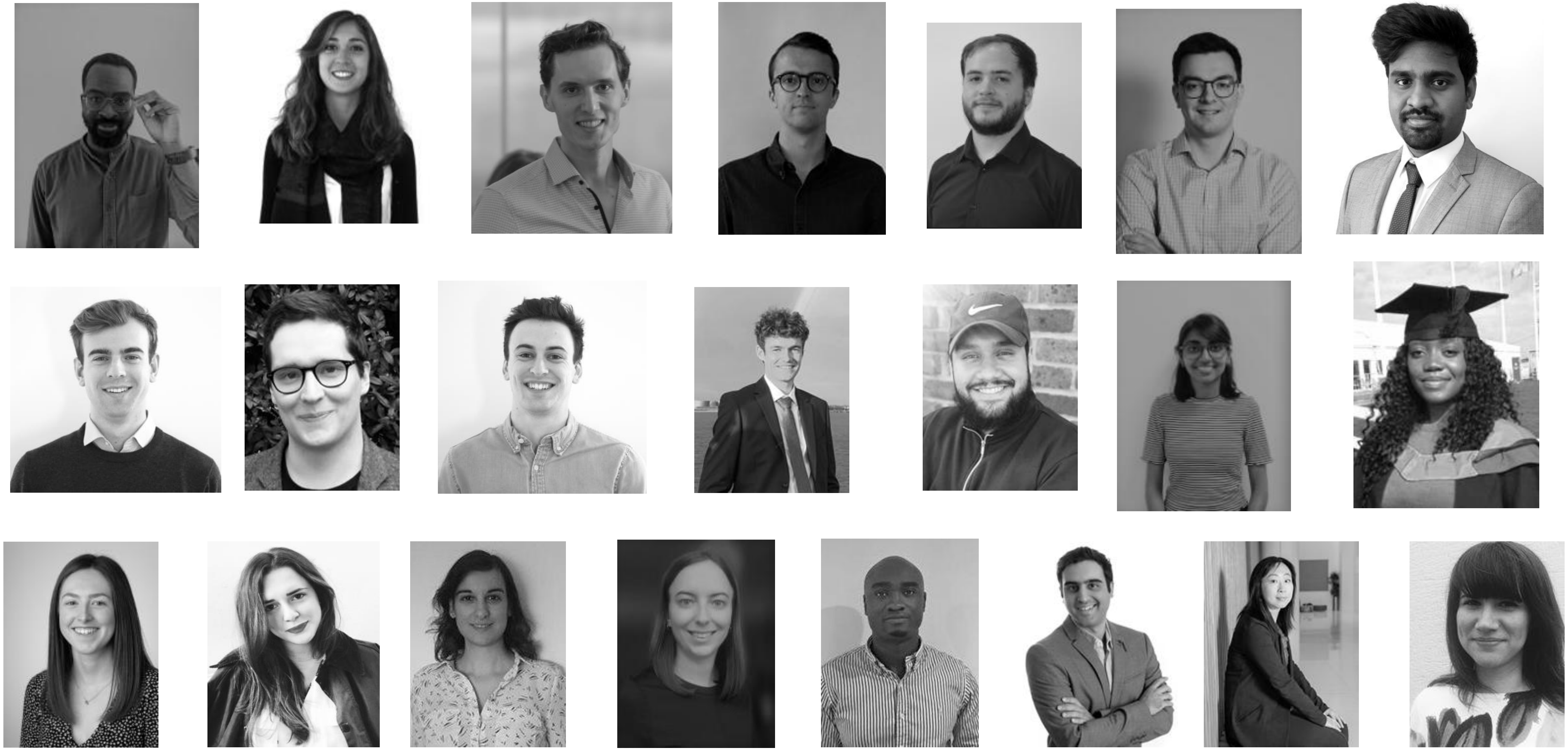
Carbon Bite Night 2

04.08.2021

Quality Assurance of Heat Networks

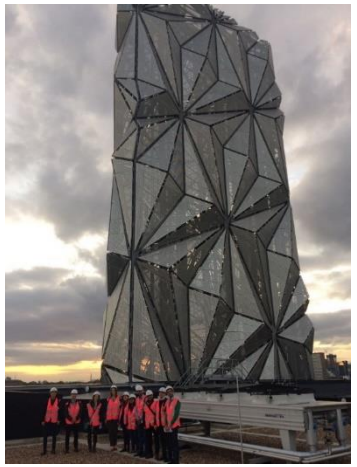


OUR TEAM

OUR MISSION

- To improve the energy performance of buildings and reduce their carbon footprint.
- To reach out to young professionals and those aspiring to join the industry, supporting them in their professional development.
- To provide a forum for discussion, enabling networking opportunities and promoting collaboration amongst members.

OUR EVENTS



Quality Assurance of Heat Networks - AGENDA

1. Tom Burton (FairHeat) – Introduction to QA processes for Heat Networks

2. Paul Craig (Telford Homes) – QA processes from a developer's perspective

3. Ivan Grahn & Ricky Stevens (Orchard Plumbing) – Importance of water treatment

4. Q&A session

Tom Burton, FairHeat

Introduction to QA processes for Heat Networks

FairHeat

Heat Networks Quality Assurance: FairHeat support role

Tom Burton

04 August 2021

Overview of FairHeat

- Specialist consultancy focused exclusively on quality assurance for heat networks and building performance
- Significant experience, having directly worked on c. 200 heat network projects
- Have been involved in all aspects of heat networks: energy strategy, design, ESCO, O&M, Metering & Billing, major refurbishments, end of life replacement, etc.
- Work with clients to: (a) improve specifications & design; and (b) manage risk and improve performance of existing heat networks

CP1 2020 update & compliance checklist

- Enhanced minimum and best practice technical requirements
- Better defined performance metrics – contractual implications
- Focus on quality assurance throughout
- Checklist developed to make monitoring compliance easier

