MOTT MACDONALD

# RAAC Strategic Planning

## Assessment of the RAAC 7 Hospitals

December 2025

Some content in this report has been redacted. This is because it is either commercially sensitive or personal information.

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# Contents

# Acknowledgements

We extend our sincere gratitude to the Trust teams at each of the hospital sites for their invaluable cooperation and support during the production of this report. Their willingness to accommodate our requests and provide detailed inputs and information has been instrumental.

We would also like to commend Trust teams and the NHS national RAAC programme for managing the risks associated with RAAC across the NHS estate. The implementation of RAAC remediation works across operational hospital environments has been complex and has been supported by incredible collaboration between estates and clinical teams to maintain patient care.

# Executive Summary

## Principal Message

The seven predominantly RAAC hospitals (the RAAC 7), as a result of the remediation programme, can remain open beyond 2030. However, the need to deliver the replacement hospitals as soon as feasibly possible remains. The RAAC remediation programme for the RAAC 7 hospitals has and will, once completed, reduce the majority of risks of RAAC plank collapse, protecting patients and staff from the greatest risks. However, between 1% and 6% of RAAC planks are inaccessible and while plank locations are known and have risk mitigation strategies in place, their inaccessibility and lack of remedial works means such planks will continue to present a risk.

Continuing to operate these hospitals is operationally costly; all 7 are considered to perform poorly and the performance benefits to be realised through the Hospital 2.0 design won't be realised until they are replaced. The need to deliver the replacement hospitals as soon as feasibly possible therefore remains a high priority.

## Introduction

This report, commissioned by the Department of Health and Social Care (DHSC) and prepared by Mott MacDonald Ltd, provides an assessment of the seven NHS hospitals constructed almost entirely of Reinforced Autoclaved Aerated Concrete (RAAC) panels and planks. The hospitals - collectively known as the "RAAC 7" - were built between 1970 and 1983 and are now planned for replacement as part of the New Hospital Programme (NHP).

These hospitals were envisaged to be replaced by 2030. This report evaluates the condition of RAAC, infrastructure risks, and operational implications of continued use of the RAAC 7 hospitals past 2030. The report considers short term (2030 + 1-3 years), medium term (2030 + 4-6 years) and long-term (2030 + 6-10 years) timeframes. This report provides suggested additional remediation and mitigation strategies to support these timeframes.

RAAC is a lightweight concrete material used extensively in mid-20th century construction. It is now known to present significant structural risks, particularly due to poor installation and poor maintenance.

This report identifies that over 80,000 RAAC roof planks are present across the RAAC 7 hospitals, with varying levels of structural remediation installed. While some hospitals are nearing the end of their remediation programmes, others still have works to complete.

This report confirms that, with appropriate mitigation and sustained maintenance, the RAAC 7 hospitals can remain operational beyond 2030. The report notes that without full replacement, the compounded effects of structural and infrastructure degradation significantly elevates operational and clinical risks.

# Summary of Findings Against Objectives

The DHSC set four objectives for this study. The report has been structured to respond to each of these objectives. The table below provide a summary;

| Objective | Objective Aims | Summary Response | Reference |
|---|---|---|---|
| 1. Remaining Expected Life | Determine the remaining expected life of each hospital site and area-by-area breakdown | The RAAC 7 hospitals have undergone significant RAAC remediation comprising full-span or end-bearing support.<br><br>Despite best efforts, RAAC risks are expected remain across each site with instances of planks being deemed inaccessible for remediation. This varies for each site and has been identified, typically 1% but in one instance up to 6%. This is not unexpected given the complexity of RAAC remediation within live hospitals and the need to balance these works with maintaining clinical operations.<br><br>Critical to risk mitigation is ongoing investment in the maintenance of infrastructure; in particular, the mechanical infrastructure that can have a direct impact on RAAC structures (e.g. leaks).<br><br>With ongoing management and maintenance, it is expected that RAAC planks and panels may technically remain serviceable beyond 2030 and in the long-term (2030 + 10 years). However, practically costs and risks are expected to increase as RAAC planks and panels are retained beyond 2030 and in the medium term (2030 + 6 years).<br><br>The assumptions for RAAC planks assume no change in environmental condition or changes in our understanding of RAAC occurs, and that fabric repairs and infrastructure maintenance, to prevent leaks continues.<br><br>Trusts will need to continue to risk assess RAAC planks and determine appropriate measures to ensure risks remain as-low-as-reasonably-practicable; particularly for inaccessible planks and if programmes extend.<br><br>It is recommended that the replacement of the RAAC hospitals continues as a priority. | Section 5 |
| 2. Additional Mitigation Works | Identify additional mitigation works to extend the safe use of the hospitals and associated costs | Additional mitigation focuses on maintaining RAAC within a dry environment. This includes roof repairs, combined with continued management surveying in the short to long term (2030 plus 1 to 10 years).<br><br>Given the age of the buildings, further surveying and isolated repairs of the primary structural frames may also be required in the medium to long term (2030 plus 6-10 years).<br><br>Ongoing mechanical and electrical infrastructure repair, maintenance and replacement will be required. As the hospitals age, the need to replace infrastructure will increase with time, particularly with regards to mechanical infrastructure.<br><br>Estimated annual costs per site range from [redacted] for RAAC remediation in the long term (2030 plus 6-10 years). | Section 6 |
| 3. Clinical Operational Impacts | Assess the clinical impacts of opening replacement hospital after 2030 or past the expected end of life | Post-remediation, the RAAC 7 hospitals will generally be in similar operational position to other hospitals of similar age, configuration, and size, yet with continued RAAC related challenges. | Section 7 |

| Objective | Objective Aims | Summary Response | Reference |
|---|---|---|---|
| | | The RAAC remedial works have in some instances compromised clinical spaces and ongoing RAAC related survey and remediation works will have an ongoing clinical disruption.<br><br>The presence of un-remediated, inaccessible panels continues to present an ongoing risk (as noted in 1 above), alongside ongoing infrastructure risks which may also exacerbate RAAC related risks.<br><br>Facilities will also be increasingly out-of-step with modern clinical practice and an ever more acutely ill patient cohort. Any further delay to the replacement of these facilities will delay and compromise the benefits realised by the New Hospital Programme – the programme business case predicted a benefit cost ratio of more than 3:1 and it is therefore paramount that they are replaced without further delay. | |
| 4. Options for Phased Approach for Replacement | Assess possible options around phased replacement to minimise RAAC and backlog risks | Phased redevelopment of the RAAC 7 hospitals is theoretically viable. Departments such as Outpatients, Pathology, Central Sterile Service Department (CSSD), and Catering are considered feasible for standalone delivery. However, services with critical adjacencies - such as Intensive Care Unit (ICU), Theatres, Urgent and Emergency Care (UEC) etc. make phasing challenging.<br><br>To be viable, a phased redevelopment approach would need to deliver facilities faster than the current New Hospital Programme (NHP) plans / timeline.<br><br>Re-evaluating the existing NHP plans to consider an alternate phased approach would likely be disruptive and risk delaying overall delivery, potentially negating the benefits of phasing.<br><br>Nonetheless, if delivery of the new hospitals under the NHP is delayed beyond the current construction timeline set out in in the New Hospital Plan for Implementation (construction expected to start between 2027-2029), it would be appropriate to reconsider phasing opportunities. | Section 8 |

## Key Messages

- RAAC remediation has stabilised the risk – but not eliminated it. The hospitals can operate safely to 2030 and beyond – but with conditions.
- Mechanical infrastructure is a critical weakness.
- Significant investment has already been given to reduce risks.
- Delays to hospital replacement increase cost and risk.
- The hospital trusts have responded to considerable challenges but see the new hospitals as the light at the end of the tunnel.
- Remediation is not a substitute for replacement.
- Delivery of the new hospitals should be prioritised over phasing, but this should be re-evaluated if delays are expected.

# 1 Report Objectives

The Department for Health and Social Care (DHSC) defined the following objectives to be achieved, which have shaped the content and purpose of this report:

- For each of the **seven RAAC hospital sites (RAAC 7)** included within the New Hospital Programme (NHP)[1]**,** determine the following based on the assessment of RAAC condition and other structural elements, backlog maintenance risks (high and significant) as well as planned and current mitigations, the **remaining expected life of**:
  a. The **whole hospital site**, and
  b. A reasonable **area-by-area breakdown** of each hospital site (e.g. building by building).

- **Establish** whether there are **additional mitigation works** that could be put in place to **extend the sufficiently safe use** of the whole hospital site or areas of the hospital site, and the associated costs of doing so.

- Set out the **clinical operational impacts** on the running of the hospital and the associated costs, of opening the replacement hospital after the estimated life of the current hospital site or 2030, whichever is sooner.

- Define, describe, and **assess options** for a **phased approach to replacement** at a programme and individual site level to **minimise risk from RAAC plank failure**, **operational impact, and other backlog maintenance risks** (high and significant).

[1] New Hospital Programme: plan for implementation - GOV.UK

# 2 Introduction

***This independent report provides a strategic review of the seven whole RAAC Hospitals currently included in the New Hospital Programme (NHP). It includes an analysis of the seven hospital sites, assessing their current structural and RAAC condition, critical infrastructure, backlog maintenance, and clinical operational continuity risks. The assessment is structured around four key objectives and is intended to inform future decision-making for safe continued use of the facilities, mitigate risks, and plan for any phased infrastructure renewal or replacement.***

## 2.1 Report Structure

This Report and its Appendices is organised according to the objectives detailed in Section 1. The report is set out in the following structure:

### 2.1.1 Main Summary Report

The Summary Report provides analysis of the RAAC 7 Hospital sites. It highlights key themes and insights into the current condition and outlines possible programmatic-level mitigations based on the assessment.

This report is structured as follows:

- Section 3 - **RAAC Hospital Sites**
  - This section sets out the contextual background to the seven "RAAC Hospital" sites.
- Section 4 - **Background to RAAC**
  - This section provides a summary commentary of RAAC planks and panels.
- Section 5 - **Objective 1**
  - This section addresses the first objective, considering the remaining life of the RAAC 7 hospitals, including a holistic assessment of RAAC condition, fabric and critical infrastructure risks.
- Section 6 **- Objective 2**
  - This section outlines any recommended additional mitigation works beyond those already considered to support continued safe operational use of the hospital sites.
- Section 7 - **Objective 3**
  - This section provides a summary of the clinical operational impacts across the RAAC 7 hospital sites.
- Section 8 - **Objective 4**
  - This section describes options for a phased approach for replacement of the RAAC 7 hospitals considering risk reduction and clinical impacts.
- Section 9 – **Overall Conclusion**
  - This section provides a summary conclusion against each of the four objectives.

- **Appendices**
  - Supporting information has been included as Appendices, including a glossary of terms. detailed information relating to the RAAC, and costing methodologies.

- **Individual Hospital Site Reports**
  - Separate reports for each hospital have been developed as Annexe's to this report. These reports follow a consistent structure, providing in-depth assessment specific to each hospital.

    These include reports for:

    - Queen Elizabeth Hospital (QEH), Kings Lynn
    - James Paget University Hospital (JPUH), Great Yarmouth
    - West Suffolk Hospital (WSH), Bury St-Edmunds
    - Hinchingbrooke Hospital, Huntingdon
    - Airedale General Hospital, Keighley
    - Leighton Hospital, Crewe
    - Frimley Park Hospital, Frimley

## 2.2 Terms of Reference

This report does not define site-specific works or programmes through its identification of proposed works or interventions. Instead, it aims to provide indicative orders of magnitude in terms of activity and estimated cost required to maintain effective functionality towards 2030 and beyond.

Should any of the proposed mitigation and recommendations be progressed, a detailed assessment would be necessary to fully evaluate their feasibility, associated risks and potential opportunities associated with their implementation.

# 3 RAAC Hospital Sites

## 3.1 Site Descriptions and Locations

There are seven whole-RAAC hospitals sites in England. Within the context of this report, these are termed the RAAC 7 hospitals. These hospitals were constructed between 1970 to 1983 with the majority being part of the Best-Buy Hospital programme[2]. These hospitals are a mixture of construction typologies, but all contain more than 10,000 RAAC roof planks and wall panels.

