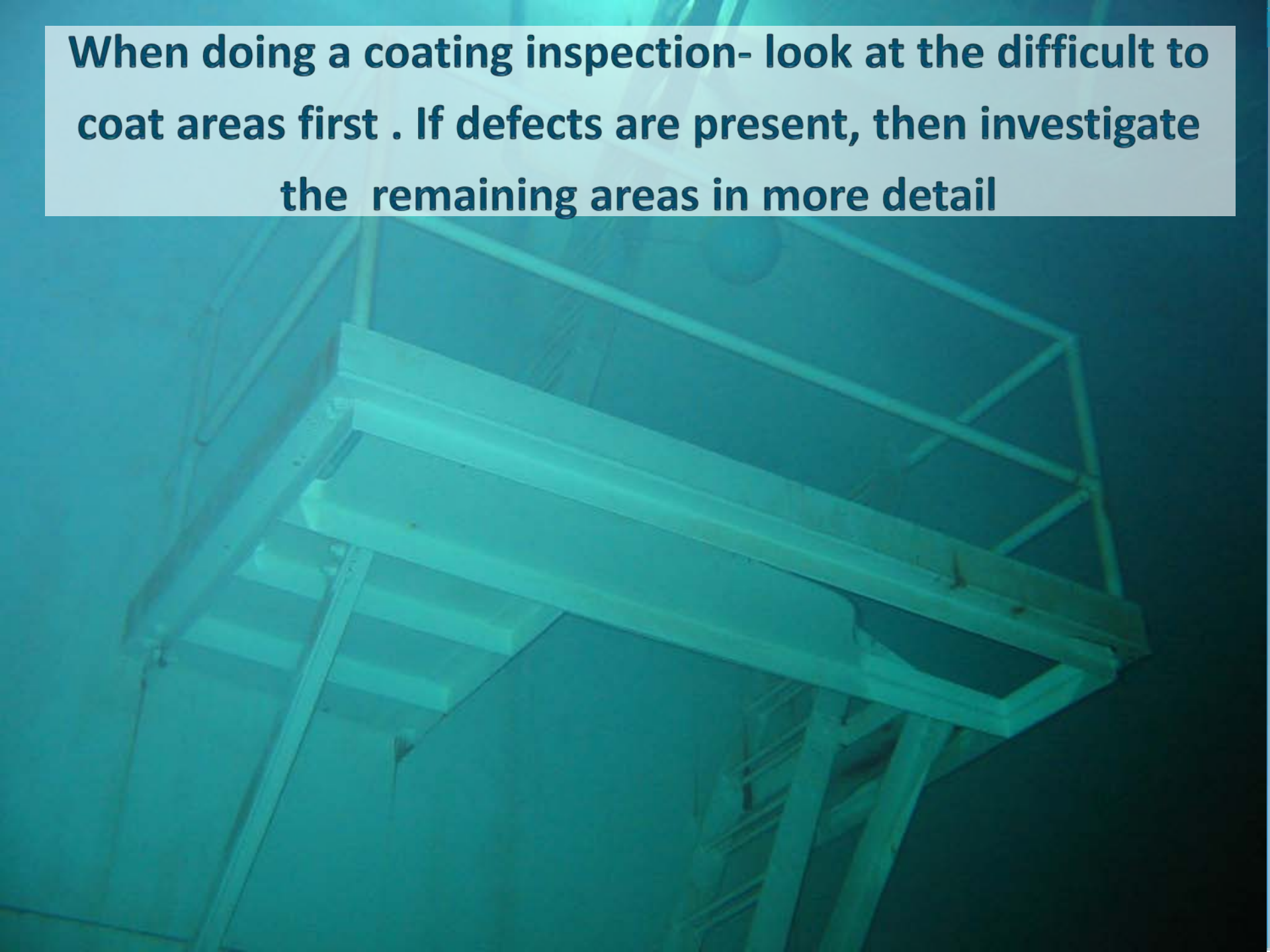
This ladder should have been epoxy coated rather than galvanized