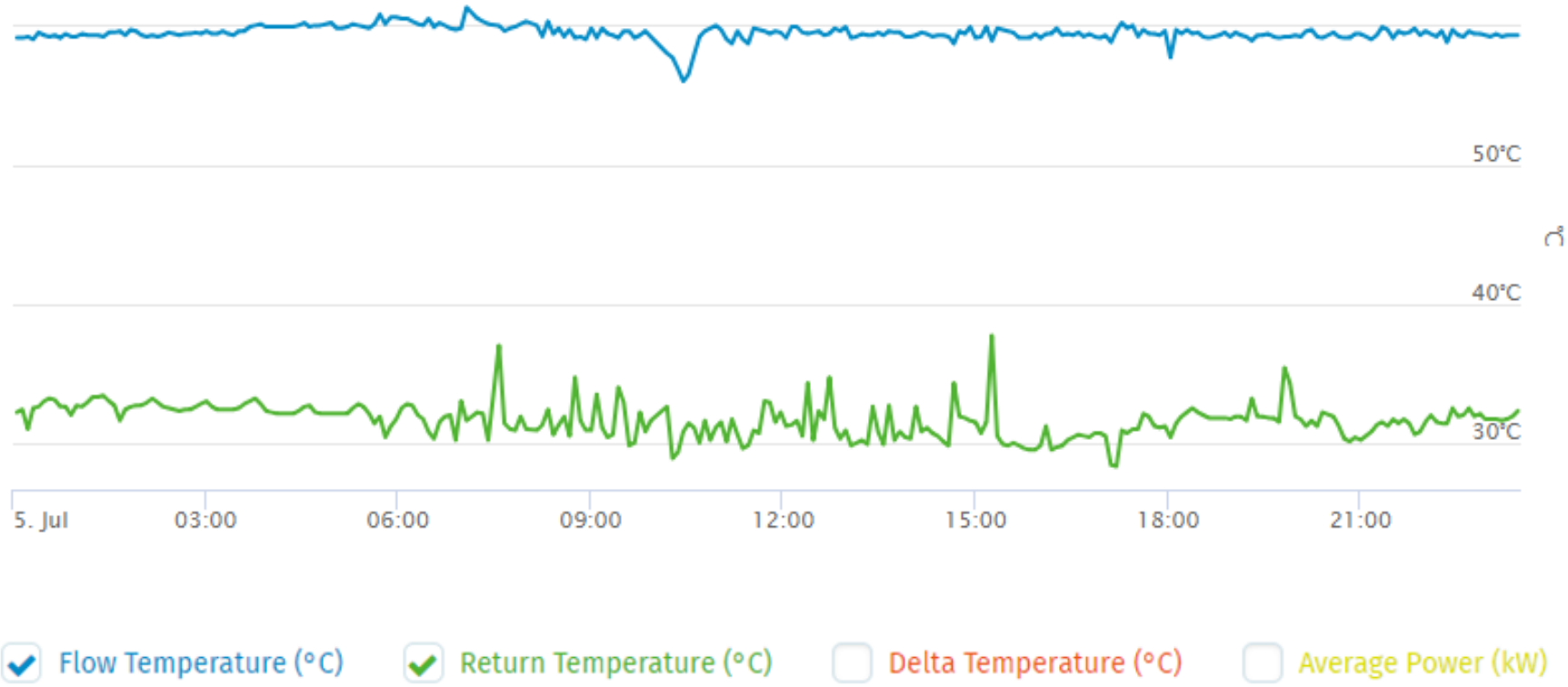
CP1 STAGE 3: Design **CHECKLIST**			– Use the drop-down to colour code columns D–G as per the key – Add risk level and mitigation into columns G and H – Include changes/explanation for variance/exceptions in column I					
OBJECTIVE		**KEY OUTPUTS**	**CP1 output developed?**	**Included in evidence pack?**	**Output signed off?**	**RISK level**	**Risk mitigation**	**Change / Reason for variance / Exception**
3.5	To achieve an energy-efficient primary heat network	Output 3.5a – Optimised pipework design						
		Output 3.5b – Optimised pipework insulation thickness report						
		Output 3.5c – Pump and control design						
3.6	To achieve a low-cost network, optimisation of routes and pipe sizing for minimum lifecycle cost	Output 3.6a – Lifecycle network optimisation study						
		Output 3.6b – Underground services survey report						
3.7	To achieve a reliable network with a long life and low maintenance requirements	Output 3.7a – Heat network component specification						
		Output 3.7b – Water quality system design						
3.8	To define a metering strategy and select heat metering, prepayment and billing systems that are accurate and cost-effective	Output 3.8a – TM39 metering strategy						
		Output 3.8b – Heat metering specification						
		Output 3.8c – AMR system specification						
		Output 3.8d – Billing system specification						

Market Framework Review

- Heat networks to be 5th Utility
- Expected c.2025
- Ofgem likely to be regulator
- Two key mechanisms:
  - Customer Protection
  - *Heat Network Assurance Schemes*
- Key point – CP1 likely to form technical framework

High performance heat networks are achievable

Example Network Flow & Return Temperatures, Quayside Totnes (The Guinness Partnership): 5 July 2018