The hospitals formed using the proprietary "Best-Buy" system building with precast floors, load-bearing internal and external RAAC walls and RAAC roofs are:

- West Suffolk Hospital (1973)
- Frimley Hospital (1974)
- Queen Elizabeth Hospital, Kings Lynn (1980)
- James Paget Hospital (1982)
- Hinchingbrooke Hospital (1983)

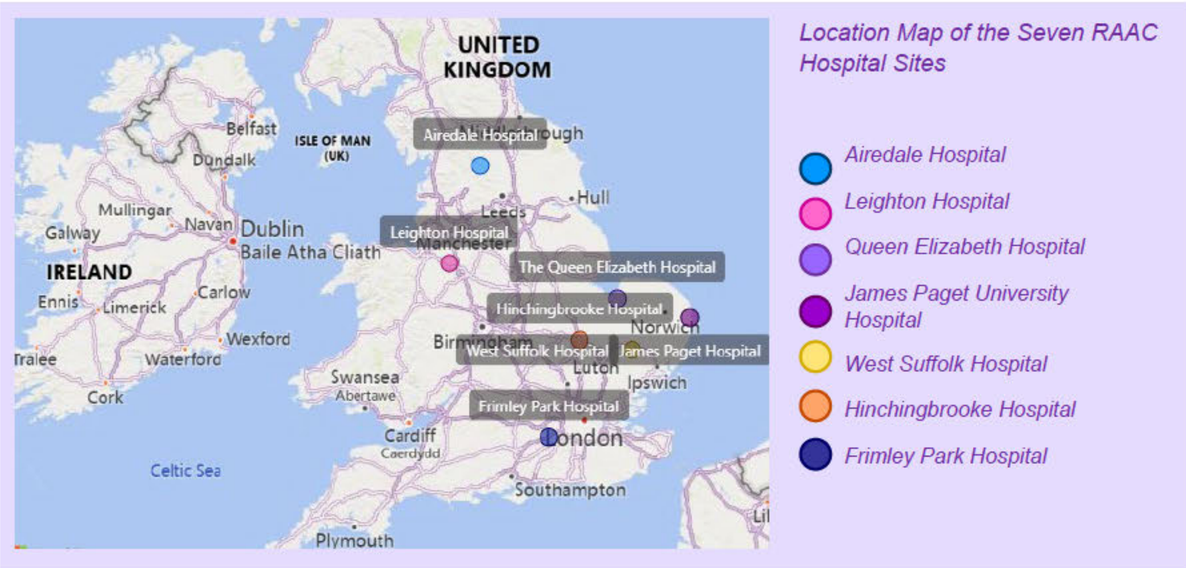
Leighton Hospital (1972) is formed using a traditional precast concrete frame[3] with precast floors, primarily non-load-bearing internal and external RAAC walls and RAAC roofs.

Airedale hospital (1970) is formed using a traditional precast concrete frame, with primarily non-load-bearing internal and external RAAC walls and RAAC floors and roofs.

Collectively these hospitals contain nearly 80,000 RAAC roof planks.

The sites included are identified on the map below. It should be noted there are additional hospital sites where RAAC has been used in construction to a lesser extent; these are excluded from this report.

**Map 3.1: Location Map of the 7 RAAC Hospitals**




[2] Introduced in 1967, the Best Buy Hospitals aimed to provide adequate facilities without being extravagant, under the slogan "Two for the Price of One!". Best Buy Hospitals were two-storey buildings with reduced spaces and simple construction methods. Susan Francis et al., *50 Years of Ideas in Health Care Buildings* (London: The Nuffield Trust, 1999), 30-31.

[3] A traditional precast concrete frame & floors is a structural system where concrete elements are cast in a factory and assembled on site.

# 4 Background to RAAC

## 4.1 Background to RAAC

RAAC is a form of lightweight precast planks and panels produced offsite and widely used within the UK between the 1950s and 1990s. RAAC elements were most commonly used in roof structures (planks), but examples also exist in floors, and in both load-bearing and non-load-bearing internal and external walls (panels).

RAAC planks and panels typically comprise 600mm wide sections spanning between 2.4m to 3.6m, although longer spans have been noted in some instances. The panels vary in thickness from 100mm to 250mm, typically 125mm within the RAAC 7 hospitals. The supporting structures vary between on-site (in situ) cast concrete, precast concrete, steelwork frames and load-bearing masonry. The RAAC installations within this report are primarily supported on precast concrete frames.

## 4.2 The History of RAAC Risks

In the 1990s, the Building Research Establishment (BRE) reported degradation of RAAC school roofs resulting in sagging planks, water ponding and leaks.

Following the collapse of RAAC roof planks in two schools in 2018/2019, the Collaborative Reporting of Safer Structures (CROSS, formally known as the Standing Committee of Structural Safety (SCOSS)) issued an alert that RAAC planks should be checked regularly for signs of failure, including creaking sounds, cracks, and dust.

This led to the establishment of the Institution of Structural Engineers (IStructE) RAAC study group who have provided guidance on inspection and structural risk evaluation for RAAC planks.

In 2019 NHS England (NHSE) wrote to all Trusts asking them to review their estate for RAAC planks and panels. Seven hospitals where a large proportion of the site's estate was identified as comprising RAAC were classed as 'whole RAAC hospitals'. Subsequently the capital programme, with funding to support risk mitigation and eradication, was stood up in April 2021.

Studies commissioned by the NHS and IStructE have identified inherent manufacturing and installation defects within RAAC planks that may result in the strength of those planks being significantly less than expected by the designers and manufacturers at the time of construction. The risk is particularly focused on the location of transverse reinforcement to the ends of planks which has been found to vary significantly from the as intended position and, based on NHS led research, can result in a 50% reduction in shear capacity.

The limitations of RAAC can be found within **Appendix C** - RAAC Background Information.

## 4.3 Degradation of RAAC

No published data is available for the longevity of RAAC or remediated RAAC. However, the constituent parts - steel reinforcement and Autoclaved Aerated Concrete - have good durability within dry inert environments.

However, there are mechanisms that may affect the long-term performance of RAAC, primarily related to water ingress. Historic and recent testing has confirmed that water ingress and the saturation of RAAC results in a reduction of strength and increase in weight of RAAC components.

The steel reinforcement in RAAC is protected by coatings. Any coating will have defects and will degrade over time. This leads to unprotected steel exposed to the environment. If sufficient moisture is present it will rust, and expand, causing spalling of AAC material. This can lead to a reduction in RAAC panel or plank strength.

As the roof waterproofing ages, instances of localised breakdown may become more frequent. Traditionally this leads to an increasing need for patch repairs until a point where full re-roofing is considered. The fragile nature of RAAC and the works involved in full waterproofing reroofing may aggravate the condition of RAAC. Furthermore, within a highly serviced hospital site, the failure of increasingly aged water systems and infrastructure may expose RAAC to increased moisture.

Under a constant loading, materials will deform over time, i.e. creep. The Building Research Establishment (BRE) noted that creep was higher in highly stressed RAAC planks – with inadequate reinforcement or increased loading such as that from re-roofing leading to additional creep of planks. The increased deformation associated with creep increases cracking, failure of finishes, water ingress, water ponding and an increase stress at bearings.

Fatigue relates to crack propagation under cyclic loading or deformation. Fatigue in RAAC is not well understood. Under cyclic loading steel can lose bond to the surrounding concrete. This has been identified as a cause of failure at one hospital site.

Cyclic movement that occurs in the building (e.g due to temperature variations) could lead to planks moving on their bearings and causing local damage to planks and finishes. The effects of this are yet to become significantly apparent but may be exacerbated with increasing fluctuations of extreme temperatures.

The lack of reliable data suggests continued inspection is required to monitor for changes of condition that may impact on the assumed stability of the constituent materials of RAAC planks. The inspection regime being more frequent than other construction products that are better understood.

## 4.4 2022 “RAAC 5” Report

In March 2022 Mott MacDonald was commissioned to review the ongoing revenue and risk implications of RAAC within five of the seven whole RAAC hospital sites in England that were not part of the original New Hospital Programme (NHP) but have subsequently been included.

The 2022 RAAC 5 report noted that estimates of remaining life of RAAC panels and planks with mitigation and failsafe in place could require hospitals to close around 2030. The report also acknowledged that only the removal of RAAC or replacement of the hospital fully reduces the risks associated with RAAC: both structural and operational and acknowledged the challenges with the replacement of these hospitals by 2030. The report also concluded that when considering the life-cycle cost of replacement vs retain and manage, replacement of the hospitals presented better value.

Since the 2022 RAAC 5 report and the commitments to eradicate RAAC, further research has been undertaken. This research has highlighted that the primary risk with RAAC planks / panels is systemic, i.e. a result of the design, manufacture and installation impacting on the end-bearing of planks / panels. Secondary effects due to creep / displacement and water-ingress exacerbate the end-bearing risk.

## 4.5 Commentary on the 2030 Timeframe for RAAC

The 2030 timeframe was initially established in 2020, following the 2018 / 2019 SCOSS (now CROSS) reporting of the RAAC school failures. At the time of this estimation (by others), the 2030 date was approximately a decade (10 years) into the future.

This timeframe was considered reasonable to plan and deliver a replacement hospital as early as possible and to minimise the time carrying the risks of maintaining the existing RAAC installation. This was given the absence of extensive remediation efforts and the limited understanding of RAAC.

The most recent of the RAAC 7 hospitals was completed in circa 1982. The 2030 estimate is also considered a reasonable projection based on an assumed 50-year design life and the condition of the RAAC planks and panels at the time of first inspection.

Since 2018/2019 (SCOSS REPORT), 2020 (projection of 2030 date) and 2022 (RAAC 5 report) significant remediation work has been undertaken across the seven RAAC hospitals, complemented by NHS backed research and an inspection and maintenance programme.

Detailed investigations and interventions have substantially improved the understanding of risk factors associated with RAAC, enabling more considered risk assessments. Consequently, the possibility of extending the projected timeframe for the RAAC beyond 2030 can now be considered, contingent upon continued maintenance and monitoring and acknowledging the residual significant risk of un-remediated planks.

## 4.6 DHSC RAAC Eradication Programme

At the time of writing, RAAC remains a significant concern within NHS infrastructure, but progress is being made toward its eradication.

The UK Government's 2025 Infrastructure Strategy outlines a clear and fully funded commitment to eradicating RAAC from within the NHS estate. This strategy includes the complete replacement of seven hospitals most severely affected by RAAC within NHP, alongside ongoing monitoring, mitigation and phased removal efforts across other NHS facilities[4].

As part of NHP, the RAAC 7 hospitals were scheduled for replacement by 2030. This commitment was made in the wider context of the Government's commitment to build 40 new hospitals by 2030[5]. Since this commitment, the Government has reviewed NHP and organised delivery into consecutive waves of investment as part of the plan for implementation.

The RAAC 7 hospitals are all part of wave 1, with expected construction start dates between 2027-2029 and commitment that these schemes will 'proceed at pace'[6].

[4] CP 1344 – UK Infrastructure: A 10 Year Strategy

[5] Five major hospitals to be rebuilt as part of over £20 billion new hospital infrastructure investment - GOV.UK

[6] New Hospital Programme: plan for implementation - GOV.UK).

# 5 Objective 1 – Remaining expected life

## Objective Aim:

***For each of the 7 hospital sites determine, from assessment of RAAC condition and other structural elements, backlog maintenance risks (high and significant) as well as planned and current mitigations the remaining expected life of:***

***A. The whole hospital site, and***
***B. A reasonable area-by-area breakdown of each hospital site (e.g. building by building).***

## Summary Response:

The RAAC 7 hospitals have undergone significant RAAC remediation. By 2030 all RAAC 7 hospitals are expected to have completed their roof plank remediation works in accordance with their remediation strategy, which addresses the majority of the RAAC planks.

Alongside direct RAAC remediation works, all RAAC 7 hospitals continue with supporting maintenance measures focused on keeping RAAC planks in a dry, well-managed environment to reduce the potential for water ingress and associated risks.

With physical remediation in place, there is little mechanism for on-going deterioration of RAAC planks. The constituent materials used to create RAAC planks and panels remain stable when appropriately managed with interventions such as improving end-bearings, mitigating water ingress, and reducing applied loading.

Despite best efforts in surveying and remediation it is expected that for each of the RAAC 7 hospitals planks may remain un-remediated, and in some instances not visible, on completion of the current remediation strategy. The positions of such planks have been identified at each site and it is estimated there are between 1% and 6% un-remediated planks depending on the site.

This is not unexpected given the complexities of remediating RAAC planks within an operational hospital environment. The areas that may remain will be distributed throughout the hospitals, typically within highly serviced areas such as main corridors and the circulation space within departments (including theatres, inpatient wards and outpatient areas), and, in particular for the best-buy hospitals, main kitchens.

In the absence of direct remediation to the inaccessible planks, other mitigation approaches have been implemented and will continue to be required to manage the associated risks. Trusts will need to continue to risk assess RAAC planks and determine appropriate measures to ensure risks remain as-low-as-reasonably-practicable

With ongoing management and maintenance, it is expected that RAAC planks and panels may <u>technically</u> remain serviceable beyond 2030 and in the long-term (2030 + 10 years).

