

NHS Lothian - Royal Hospital for Children and Young People & Department of Clinical Neurosciences

NHS National Services Scotland – Review of: Water,
Ventilation, Drainage and Plumbing Systems

09 September 2019
Version 1.0

Contents

1.	Executive Summary	3
1.1	Overview	3
1.2	Summary of findings.....	4
2.	Review methodology	5
2.1	Review process	5
2.2	Specifications and Guidance	5
2.3	Reporting methodology	7
3.	Analysis of information provided	8
3.1	Information provided.....	8
4.	Findings	10
4.1	Management and assurance	10
4.2	Ventilation	11
4.3	Water.....	16
4.4	Drainage and Plumbing	20

1. Executive Summary

1.1 Overview

A decision was taken on 2 July 2019 to delay moving to the new Royal Hospital for Children and Young People & Department of Clinical Neurosciences (RHCYP & DCN) on 9 July 2019. This followed an inspection of the facility, which raised concerns regarding the ventilation arrangements for critical care beds (intensive care and high dependency) and other areas of the hospital. NHS National Services Scotland (NSS) received a commission from Scottish Government to undertake an external series of checks, led by Health Facilities Scotland (HFS) and Health Protection Scotland (HPS), to ensure that the relevant technical specifications and guidance applicable to the new hospital have been followed and are being implemented.

The objectives of the review in relation to RHCYP & DCN were:

- To provide a report by September 2019 to Scottish Government on whether the relevant technical specifications and guidance applicable to the RHCYP & DCN are being followed and implemented.
- Where relevant technical specifications and guidance have not been followed, identify necessary remedial actions.

Given the specific focus on the control of Healthcare Associated Infections (HAI), the review concentrated on a system wide approach for ventilation, water and drainage systems. The process involved site visits, sample inspections and a targeted review of available documentation.

NHS Lothian informed the reviewers at the start of the process that elements of the Critical Care ventilation system required redesign and modification to ensure compliance with guidance. Additionally, Haematology / Oncology is also being reviewed as a result of changing clinical needs, and specific risks were identified. NSS provided advice relating to the design instruction for elements of the Critical Care ventilation system and similar advice will be provided in relation to Haematology / Oncology.

The review commenced on the 9th July 2019 with this final report published in September 2019 for consideration by the established RHCYP & DCN Oversight Board.

1.2 Summary of findings

The findings have been collated based on information provided by NHS Lothian and on-site reviews of the RHCYP & DCN. Expert advice was sought within the key focus areas of ventilation, water and drainage and plumbing systems and their overarching management and assurance processes relating to these systems. The following table outlines the status of key findings:

Review	Summary Assessment	No. of Issues per priority				
		1 (H)	2	3	4	5 (L)
Management & Assurance	Omissions identified in key roles within the management structure, ease of access to information and prioritisation of building system alarms.	-	-	1	2	-
Ventilation Systems	Remedial action is required within both general and theatre ventilation systems. Critical Care redesign was already being considered separately by the Board. Haematology / Oncology is also being reviewed as a result of changing clinical need and specific risks were identified. Risk assessments are underway as part of the ward by ward risk assessments being done locally, requested as part of the review.	-	1	2	-	-
Water Systems	Independent testing identified no widespread contamination of the water systems, however, remedial action is required on a number of water system areas as well as system wide disinfection prior to occupation.	-	1	2	1	-
Drainage & Plumbing	The drainage system has multiple redundancies in place; active monitoring is required. Elements of plumbing require inspection and appropriate remedial action taken.	-	-	-	1	-

The following definitions were used to categorise the findings:

Priority	Definition
1	Significant – Concerns requiring immediate attention, no adherence with guidance
2	Major – Absence of key controls, major deviations from guidance
3	Moderate – Not all control procedures working effectively, elements of noncompliance with guidance
4	Minor – Minor control procedures lacking or improvement identified based on emerging practice
5	Observation and improvement activity

Overall remedial action is required to be undertaken within the ventilation and water systems prior to occupation. Following acceptance of this report, the review team are ready to assist the NHS Lothian team in developing a programme of activity and remedial actions.

2. Review methodology

2.1 Review process

2.1.1 The review process initially took place between 9th July and 30th August 2019. For this report no further information has been considered after 5th September 2019.

2.1.2 The approach taken was to gather information relating to the services detailed in section 1.2 in drawing, specification, report and oral form and to compare these to the specifications and guidance appropriate for the building type, drawing conclusions on whether what is provided matches the requirements. In addition to existing specifications and guidance, learning generated from recent experience and national and international guidance and expertise was also used to inform the review. This learning will also inform future guidance development in Scotland.