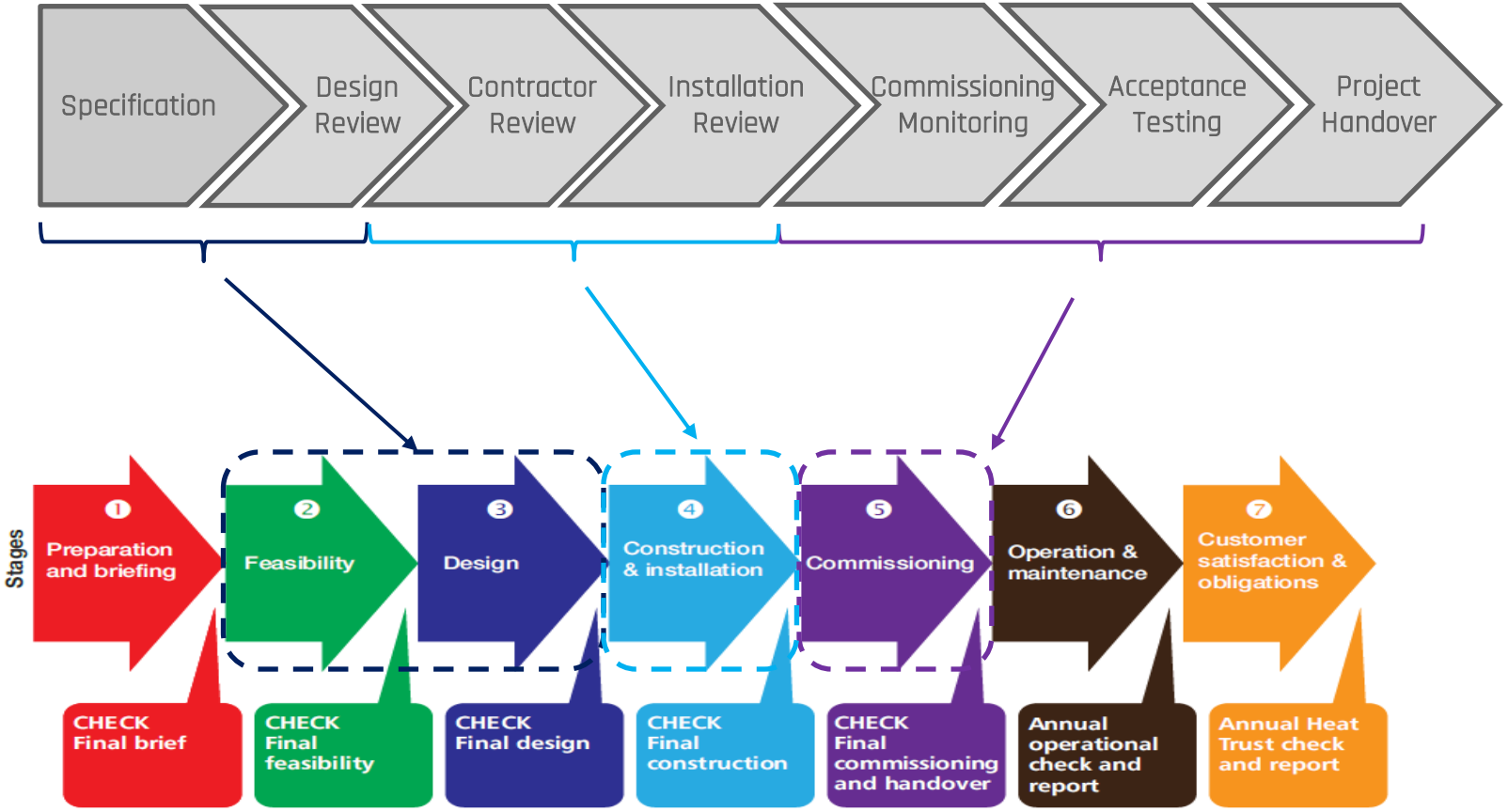


Benefits of Peer Review and Quality Assurance Process

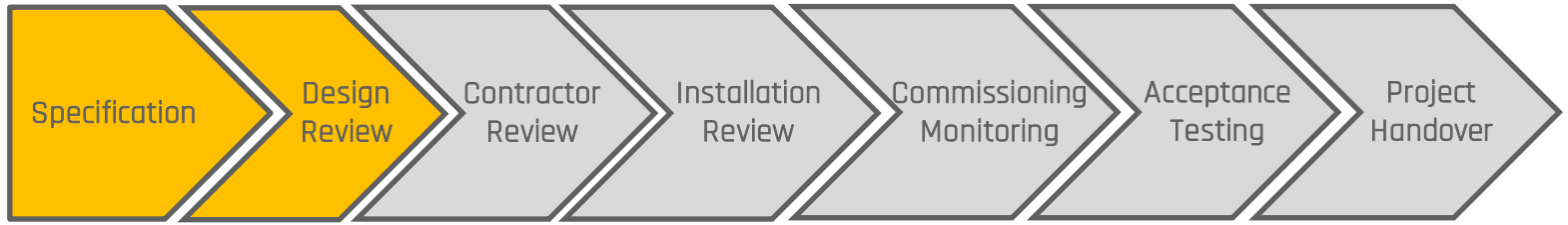
1. Proven record of delivering CAPEX reductions alongside performance improvements
2. Developer risk significantly reduced through high quality delivery
3. Performance is real, and long term
4. Resident experience greatly improved
5. Develops mature, skilled and motivated supply chain partnerships

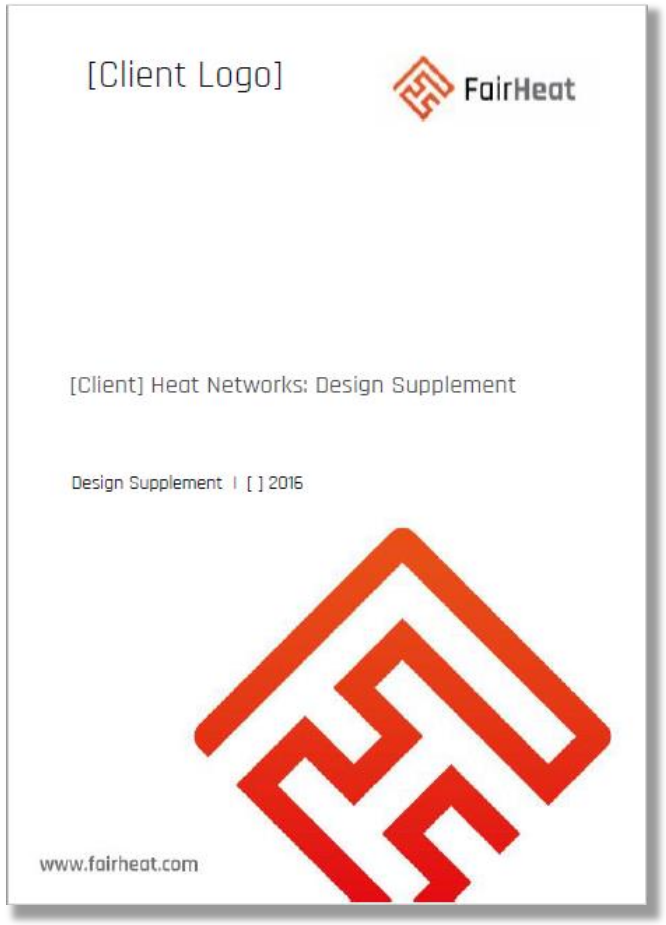
Delivering high performance: Three key messages

1. Collaboration is key
2. Measuring and verifying of performance is crucial – "Trust but verify"
3. All about process



Design supplement and peer review process





- Guide to how to use CP1 2020, rather than replacing it
- Sets out core design principles
- Provides specific objectives and performance criteria for projects
- Sets out basis for measurement and verification

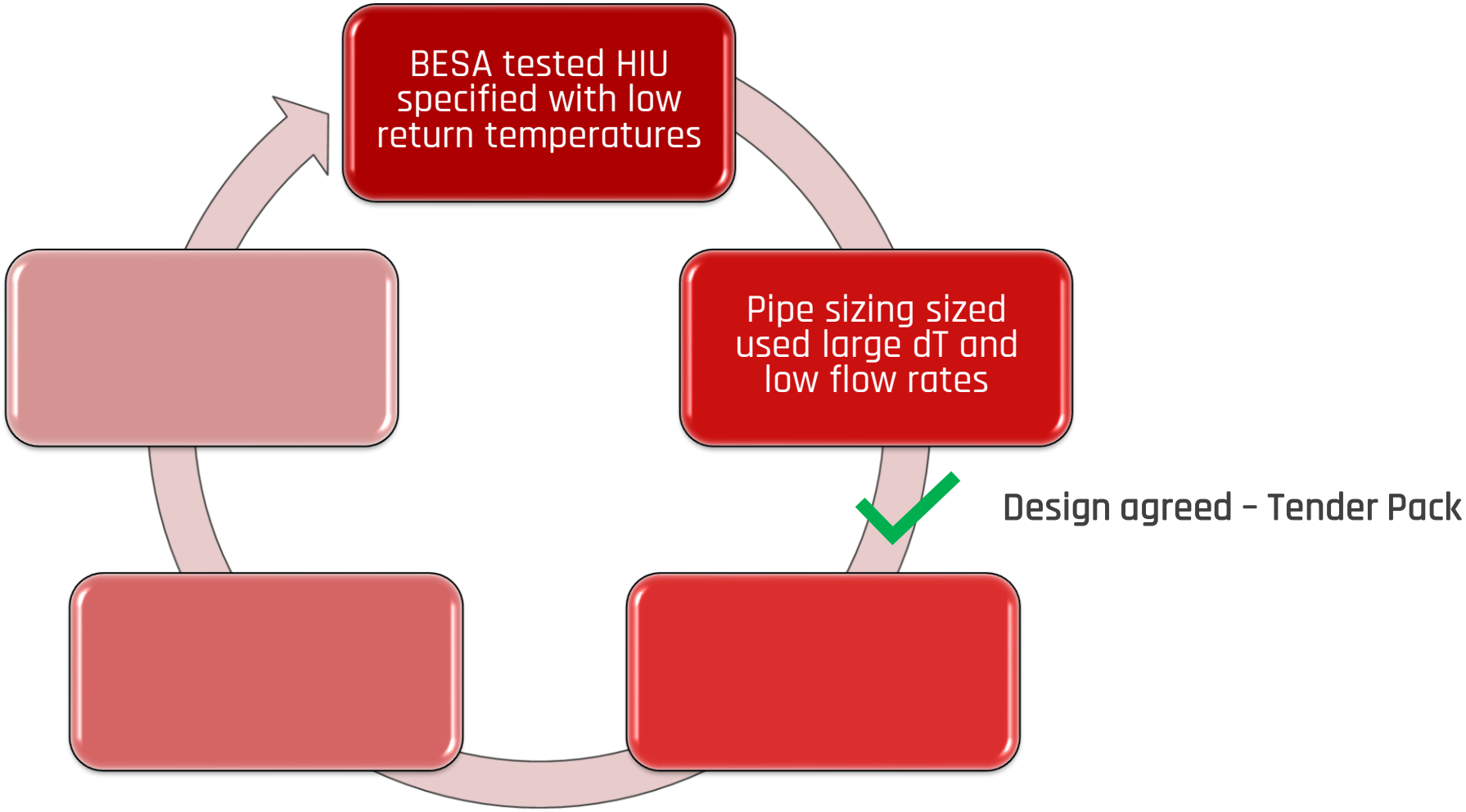
- 21 organisations now using, with >20k new homes pa
- In use in contractual documents
- Forms basis of FairHeat's design review process