This assumes no change in environmental condition or changes in our understanding of RAAC occurs, and that fabric repairs and infrastructure maintenance, to prevent leaks continues. Note that this does not apply to those planks that cannot be remediated which may present a high-risk of failure over-time without continued management.

Given the management approaches taken by the RAAC 7 hospitals, this statement is considered applicable to all RAAC-7 hospitals with no significant differences identified. The table below sets out the residual risks associated with the ongoing management of RAAC to the seven hospital sites.

It should be noted that the current DHSC policy is the removal of all RAAC from the NHS estate in England by 2035.

**Table 5.1: Remedial Works and Residual Risks to the RAAC 7 Hospitals**

| Hospital | Remedial works Strategy | Residual risk to longevity (Total) 2030 onwards | Additional comments |
|---|---|---|---|
| Hinchingbrooke | Maintenance to walls (load bearing).<br>End-bearing support to RAAC roof planks. | **Medium** | Ongoing RAAC remedial works required to areas without full-span-support over time. |
| James Paget | Maintenance protection to walls (load bearing).<br>End-bearing support to RAAC roof planks, full-span-support to some clinical areas. | **Medium** | Ongoing RAAC remedial works required to areas without full-span-support over time. |
| West-Suffolk | Enhanced protection to walls (load bearing).<br>Full span support to RAAC roof planks. | **Low** | Ongoing inspection and management including to inaccessible planks. |
| Frimley | Maintenance to walls (load bearing).<br>Full span support to RAAC roof planks. | **Low** | Ongoing inspection and management including to inaccessible planks. |
| Kings Lynn (QEH) | Enhanced protection to walls (load bearing).<br>Full span support to RAAC roof planks. | **Low** | Ongoing inspection and management including to inaccessible planks. |
| Leighton | Maintenance to walls (non-load bearing)<br>Full span support to RAAC roof planks. | **Low** | Ongoing inspection and management including to inaccessible planks. |
| Airedale | Maintenance to walls (non-load bearing)<br>Full span support to RAAC roof and floor planks. | **Low** | Ongoing inspection and management including to inaccessible planks. |

# Background to Objective 1 Response

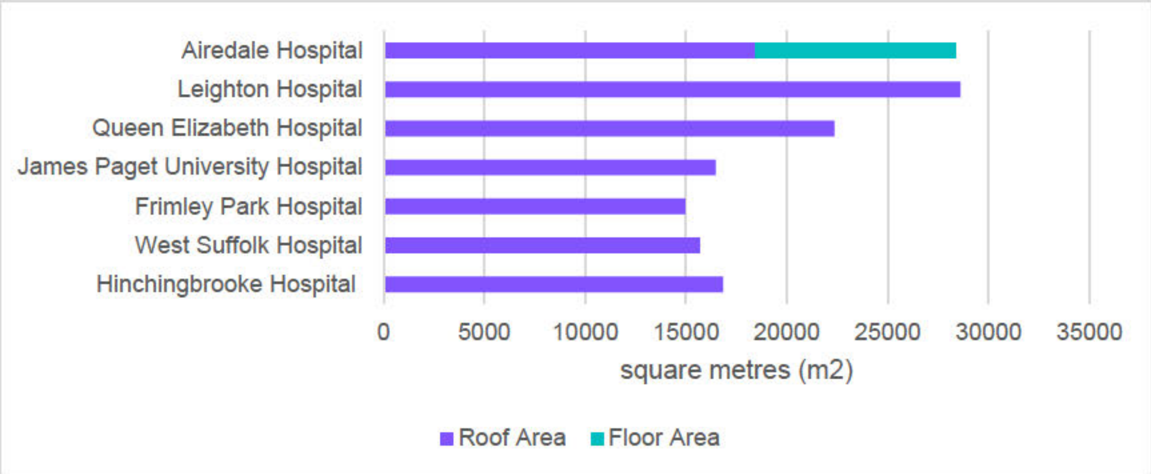
## 5.1 Comparison of RAAC Installation

### 5.1.1 Roof Areas & RAAC Planks

The approximate area of RAAC roof planks and impacted areas across each of the sites contained within the RAAC 7 hospitals is provided below. This highlights the magnitude of the installation in each case, with Leighton and Airedale being the most significant. Airedale is an exception with RAAC floors present within the construction.

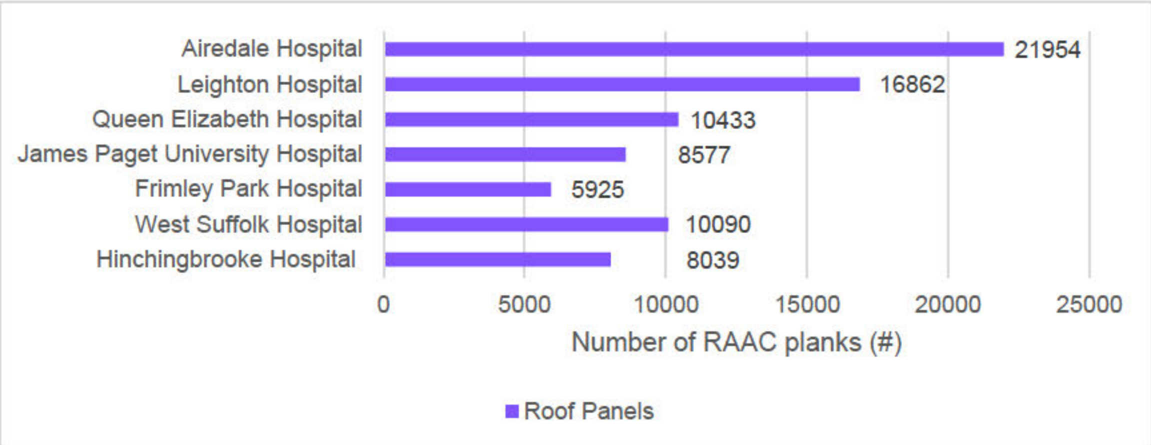
Variances in planks numbers exist between the sites. Although similarities in building typology exist, the configuration subtly different in each instance.

**Chart 5.1: Roof and Floor Areas Containing RAAC**




The total area of roof across the seven hospitals is estimated as 133,500 sqm. This translates into the number of roof planks per site as indicated on the graph below.

**Chart 5.2: Number of Planks by Site**



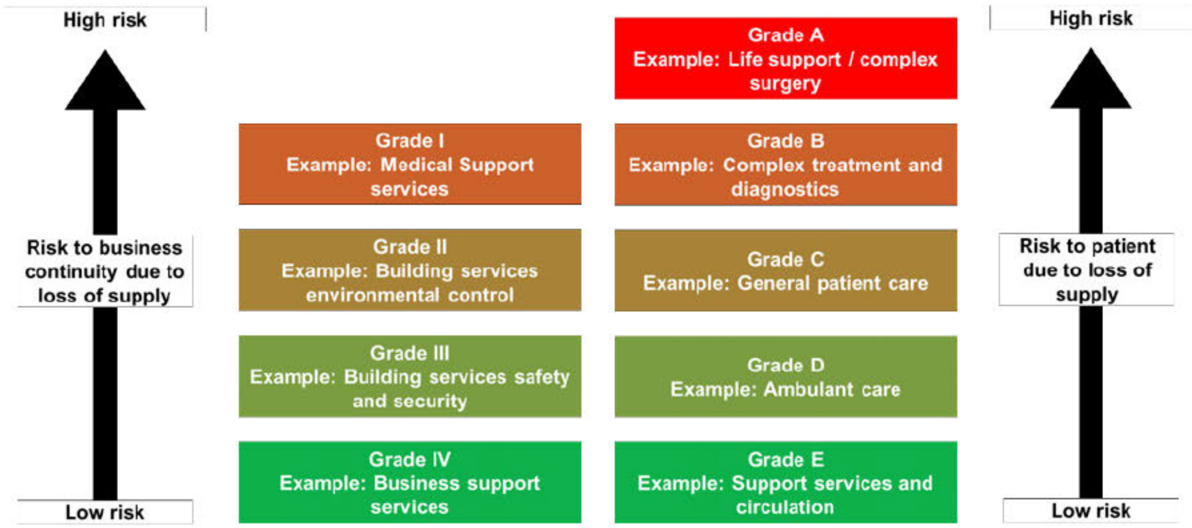

Within the RAAC 7 there is estimated to be 80,000 number roof planks (including North Lights).

### 5.1.2 Departments Impacted

This study used a standardised set of clinical departments to compare the impact of the RAAC installations across the RAAC 7 hospitals.

The HTM 06-01 approach to describing clinical risk categories has been adopted to explain how RAAC planks impact clinical operations. This clinical risk grading system provides a valuable framework for assessing the potential impact of RAAC on hospital operations.

**Figure 5.1: HTM 06-01 impact rating**




By categorising clinical spaces into risk grades ranging from Grade A (critical care areas) to Grade E (non-clinical areas), HTM 06-01 helps identify where structural failure would pose the greatest risk to patient safety and service continuity. This methodology has been applied within the individual site RAAC 7 hospital reports. The output of this review is provided within the table below:

**Table 5.2: RAAC Presence by Departments**

| | Theatres | ICU | Maternity (inc. Neo) | Diagnostics | Pathology | Adult inpatients | ED | Pharmacy | Circulation | Catering (inc. kitchens | Outpatients | Ambulatory | Admin | Education | CSSD | Estates (inc. Plant) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HTM 06-01 Rating** | A | A | B/A | B | B | C | C | C | C | C | D | D | E | E | E | E |
| Hinchingbrooke | ● | ● | ● | | | ● | | | ● | ● | | | | | ● | ● |
| West-Suffolk | ● | ● | ● | | | ● | | | ● | ● | ● | ● | ● | | | ● |
| Frimley | ● | | ● | | | ● | | | ● | | ● | | | | | ● |
| James Paget | ● | ● | ● | | | ● | | | ● | ● | ● | ● | ● | | | ● |
| Kings Lynn (QEH) | ● | ● | ● | | | ● | | | ● | ● | ● | | ● | | ● | ● |
| Leighton | | | ● | ● | ● | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● |
| Airedale | | | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

KEY: (grey) Department does not exist below RAAC planks; (yellow ●) Department exists below RAAC planks

The modular standardised nature of the best-buy hospitals is highlighted by the above comparison, with similar departments impacted by the RAAC roof construction.

Similarly for Leighton and Airedale, comparison can be drawn between sites.

The arrangement of the hospitals means that most of the planks are located above inpatient ward spaces. This is not surprising as with both the best-buy and Poulson hospitals inpatient spaces are located at the upper floors. This equates to circa 35,000 planks located above inpatient wards, according to the data collected.

The distribution of planks for the entire population is shown below, combined for all of the RAAC 7 hospitals.

**Figure 5.2: Total Number of Planks across RAAC 7 Hospitals**


The best-buy arrangement also locates theatres and ICU spaces at upper floors and as such these are impacted by RAAC planks. This has proved problematic in the remediation of these hospitals, with phasing and decant facilities being required to enable access. Outpatient and emergency departments at ground floor and therefore remain unaffected by RAAC planks.

Theatres and associated corridors are difficult to access for surveying, with some of the best-buy hospitals still holding un-surveyed planks in these areas. This is discussed later.

## 5.2 RAAC Condition

The condition of the RAAC installation across the RAAC 7 hospitals varies.

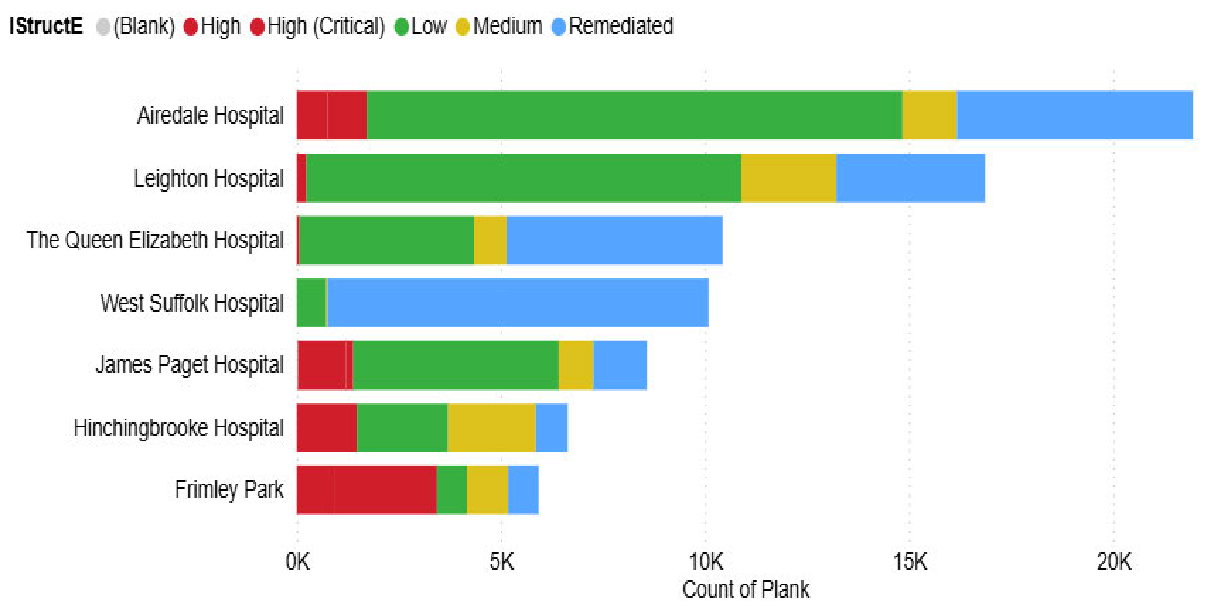
### 5.2.1 Plank Categorisation

The surveying and plank categorisation system for each hospital varies, depending on the consultant employed and when surveys were commenced.