2.1.3 The review has included

- Establishing a brief.
- Establishing the baseline data to allow the brief to be met.
- Preparation of several question sets to get a greater understanding of the project.
- Preparation and management of detailed question sets and information requests.
- Commissioning UK topic experts to review certain aspects of the project.
- Several site visits.
- Several meetings.
- Analysis of data.
- Analysis of microbiology results related to the hot and cold water systems.
- A rapid review of the literature and international guidance on ventilation systems in relation to infection.

2.2 Specifications and Guidance

2.2.1 HFS currently provides a range of advisory and delivery services across a wide variety of topics from a portfolio which covers the built estate, engineering and environment and facilities management. With some exceptions these services are largely advisory in nature, identifying best practice and developing national guidance and standards.

2.2.2 HPS currently provides advice and guidance on all aspects of health protection nationally in Scotland, inclusive of expert advice and guidance on the topic of Healthcare Associated Infections (HAI) and antimicrobial resistance. It maintains and continues to develop a practice guide (National Infection Prevention and Control Manual – NIPCM) as well as a HAI Compendium of all extant guidance and policy appropriate for use in NHS Scotland. Like HFS, these services are largely advisory in nature, identifying best practice and developing national guidance and standards. The NHS Scotland NIPCM was first published on 13 January 2012 as mandatory

guidance, by the Chief Nursing Officer (CNO (2012)1), and updated on 17 May 2012 (CNO(2012)01-update). The NIPCM provides guidance for all those involved in care provision and should be adopted for infection, prevention and control practices and procedures. The NIPCM is mandatory policy for NHS Scotland.

The authority of guidance produced by NSS and other national organisations e.g. Healthcare Improvement Scotland is best described by the definitions outlined below (SHMT 00 – Best practice guidelines for healthcare engineering):

Regulations are law, approved by Parliament. These are usually made under the Health and Safety at Work etc Act following proposals from the Health & Safety Commission. Regulations identify certain risks and set out specific actions which must be taken.

Approved Codes of Practice give advice on how to comply with the law by offering practical examples of best practice. If employers follow the advice, they will be doing enough to comply with the law.

Approved Codes of Practice have a special legal status. If employers are prosecuted for a breach of health and safety law, and it is proved that they did not follow the relevant provisions of an Approved Code of Practice, they will need to show that they have complied with the law in some other way, or a court will find them at fault.

Standards (British or European), institutional guides and industry best practice play a large part in how things should be done. They have no direct legal status (unless specified by Regulations). However, should there be an accident; the applied safety practices at the place of work would be examined against existing British or European Standards. It would be difficult to argue in favour of an organisation where safety was not to the described level.

Guidance is issued in some cases to indicate the best way to comply with Regulations, but the guidance has no legal enforcement status.

- 2.2.3 Whilst guidance is deemed not compulsory by HSE (not legally enforceable), where compliance with guidance is specified in a contract, as is the case here, it becomes a contractual requirement. Therefore, any permitted deviation from it would be expected to follow a formal process with input from all relevant parties, with clarity around how the outcome was reached, including risk assessments where appropriate and sign off by all those authorised to approve it.
- 2.2.4 The terms specifications and guidance are used in the report to refer to the publications setting out the expectations about the level of service to be provided, including legislation, approved codes of practice and guidance. Compliance with guidance is reported on, regardless of whether this implies a contractual requirement or not, as contract compliance is outwith the scope of this report. For the avoidance of doubt we have not considered the project agreement and contractual compliance in accordance with its terms, as this is subject to a separate review commissioned by Scottish Government.

2.3 Reporting methodology

2.3.1 For clarity this report organises issues with each of the systems considered into a priority rating, identifying the importance of deviations from what would be expected based on the specifications and guidance. The distinction between the categories is based on NSS judgement of the degree of non-compliance and the implications of that non-compliance. The criteria used are described below.

Priority	Definition
1	Significant – Concerns requiring immediate attention, no adherence with guidance
2	Major – Absence of key controls, major deviations from guidance
3	Moderate – Not all control procedures working effectively, elements of noncompliance with guidance
4	Minor – Minor control procedures lacking or improvement identified based on emerging practice
5	Observation and improvement activity

3. Analysis of information provided

3.1 Information provided

- 3.1.1 The support of the NHS Lothian project team in responding to questions and accessing data is gratefully acknowledged.
- 3.1.2 At the time of writing the majority of the information required had been received and whilst the timescale for the review means a selective targeted review of documentation was necessary, the main themes appear clear. However, some information remains outstanding, and NHS Lothian colleagues continue to pursue a response.
- 3.1.3 The Special Purpose Vehicle (SPV), Contractor, sub-contractors, Facilities Management Contractor and Independent Tester were not directly involved in the production of this report, nor were they requested to verify its contents and they may have additional information not considered here. It is acknowledged that some of the information provided by NHS Lothian came directly from these sources.