Contractor reviews to maintain performance through design

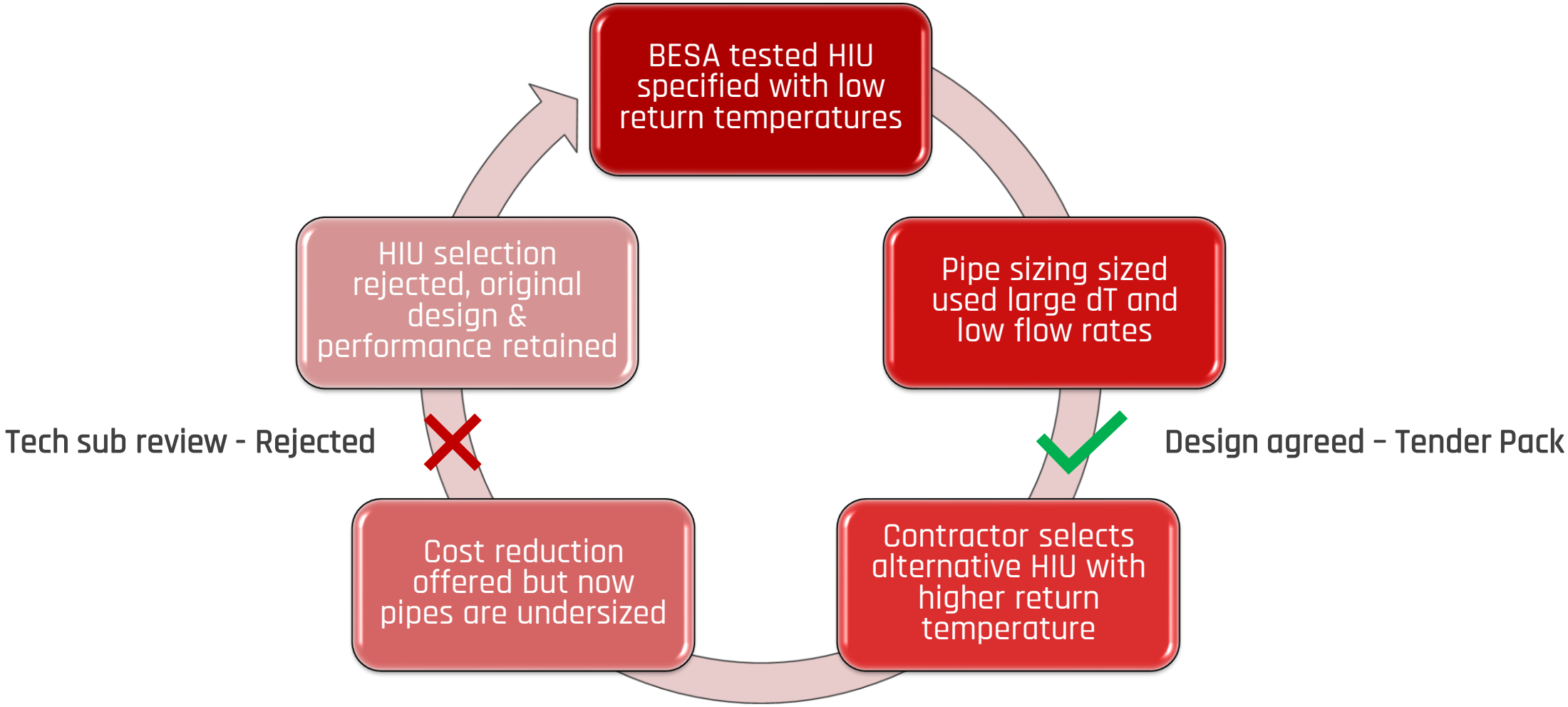
Objectives:

- Support contractor in developing design that will be installable and operable
- Prevent inappropriate Value Engineering that could compromise performance
- Avoid incorrect equipment selection
- Avoid program delays due to installation non-compliance

Contractor review example: Avoiding inappropriate VE



Contractor review example: Avoiding inappropriate VE



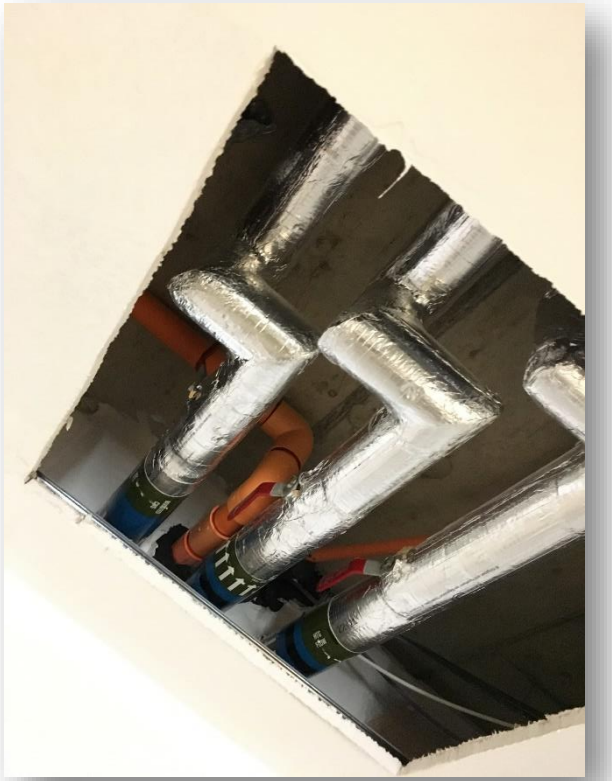
Installation reviews to ensure design and quality compliance

Objectives:

- Ensure design compliance
- Ensure quality of workmanship
- Avoid issues that will impact on programme and/or operational performance (ensure that the system will actually work)

With a longer term aim:

- Improving overall quality of installation practices



Commissioning must replicate design intent

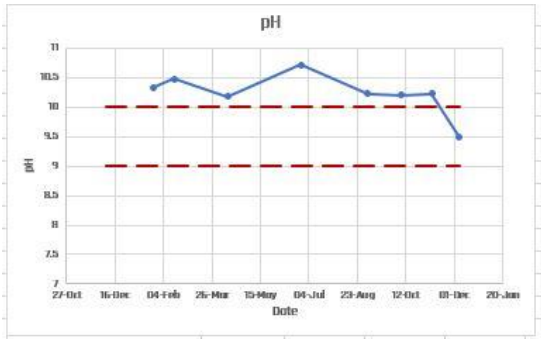
Objectives:

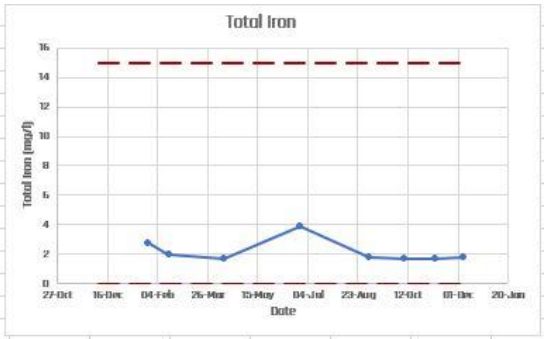
- Ensure that the systems will work as intended
- Protect the system from Day One (e.g. water treatment)
- Increase documentation for records

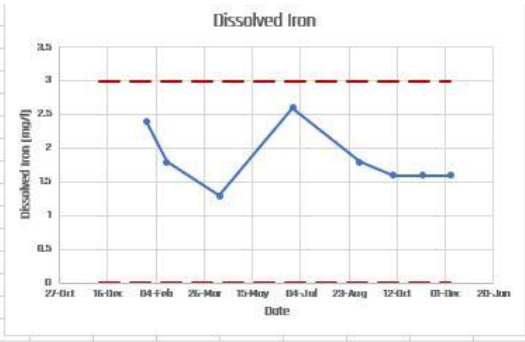
With a longer term aim:

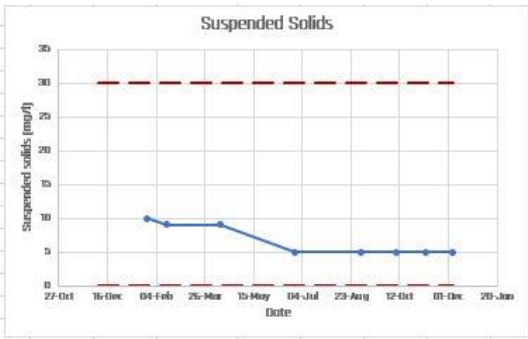
- Raise expertise and know how across the Contractor supply chain

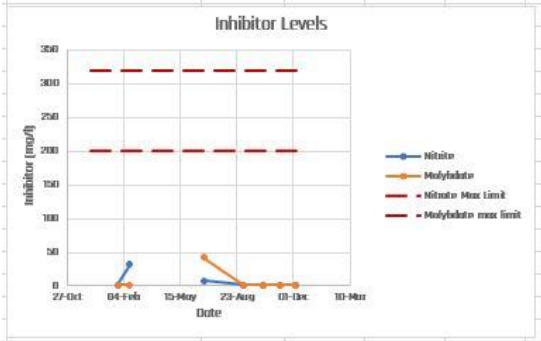
Extensive record keeping de-risks future issues

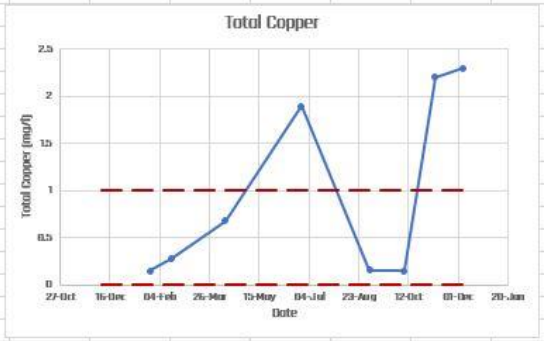


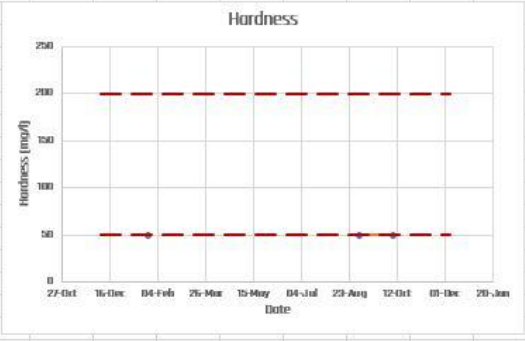


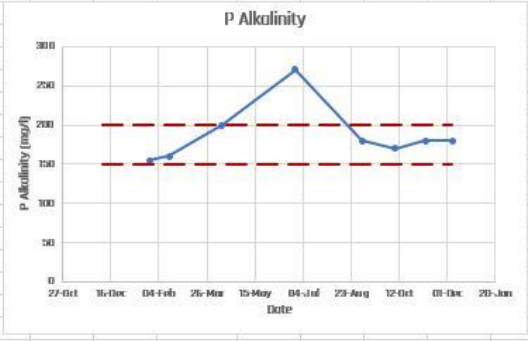


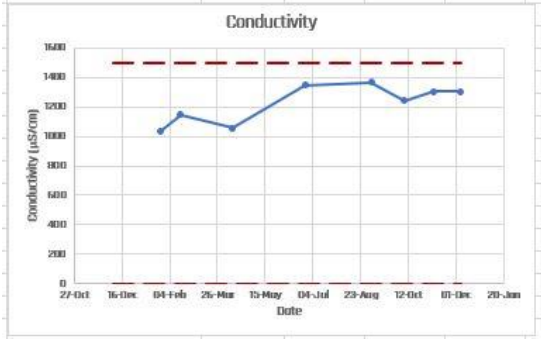


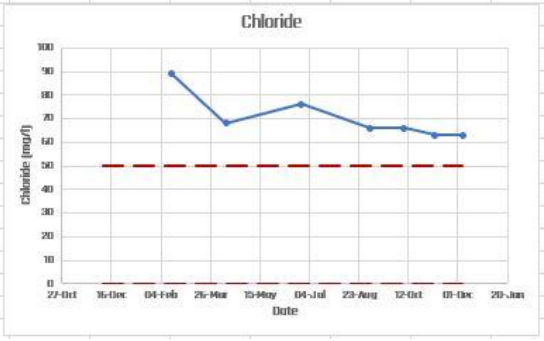


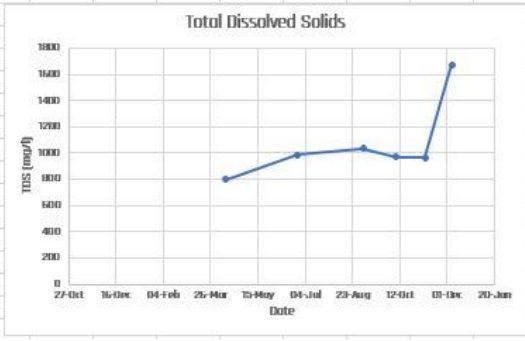


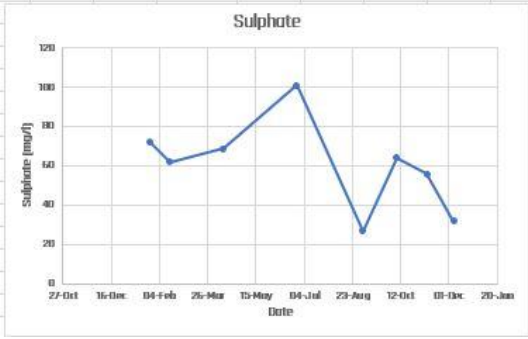












Acceptance Testing essential for good performance

Objectives:

- Ensure that every dwelling is operating in such a way that:
  a) Residents will have a good experience
  b) Design parameters are met = good network performance
- Reduced call outs post occupation