To enable like-for-like comparison, all RAAC roof plank data has been converted to align with the IStructE further guidance risk rating system. The methodology for aligning the results is described in Appendix C.

Within this alignment exercise, full-span-support remediated planks are defined as a separate category and inaccessible planks considered high-risk. A summary is provided below (based on the data provided by the Trusts).

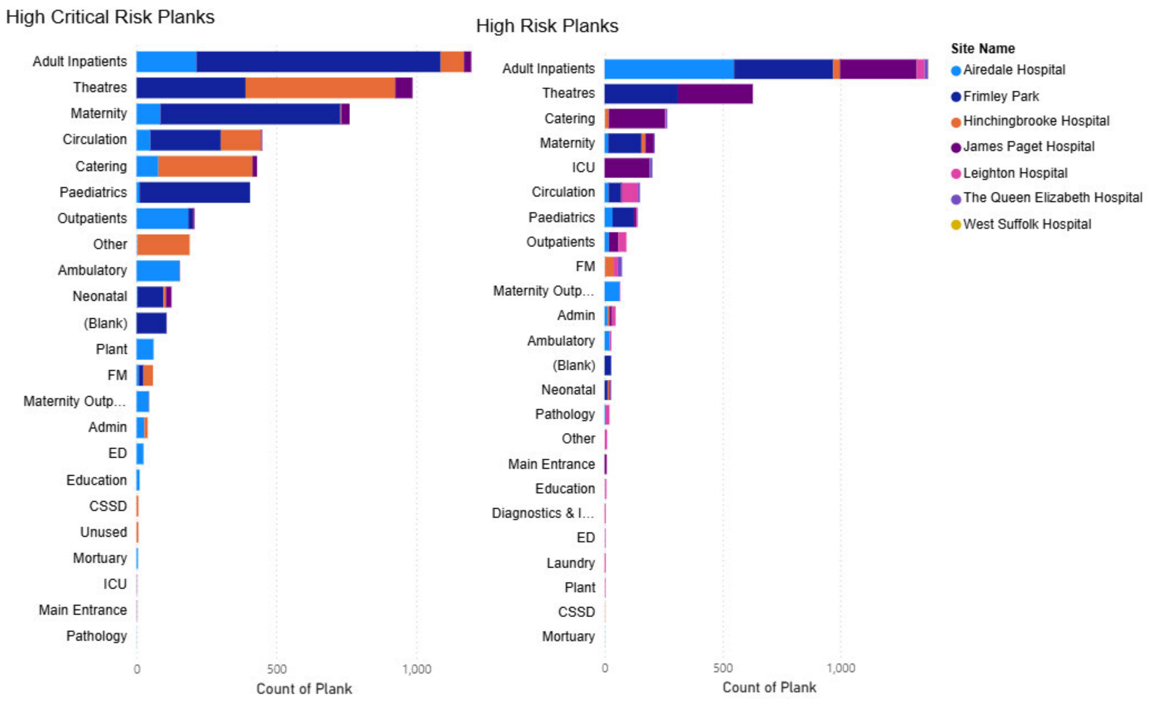
**Figure 5.3: IStructE Plank Status Per Site**




The location of the high and high critical planks has been mapped against location for each of the RAAC 7 Hospitals. This is provided below in figure 5.4. A large proportion of the RAAC planks are located above adult inpatient ward spaces, therefore a significant proportion of high-critical and high risk planks remain above these areas.

The challenges with access to theatres and maternity spaces is also highlighted in this data set, with these clinical spaces also having a high proportion of high-crtical and high risk planks.

**Figure 5.4: Plank by Location and Site**




### 5.2.2 Inaccessible Planks

Surveying and installing remedial works within an operational hospital environment is challenging. All RAAC 7 hospital Trusts highlighted this during the site visits and interviews.

Despite best efforts, it is expected that for all the RAAC 7 Trusts, at the conclusion of their remediation programme, there will remain identified planks that do not have any form of remediation installed or in some instances have not been fully surveyed.

The data for such planks is reported differently between hospital Trusts making processing of the precise locations challenging. However, from the datasets provided, inaccessible planks are typically located within highly serviced areas such as the circulation spaces within departments including operating theatre and inpatient ward areas.

Estimates have been confirmed with each of the RAAC 7 as outlined in table 5.3

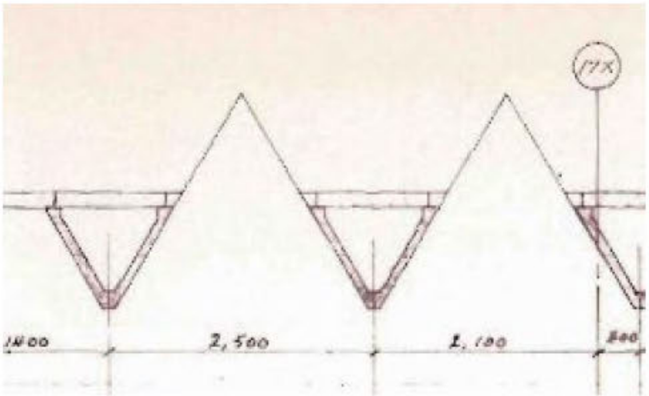
**Table 5.3: Estimated inaccessible planks per hospital**

| Hospital | %age of un-remediated panels | Commentary |
|---|---|---|
| Hinchingbrooke | circa 1% | Assumed primarily located outside of theatres (circulation) and kitchen V-beam detail. |
| James Paget | circa 2% | Assumed primarily located outside of theatres (circulation) and kitchen V-beam detail. |
| West-Suffolk | circa 1.5%* | Distributed across the site. Located within circulation spaces of departments. |
| Frimley | circa 1% | Estimated. |
| Kings Lynn (QEH) | circa 1% | Assumed within the kitchen V-beam detail. |
| Leighton | circa 1%* | Located in highly serviced circulation spaces or above large equipment installations, such as pathology fridges. |
| Airedale | circa 6%* | Located within highly serviced main corridor spaces. Unlike the best-buy hospitals, Airedale main corridors have a RAAC impacted ceiling which cannot be remediated. |

** confirmed by the trust*

Within the best-buy hospitals, the kitchen areas contain a precast concrete V-beam detail with RAAC panels above. These cannot be inspected or remediated but are considered to present a low risk of plank failure.

**Figure 5.5: Kitchen V-beam details**




For highly serviced areas, plank failures would disrupt the building services installation. However, in the unlikely event of a plank failure the services installation may prevent a full plank collapse through providing a degree of restraint.

In all instances, alternative measures have been undertaken and will need to continue to reduce the risk associated with un-remediated planks, such as surveying adjacent planks, relocating roof-mounted infrastructure, preventing access/ providing alternative access routes and installing pitched roof decks above RAAC roofs to remove the risk of water ingress and snow loading or where possible, relocation of some activity. In all instances the RAAC management and remediation programme has significant reduced risk to patient spaces. On completion of the remediation programme, no un-remediated RAAC planks are expected above inpatient bedded areas.

If the dates for hospital replacement extend, Trusts should reassess whether the residual risks are appropriate and whether further management of inaccessible planks is required such as decanting clinical spaces or relocating building services infrastructure. The cost and impact associated with this could be significant and not considered to be proportional. It is not possible to quantify such measures at this juncture, hence proposed further mitigations and associated costs have not been considered.

## 5.3 RAAC Remediation

### 5.3.1 Approach

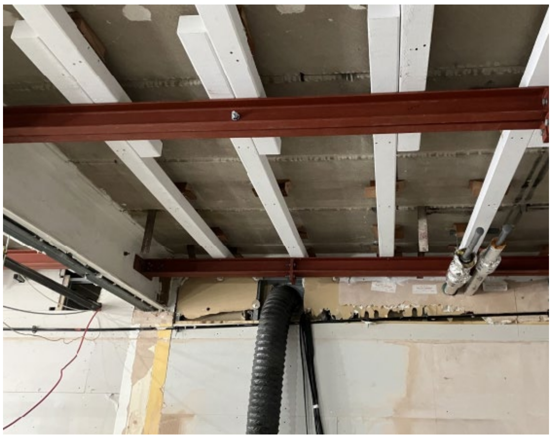
All Trusts have undertaken remediation to mitigate the risks associated with RAAC roof planks, with two also applying remediation to RAAC wall panels.

There is a variance in the methodology used for remedial works across the RAAC 7 hospitals linked to the Structural Engineering advisors employed.

In all instances, remedial works adopt the latest codes of practice (England); namely Eurocodes 0 to 5. The minimum design life for general building structures within BS EN 1990 is 50-years and each consultant has confirmed that this has been applied - subject to assumptions of good maintenance and repair. This design-life applies to the remedial works only; the existing primary frame and RAAC planks do not have this same design-life.

Trusts have installed full-span-support comprising of a secondary support frame located below the RAAC planks, connected back to the primary frame. Full-span-support frames are formed in either steel or timber or a hybrid of both materials, depending on the consultant designing the remedial works.

**Photo 5.1 – Full span support using hybrid of steel and timber (left) and end-bearing support using timber sections (right)**



Risk reduction / remediation strategy for each hospital depends on the balance between initial disruption and ongoing surveying requirements.

Two Trusts, Hinchingbrooke and James Paget Hospitals, have adopted an end-bearing support strategy only, with full-span-support only installed where it is deemed necessary (e.g. for high-risk planks). Latterly this approach at James Paget Hospital has been adapted; installing full-span-support to clinical areas.

Adopting either full-span-support or end-bearing support with targeted full span support are considered equally valid risk reduction strategies. However, this influences the residual risk that remains and leads to increased surveying (annual) in the period between completion of remediation and removal of the existing hospital (when compared to other hospitals' approaches).

For hospitals applying end-bearing only, that introduction of further full-span-support may be required in the future should planks degrade. The end-bearing structure has been designed to sustain future full-span support to allow this future adaption – however it is noted that this will require additional funding and result in further disruption.

Hinchingbrooke and James Paget have also adopted a different approach to remediation of north-light roofs, part of the best-buy template design, adopting to not remediate these panels with end-bearing or full span support.

**Photo 5.2 – End-bearing support using timber sections**

During the course of this study the lack of remediation of the north-light roofs has been challenged and further investigation by the hospital's RAAC consultant is being undertaken with an expectation that end-bearing support will be required. This will result in further remediation works, and consequent clinical and operational disruption. This additional remediation is not expected to impact on already completed remediation woks however it is noted that this will require additional funding and result in further disruption.

For two of the best-buy hospitals, West Suffolk and Queen Elizabeth Hospital, investigations by the hospital's RAAC consultant and a corrosion protection specialist determined that the load-bearing external walls required extensive remediation using sacrificial anode cathodic protection – applied to the embedded reinforcement.

The remaining best-buy hospitals plan to continue ongoing visual surveys of their load-bearing walls to identify defects and maintain the applied finishes to mitigate water ingress and deterioration. This maintenance strategy is not a concern, and it is not expected that remaining hospitals will adopt full-scale cathodic protection measures. Some isolated remedial measures may be undertaken.

The RAAC plank remedial works for each hospital has been combined within additional supportive measures to reduce risk, particularly of water ingress. These include re-roofing and repair to existing roof finishes, installation of new access walkways and in some instances removal of existing building services.

### 5.3.2 Completion of Remediation Programme

The remediation programme for each of the sites has varied significantly depending on the site-specific risk assessments undertaken. The table below shows the estimated current stage of remediation at the time of writing. This has been based on the data provided by each Trust and updated to reflect the interviews undertaken.