Ventilation systems

- 3.1.4 Prior to this review NHS Lothian commissioned a specialist contractor to validate the performance of ventilation systems within the facility and their report identified that elements of the ventilation system in Critical Care Units was not in accordance with current guidance (SHTM 03-01). Whilst this report notes that finding and NSS has been asked to support NHS Lothian in achieving a solution in compliance with guidance, this report focuses primarily on other ventilation issues. Additionally, Haematology / Oncology is also being reviewed as a result of changing clinical needs and NHS NSS will support NHSL in this.
- 3.1.5 An explanation and validation of the ventilation design whereby areas with air handling units out of service, for whatever reason, are served by an adjacent air handling unit, which also continues to serve its own area has not yet been provided.
- 3.1.6 The theatre ventilation appears not to have been installed in accordance with current guidance in respect to required pressure cascades in corridors and removal of contaminants from scrub areas. The Board has sought demonstration of compliance from Integrated Health Solutions Lothian (IHSL) in relation to issues identified.

Water systems

- 3.1.7 Whilst elements of the water testing carried out as part of this review are not detailed in current guidance, and NHS Lothian could not have been expected to be aware, lessons learned recently across health systems suggest that any potential pathogenic contamination found should be investigated and treated appropriately before patients and staff move in. Water test results in RHCYP & DCN indicate some fungi in the water, mainly at taps, as well as higher than anticipated total viable counts (TVC). The latter may be related to the fact that the building is unoccupied with only maintenance processes in place to ensure water turnover. In augmented care areas testing carried out for NHS Lothian identified *Pseudomonas aeruginosa* found in approximately 10% of taps tested. There would appear to be no systemic

contamination of the hot and cold water systems, rather, contamination has been found at outlets, and particularly thermostatic mixing taps with complex interstices and polymeric components, which can make them more susceptible to persistent contamination.

Drainage and plumbing systems

- 3.1.8 The drainage for the hospital utilises one gravity system and two pumped systems. The pumped systems are used to overcome gravity as they are installed below the local water table and level of the external drains. The main concern is the pumped system in the basement, in the vicinity of the kitchen, may fail. The risk is that if these fail the kitchen drains will back up requiring the kitchen to close, which would have an impact on food services to the hospital. Extensive use of standby equipment and power supplies is in place, such that multiple failures would need to occur to cause sewage to back up into the basement. Procedures for maintenance and repair have been extensively considered but will need to be tested in operation.

4. Findings

4.1 Management and assurance

Summary

Review	Summary Assessment	No. of Issues per priority				
		1 (H)	2	3	4	5 (L)
Management & Assurance	Omissions identified in key roles within the management structure, ease of access to information and prioritisation of building system alarms.	-	-	1	2	-

Main Findings

Priority	Review	Action Assessment
4	Structures and processes are not fully in place to assure the Board that the facility is being operated in compliance with contract requirements. These should be in place from the point where the building services referred to in this report are put into use.	NHS Lothian and IHSL should adopt the management and reporting processes as described in SHTM 00 - Best Practice Guidance for Healthcare Engineering and the SHTMs for each critical engineering service.
3	Some of the records and documents necessary for the effective and safe operation of the hospital could not be found. The document management system appears to lack a logical structure which will impact on the ability to readily find necessary information. Some of the sections contain none, or only part, of the documentation they should have as required by the Construction (Design and Management) Regulations 2015.	The Board should require IHSL to rectify the filing structure of the documentation and verify that the information contained is both complete and accurate as required by the Construction (Design and Management) Regulations 2015.
4	The alarms for the building are reportedly un-prioritised, resulting in a very large number of alarms potentially masking critical alarms.	Prioritise alarms to make most critical failures visible and manageable. Until alarms are prioritised, have procedures and staff in place to ensure critical alarms are not missed as per SHTM 08-05 - Specialist services building management systems.

Detailed Narrative

- 4.1.1 Healthcare organisations have a duty of care to patients, their workforce and the general public to ensure a safe and appropriate environment. This requirement is identified in a wide range of legislation. At the most senior level within an organisation, the appointed responsible person should have access to a robust structure which delivers governance, assurance and compliance through a formal reporting mechanism.
- 4.1.2 The review identified that for both IHSL and NHS Lothian, there appeared to be omissions in the identification, appointment and definition of key roles in an effective management structure. Additionally, some records which are necessary to demonstrate compliance with appropriate specifications and guidance remain outstanding.
- 4.1.3 The Board cannot pass its responsibilities under health and safety law to a third party. It can pass duties, but the responsibility for ensuring the safety of those accessing its premises remains with the Board. To discharge its duties, the Board should ensure appropriate structures, processes and personnel are in place to ensure that those responsible for operating the facility are doing so in compliance. The structures and processes set out in the Scottish Health Technical Memorandum (SHTM) suite of guidance, Statutory Compliance Audit and Risk Tool (SCART)¹ and Healthcare Associated Infection-System for Controlling Risk in the Built Environment (HAI_SCRIBE)² produced by Health Facilities Scotland, should form the core of this. These arrangements should be in place as soon as practicable and prior to occupation of the RHYCP & DCN.