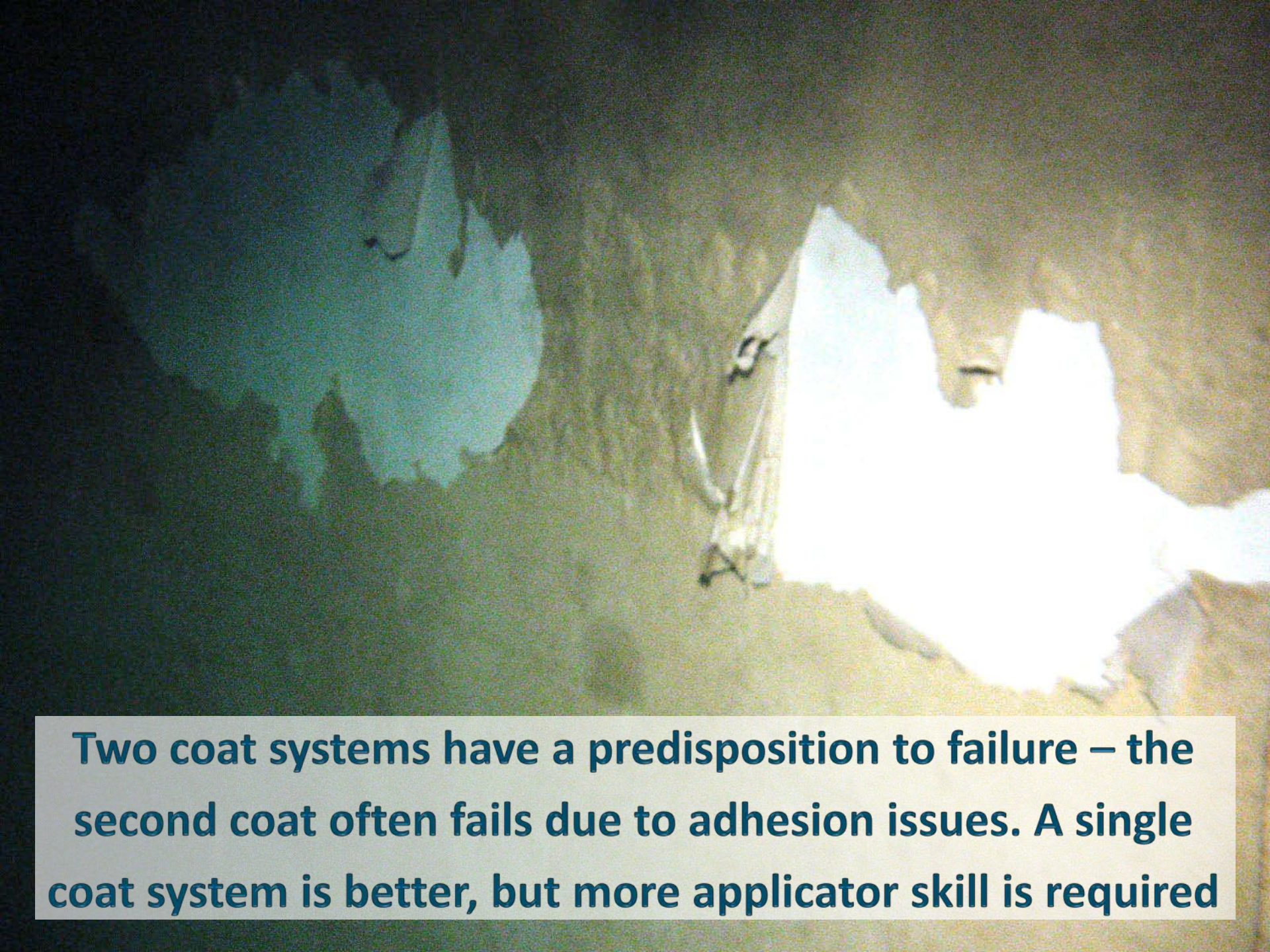
Galvanized post and base have deteriorated significantly – stainless steel would have been a better option