### Table 5.4: Remedial works underway within departments and estimated completion date

| | Theatres | ICU | Maternity (inc. Neo) | Pathology | Diagnostics | Catering inc. kitchens | Circulation | Adult inpatients | Circulation | ED | Pharmacy | Outpatients | Ambulatory | Admin | Education | CSSD | Estates (inc. Plant) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **HTM 06-01 Rating** | **A** | **A** | **B/A** | **B** | **B** | **C** | **C** | **C** | **C** | **C** | **C** | **D** | **D** | **E** | **E** | **E** | **E** |
| Hinchingbrooke | 26 | 27 | 28 | | | C | C | 28 | C | | | | | | | C | C |
| West-Suffolk | C | C | C | | | C | C | C | C | | | C | C | C | | | C |
| Frimley | C | | 26 | | | | C | 29 | C | | | C | | | | | C |
| James Paget | 27 | 28 | 27 | | | 26 | C | 28 | C | | | C | C | C | | | C |
| Kings Lynn (QEH) | C | 26 | C | | | C | 26 | 26 | 26 | | | C | | C | | C | 26 |
| Leighton | | | C | 26 | C | C | C | 27 | C | C | | 26 | C | C | C | C | 27 |
| Airedale | | | 26 | C | | C | 28 | 27 | 28 | C | C | 26 | C | C | C | C | 28 |

KEY:

| | |
|---|---|
| ## (orange) | RAAC exists above department and works are underway. Number identifies proposed programme completion for remediation |
| C | RAAC exists above department and has been remediated. |
| (grey) | Department does not exist below RAAC planks |

The date of completion of the remediation programme can be summarised as the below, highlighting the context of the time from remedial works completion to 2030.

**Table 5.5: Expected Remediation Programme Completion Dates**

| Hosptial | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | Comment |
|---|---|---|---|---|---|---|---|
| Hinchingbrooke | | | | ◆ | | | It is understood that the programme of remediation is under review, but the target date of 2028 is considered reasonable. Remediation is based on an end-bearing strategy only. |
| West-Suffolk | ◆ | | | | | | The remediation works are complete, including extensive wall remediation. |
| Frimley | | | | | ◆ | | Remediation works progressing. |
| James Paget | | | | ◆ | | | Remediation is generally based on an end-bearing strategy only. |
| Kings Lynn (QEH) | | ◆ | | | | | The remediation works are nearing completion, including extensive wall remediation. |
| Leighton | | | | ◆ | | | Remediation works progressing. |
| Airedale | | | | ◆ | | | Remediation works progressing. |

Key

| | |
|---|---|
| ◆ | Remediation Programme: Target Completion Dates |
| | 2030 timeframe: initially established around 2018 / 2019, following the school failures. Originating from advice provided to NHS Trusts by advisors regarding the residual life of RAAC installations. |

## 5.4 Remaining Life Expectancy

It is not possible to present a specific lifespan or life-expectancy for RAAC planks or panels. There has been no formal research into the longevity of RAAC in either the un-remediated or remediated state. However, there is equally no information or research to show that the constituent materials used in RAAC plank or panel construction are unstable over time.

AAC is widely used in blockwork across the UK construction industry and demonstrates strong durability characteristics.

Steel reinforcement bars will corrode under atmospheric conditions and the AAC does not provide the same protective barrier to corrosion that normal concrete would do. For this reason, the reinforcement is coated. Studies, identified within Appendix C, highlight the impact that corrosion of reinforcement would have on typical un-remediated RAAC plank capacity. Where planks are remediated, the impact of corrosion on the structural capacity is much less.

The BRE and SCOSS reports note that in instances where RAAC has remained dry and adequately protected, the reinforcement exposed during demolition works has generally been in good condition. This has been witnessed recently during demolition works of panels.

Based on current knowledge of the materials used in RAAC construction, this suggests that, if the planks remain in an inert dry environment, there is no reason the materials should degrade. However, the lack of reliable data suggests continued inspection is required to monitor for changes of condition that may impact on the assumed stability of the constituent materials of RAAC planks. The inspection regime being more frequent than other construction products that are better understood.

Where roof planks within the RAAC 7 hospitals have been subjected to full remediation, there is a significant reduction in risk. The residual risk is of spalling of AAC should water ingress be sufficient to produce corrosion and expansion of the reinforcement.

For RAAC roof planks where only end-bearing support has been installed, there is a reduction in residual risk. However, it remains possible that planks will displace / creep further and full remediation may be required over-time – particularly if water-ingress is prevalent.

Water ingress is likely to be a significant challenge for the longevity of RAAC plank structures. Although all structures are impacted by water-ingress, the specific vulnerabilities of RAAC planks associated with the manufacturer and installation, can increase risks of local failures – such as spalling. Ongoing maintenance and potential upgrades to drainage systems may be required; particularly guarding against the impacts of climate change.

This ongoing maintenance and management of RAAC extends to infrastructure, in particular wet-services mounted above RAAC planks. Domestic water systems are typically in poor condition; for example, Queen Elizabeth has multiple incidents of legionella associated with the poor condition of water storage tanks, Frimley has twice-weekly meetings to review legionella issues and Airedale hospital reported issues with pin-hole leaks within their pipework. Leaks are also a pervasive issue across the hospitals, with roof-mounted pipework posing a particular risk to RAAC planks

With ongoing management and maintenance, it is expected that RAAC planks and panels may technically remain serviceable beyond 2030 and in the long-term (2030 + 10 years). However, this does not apply to those planks that cannot be remediated which may increasingly present a risk of failure over time.

This timeframe assumes that no water ingress, change in environmental condition or changes in our understanding of RAAC occurs. Fabric repairs and infrastructure maintenance to prevent leaks will remain critical to achieve longevity of planks.

Given the management approaches taken by the RAAC 7 hospitals, this statement is considered applicable to all of the RAAC-7 hospitals with no significant differences identified.

The current DHSC policy is the removal of RAAC by 2035 from the NHS estate.

Refer to Appendix C for further details.

## 5.5 Infrastructure Implications

Unlike non-RAAC hospitals, infrastructure teams within the RAAC-7 are required to consider the impact of RAAC on the infrastructure and visa-versa.

### 5.5.1 RAAC Failure and Impact on Infrastructure

The NHS in England has undertaken work to prevent the failure of RAAC planks within a hospital. This risk is significantly reduced through the actions taken to manage and remediate RAAC planks.

If a RAAC plank was to fail, a direct impact would be on the building services infrastructure. This is likely to locally disrupt the building services but may result in greater widespread disruption. The operational impacts of many of these failures could be significant, causing wider implications across the hospital above and beyond direct structural failure impacts. These are considered below.

This risk remains elevated in areas where RAAC remediation continues or is yet to be completed or planks are inaccessible, such as circulation / corridor areas which have congested services installations.

**Table 5.6: Infrastructure Failure and Impacts**

| Failure point | Infrastructure implication |
|---|---|
| **Collapse of containment system** | Cable Damage<br>Power failure, substantial impact if sub-main cable or major final circuit tray/trunking |
| | Electrocution risk |
| | Communications system failure, loss of Local Area Network, loss of nurse call system |
| | Fire alarm and security systems may be partly compromised |
| **Breach of electrical panel by debris** | Power failure, substantial impact if distribution centre panel |
| | Fire risk |
| | Electrocution risk |
| **Generator/Generator panel damaged by debris** | Loss or partial loss of secondary supply |
| **Collapse of pipework system** | Localised flooding (secondary electrical fault risk) |
| | Primary and secondary heating/cooling system failure, substantial impact if heating main affected |
| | Medical gas system failure, insufficient medical gas supply |
| **Collapse of ductwork system** | Localised/site-wide ventilation system failure, insufficient fresh air supplied affecting indoor air quality in critical areas |
| **Generator damaged** | Localised fuel leakage |

| Failure point | Infrastructure implication |
|---|---|
| **Collapse of mechanical system** | Major system failure across the hospital |
| | Localised/site-wide ventilation system failure, insufficient fresh air supplied affecting indoor air quality in critical areas |
| | Disruptions to domestic water supply systems |
| | Failure of medical gas systems |
| | Localised flooding |

### 5.5.2 Infrastructure Failure Impact on RAAC

Unlike non-RAAC hospitals, infrastructure failures can have additional secondary impacts on the structure (RAAC). Generally, the impact of mechanical service failures are considered more significant than electrical services associated failure.

#### 5.5.2.1 Leaks

Roof level pipe-work leaks may directly lead to water-ingress and increase of moisture content within RAAC planks. Persistent leakages would elevate the risk of moisture penetrating RAAC increasing displacement/ creep and spalling of the RAAC plank surface or failure of un-remediated planks. Where RAAC planks are supplied with end-bearing only, this may result in additional remedial works being required. Roof pumps would help to reduce water build-up but identifying leakages as soon as possible is key. Refrigerant system leakage could cause contamination but is unlikely to be substantial enough to cause major issues with RAAC. The use of leak detection systems is unlikely to be appropriate in most situations; therefore, Estates teams may consider undertaking more regular and specific inspections of pipework in high-risk areas with older pipework.

#### 5.5.2.2 Ductwork or pipework collapse

A ductwork, pipework, or equipment support system collapse is not directly considered an infrastructure failure but would cause a failure of the associated system and loading onto RAAC below. Any pipework would be likely to rupture in such a situation which could result in excessive water ingress to RAAC planks. This is considered an unlikely incident but could have significant consequences. Estates teams should consider undertaking a specific review of plant support condition, particularly for larger and more critical items of plant, if this has not been undertaken as part of RAAC management.

#### 5.5.2.3 Repairs

Repairs to roof mounted plant would directly increase the loading on the roof through additional personnel and equipment. Such works are restricted by RAAC, with all works being undertaken in accordance with the RAAC management plan. Where the RAAC planks have end-bearings only, loads are placed on RAAC planks limiting the number of personnel and equipment allowed on the roof to undertake the maintenance and repairs, extending the length of time required for the works to be carried out. Additional strengthening of the RAAC planks maybe required to allow roof mounted plant replacement.

#### 5.5.2.4 Roof Pumps

A proposed non-structural mitigation for RAAC introduces additional roof pumps to remove water build up and stop ponding on the flat roofs. This introduces a minor risk of the failure of roof pump supplies allowing rainwater to build-up although with new pumps and new power supplies, the risk of failure is considered very low. Pumps in this instance should be powered from an essential board to continue operating in a mains failure off the generators, the electrical demand will be low and therefore would not significantly reduce secondary power available to clinical services.

The overall risk of impact on RAAC from infrastructure failure is considered relatively low.

### 5.5.3 RAAC Mitigation and Infrastructure Access

The RAAC plank remedial measures used across the hospitals mean services are either already installed below or dropped below structural elements, other services are mounted above the steelwork, but clear access was maintained in all examples observed. Various services are now supported from the new support beams installed to remediate RAAC; the relocation of services supports away from RAAC panels directly aids in de-loading. Smaller items, particularly conduits, are still supported from RAAC panels though loading would be minimal with access still attainable.

Where mechanical services have been relocated from RAAC roofs and into courtyards, plant replacement will require specialist access equipment. For larger items of equipment this could extend to heavy lifting cranes with extended booms.

For mechanical services that have been retained on the roof, the replacement of any item of equipment above RAAC impacted roofs would need to be restricted to the load-limitations of the designed remediation works, not the RAAC panels. If the replacement item equipment exceeds the remediation design loads, then additional reinforcement will be required adding time and cost to the works. Where possible, consideration should be made to locating any replacement equipment away from RAAC roofs.

The servicing of any mechanical services equipment retained on the RAAC roof needs to be undertaken in accordance with the RAAC management plan.

### 5.5.4 RAAC and services installations

The presence of RAAC impacts ongoing upgrades such as installation of new pipework or IT infrastructure. The lack of resilience within the floor, roof and wall systems means the majority of any new penetrations will require remedial works and trimming, increasing the cost of such works.

There are also additional complexities with obtaining appropriate fire certification for standard passive-fire protection measures which are untested through RAAC walls and floors.

# 6 Objective 2 – Additional Mitigations

## Objective Aim:

***Establish whether there are additional mitigation works that could be put in place to extend the sufficiently safe use of the whole hospital site or areas of the hospital site, and the associated costs of doing so.***

## Summary Response:

By 2030 all expected RAAC remediation works will be complete based on the strategies adopted and programmes of work presented by each of the RAAC 7 Trusts. This date aligns with the originally targeted RAAC hospital redevelopment / removal timeframes.