4.2 Ventilation

Summary

Review	Summary Assessment	No. of Issues per priority				
		1 (H)	2	3	4	5 (L)
Ventilation Systems	Remedial action is required within both general and theatre ventilation systems. Critical Care ventilation redesign was already being considered separately by the Board. Haematology / Oncology is also being reviewed as a result of changing clinical need and specific risks were identified. Risk assessments are underway as part of the ward by ward risk assessments being done locally, requested as part of the review.	-	1	2	-	-

¹ SCART is a risk based tool used by Boards in NHS Scotland to measure their compliance against statutory and non-statutory position.

² HAI_SCRIBE provides Built Environment Infection Prevention and Control information for Design Teams, Construction Teams, Infection Prevention and Control Teams and Estates & Facilities Teams, as well as an assessment process allowing the identification and management of infection control risks in the built environment.

Main Findings

Priority	Review	Action Assessment
2	<p>General Ventilation Systems - Provision for maintenance or plant failure in the ventilation systems has not been validated in accordance with SHTM 03-01 Ventilation for Healthcare Premises. The bypass arrangements and functioning of ventilation in the event of plant failure remains to be demonstrated.</p>	<p>Demonstrate efficacy of approach of utilising adjacent air handling unit to supply areas not served by failed plant.</p> <p>Commission and validate isolation rooms, singles and multi-bed spaces in the event of supply by adjacent air handling unit.</p> <p>Clinical leads and Infection Prevention and Control colleagues to consider the effect of air handling plant failure in developing service provision strategies.</p> <p>Confirm damper operation and compliance with fire requirements in bypass mode.</p>
	<p>Air handling units and ductwork contain numerous deviations from contract requirements (SHTM 03-01) and were found not to be clean despite having been presented for validation. Deviations include: loose internal cabling in the airflow, cable routes allowing air to bypass filters, air leakage at penetrations and possible fan replacement difficulties which need to be corrected.</p>	<p>The ventilation systems throughout the hospital should be subject to a full snagging exercise and all defects rectified following which air handling units and ventilation systems are cleaned. All deficiencies identified in validation and specialist Consultant Engineer reports should be addressed as part of this.</p>
	<p>The single and multi-bed ventilation design is based on four air changes per hour mechanical ventilation and there is a component of natural ventilation which is not part of the design. With a few exceptions, the mechanical component has been validated. However the natural component has not been proven.</p>	<p>Confirm that all areas served by this arrangement are suitable for categorisation as listed in SHTM 03-01 Part A, Appendix 1.</p> <p>Undertake an IPCT risk assessment ward by ward/ speciality specific in relation to the guidance.</p>
	<p>The pressure regimen detailed in the design, and reflecting the environmental matrix, will be affected by opening windows and the pressure between the room and the corridor, and therefore direction of air flow, cannot be</p>	<p>A full assessment of the services and patient population should be carried out and mechanisms for monitoring established.</p>

	<p>relied upon when windows are open.</p> <p>External doors to plant rooms</p> <p>Fire dampers in some locations cannot be adequately tested as duct access has not been provided. Also, locations of fire dampers and fire rated ductwork has been questioned in relation to the requirements of SHTM 03-01 and confirmation of compliant provision is awaited.</p> <p>Air intakes and opening windows are sited in the courtyard below the helipad and at the adjacent RIE. Information has not been provided on the impact of downdraft on air flows and pressures or entrainment of contaminants as per SHTM 03-01.</p>	<p>Ensure that excessive gaps are removed and appropriate anti vermin measures are applied to all the doors and screens as per SHTM 03-01 and HFS Interim Guidance - Managing the Risk of Contamination of Ventilation Systems by Fungi from Bird Droppings – February 2019.</p> <p>Provide access so all fire dampers can be readily visually inspected to verify operation. Review fire damper provision and fire rated ductwork and confirm appropriate provision</p> <p>Demonstrate the effect of helicopter landing on air flows in ventilation systems with intakes below through measurement when test flights take place or through modelling. This should include the air intakes of the RIE adjacent.</p>
<p>3</p>	<p>Theatre Ventilation Systems - Scrub areas which are narrow and deep are unlikely to be scavenged effectively by theatre air changes and require alternative means of achieving removal of contaminants as per SHTM 03-01. The efficacy of the high level extract to achieve sufficient dilution of contaminants or entrainment of heavier than air water droplets is not in accordance with the requirements of SHTM 03-01 and has not been demonstrated as equivalent.</p> <p>Anaesthetic rooms 31 and 34 do not demonstrate a clean air flow path to reduce exposure of staff to gasses as per SHTM 03-01. Room 30 supply is too close to the door</p>	<p>The ability of the single high level extract provided in deep plan scrub areas to effectively prevent contaminants being dispersed into theatres should be demonstrated and/or additional low level ventilation provided.</p> <p>Move ceiling supply to opposite side of room from extract.</p> <p>In room 30, move supply away from door.</p>