Dwelling/end user level Acceptance Testing

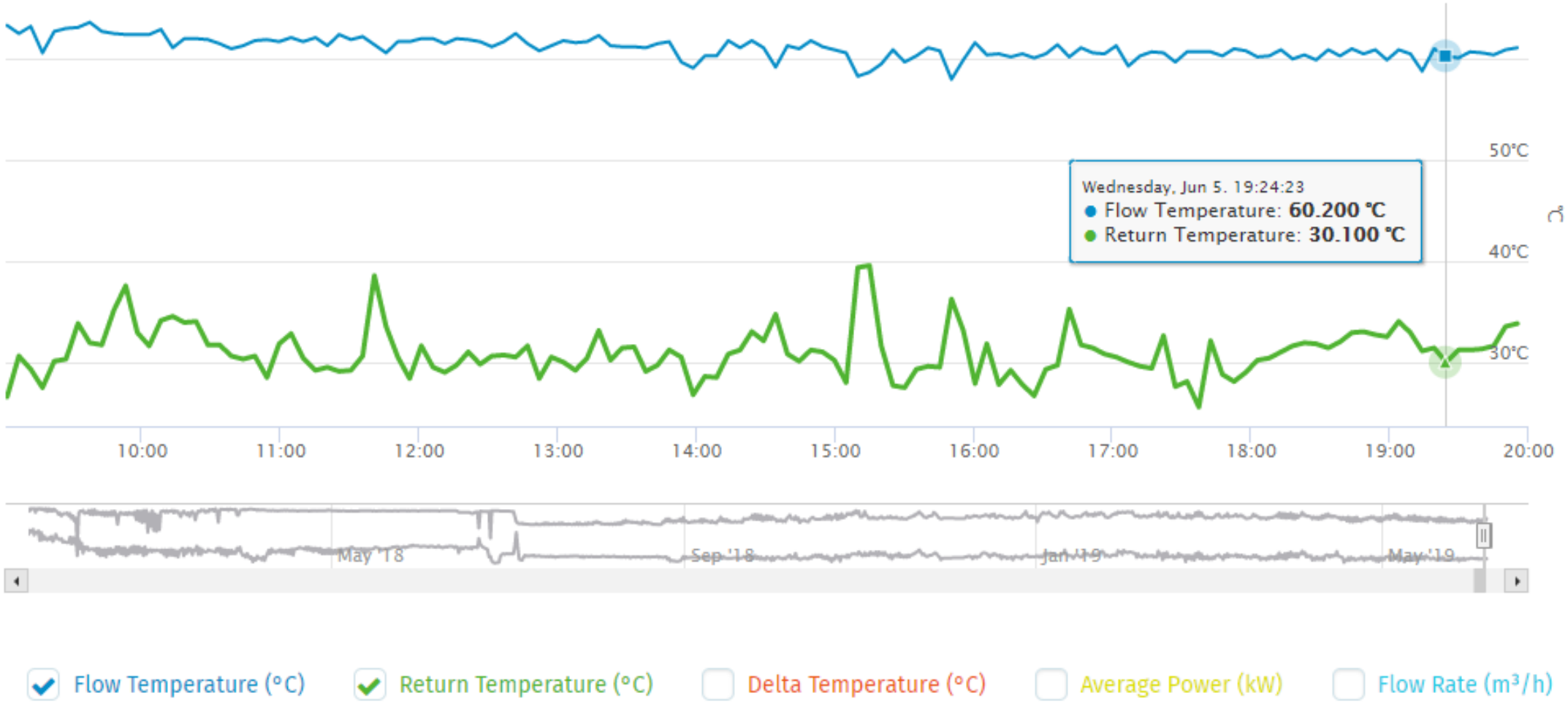
- End user equipment has significant impact on ongoing heat network performance
- Inspection of end user level equipment
- Rigorous testing through all modes of operation

Acceptance Testing developed by FairHeat, now a Min Req in CP1 2020

Objective *"To carry out on-site Acceptance Tests to deliver an efficient and reliable service"*

Acceptance Testing results in good network performance

Example site network flow & return temperatures: 5 June 2019



Delivering high performance: Engagement & Process is essential

1. Collaboration is key
   - Stakeholder engagement and buy-in will result in improved performance
2. Measuring and verifying of performance is crucial – "Trust but verify"
   - Proving performance metrics before handover de-risks everyone's position
3. All about process
   - Process and rigour builds trust amongst project teams and provides transparency

Paul Craig, Telford Homes

QA processes from a developer's perspective

Developer perspective: Paul Craig – Telford Homes – M&E Site Manager

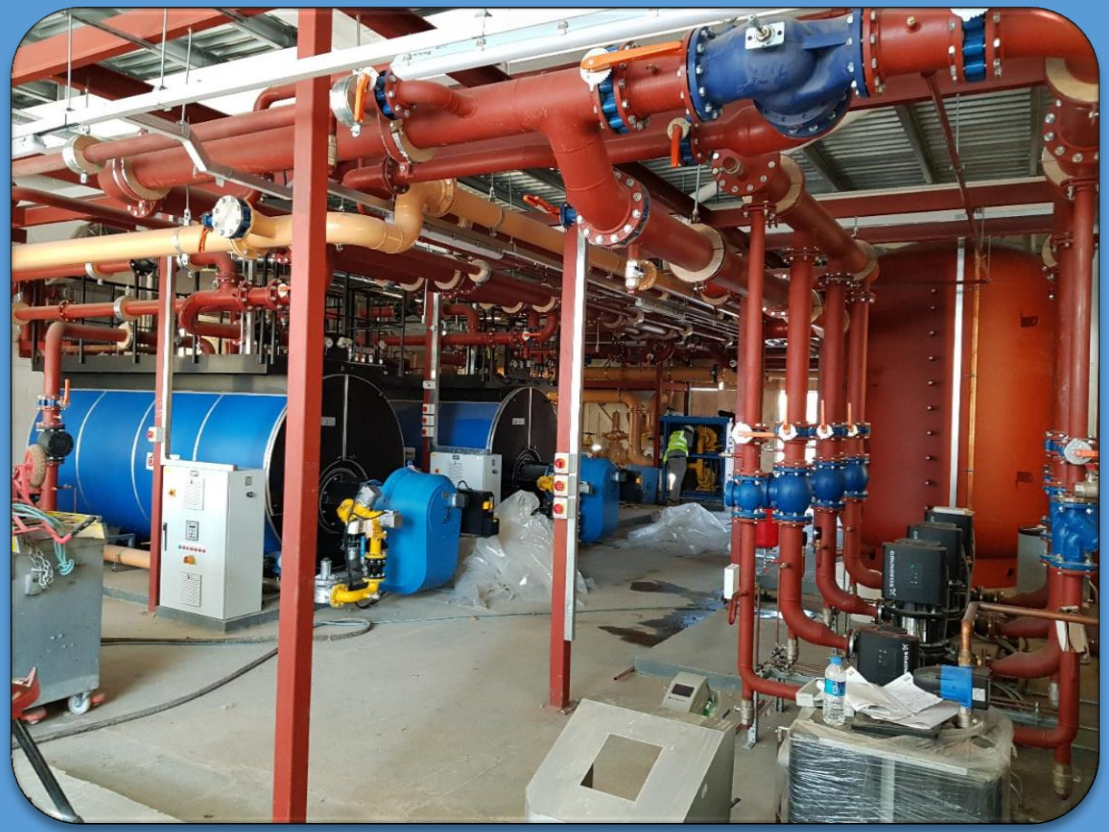
- Introduction
- Adopted as standard across business
  - 14 sites, almost 3,000 dwellings tested
  - 4 further sites commencing within next 6 months
- Introduced several internal processes and policies to streamline and make the most out of Acceptance Testing
- Heat networks installed and commissioned to meet design
- Vast reduction in resident complaints

