

Scottish Hospitals Inquiry

Witness Statement of Questions and Responses

Tim Wafer

Personal details

1. What is your professional background and qualifications and what is Water Solutions Group? What are its activities? Do its specialisms reflect your own?

A I have spent over 50 years involved with water in various disciplines. Have worked for a number of large organisations and prior to forming H2O Solutions LPP in 2008 was head of the Chlorine dioxide division for Clearwater Technology who were latterly bought by the Marlow group (WCS).

I was brought into Clearwater to form a Chlorine dioxide division due to prior expertise in working with Chlorine dioxide systems alongside an American Company, (Dripping Wet Water Inc) advancing their catalytic technology into the healthcare market. This included the design, project management and technical support for one of the largest Chlorine dioxide generators in the UK at the then BP refinery Grangemouth.

I set up H2O Solutions LLP to be a specialist water consultancy company with a focus on healthcare and to audit the performance for Chlorine dioxide systems. Over the past 15 years the business has evolved through business partnerships to offer laboratory services (microbiology, chemistry, metallurgy, forensic water investigation, electron microscopy) which has dovetailed with our consultancy service to fulfil a niche sector of this market. Further details can be found by visiting our website: www.watersolutionsgroup.org.uk which explains the services offered.

As founder of H2O Solutions LLP, the business does reflect many of my own specialisms and draws on additional expertise as and when required through a network of working relationships.

Your Initial Involvement with QEUH

2. The Inquiry understand that you first became involved in the QEUH/RHC after being contacted by telephone by Ian Powrie then Deputy General Manager for Estates at the hospital in June of 2018. What did Mr. Powrie ask you to do for NHS GGC?
 - A. Ian Powrie made contact June 2018 and organised an initial meeting at QEUH 08:00 15th June. The initial action was to develop a programme for the implementation of a chlorine dioxide biocide regime to assist with microbiological issues being experienced on-site. Water Solutions Group (WSG) has extensive experience on the implementation of such regimes from a technical aspect. The engineering aspects would be assisted by others.
Ian Powrie also requested microbiological analysis of the water systems/outlets using our laboratory services which are facilitated by the Intertek Group, to investigate issues related to taps and other components.
3. How was the then state of the water system at the QEUH/RHC described to you by Mr. Powrie at that time, and what reason was given to you for getting you and your company involved. Was that sufficient to enable you form an understanding of what might be involved?
 - A. The system was described as having microbiological issues that had materialised since building hand-over. WSG was brought in for technical input regarding biocide systems, focusing on chlorine dioxide. The initial discussions were in sufficient detail to obtain an understanding of the requirements but would require continual input from Ian Powrie due to his knowledge of the site and additional information regarding water systems/BMS/engineering, etc. required.

WSG has had key involvement in the technical aspects of a number of key controlling biocide systems predominantly in healthcare and it was that level of expertise that was required for this project. Due to the complexity of the water system IP required WSG to work with the facilitators of the biocide systems to ensure the necessary control measures and dosing strategy was implemented.

As with any complex water systems involving a dosing strategy it is important to ensure that dosing is within agreed parameters and meets the necessary

guidance and in this case not to exceed Drinking Water Inspectorate guidelines of 0.5 mg/litre for drinking water. There was a requirement to ensure biocide dosing levels were robust and effectively managed.

4. Between that initial contact and your visiting the hospital, did you have further contact regarding your task? With whom? Were you given further information? To what extent was that information sufficient to allow you to understand your task?

A. Met with a number of people including Colin Purdon, Melville MacMillan; Mary Anne Kane; Alan Gallagher, all of whom provided information requested as part of facilitating this project. At this time the chlorine dioxide supplier had been selected and was being worked with at that time as well. The first project team meeting took place 5th September 2018 at which time the Chlorine dioxide project group was established under the steorage of Ian Powrie. The project group brought in engineering resources who would have to be working on the pipework systems as part of the interface for the chlorine dioxide.

On this occasion the challenge was the number of systems and the integration of these into the water infrastructure. This was achieved by working alongside the Water Technical Group and the Chlorine dioxide project group.

5. When you visited the hospital did you form any views or opinions about the design, size, or complexity of the water system, or with how it was then being operated? Did your impressions fit with the scenario that had been described to you? Did your understanding of the task change as a result?

A. Initial impression was the potential vulnerability of such a large facility being sourced from one centralised water tank system, the potential risk being water tanks out of balance and creating a “lead/lag situation”. There was concern about the amount of water and “damp” within the plant room and the overwhelming smell of mould. (The odour issue was also commented on much later by Dr Tom Makin when inspected the plant room area). There was a concern that the services corridor air intake which ultimately impacted on the water plant room came from the end of the sewage treatment beds which were located adjacent to the laboratory building.