	<p>Theatre utility rooms extract ventilation means theatres have to be used in pairs and taking a theatre out of service may reduce the extract in utility room below the levels as per SHTM 03-01.</p>	<p>Add supplementary extract ventilation to allow for one theatre being out of service or plan for service impact following the loss of a pair of theatres. <i>NHS Lothian has advised that the appropriate pressure differentials are maintained when only one theatre is operation. Validation evidence is to be provided.</i></p>
<p>3</p>	<p>Isolation Room Ventilation Systems are not served by a single ventilation system for each room as recommended in SHPN4 Supplement 1. The arrangement provided, where ventilation systems serve an area of the building including contained isolation rooms, has not yet been proven in the event of failure of an air handling unit and the implications for service impact are not yet understood.</p>	<p>Prove that bypass connections to adjacent ventilation systems will allow safe operation of both areas and / or explain service provision strategy for loss of each area including isolation rooms. Also include assurance on operational effectiveness e.g. the pressure differentials and air flows being maintained. Develop clinical service provision plan to reflect the potential loss of design conditions in up to 5 of the 19 isolation rooms on the failure of an air handling unit and confirm impact on service continuity.</p>

Detailed Narrative

- 4.2.1 The ventilation systems at RHCYP & DCN were considered in relation to legislation, guidance and the lessons learned from other recent similar projects which may have an impact on the patient group.
- 4.2.2 The principal legislation which is relevant to the ventilation systems is The Control of Substances Hazardous to Health Regulations 2002 (COSHH).
- 4.2.3 The principal guidance which is relevant to the ventilation systems is: Scottish Health Technical Memorandum (SHTM) 03-01: Ventilation for healthcare premises; and Scottish Health Planning Note 04 Inpatient Accommodation, Supplement 1 Isolation Facilities in Acute Settings.
- 4.2.4 Elements of the ventilation within Critical Care were identified by NHS Lothian's validation contractor, and verified in this review, to be not in accordance with the requirements of SHTM 03-01. NHS Lothian is working with IHSL to design a suitable solution to provide the conditions required within Critical Care. NSS has been asked by Scottish Government to support NHS Lothian to ensure that the system delivered is compliant with requirements.
- 4.2.5 The general ventilation for non-specialist applications, such as single / multi-bed rooms, was identified by the Board's validation contractor as having lower air change rates than specified in SHTM 03-01, i.e. 4 air changes per hour as opposed to 6.

During the review, NHS Lothian supplied information about a natural ventilation component, with some documents referring to a mixed mode ventilation system. However, IHSL later advised that natural ventilation is not part of their design. NSS visited the site with specialist ventilation consultants who produced a report on the general ventilation systems and noted non-compliances with air handling unit provision and installation and pressure regimens, including several identified by the Board's validation contractor.