telfordhomes
A TRAMMELL CROW COMPANY DEVELOPER

Ivan Grahn & Ricky Stevens, Orchard Plumbing

Importance of water treatment

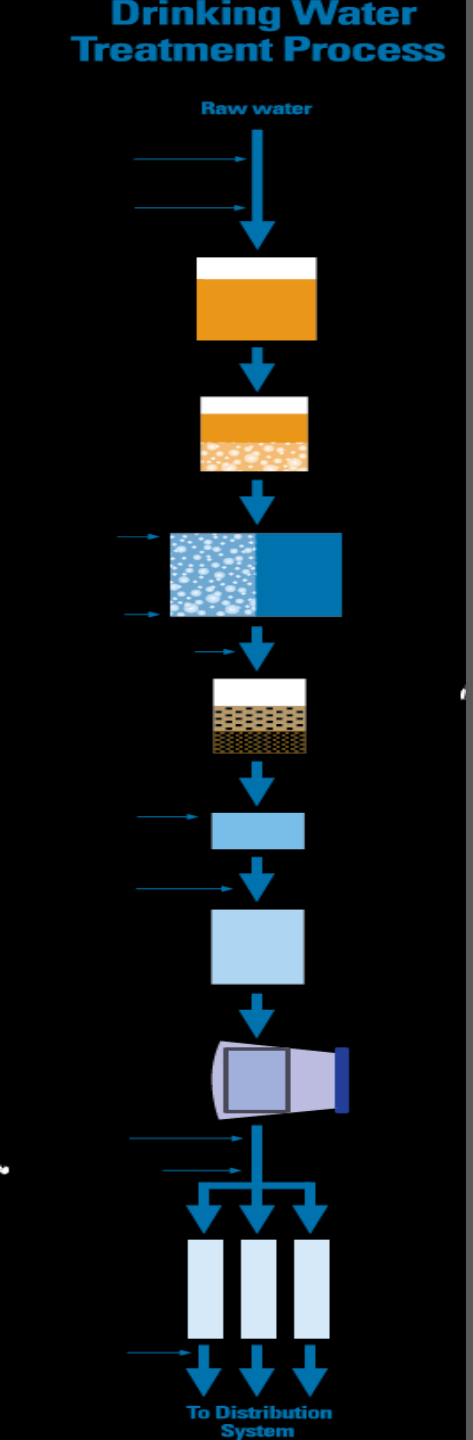
The Importance of Water Treatment



By Ivan Grahn

Orchard Plumbing Ltd

Mechanical Site Contractors



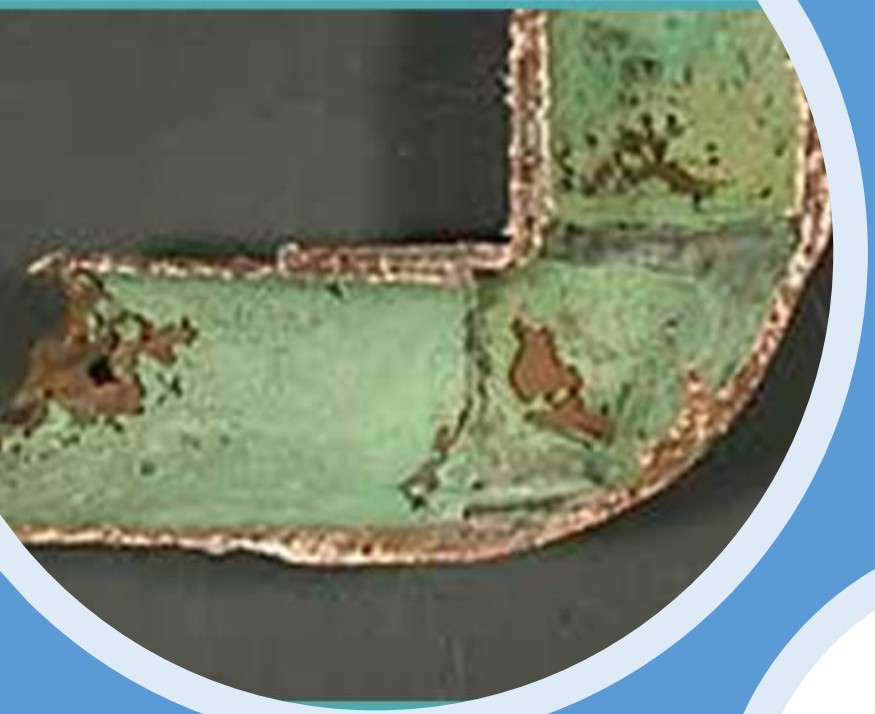
What is Water Treatment ?

"Water treatment is any ***process that improves the quality of water to make it appropriate for a specific end-use***. The end use may be drinking, industrial water supply, irrigation, river flow maintenance, water recreation or many other uses, including being safely returned to the environment." (ref. Wikipedia)

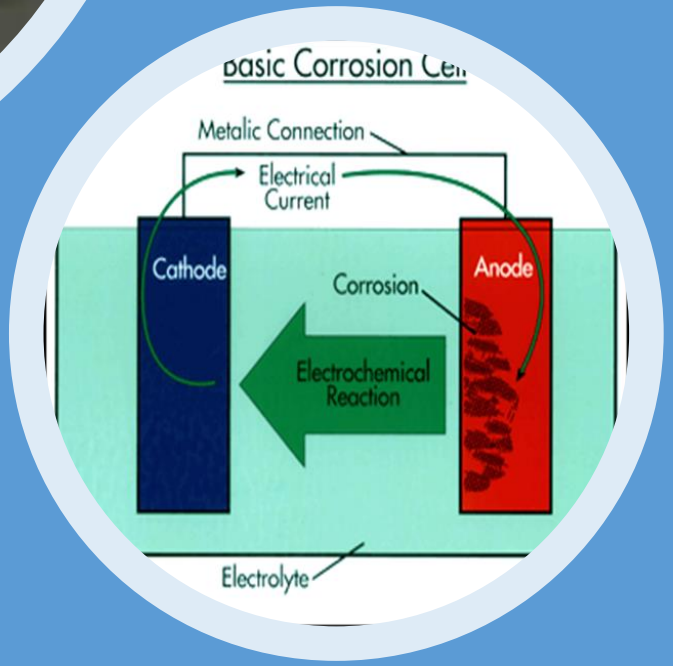
Water Treatment & the Build Environment

Where water is used for filling heating systems, we get 4 problems:

1. Corrosion
2. Scale Formation
3. Microbiological Growth
4. Fouling



What is Corrosion?



Corrosion is the reaction of a metal with its environment to return to a stable, low energy state.

It is a natural process which will always occur if the correct conditions are present.

The three main processes of corrosion are:

1. Oxygen
2. Galvanic
3. pH facilitated

The effects of Corrosion:

- Destroys system metals
- Reduced heat transfer efficiencies
- Creates leaks in equipment
- Increases operational costs

Examples of Corrosion

pH facilitated Corrosion of Aluminium

Galvanic Corrosion of Dissimilar Metals

Oxygen Corrosion of Iron

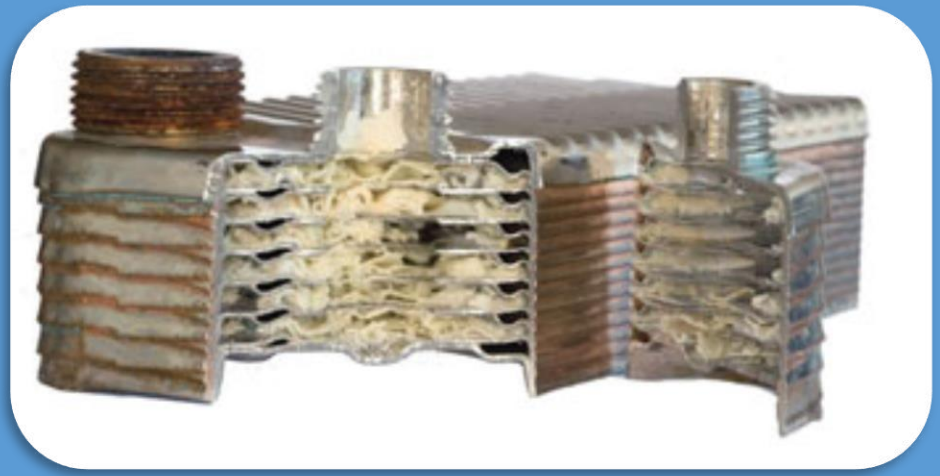
Scale Formation

Scaling is the deposition of sparingly soluble compounds as hard, crystalline deposits on heat exchanger surfaces and pipework.