Despite remedial works, residual risks will remain for each of the hospitals for each potential failure mechanism associated with RAAC planks and panels. These risks will be mitigated primarily through:

a) Maintenance of non-RAAC estate and fabric, such as critical infrastructure and re-roofing.
b) Mitigating the impact of external events – such as climate change and the impact of rainfall on RAAC roofs.
c) Maintaining RAAC remedial works in good order.
d) Ongoing surveying and monitoring.
e) Ongoing management and risk assessments.
f) Risk management plans and identification of mitigations for inaccessible / un-remediated RAAC planks and the primary structural frame.

The estimated cost for providing the above in the medium to long-term (2030+ 4 - 10years) per site / per annum, based on costs for similar works and assumed scope would be as follows:

**Table 6.1: Estimated Costs of Mitigations**

| Remedial Works Measure | Approx. Cost Range (per site / per annum | Comment |
|---|---|---|
| **Roof Repairs** | [redacted] | Roof repairs would include life-cycle repairs, assumed across circa 10% of the roof surface. |
| **Access walkway repairs** | [redacted] | Assumes continued maintenance and potential upgrades to access systems, such as additional access or re-covering / painting. |
| **Roof Pumps** | [redacted] | Addition of roof pumps to prevent ponding. |
| **RAAC Remedial works** | [redacted] | Includes additional remedial works for those Trusts that do not have full-span-support OR netting or reinforced ceiling tiles to prevent spalling debris. |
| **RAAC wall panel maintenance** | [redacted] | Includes ongoing painting and decoration to prevent water-ingress. |
| **Ongoing survey Costs – RAAC Roofs** | [redacted] | For 3-yearly inspections or after adverse events (e.g. leaks, storms) and annually for Trusts adopting end-bearing support only. |

| Remedial Works Measure | Approx. Cost Range (per site / per annum | Comment |
|---|---|---|
| **Ongoing survey Costs – RAAC walls** | [redacted] | Annual inspections or upon signs of spalling/cracking. |
| **Primary Frame surveys and inspections** | [redacted] | |
| **Ongoing Management** | [redacted] | Includes annual or biennial ALARP workshops, RAAC team operations, and SOP maintenance. |

### Mitigation Costs per site:

The following provides the high-level estimated annual mitigation costs per site for combined RAAC physical and non-physical related costs:

**Table 6.2: Estimated Annual Costs of Mitigations**

| Site | Short-Term 2030 plus 1-3 years (annually) | Medium-Term 2030 plus 4-6 years (annually) | Long-Term 2030 plus 6-10 years (annually) |
|---|---|---|---|
| Hinchingbrooke | [redacted] | [redacted] | [redacted] |
| West Suffolk | [redacted] | [redacted] | [redacted] |
| Frimley | [redacted] | [redacted] | [redacted] |
| James Paget | [redacted] | [redacted] | [redacted] |
| Kings Lynn (QEH) | [redacted] | [redacted] | [redacted] |
| Leighton | [redacted] | [redacted] | [redacted] |
| Airedale | [redacted] | [redacted] | [redacted] |

These costs are cumulative per annum and increase over time.

For example, if Hinchingbrooke Hospital was to be completed by 2035 (2030 plus 5 years), the estimated costs would be 3years at [redacted] and 2years at [redacted], so [redacted].

Using this approach, the total estimated cost for all hospitals being completed by 2035 (2030 plus 5 years) is [redacted], increasing to [redacted] in the long-term (2030 plus 10 years).

These estimated costs exclude any associated infrastructure works.

### Infrastructure Mitigations

Backlog maintenance is not unusual in the public estate however for these hospitals there are specific infrastructure risks associated with RAAC which need to be addressed on a continued basis, primary with regards to roof loading to RAAC planks and the potential for water ingress, through failure of roof top plant or drainage systems.

**Table 6.3: Electrical infrastructure mitigation**

| Electrical infrastructure mitigation | |
|---|---|
| Short Term | Focus on regular maintenance and emergency temporary solutions (e.g., generators, UPS, spare parts). |
| Medium Term | Replace outdated components (e.g., distribution boards, UPS) and enhance resilience (e.g., N+1 generator capacity). |
| Long Term | Full replacement of legacy HV/LV equipment and generators to ensure long-term reliability. |
| Additional Considerations | Establish contracts with emergency generator suppliers and consider centralised wireless backup systems for nurse call. Standalone data centres or communication hubs at each hospital to protect critical IT systems. |

**Table 6.4: Mechanical infrastructure mitigation**

| Mechanical infrastructure mitigation | |
|---|---|
| Short Term | Regular maintenance and ensure availability of temporary emergency measure (e.g. portable oxygen, temporary boilers). Regular inspections and mitigation of mechanical plant which could result in water ingress to RAAC planks – e.g. drainage pumps and water distribution systems. |
| Medium Term | Replace outdated components and worn parts, plus management of infrastructure risks to RAAC. |
| Long Term | Full replacement of legacy systems (AHUs and Chillers) plus management of infrastructure risks to RAAC. |

# Background to Objective 2 Response

## 6.1 Risk Management

Given the known structural vulnerabilities of RAAC, unlike other construction materials / products, it is important that water-ingress is mitigated, remedial works are maintained, and ongoing surveys and management is implemented.

Given the system nature of the RAAC 7 hospitals there is significant repetition in the recommendations made across the sites. This is symptomatic of the construction methods adopted in the original design and the similarities in approaches used to mitigate the risks associated with RAAC by collections of hospitals being managed by the same consultants.

## 6.2 Post-Remediation Risk Assessment

It is useful to consider the residual risk that each Trust will hold on completion of their remediation programme.

Most NHS organisations employ a standard 5 x 5 risk assessment matrix for the review of estates risks, including RAAC planks. This form of risk assessment matrix is used to evaluate risks based on their impact and likelihood. This risk matrix is used extensively within the NHS and RAAC 7 hospitals, with only minor variations. Within this report, the following methodology has been adopted:

**Table 6.5: Risk Matrix**

| | | Impact/ Consequence | | | | |
|---|---|---|---|---|---|---|
| | | Insignificant 1 | Minor 2 | Significant 3 | Major 4 | Severe 5 |
| Probability / Likelihood | Rare (1) | Very low | Very low | Low | Medium | Medium |
| | Unlikely (2) | Very low | Low | Medium | Medium | High |
| | Moderate (3) | Low | Medium | Medium | High | Very high |
| | Likely (4) | Medium | Medium | High | Very high | Extreme |
| | Almost certain (5) | Medium | High | Very high | Extreme | Extreme |

Using this risk matrix approach the post-remediated risk rating for each potential failure mechanism for RAAC planks has been considered for each of the RAAC 7 hospital sites.

Within the following, the consequence of a RAAC plank or panel failure has been considered to be major (4) or severe (5), given the impact that such a failure would have on the clinical operations of the hospital and the wider NHS RAAC estate. In the event that a a remediated plank should fail, it is recognised that this would require a significant re-evaluation of the approach to RAAC remediation and risks associated with remediated planks, having very significant consequences of the assumptions in this report.

The likelihood of a remediated RAAC plank failure is typically taken as Rare (1) or Unlikely (2), depending on the strategy for remediation that has been adopted. Using this approach, it is demonstrated that whilst the consequences of any RAAC plank failure are major or severe, the RAAC remediation measures are considered to reduce the likelihood of a failure, reducing the overall risk.

For example;

- For planks that are inaccessible / uninspected the risk remains Very High (15), with the consequence remaining as Severe (5), but the likelihood considered to be higher than remediated planks – taken as Moderate (3).
- In all RAAC 7 hospitals, RAAC planks are receiving end-bearing enhancement to prevent an end-bearing failure. The likelihood of this failure is therefore taken as Rare (1), but the consequence of a plank with end-bearing enhancement in place failing would be Severe (5), giving a total post-remediated risk of Medium (5).
- For the Trusts that have adopted end-bearing only or not remediated the north-light features, it is recognised that these will hold a higher risk. Typically, the likelihood is still considered low, i.e. Unlikely (2), but again the consequence is taken as Severe (5) – this gives a risk rating of High (10).
- For elements such as ‘spalling / debris’ damage, with ongoing surveying of the planks and the prevention of water ingress the likelihood of occurrence is considered Unlikely (2), with the impact considered to be Major (4). The impact remains Medium (8) as such an event may reduce the trust in the monitoring and management regimes, with potential to have wider impacts on RAAC remediation approaches.
- The post-remediation assessment for walls is also provided, again reflecting the variance in works that has been undertaken across the RAAC 7 Hospitals and also noting that both Airedale and Leighton do not contain substantial installation of load-bearing walls. Typically considered a Medium Risk (4 – 9).

## Table 6.6: Residual Risk Appraisal

| Failure Point | Risks | Airedale | Leighton | Kings Lynn (QEH) | James Paget | Frimley | Hinchingbrooke | West-Suffolk |
|---|---|---|---|---|---|---|---|---|
| Catastrophic failure of uninspected / unremediated planks. | Collapse of a RAAC plank due to bearing failure / shear. Plank falls into space. | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Catastrophic failure - Full Plank Failure – through end bearing | Collapse of a RAAC plank due to bearing failure / shear. Plank falls into space. | 10 | 5 | 5 | 5 | 5 | 5 | 5 |
| Catastrophic failure - Full Plank Failure – through end bearing – NORTH LIGHTS | Collapse of a RAAC plank due to bearing failure / shear. Plank falls into space. | X | X | X | 10 | X | 15 | X |
| Catastrophic failure - Full Plank Failure – through mid-span | Collapse of a RAAC plank due to bearing failure / shear. Plank falls into space. | 10 | 5 | 5 | 10 | 5 | 10 | 5 |
| Damage - spalling / debris | Spalling of RAAC plank surface with debris falling into space. | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Performance failure – Displacement / Creep | Excessive displacement or creep of plank | 4 | 4 | 4 | 8 | 4 | 8 | 4 |
| Failure of remedial measures | Failure of remedial works; elements or fixings. | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Failure of RAAC wall panel - compressive | Corrosion of the reinforcement causes spalling, leading to loss of section and compressive failure | X | X | 4 | 9 | 9 | 9 | 4 |
| Failure of RAAC wall panels - bending | Corrosion of the reinforcement causes spalling, leading to loss of section and bending failure | 8 | 8 | 4 | 9 | 9 | 9 | 4 |
| Deterioration of the Primary Frame | Based on reinforced concrete buildings of a similar age, it is likely that the primary structural frame is carbonated, and reinforcement is at risk of corrosion. This can lead to local spalling and the requirement for remediation. | 8 | 8 | 6 | 6 | 9 | 6 | 6 |

## 6.3 Structural Mitigation Works

All RAAC 7 hospital sites have already implemented mitigation measures to extend the life of the RAAC planks. The following are proposed to support the ongoing works from now until the point of completion of the new hospital construction. The structural remediation works are common across all sites, with some nuances captured within the range of cost.

### 6.3.1 Physical

#### 6.4.1.1 Roof Finishes

To support the long-term integrity of the RAAC planks and RAAC remediation, maintaining a dry environment is essential.

Given the criticality of roof finishes, regular maintenance is assuming that life-cycle repair works to roof finishes will be required every 3–5 years, depending on material and condition.

**Table 6.7: Mitigations: Roof Finishes**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | [redacted] | Includes patch repairs (e.g. around movement joints, roof lights), temporary access, and contractor preliminaries. Assumes 10% of roof area affected. |
| Medium-term (2030 + 4–6 years) | | |
| Long-term (2030 + 6–10 years) | | |

#### 6.4.1.2 Roof Access Works

Ongoing access to the roof is necessary to facilitate regular inspections and maintenance of RAAC infrastructure.

Hospitals have installed defined walkways and step-over platforms directly onto the roof finishes. These walkways are strategically placed over remediated RAAC plank areas. The installations are designed to restrict general access and guide maintenance personnel along safe routes, thereby reducing the risk of accidental overloading or damage.

In some cases, these walkways were integrated into re-roofing works, allowing for pre-emptive reinforcement and compatibility with new roof finishes.

In the medium to long-term (2030 plus 4 to 10 years), access walkways may require maintenance or improvements.

**Table 6.8: Mitigations: Roof Access Works**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | N/A | No roof access works are expected during this period. |
| Medium-term (2030 + 4–6 years) | [redacted] | Includes installation of additional walkways and access points to support maintenance of roof-mounted equipment. |
| Long-term (2030 + 6–10 years) | [redacted] | Assumes continued maintenance and potential upgrades to access systems. |

### 6.4.1.3 Roof Pumps

Where re-roofing has not improved roof falls or outfalls the potential for roof ponding remains, particularly with increased intense rainfall. Roof pumps are an effective method of removing water.

It is suggested that in the medium to long-term (2030 plus 4 to 10 years) an increased in the installation of these pumps may be expected, along with associated infrastructure costs.