- 4.2.6 From an infection prevention and control perspective, there is low-quality to no evidence from outbreak reports and current guidance, respectively, to support minimum ventilation requirements. Therefore, it is not possible to make conclusive statements regarding the individual minimum ventilation parameters for inpatient care areas. A rapid review of the literature found limited clinical evidence to directly implicate air change rates alone in having a direct impact on the development of an outbreak or incidence of infection. Therefore, it is reasonable that, in the absence of evidence, healthcare design teams should continue to adhere to current national guidance. In the event of a deviation from the current recommended ventilation parameters, design teams should ensure that air changes per hour are maintained as close as possible to the recommended air changes per hour without compromising other aspects of the ventilation system requirements. In addition a full assessment of the services and patient population should be carried out and mechanisms for monitoring established. Caution is advised in relying on air change rates alone to provide adequate protection from infection; this is only one part of a multifactorial process involved in creating the appropriate airflow patterns with appropriate mixing and dilution of contaminants. Nationally, further research is required to look beyond air change rates to examine the effects that other factors such as supply and exhaust location, door position and motion, spatial orientation, surface composition, temperature, humidity, and air distribution patterns have on particle migration in clinical areas.
- 4.2.7 Theatre ventilation was identified by NHS Lothian's validation contractor as having some deficiencies. NSS visited the site with a specialist Consultant Engineer, who was lead author on the last three iterations of the ventilation HTM guidance. This identified and confirmed several deficiencies, including lack of evidence about the efficacy of the ventilation in the scrub rooms; deviating from the standard models recommended in SHTM 03-01. The current design of the theatre ventilation system is such that maintenance might entail loss of two theatres rather than one. Additionally, there is an overuse of flexible ductwork, potentially causing problems with balancing theatre ventilation.
- 4.2.8 The building contains a number of Positive Pressure Ventilated Lobby (PPVL) isolation rooms for which the guidance, SHPN4 supplement 1, recommends that each isolation room should ideally have its own air handling unit, such that if an air handling unit fails, or is offline for maintenance, only one isolation room is out of commission.
- The building, as built, has an air handling unit serving each area of the building, including any contained isolation rooms. This means that up to five out of 19 isolation rooms may be not performing as intended in the event of an air handling unit failure. NHS Lothian have advised that the strategy for maintenance is that a bypass duct will be used to feed an area from an adjacent air handling unit. This mode has

not yet been proven and the successful operation of isolation rooms and other spaces in the event of use of this bypass has not been demonstrated. NHS Lothian needs to consider in its clinical service model how each isolation room and ward will function in the event of loss of an air handling unit. This will require full design and validation of air change rates, pressure differentials and direction of air flow for each area in this mode, as well as predicted times to rectify any plant failure.

- 4.2.9 IHSL has advised NHS Lothian that the design of the isolation rooms is as per Scottish Health Planning Note (SHPN) 04-01 Supplement 1: In-patient Accommodation: Options for Choice Supplement 1: Isolation Facilities in Acute Settings. This guidance notes that isolation rooms ideally should have its own air handling unit (AHU) and the ventilation systems should be as robust as possible so that standby fans are not required. The guidance acknowledges that in high rise buildings a common supply and extract may be the only feasible solution with duct branches fitted with spring close gas tight dampers in the event of failure. The height of this building is less than that defined in the Scottish Building Standards Technical Handbook - Non-Domestic, for high rise (18m). At the time of writing the provision of gas tight dampers at ward level as required by the validated design parameters detailed in SHPN 04-01 Supplement 1 had not been evidenced.
- 4.2.10 Additional observations during a site visit by NSS have highlighted potential concerns linked to the location of some high risk wards, including Haematology / Oncology in relation to the helipad. A demonstration of the effect of helicopter landing/take-off on airflows needs to be completed by NHS Lothian.

4.3 Water

Summary

Review	Summary Assessment	No. of Issues per priority				
		1	2	3	4	5
Water Systems	Independent testing identified no widespread contamination of the water systems, however, remedial action is required on a number of water system areas as well as system wide disinfection prior to occupation.	-	1	2	1	-

Main Findings

Priority	Review	Action Assessment
4	Water Services Augmented Care - Pseudomonas found in taps, in Paediatric Medical Inpatients and DCN Inpatients. (SHTM 04-01 Part A published in July 2014)	All taps (not just TMT/TMV ³) to be disinfected and retested. Inspect and replace, as appropriate, taps, tap components and pipework. Replace tap strainers and cartridges in affected TMT taps.

³ TMT – Thermostatic Mixing Taps, TMV – Thermostatic Mixing Valves
09 September 2019

<p>3</p>	<p>Water Services Non Augmented Care - Swarf and biofilm found in tap strainers, contrary to SHTM 04-01 Water safety for healthcare premises.</p>	<p>Replace tap strainers in all areas.</p>
<p>2</p>	<p>Showers - Shower hose lengths do not comply with Scottish Water byelaws and guidance in SHTM 04-01 Water safety for healthcare premises.</p>	<p>Shorten hose length, or add retaining ring, to ensure that shower head cannot reach WC or drain Disinfect showers, hose and drain after rectification.</p>
<p>3</p>	<p>Water General - Testing has found some fungal / mould contamination and high total viable counts. <i>Legionella</i> risk assessment actions not recorded as required by HSE Approved Code of Practice and Guidance L8 - Legionnaires' disease. The control of <i>Legionella</i> bacteria in water systems. <i>Legionella</i> risk assessment insufficient to reflect system contamination in general. Those responsible for the system have a responsibility under the Control of Substances Hazardous to Health Regulations 2002 (COSHH) to prevent exposure to microorganisms.</p> <p>Designated roles and responsibility as per SHTM 00 Best practice guidance for healthcare engineering.</p> <p>Water tanks as per SHTM 04-01 Water safety for healthcare premises.</p> <p>Hot and cold water temperatures / flushing. SHTM 04-01 Water safety for healthcare premises</p>	<p>Given a number of indicators the water system should be disinfected and re-tested.</p> <p>The <i>Legionella</i> Risk assessment Feb 2019 identified a range of actions. The Action Tracker does not demonstrate that the issues raised have been resolved, or a timeline provided for resolution. Record rectification of actions. The risk assessment is heavily focussed on <i>Legionella</i> and not taking into account other organisms in line with patient type that will occupy the building. Broaden to reflect system contamination in general. Develop analysis categorisation of patient type, and consideration to susceptibility, for each area.</p> <p>The current Responsible Person (RP) has not been appointed in writing and uncertain as to whether received RP training. Additionally, has no previous experience of healthcare.</p> <p>To be inspected. The Raw Water and Filtrate water tanks are interconnected at the drain. These must be separated.</p> <p>There was an issue with raised cold water temperatures during the boiler outage – this requires investigation.</p>