The most common scale-forming salt is Calcium Carbonate. Typically, the scale found in kettles.

When scale is allowed to build up inside pipes, the **resistance to heat transfer increases cumulatively**. This means that as the system becomes more inefficient, it takes increasing energy to heat water in the fouled pipes. This leads to energy wastage and failure of high value plant and equipment.

Examples of Scale Formation



Stainless Steel HIU Plate Heat Exchanger

Boiler Tube

Copper Pipe – Hot Water Cylinder

Scale Thickness (mm)	Heat Transfer Coefficient (BTE/ft./÷F)	Loss in Heat Transfer (%)
0	92.77	0
0.3	73.68	21
0.6	61.12	34
0.9	52.20	44
1.2	45.60	56
1.6	39.52	57

Scale Thickness to Heat Loss Comparison Table

Microbial Growth

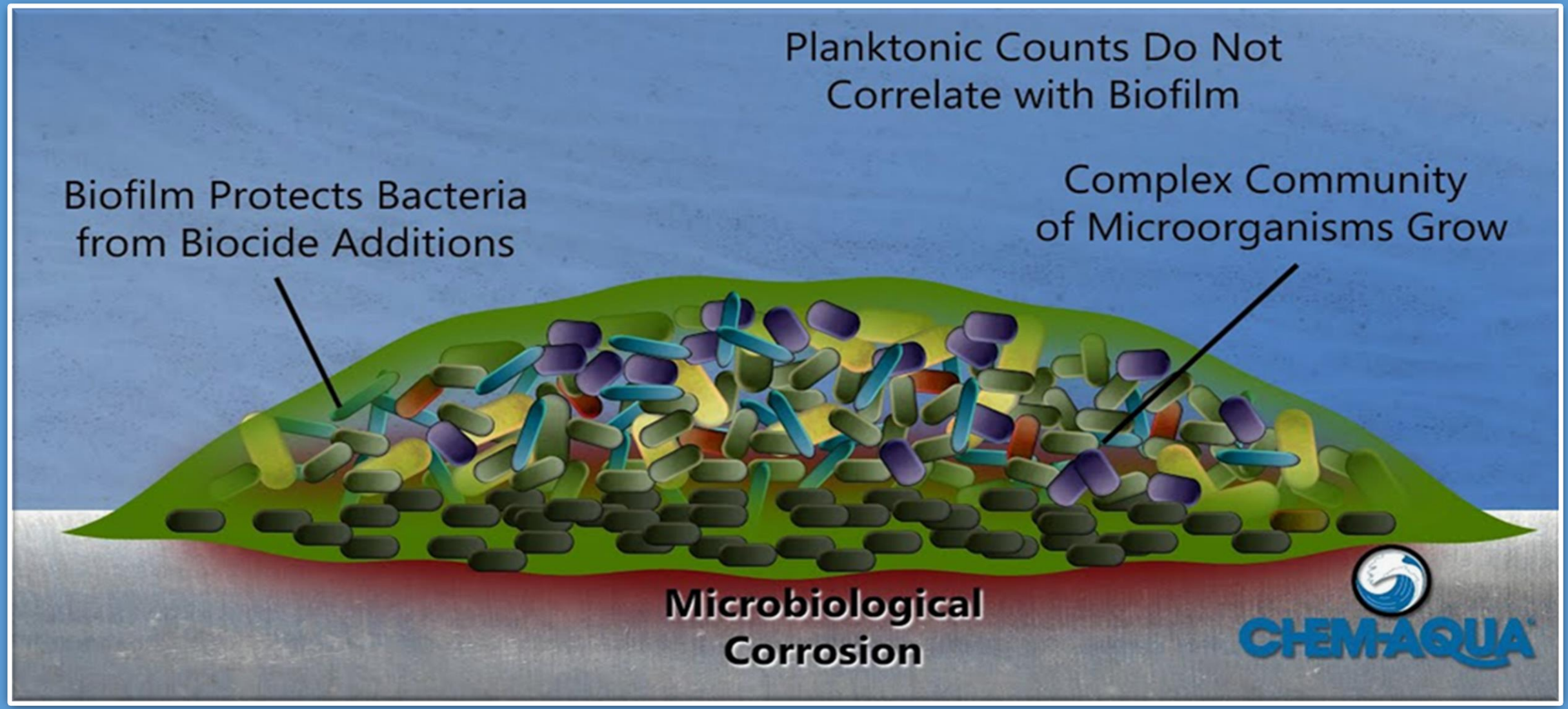
Microbial growth is the growth of numerous individual micro-organisms to the extent that they form masses of cells called biofilm.

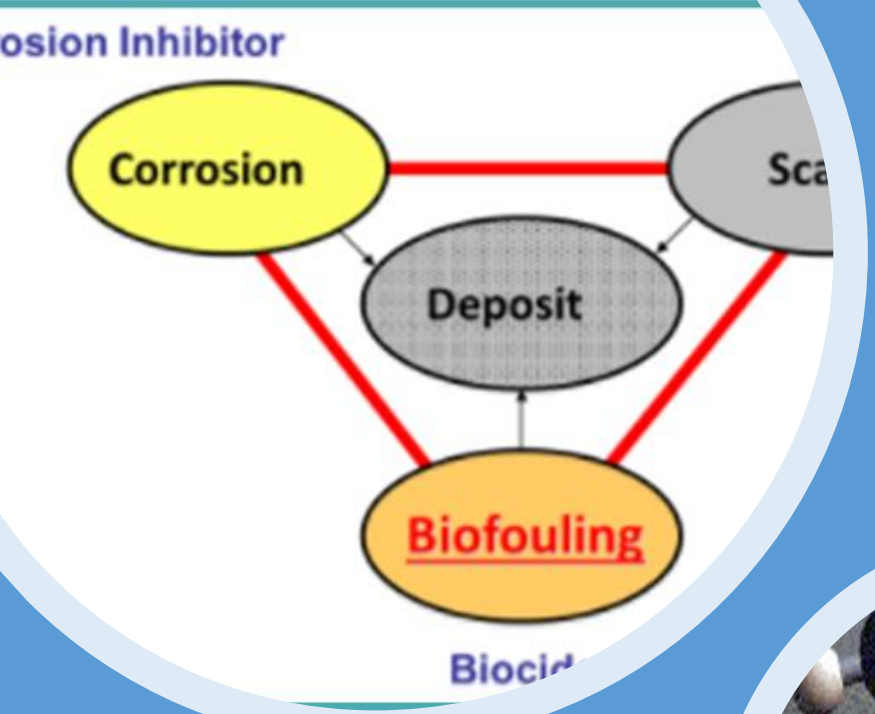
Biofilm is a thermal insulator which can interfere with heat transfer across a metal surface. It is four times better at preventing heat transfer than scale.

In addition to affecting heat transfer, some micro-organisms have the potential of causing serious problems like:

- System Blockages - strainers, control valves, heat exchangers and pipework.
- Reduced system efficiency – thermal insulation across plate heat exchangers.
- Accelerated corrosion – across all metal surfaces
- Poor commissioning data – caused by internal bacterial gasses affecting accuracy of data leading to poorly configured systems.

Mature Biofilm Formation





Fouling

Fouling is the accumulation of suspended matter, usually as loose deposits, which interfere with heat transfer and fluid flow.

Effects of fouling:

- Reduces heat transfer efficiencies
- Decreases fluid flow
- Increases system pressures
- Interferes with Commissioning Data
- Increases operational cost

Improper Water Treatment or no treatment at all will increase your energy consumption and operating cost while decreasing your mechanical equipment’s efficiencies and life expectancy.

Q&A