**Table 6.9: Mitigations: Roof Pumps**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | N/A | No works expected. |
| Medium-term (2030 + 4–6 years) | [redacted] | For additional roof-level water pumps to prevent ponding. |
| Long-term (2030 + 6–10 years) | [redacted] | Continued resilience upgrades for inaccessible areas. |

### 6.3.1.4 RAAC / RAAC Remedial Works

Additional RAAC remedial works may be required across the RAAC-affected hospitals to maintain the long-term safety and performance of previously remediated areas. These works are generally considered in the medium- and long-term (2030 plus 4 to 10 years) planning horizons and are intended to address minor degradation, ensure compliance with design intent, and mitigate risks such as spalling or structural fatigue.

In general, medium-term (2030 plus 4-6 years) remedial works include minor repairs to existing interventions, such as the addition of timber bearers, wedges, or screws to reinforce support systems. These works may also involve re-application of grout or decorative finishes to maintain the integrity and appearance of the installations. In the long term, hospitals may need to install netting or reinforced ceiling tiles beneath RAAC planks to prevent debris from falling into occupied spaces in the event of surface spalling. These interventions typically require localised decanting of clinical areas to allow safe access for contractors.

At Hinchingbrooke Hospital and James Paget University Hospital, the remediation strategy has primarily relied on end-bearing support (EBS), with only around 15-50% of planks having received full-span support (FSS). This approach, while effective in the short term, may necessitate further upgrades in the medium to long-term (2030 plus 4-10 years) as planks continue to age or degrade. It is estimated for costing) that approximately 10% of planks within these two hospital sites may require FSS each year, particularly in areas where creep or displacement becomes evident. This estimation sits outside of the current remedial works programme.

Ongoing remediation funding and associated operational disruption may continue to be required post-2030 and to a point where the new hospital is completed.

**Table 6.10: RAAC Remediation**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | N/A | No works expected. |
| Medium-term (2030 + 4–6 years) | [redacted] | Includes timber bearers, wedges, ceiling removal, and site protection.<br>Note that the higher value shown is applicable to the two sites adopting end-bearing-support only. |
| Long-term (2030 + 6–10 years) | [redacted] | Includes netting or reinforced ceiling tiles to prevent spalling debris.<br>Note that the higher value shown is applicable to the two sites adopting end-bearing-support only. |

Many of these works would require local decanting or re-organisation of clinical spaces to allow access; this would require prior planning and agreement with the relevant service providers.

At some hospitals, there are now inpatient decant facilities, but these may not necessarily provide sufficient clinical resilience for Level 2 and Level 3 Critical Care (ICU) patients; specialist services such as theatres, maternity, etc. may need to reduce service levels whilst work is undertaken. However, all sites have now achieved considerable expertise in planning for such contingencies.

#### 6.4.1.5 RAAC Walls

Ongoing works for RAAC walls across the RAAC-affected hospitals focus on maintaining weatherproofing, preventing corrosion of embedded reinforcement, and ensuring long-term structural integrity. These works are generally categorised into physical repairs and regular surveying.

In the short term (2030 plus 1-3 years), no physical works are expected for RAAC walls.

In the medium term (2030 plus 4-6 years), minimal physical repairs are anticipated. These include painting and decoration of RAAC wall panels, typically assuming a 15-year design life for the protective coatings. The goal is to prevent moisture ingress and corrosion of reinforcement. These works are generally low-impact and do not require decanting of clinical areas, provided there is sufficient working height and access.

In the long term (2030 plus 6-10 years), more substantial interventions may be required depending on the hospital. For example, at West Suffolk and Queen Elizabeth Hospitals, sacrificial anodes have been installed as part of a cathodic protection system for external RAAC wall panels. These anodes have a design life of approximately 15 years, meaning replacements may be necessary post-2040.

**Table 6.11: Mitigation: Walls**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | [redacted] | Painting and decoration to prevent corrosion. |
| Medium-term (2030 + 4–6 years) | | |
| Long-term (2030 + 6–10 years) | [redacted] | Includes potential replacement of anodes and continued maintenance. |

## 6.3.2 Management Works (non-physical works)

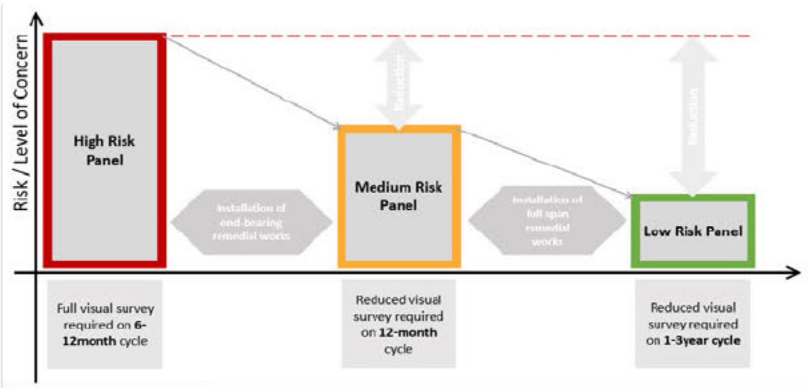
### 6.3.2.1 Ongoing Surveying Works – Roofs

Regular surveys of RAAC roof planks are planned to monitor their condition and the effectiveness of remediation efforts. This applies to remediated and un-remediated panels depending on their condition.

By 2030, with the completion of the remedial works programme, it is expected that nearly all planks will be considered low-risk; as such requiring surveys every 3-years only. The exception to this being the two Trusts that have adopted end-bearing-support only which would remain as a medium risk and adopting annual survey cycles.

These ongoing survey works are assumed to follow NHS RAAC guidance which is outlined below:

**Figure 6.1: Survey Frequency**




| | | |
|---|---|---|
| High Risk Panel | 6-12month cycle | In line with the IStructE guidance:<br>Full visual survey of the panels.<br>- Cracking<br>- Water penetration<br>- Builders work<br>Tap-testing<br>Full displacement survey (LIDAR)<br>Survey of roof level |
| Medium Risk Remediated Panel<br>Medium Risk Panel | 12month cycle | Full visual survey of the panels to identify changes (as above). Spot-check of displacement where possible |
| Low Risk Remediated Panel | 1-3year cycle | Visual survey of panel (only) |
| Low Risk Panel | 1-3year cycle | Full visual survey of the panels to identify changes (as above). Spot-check of displacement where possible |

Cost estimates for these reduced ongoing surveys are provided below:

**Table 6.12: Mitigation: Surveys**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Pre-2030 (Between remediation and 2030) | [redacted] | For 3-yearly inspections or after adverse events (e.g. leaks, storms). |
| Short-term (2030 + 1–3 years) | | |
| Medium-term (2030 + 4–6 years) | | |
| Long-term (2030 + 6–10 years) | | |

The cost estimates above are based on a Mott MacDonald assessment of the total number of RAAC planks per department and assumed number of planks that may be surveyed per day.

Typically, these costs are distributed over the 3-year survey period and considered a reduced level of survey for fully remediated hospitals. Where end-bearing only has been installed, survey costs are based on annual inspection.

#### 6.3.2.2 Ongoing Surveying Works – Walls

Ongoing RAAC wall surveys will remain as part of the ongoing risk management strategy across the majority of the RAAC-affected hospitals. These surveys are designed to monitor the condition of remediated wall panels and detect early signs of deterioration, such as spalling or cracking, which could indicate corrosion of embedded reinforcement or structural fatigue.

Typically, this will involve conducting visual inspections on an annual basis or in response to changes in condition. These surveys are non-intrusive and aim to maintain a minimum level of oversight for all remediated RAAC wall panels. Importantly, they would have no operational impact, meaning they do not require decanting of clinical areas or disruption to services.

**Table 6.13: Mitigation: Surveying**

| Period | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Pre-2030 (Between remediation and 2030) | [redacted] | Annual inspections or upon signs of spalling/cracking. |
| Short-term (2030 + 1–3 years) | | |
| Medium-term (2030 + 4–6 years) | | |
| Long-term (2030 + 6–10 years) | | |

The cost estimates above are based on a Mott MacDonald assessment of the total number of RAAC wall panels, based on clear access across the sites.

#### 6.3.2.3 Primary Structural Frame

Ongoing monitoring of RAAC installations across the RAAC 7 hospitals has, to date, largely excluded the primary structural frame from routine inspection programmes. As a result, no significant remedial works have been undertaken on these frames.

This is a notable gap in the overall risk management strategy, particularly given the age and construction context of these buildings. By 2030, the primary structural frames in these hospitals will be approximately 60 years old. At the time of their original construction, the concept of a defined design life was not formally applied, and the codes of practice used during the design did not fully account for the long-term environmental impacts on reinforced concrete - such as carbonation, chloride ingress, and moisture-induced corrosion.

Given these factors, it is recommended that hospitals begin to incorporate targeted inspections of the primary structural frame into their medium to long-term maintenance strategies. These inspections should focus on high-risk areas, such as plant rooms, exposed concrete façades, and locations where previous structural interventions have occurred. The aim is to identify early signs of deterioration such as cracking, spalling, or reinforcement corrosion before they develop into structural issues. While no immediate physical works are anticipated in the short term, the findings from these surveys may necessitate localised remedial actions. These could include application of protective coatings, or even partial replacement of damaged concrete elements.

Some hospitals have already encountered issues that highlight the importance of this proactive approach. For example, both Airedale and Frimley Park Hospitals have experienced failures in corbels due to insufficient reinforcement, which required urgent strengthening works. These cases serve as a warning that, although the primary frame may appear robust, its long-term performance cannot be assumed without evidence from regular condition assessments.

**Table 6.14: Mitigation: Primary Frame**

| | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | [redacted] | Suggested surveying of the primary frame in high-risk areas (e.g. plant rooms, exposed concrete façades). |
| Medium-term (2030 + 4–6 years) | | |
| Long-term (2030 + 6–10 years) | | |

#### 6.3.2.4 Ongoing Risk Assessments and Management

Ongoing management of RAAC across the RAAC 7 hospitals will require a structured and proactive approach to ensure continued safety and operational resilience. Central to this is the implementation of a formal RAAC Management Plan at each site, aligned with NHS guidance and maintained by operational estates teams within each site.

This plan should include clear protocols for inspection, maintenance, and response to emerging risks. A key component of this ongoing management is the regular convening of ALARP (As Low As Reasonably Practicable) workshops.

These workshops provide a structured forum for reviewing the current risk profile of RAAC elements, assessing the effectiveness of mitigation measures, and identifying any new actions required to reduce residual risks. They also support cross-disciplinary collaboration between estates, clinical, and operational teams, ensuring that decisions are informed by both technical assessments and service delivery needs.

In addition to ALARP reviews, hospitals must maintain dedicated RAAC oversight teams, continue routine surveying of remediated areas, and update standard operating procedures (SOPs) to reflect evolving understanding of RAAC behaviour.

This ongoing management framework is considered essential for maintaining compliance and safety and supporting informed decision-making around future investment, refurbishment, or replacement of RAAC-affected infrastructure.

**Table 6.15: Mitigation: Risk Assessment**

| | Typical Cost Range (per site / per annum | Comment |
|---|---|---|
| Short-term (2030 + 1–3 years) | [redacted] | Includes annual or biennial ALARP workshops, RAAC team operations, and SOP maintenance. |
| Medium-term (2030 + 4–6 years) | | |
| Long-term (2030 + 6–10 years) | | |

The cost estimates above are based on a Mott MacDonald assessment of an assumed post-remedial organisation structure comprising one full-time RAAC lead supported by part-time personnel and external consultants.

## 6.4 Infrastructure Risk Mitigation Works

The RAAC 7 hospitals will need continued investment in maintaining, servicing, and replacing mechanical and electrical services infrastructure to mitigate the service delivery risks presented by critical infrastructure failure. Regular inspections and monitoring of failures across all systems is required to balance available funding against the risks presented.

Electrically, continued backlog maintenance and some targeted investment in key elements for resilience improvements is considered sufficient to prolong usage of the hospitals until their replacements are complete.

Mechanically, the targeted investments are generally much more significant and broader. Some of the hospitals' mechanical services have already been underperforming for some time, and any extension of use will continue the decline.

As infrastructure continues to age, reactive maintenance spending and resource levels may need increase, reflected in funding levels and allocations. Funding will need to continue until the new hospital is fully commissioned, therefore any slippage of new hospital programme completion needs to be considered in forward funding planning.

Where ongoing, or increased, maintenance and mitigation works are placing additional strain on estates resources consideration should be made to either increasing capacity in teams in the short to medium term or using the supply chain to undertake planned or scheduled work to increase capacity.