<p>Filtration Plants</p>	<p>From lessons learned by NSS in recent work, microbiological growth potential was identified as part of the Backwash cycle. Consideration should be given to Chlorine dioxide addition to backwash water tank to counter microbiological and biofilm development on filters.</p>
<p>Instant Boil Taps and Rise and Fall Baths</p>	<p>These were found to be contaminated and need to be disinfected and tested to demonstrate safe water delivery as per SHTM 04-01 Water safety for healthcare premises.</p>

Detailed Narrative

- 4.3.1 The domestic hot and cold water services (DHCWS) at RHCYP & DCN were considered in relation to legislation, guidance and the lessons learned from other recent similar projects which may have an impact on the patient group.
- 4.3.2 The legislation which is relevant to the water system are Public Water Supplies (Scotland) Regulations SSI 2014/364 and The Control of Substances Hazardous to Health Regulations 2002 (COSHH). In relation to COSHH, the Health and Safety Executive (HSE) note that *“Micro-organisms are covered in COSHH by the term biological agents. These are defined as any micro-organism, cell culture, prion or human endoparasite whether or not genetically modified which may cause infection, allergy, toxicity or otherwise create a hazard to human health.”*
- 4.3.3 The guidance which is relevant to the water system are HSE Approved Code of Practice L8: Legionnaires' disease. The control of *Legionella* bacteria in water systems; HSE 274: Legionnaires' disease: Technical guidance; Scottish Healthcare Technical Memorandum (SHTM) 04-01: Water safety for healthcare premises and HPS document: *Pseudomonas aeruginosa* routine water sampling in augmented care areas for NHS Scotland (*published in draft September 2018*).
- 4.3.4 From initial inspection of the Independent Tester's reports, there is evidence that areas of the pipe work systems were installed without end protection. This may have allowed dust and organic material to enter the pipe system and this may not have been eradicated by the disinfection process.
- 4.3.5 The Facilities Management (FM) contractor Bouygues FM (BFM) commissioned a *Legionella* risk assessment when they took possession of the site from the construction contractor. This report has yet to be provided and will be reviewed and assessed when presented.
- 4.3.6 NHS Lothian commissioned a specialist safety consultant in May 2019 to conduct an overall safety audit of the RHCYP & DCN. Contained within their report is a section on the water system. They assessed the risk condition of the system as “high” mainly as a result of BFM's *Legionella* risk assessment, the lack of evidence of flushing across the system, the lack of maintenance on shower heads and outstanding information on the water management responsibilities by BFM.