The impressions fitted the described scenario but that the task was more urgent and going to be more complex from an engineering perspective due to the need to install some 29 chlorine dioxide systems. It was not that the task required change, but the amount of biocide systems that were going to be employed increased which had an effect on timeline.

6. When were you first shown the report by DMA Canyon Ltd L8 Risk Assessment of the QUEH/RHC in respect of a site survey completed on 29 April 2015? Who showed it to you and what were your immediate thoughts? **Please refer to Bundle 6, Document No. 29, Page 122.**

A. We were not provided with sight of this document and any interpretation from findings and recommendations would have been provided by Ian Powrie. As our involvement commenced June 2018 the 2017 document (question 7 below) would have been more appropriate.

7. Are you aware of the further Reports compiled by DMA Canyon in 2017 and 2018? Who showed them to you? What were your thoughts? Were you shown them in good time to inform your work? **Please refer to Bundle 6, Miscellaneous Documents, Document 30, Page 416**

A. Whilst we have on file the report of 2017, which would have been provided by Ian Powrie, it did not relate specifically to the Chlorine dioxide project which focussed specifically on Ward 2A and 2B together with the full site facility (QEUH/RHC).

However, it does highlight vulnerability of the filtration units located in the water tank room together with piping issues. As part of the Chlorine dioxide project the piping issues were to be incorporated into the Chlorine dioxide project together with the installation of a 3rd filtration unit.

It was highlighted during the Chlorine dioxide project and incorporated within the design work that Chlorine dioxide dosing units would be installed on each of the 3 filtration units to aid “backwash” and prevent the build up of biofilms and contamination on the reverse side of the filtration membranes.

There was also reference and discussions around “dead-legs” within the water systems and how the chlorine dioxide would react to these. The action was to either remove, re-engineer or place on a robust flushing regime.

In the initial period Ian Powrie was very specific about what he required as part of the remediation programme.

The Water System

8. The Inquiry understands that as part of your work a Chlorine Dioxide Group was set up and you were asked to design the chlorine dioxide strategy. Please explain your contributions to this group. **Please refer to Chlorine Dioxide Meeting Minutes in the Objective Connect file.**

A. Initially worked with Ian Powrie to define the requirements for Ward 2A and 2B as a priority and then to complete a programme to encompass the remaining water infrastructure for QEUH/RHC. This included generation technology, service providers and provision; engineering works required to implement the chlorine dioxide programme and to work through specific high-risk areas which could be impacted on the chlorine dioxide - e.g. renal; filtration units in water tank room.

During meetings specific chlorine dioxide aspects with the then chosen service provider would be rationalised and confirmed alongside the installation teams (M&S) and any specific technical issues that arose as part of the installation programme would be clarified.

9. What was the chlorine dioxide strategy that you produced and when was it finalised?

A. Commenced the design work in June 2018 and the implementation programme commenced in September 2018. Water tank plant room units became operational December 2018 and the other systems operational during first half of 2019.

The strategy employed a robust, tried and tested high purity generation technology so as to avoid unwanted by-products (Chlorite). The cold water would be treated centrally within the water tank plant room, whereas the hot water systems would be generated and dosed locally within hot water plant rooms.

The dosing strategy was proportional dosing based on water volume via impulse water meters with its monitoring and protection system utilising the latest ion specific membrane electrode technology to provide accurate residual values for chlorine dioxide and chlorite where required.

The strategy followed the requirements of HSG274 Part 2 - Para 2.91 to 2.10; Drinking water inspectorate guidelines; World Health Organisation Drinking Water Guidance; plus, any other related guidance which would support the project.

The target Chlorine dioxide treatment levels were >0.1 mg/litre and <0.5 mg/litre. On the monitors the required low and high alarm levels and cut-off's were implemented together with the necessary hysteresis to allow the system to stabilise. All data was to be linked back to site BMS system and service provider online monitoring portal.

10. Was there any work that required to be carried out within the hospital to enable the strategy to be implemented and what was that work?

A. There were engineering works to support the chlorine dioxide regime. These encompassed both mechanical, electrical and IT.

The work was mainly contained to the plant rooms, with modifications to pipework, improvements to air handling within the plant room; rectification of the damp/wet conditions within the water tank rooms and relocation of new/spare plumbing components to a drier environment.

There was additional work to investigate the condition of calorifiers, expansion vessels, pipework joints and the quality of pipework used within the infrastructure.