Condition of Internal Coatings

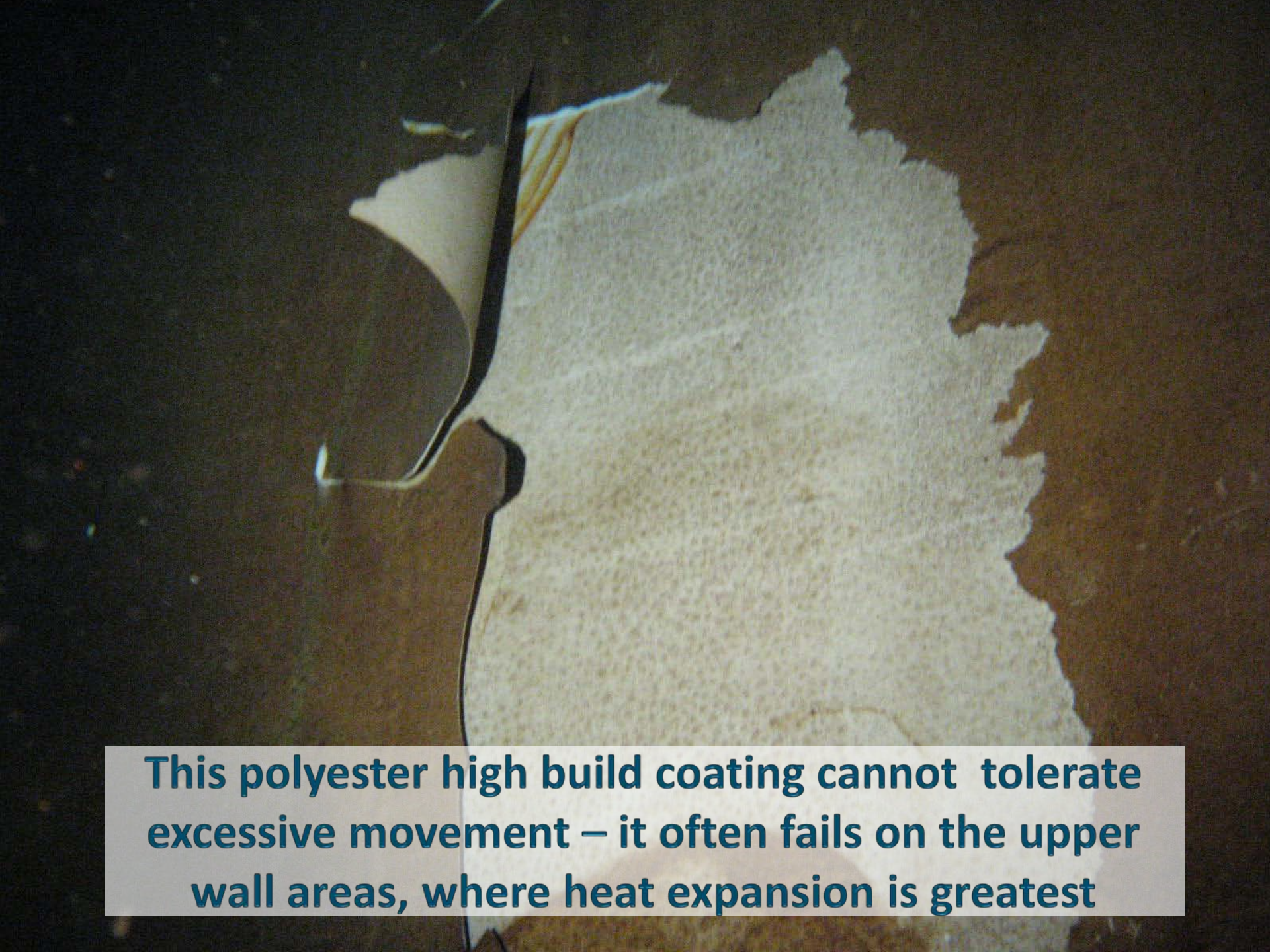
- How effective are the coatings?
- How good were the applicators?
- What is the expected life of the coating?

When doing a coating inspection- look at the difficult to coat areas first . If defects are present, then investigate the remaining areas in more detail