- 4.3.7 NHS Lothian separately commissioned water testing from a specialist water safety consultant, on 12th July 2019, which indicated that certain tap outlets within the augmented care areas were positive for *Pseudomonas aeruginosa*. This report also noted high Total Viable Counts (TVC). In addition, *Pseudomonas aeruginosa* was recorded in the Instant Boil Taps and the rise and fall baths. The consultant concluded that there was no evidence of wide spread contamination of the water system.
- 4.3.8 As part of the NSS review, a specialist water consultant carried out water tests around the facility on 18th July 2019 to determine if there were any significant issues.
- 4.3.9 In summary the NSS specialist contractor concluded from their investigations and as a result of the microbiological samples taken by them and others that: -
- There was no indication that the water system (as a whole) was cause for concern referenced to existing guidance.
 - There was no atypical mycobacteria found in the 60 samples taken (mainly from neonatal and intensive care areas); however, there was some Gram-negative activity and mould present.
 - Concern was expressed regarding the management of the water system given the lack of occupancy and turnover of the water system.
 - The management aspects of the water system by IHSL's FM contractor were not satisfactorily demonstrated.
 - The system showed signs of biofilm and swarf contamination, particularly at the taps.
 - Shower heads and hoses do not meet the required standards with respect to length.
 - During the site investigation it was noted that the cold water temperatures were rising and the hot water temperatures decreasing. In discussions with BFM it was discovered that a boiler had tripped, together with the circulating pumps, and the other boilers did not come on as they should have. The result of this was that the temperature of the water for both hot and cold domestic water systems fell into the *Legionella* growth band for approximately a 12 hour period.
 - The NSS commissioned consultant engaged noted that at commissioning only 5% sampling of the number of taps across the whole hospital was completed.
 - The management strategy for the Kemper system (water temperature regulation system) requires close control to ensure that water is not "dumped" unnecessarily in an effort to control cold water temperatures.
- 4.3.10 The tests for atypical mycobacteria proved negative. However fungi were identified in 22% of the samples taken in the water system based on a sample size of 60 taps from a population of c2000. These are not required to be tested as part of the current guidance. However, based on NSS experiences at other hospital sites it was considered prudent to have these tests done.
- 4.3.11 Based on NSS experiences at other hospital sites that became apparent after the construction of RHCYP & DCN, it is recommended that specific components parts of

the water system such as pressurisation unit, meter etc are replaced and the originals tested, particularly those which have proven to be problematic.

4.4 Drainage and Plumbing

Summary

Review	Summary Assessment	No. of Issues per priority				
		1 (H)	2	3	4	5 (L)
Drainage & Plumbing	The drainage system has multiple redundancies in place, however, active monitoring is required. Elements of plumbing require inspection and appropriate remedial action taken.	-	-	-	1	-

Main Findings

Priority	Review	Action Assessment
4	Sinks drains	Initial testing indicates that these are not significantly contaminated, however the horizontal drain and protruding seal means they retain stagnant water and they need to be disinfected periodically prior to and post occupancy to maintain their condition. From lessons learned, there should be a system of inspection and appropriate remedial action taken.
	Bottle traps	There would appear to be an inconsistency of installation and potential of back-feed from trap to drain. This requires review and rectification.
	Pumped Drainage	The internal pumped sewage drainage system presents the potential for sewage to back up through basement drains on pump failure and will require active monitoring.

Detailed Narrative

- 4.4.1 The range of clinical and non-clinical wash hand basins chosen by the IHSL are from a recognised manufacturer of healthcare drainage products. There is no facility to connect the tap on the sink as the taps are panel mounted. The drain connection is at the rear of the sink bowl and there is no overflow, all as per guidance.
- 4.4.2 The connection on to the wash hand basin from the drain has proven to be an area where water does not drain freely as the connection reduces the diameter of the

drainage outlet and creates a dam effect. Lessons learned by NSS from other projects, after commencement of the construction of RHCYP & DCN, have shown that various organisms were grown from this area in some circumstances.

- 4.4.3 The plumbing system is connected to the main sewage system via three drainage systems. The first is a gravity fed system. The second is a sump pump arrangement in the external courtyard. The third is a sump in the basement area of the hospital. The rationale behind the use of the sumps is that the basement areas are below the water table and any waste material has to be pumped up and out to the sewer.
- 4.4.4 The Independent Tester has noted in their report of 30th June 2017 that an issue had been raised regarding the capacity of the basement sump. In further investigation this appears to be related to the fact that more areas/floors were connected to this system than NHS Lothian had originally been made aware of.
- 4.4.5 The main drainage risk lies with the basement sump. It has a resilience system of back-up power supplies, multiple pumps and alarm systems to three different locations. There are two discharge pipes to sewer, reducing the risk of blockage and the consequent risk of sewage backing up into the basement in the proximity of the kitchen. In addition, if a failure occurred or a maintenance activity was to take place, the location of this sump chamber would mean that all traffic flow through the affected area would have to be halted to permit a safe operating procedure to be implemented.
- 4.4.6 The external courtyard sump has a duty/standby pump as well as a spare submersible pump and also has similar alarm arrangements to the basement pumps. In the event of a catastrophic blockage and spillage the court yard would be impacted.

End of Report



Scottish Government
Riaghaltas na h-Alba
gov.scot

© Crown copyright 2019

OGL

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3 or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: psi@nationalarchives.gsi.gov.uk.

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

This publication is available at www.gov.scot

Any enquiries regarding this publication should be sent to us at

The Scottish Government
St Andrew's House
Edinburgh
EH1 3DG

ISBN: 978-1-83960-156-9 (web only)

Published by The Scottish Government, September 2019

Produced for The Scottish Government by APS Group Scotland, 21 Tennant Street, Edinburgh EH6 5NA
PPDAS634042 (09/19)

W W W . g o v . s c o t