The Water Solutions Group was not directly involved with these works but was aware of the need for these to be carried out.

11. Were you and your company involved in carrying out water testing in 2017, 2018 and 2019? What conclusions about the state of the of the water system and how it was then being operated did you draw from the results of these tests?

A. Between 1/1/17 to 31/12/19 the laboratory processed some 3715 samples based on schedules provided by Ian Powrie and samples taken on site by DMA Canyon. Samples were analysed for Mould; TVC@22; TVC@37; Yeast; Legionella; E coli; Coliforms; Pseudomonas aeruginosa.

Analysis determined 134 positive results (as per the attached spreadsheet)

The conclusion drawn by Ian Powrie and the Water Technical Group was that given the size of the water infrastructure and number of outlets the failure rate was low and not typical of that found in other healthcare establishments which is often considerably higher. The results were shared by the Water Technical Group and the main Water Safety Group.

12. Now that the chlorine dioxide programme is in place is your company still involved in carrying out water tests at the hospital and what conclusions did you draw from the results of these tests?

A. WSG remains involved with QEUH in two capacities: -

On-going 6 monthly audits of the Chlorine dioxide units and service provider provision to the site.

Monthly microbiological sampling analysis based on the benchmark sampling provided by Ian Powrie and agreed by Water Technical Group

Testing includes Mould; TVC22; TVC37; Yeast; Legionella; E coli; Coliforms; Pseudomonas aeruginosa. Further analysis was undertaken for NTM's (non-tuberculosis mycobacterium) on a quarterly basis.

The conclusion is that the Chlorine dioxide regime is assisting in controlling the microbiological integrity of the water system within QEUH/RHC.

Conclusion

13. You are an author of a paper published in the Journal of Hospital Infections 11 (2021) 53-64 entitled "Investigation and control of an outbreak due to contaminated hospital water system, identified following a rare case of Cupriavadis pauculus bacteraemia". (**Bundle 6, Page 1236**) Does this paper set out your opinion and does it remain your opinion?

A. The paper provides an insight into "lessons learned" and illustrates the changes in knowledge that have not been reflected in updates to guidance.

My opinion supports the paragraphs within this paper with specific focus on the discussion and conclusion points raised.

14. What, in your opinion, is the cause or origin of the issues or problems with the water system at the QEUH/RHC that appear to have caused Mr. Powrie (on behalf of NHS GGC) to seek your help and assistance in June 2018.

A. The key to maintaining a water system is based on a simple rule: - Keep Hot water Hot - (>60C Flow; >55C return)
Keep Cold Water Cold - (<20C)
Keep it moving - prevent stagnation and under use.

This is always going to be a challenge with systems of this size with so many outlets (some of which will be under-utilised), particularly keeping the cold water <20C in a warm plant room environment. This is further compounded by cold water coming from centralised water tanks located in the basement service corridors.

There is always a potential challenge from drains and the splashing that occurs when taps are used. Microorganisms thrive in drains as there are high nutrient levels which creates high risk during cleaning of outlets due to cross contamination. The focus on drains, however, has only been recognised over the past few years brought about by non-tuberculosis mycobacterium (NTM's) and carbapenemase producing Enterobacteriaceae (CPE) patient issues at other hospital sites.

Experience indicates that microbiological problems often originate during the construction phase; water systems "wetted" far too early and combined with lack of flushing allows biofilms to form and microbiological colonies to develop and provide nutrient sources for other organisms which may enter through the incoming water systems.

The above are regularly seen on much smaller scale construction projects but will become magnified when taking into account the size of QEUH/RHC and a centralised approach to water management.

There was no continuous secondary control measure employed during the construction phase which would have been very supportive in terms of microbiological management. (There are other hospitals where this has been done and their microbiology was significantly improved)

The disinfection protocols whilst very effective on small scale water systems, did not take into account the demands of a site this size and needed to be reviewed to provide a more robust protocol for this specific hospital.

Reportedly the handover was rushed, and this will undoubtedly have contributed to issues seen on site. Effective system “balancing” can create challenges when bringing a building into occupancy and demands thorough testing and validating.

One key issue seen time and time again is a lack of water knowledge by construction teams and their impact will create a legacy which will take many years to correct. There is often a failure to pick up on lessons learned and involve those with the knowledge far too late in the project (if at all).

Therefore, given the above comments, and from the knowledge we acquired during the remediation period, my opinion is that it is unsurprising that the water infrastructure was compromised and that a significant intervention was necessary in order to provide a robust solution to the challenges faced.

Appendix A

A42950741 - Bundle 6 – Miscellaneous Documents

A48891993 - Bundle 27 – Miscellaneous