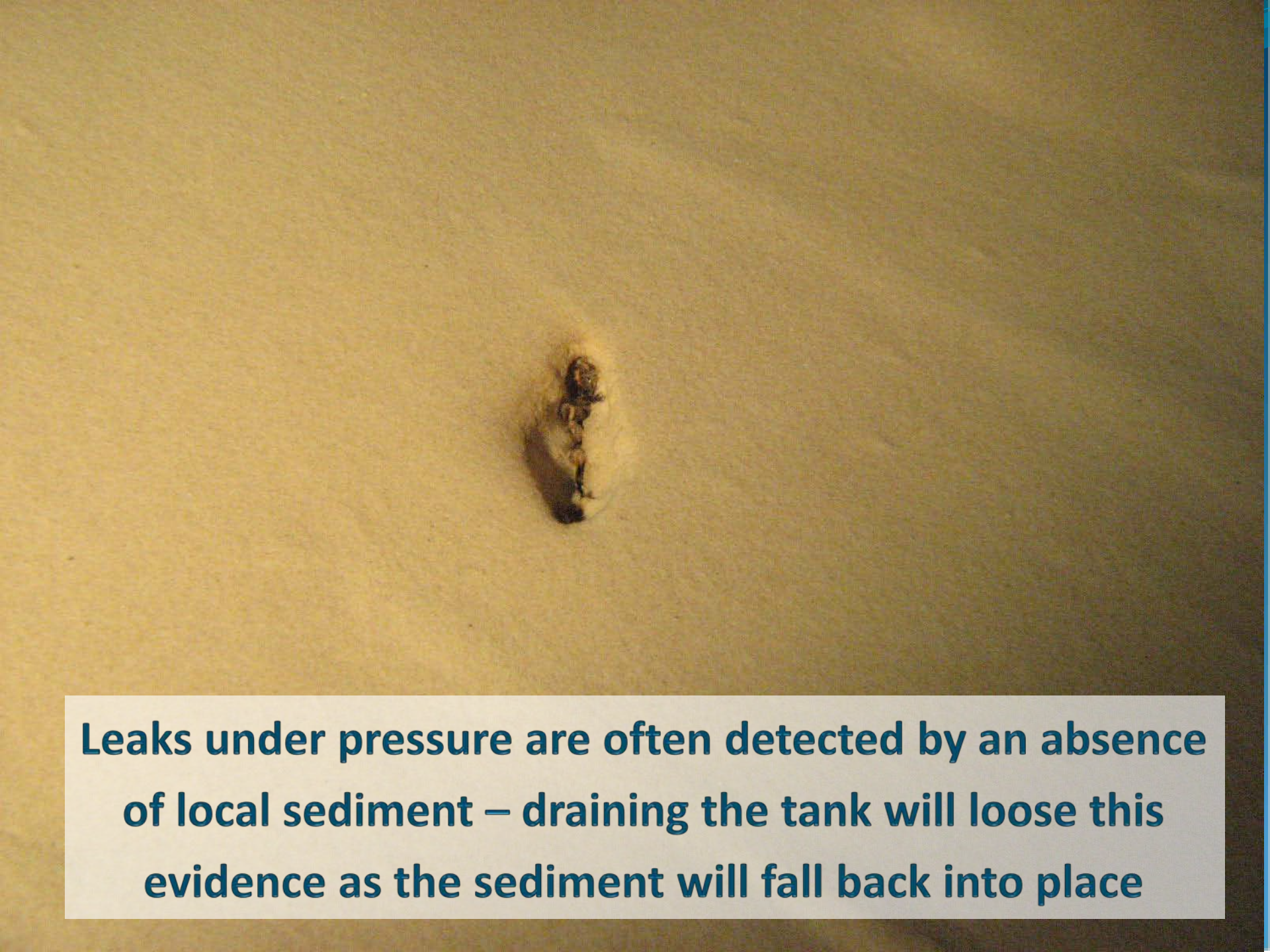
Two coat systems have a predisposition to failure – the second coat often fails due to adhesion issues. A single coat system is better, but more applicator skill is required



This polyester high build coating cannot tolerate excessive movement – it often fails on the upper wall areas, where heat expansion is greatest

Leak Detection

- Tree root ingress
- Observation under actual working pressures
- Sediments missing in and around joints
- Subsided seals
- Water flows detected by dye tracing



Leaks under pressure are often detected by an absence of local sediment – draining the tank will loose this evidence as the sediment will fall back into place


Leaking floor joints often open up under pressure,
but close up again when the tank is empty

Information collected…. what does this mean?

Reporting back to the asset owner on…

- The life expectancy of the asset or internal condition?
- OH&S risks to personnel?
- Health risks to customers?
- Disinfectant demand rates/levels?

Information Collected…. what now?

- ASAM to record and report on all details
- Critical works required & timelines
  - allows maintenance planning
- Categories for projects
  - Water Quality, OH&S and Structural issues

Information Collected…. what now?

- Register of products, contractors and coatings used
- Monitor progress of individual or multiple projects
- Compliance management system – a responsibility register for project delivery
- Work as Executed archive - information on completed projects

Following a project……

The following slides give examples of…

1. An external maintenance report which identifies a number of issues
2. ‘Ventilation’ has been selected to create a compliance recording document
3. Reports can be generated at any time to track the status of a project
4. Projects are stored in an online register for easy search and retrieval of information

Asset Details
High St No1

General Details
General
Cleaning
Safety
Mixer C.P.
Penetrations
Valuation
Comments

External Inspection
General
Condition
Coatings
Renovations
Comments

Internal Inspection
General
Condition
Coatings
Renovations
Comments

Attachments
View Details
Insert Attachment

Contractors
Contractor Roles

Actions
Compliance

Help
Help
FAQ

Compliance Recording System	Area Inspected	P Rating	Status	Comments
	Compound	4	D	Appears to be in good order
	Vandalism	4	D	Appears to be in good order
	Walls	4	D	Appears to be in good order
	Ladder External	4	D	A temporary section is required
	Entry Hatch	4	D	Appears to be in good order
	Roof Platforms	3	A	Mesh panels are required to minimize contact with the asbestos roof and to provide a solid working surface
	Walkways	Na	Na	No Comment
	Roof	2	A	Flashing is required to seal the sheet edges against the walls - there are no safety screens under the skylights to prevent an accidental fall into the tank
	Roof Hatches	4	D	Appears to be in good order
	Handrails	4	D	Appears to be in good order
	Davit	2	A	There is no rescue system fitted - a Titan arm should be put in place to make the tank confined space compliant
	Ventilation	1	A	Several side wall vent covers have corroded away and birds can enter the tank
	Bird Proofing	1	A	Several side wall vent covers have corroded away and birds can enter the tank
	Electrical	Na	Na	No Comment
	Level Indicator	Na	Na	No Comment

Edit

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Compliance Recording System

Compliance Type: Water Quality

Reservoir: High St No1

Compliance Status: 3

External/Internal: External

Priority: 1

Raised By: stevel

Status: A

Map Datum Standard: WGS 84

Maintenance Item: Ventilation

Co-Ord 1: S 027 58 6 E 153 01 0

Co-Ord 2:

Client Responsible Person: H Fizula

Responsible Date: 06/07/2010

Person Nominated For Action: H Fizula

Action Date: 06/07/2010

Action Taken:

The vents are to be replaced ASAP, using SS security mesh. The diving contractor will provide rope access personnel, and all materials for this job. This process has been used by several other Councils in QLD and it has proved safer and more cost effective than using an elevated work platform.

☐ Completed and Accepted ☐ Copy Forwarded to DBS ☐ Digital Images Taken ☐ Entered into ASAM

Client Sign Off Person:

Sign Off Date:

DBS Responsible Person:

DBS Date:

☑ Accepted/Modified & Approved for Action 07/07/2010

☑ Finance Approved 08/07/2010

☑ Work order issued 12/07/2010

☐ Work completed and accepted

☐ WAE archived-closed off

Update | List | Report | Cancel

ASAM Compliance Recording System Report

Tuesday, 3 August, 2010

Date:	3/8/2010	**Client Name:**	All State City Council		
WS #:	0	**Reservoir Name:**	High St No1		
Job No:	024613	**Project Number:**	0		
Cleaning Due:	21/6/2003	**Inspection Due:**	21/6/2003	**Register No:**	18
Raised By:	dbsAdmin			**Date:**	6/7/2010
Map Standard:	WGS 84				
Co-ord 1:	S 027 58 602	E 153 01 040			
Co-ord 2:					

Compliance Category - Water Quality — External

Maintenance Item:	Priority:	Status:
Ventilation	1	A

Comments:

Several side wall vent covers have corroded away and birds can enter the tank

Client Responsible Person: H Fizula **Date:** 6/7/2010

Staff member/contractor nomination for action: H Fizula **Date:** 7/6/2010

Action taken by nominated staff member/contractor:

The vents are to be replaced ASAP, using SS security mesh. The diving contractor will provide rope access personnel, and all materials for this job. This process has been used by several other Councils in QLD and it has proved safer and more cost effective than using an elevated work platform.

Accepted or modified and approved for action:	**Date:**	7/7/2010	**Yes**
Finance approved:	**Date:**	7/8/2010	**Yes**
Work order issued:	**Date:**	7/12/2010	**Yes**
Work Order completed and accepted:	**Date:**		**No**

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Contractors
Contractor Roles

Actions
Compliance

Help
Help
FAQ

Compliance Recording System

Client: All State City Council

Asset: High St No1

Filter By: Please Select...

Show: ○ All ◉ Outstanding ○ Closed

Sort By: ◉ None ○ Item ○ P Rating ○ Progress

Reg #	Type	Asset Name	Progress	Job No	Project No	Date	Item	P Rating			
18	External	High St No1		024613	0	06/07/2010	Ventilation	1	Edit	Delete	Report
17	External	High St No1		024613	0	06/07/2010	Roof	2	Edit	Delete	Report
19	Internal	High St No1		024613	0	06/07/2010	Overflow	2	Edit	Delete	Report

Total Results: 3

Summary

.....and Benefits

- Not just cleaning…

  a regular review and health check of the asset
- Observations from a different perspective
- Asset life and water quality preserved
- High risks identified
- Information is not lost
- Businesses can track progress
- Learn from past experiences