Detailed suggestions of infrastructure risk mitigation work for each hospital site are included in the site-specific reports, taking consideration of short, medium and long-term timescales. Additional considerations are alternate mitigations that could be applied to any site. These are largely similar across the sites, with the main exceptions being works to HV and LV panels, generators, and heating systems.

Timeframes are defined as follows:

- **Original target date** for completion of the new Hospital: **2030**
- **Short-term** is defined as the original date plus an extension **2030 plus 1-3 years**
- **Medium-term** is defined as the original date plus an extension **2030 plus 4-6 years**
- **Long-term** is defined as the original date plus an extension **2030 plus 6-10 years**

The implementation of these mitigation measures seeks risk reduction whilst avoiding wholesale replacements given the prospective timeline for the new hospitals.

An overview of potential mitigations is below.

### 6.4.1 Typical Electrical Measures Recommended

**Table 6.16: Electrical Infrastructure Mitigation Measures**

| Short Term | Medium Term | Long Term | Additional Considerations |
|---|---|---|---|
| **HV/ LV Main equipment** | | | |
| Regular maintenance, allow for temporary generator and connections. | Continued regular maintenance; replacement of legacy distribution boards; allowance for additional temporary generator and connections where not installed | Replacement of legacy HV switchgear, HV/LV equipment, and LV switchgear | |
| **Backup Generators** | | | |
| Regular maintenance, allow for temporary generator and connections. | Continued regular maintenance; additional generators for N+1 capacity where there is insufficient resilience | Replace all generators and increase provision to provide N+1 capacity where there is insufficient resilience | An on-call supplier under a contract that is able to provide emergency generator supplies to any of the affected sites would save time in an emergency. |
| **LV Distribution equipment** | | | |
| LV and UPS provide no-break supplies to essential equipment, replacement device from spares within hours. | Replace LV distribution boards and UPS equipment | N/A | |
| **Nurse Call** | | | |
| Troubleshooting by Estates team; system repair or partial replacement; consider procuring wireless pager system as fallback | Monitoring and management of existing systems –mitigations plans in the event of a failure | Monitoring and management with localised replacement where needed/ feasible. Potential for the use of a wireless back-up system. | Full replacement of Nurse Call – following a comprehensive survey to determine the feasibility of these works. |
| **Digital Infrastructure** | | | |
| No specific mitigations proposed. | A standalone data centre or communications hub could be developed at each hospital to house critical IT systems, fibre connections, and UPS systems. This would reduce the risk of digital infrastructure service disruption due to RAAC-related failures in ceiling voids or corridors and could be integrated into the future hospitals' digital backbones. | | |

### 6.4.2 Typical Mechanical Measures Recommended

**Table 6.17: Mechanical Infrastructure Mitigation Measures**

| Short Term | Medium Term | Long Term | Additional Considerations |
|---|---|---|---|
| **VIE** | | | |
| Regular visual inspection, servicing, and maintenance; secure space for temporary portable oxygen solution where not already available | Regular visual inspection, servicing, and maintenance; ensure portable oxygen tanks are available | Replace VIE oxygen system | |
| **CHP/Boilers** | | | |
| Back-up temporary boilers: temporary electric water heaters and heaters may be considered | Back-up temporary boilers to be installed to support the heating load from the existing boilers. Temporary point-of-use electric water heater and electric heaters to be placed around the hospital to supplement the lack of heat generation. | Addition of dual fuel boilers to mitigate the remaining load required from removal of CHP unit to support the heating. Full service and maintenance of CHP unit, complete replacement if necessary. | A new energy centre—housing boilers, chillers, or combined heat and power (CHP) unit could be constructed as a standalone facility. This would allow hospitals to decommission ageing rooftop plant located on RAAC structures and reduce the risk of mechanical failure. |
| **Ventilation / AHU** | | | |
| Continued backlog maintenance replacement of worn components | Replacement of life-expired parts | Plan for replacement AHUs progressively throughout hospital including removal of life-expired equipment. | |
| **Chillers** | | | |
| Continued regular maintenance, replacement of worn components | Replacement of life-expired parts | Plan for replacement of chillers progressively throughout, including removal of all life-expired and any rental units. | |
| **Pipework** | | | |
| Continued regular maintenance, replacement of worn components and damaged insulation | Installation of new valves and isolation to maintain existing systems. | Replacement of corroded pipework as part of the ongoing backlog maintenance regime. | |

### 6.4.3 Funding

As the infrastructure continues to age at the RAAC 7 hospital sites, there could be an increased need to repair and replace equipment to maintain service delivery – until the new hospital is commissioned. As completion dates get more certain, it will make less sense to invest in large scale infrastructure replacement, meaning reactive repairs and interim measures will be more likely. This may create funding pressure depending on the nature of infrastructure repairs.

## 6.5 Spending to Date

The RAAC 7 hospitals receive Operational Capital Funding to support the ongoing operation of their estate, similar to other NHS Trusts in England. This funding is used to support the ongoing maintenance of the estate, typically targeted at infrastructure. In the year 2025-2026, this has equated to £4bn across all NHS Trusts in England, however the individual allocations for the RAAC 7 hospital sites is not publicly available.

In addition to this Operational Capital Funding, the RAAC 7 hospitals have received targeted funding for RAAC and Critical Infrastructure Risk (CIR) through the RAAC funding stream and the Estates Safety Fund. This funding is described below.

### 6.5.1 RAAC Funding

Since the RAAC programme was started in 2021, the RAAC 7 Hospitals have received significant funding to support their ongoing remediation and management. This equates to over £480m across the hospitals between 2021 and 2025.

This is outlined below:

**Table 6.18: RAAC Funding spending to date**

| Site | RAAC funding 2021-22 | RAAC funding 2022-23 | RAAC funding 2023-24 | RAAC Funding 2024-25 | Total RAAC Funding<br>2021-25 |
|---|---|---|---|---|---|
| Hinchingbrooke | £13.0m | £20.0m | £10.7m | £5.0m | **£48.7m** |
| West Suffolk | £30.0m | £22.5m | £10.9m | £6.1m | **£69.5m** |
| Frimley | £7.5m | £9.1m | £14.5m | £7.1m | **£38.1m** |
| James Paget | £2.8m | £14.4m | £7.8m | £9.0m | **£34.0m** |
| Kings Lynn (QEH) | £20.7m | £30.8m | £32.0m | £35.0m | **£118.5m** |
| Leighton | £22.0m | £29.7m | £29.3m | £27.5m | **£108.5m** |
| Airedale | £10.0m | £20.0m | £17.0m | £18.9m | **£65.9m** |
| **TOTAL** | **£106.00m** | **£146.50m** | **£122.20m** | **£108.60m** | **£483.20m** |

### 6.5.2 Estates Safety Fund Allocations

Additional estates safety funding has been made available to all NHS Trusts. For the RAAC 7 hospitals, the following allocations by their relevant Integrated Care Board were made for 2025-26; equating to circa £23.5m.

**Table 6.19: Critical Infrastructure Allocation 2025-26**

| Site | Total allocated Estates Safety Funding<br><br>2025-26 | `Description of works |
|---|---|---|
| Hinchingbrooke | £5.7m | Improvements to internal and external building fabric and fixtures, ventilation systems, medical gases systems, electrical systems, technology systems, fixed plant/or equipment and energy systems. Roof works. Fire safety works. |
| West Suffolk | - | No allocation requested. |
| Frimley | £6.2m | Improvements to security systems, energy systems, water systems and ventilation systems. Replacement of nurse call systems. |
| James Paget | £1.4m | Improvements to security systems. Fire safety works. Lift upgrade or replacement. |
| Kings Lynn (QEH) | £3.0m | Improvements to medical gas systems, electrical systems, water systems, and fixed and/or plant equipment. Lift upgrade or replacement. Fire safety works. |
| Leighton | - | No allocation requested. |
| Airedale | £0.8m | Improvements to internal building fabric and fittings, electrical systems, medical gas systems, water systems, security systems and fixed plant and/or equipment. Fire safety works. Nurse call system replacement. |

# 7 Objective 3 – Clinical Operational Impacts

## Objective Aim:

***Set out the clinical operational impacts on the running of the hospital and the associated costs, of opening the replacement hospital after the estimated life of the current hospital site or 2030, whichever is sooner.***

## Summary Response:

The RAAC 7 hospital Trusts are all progressing to completing remediation before 2030. All hospitals have a well-planned programme of works, although some sites have yet to remediate all high-risk departments (e.g. Critical Care at James Paget).

These remediation works have been effectively managed, they have been disruptive, often requiring multiple relocations of clinical services – placing pressure on operational efficiency and sometimes impacted clinical spaces.

It is not possible to quantify accurately the operational impact that the presence of RAAC has had within the RAAC 7 hospitals. However, all hospitals currently run at a deficit and are subject to increased oversight by the NHS, under the NHS Oversight Framework.

Once remediation is complete, the services will be able to operate 'as normal'. However, unlike hospitals not impacted by RAAC, the RAAC 7 will continue to face constrictions by the remediation works and under ongoing disruption associated with routine inspections of the RAAC planks, panels and remediation works.

The hospital staff have shown commendable resilience throughout the remediation works, with many lessons learned and shared. However, this resilience may face increasing pressure if the timeline of the new hospitals extends beyond the current projects, underscoring the importance of maintaining momentum of the hospital replacement programmes.

Although remediated, RAAC will still be present in these hospitals. There remains an adverse impact on staff and patient confidence from the knowledge that RAAC is still present. This is not quantifiable.

In addition to RAAC related challenges, the hospitals also face ongoing potential risks from ageing critical infrastructure, primarily those systems which are essential to clinical operations e.g. Emergency Generators. Unlike RAAC related disruptions, these infrastructure failures would be unplanned and pose a greater operational risk. It is noted that such infrastructure issues are not unique to the RAAC hospitals.

Systems risks exist in the East of England where neighbouring hospitals that could support during an unplanned event are equally subject to RAAC and infrastructure risks.

# Background to Objective 3 Response

## 7.1 NHS Oversight Framework – Financial

The new NHS Oversight Framework (NOF) 2025/26 describes the approach to assessing and supporting NHS Trusts to support improvement. Within this framework there are 5-segments that describe performance. The RAAC 7 hospital Trusts are all located within NOF3 or NOF4, described below:

- NOF 3; NHS England may apply interventions and/or require the organisation to take action in specific areas of low performance. This may involve use of our enforcement powers, particularly where performance concerns persist.
- NOF4; NHS England may apply interventions and/or require the organisation to take broad actions or address specific concerns related to known issues. This may involve use of our enforcement action, particularly to secure improvement or where improvement is insufficient.

The NOF system provides insight into the deficit position of the NHS trust, providing a metric score for financial position, which alongside other metrics, is used to rank individual Trusts. The data shown in the table below is taken from the NOF dashboard[7] at Trust level for the RAAC 7:

**Table 7.1: Extract from NOF Dashboard**

| Hospital | NOF Segment | Rank | In deficit | Planned surplus / deficit (metric score) |
|---|---|---|---|---|
| Hinchingbrooke | 4 – Low performing | 105 | Yes | -1.45 |
| James Paget | 4 – Low performing | 129 | Yes | -5.57 |
| West-Suffolk | 3 – Below Average and/or Financial Deficit | 90 | Yes | -4.91 |
| Frimley | 3 – Below Average and/or Financial Deficit | 37 | Yes | -1.85 |
| Kings Lynn (QEH) | 4 – Low performing | 134 | Yes | -7.26 |
| Leighton | 3 – Below Average and/or Financial Deficit | 96 | Yes | -9.61 |
| Airedale | 3 – Below Average and/or Financial Deficit | 44 | Yes | -9.03 |

This table highlights that all RAAC 7 Trusts operate at a deficit, and that some are ranked among some of the lowest in England; of the 134 Trusts, three are within the bottom 25% of the ranking and one is at the bottom.

The metrics do not measure how operational efficiency and financial position is impacted by the RAAC estate and, the change in measurement of financial performance over the last decade does not allow direct comparison of how RAAC works have impacted finances over time.

However, the NOF segment and ranking highlight the challenges with operating within these aging hospitals.

The group Chief Executive of QEH recently stated that the presence of RAAC 'makes things harder, it doesn't make things impossible'.

[7] Home - NHS England Data Dashboard

## 7.2 Clinical Quality

The newest of the RAAC 7 hospitals is over 40 years old. Collectively, they all suffer a range of insurmountable issues with their layout, adjacencies, and functional content, including:

- Undersized wards, generally less than half the size of an equivalent modern ward (e.g. NHP Hospital 2.0 standard).
- Lack of adequate storage space.
- Compromised privacy and dignity, particularly in ward areas, with six-bed bays with no ensuite sanitary provision.
- The management of infection risk is severely hampered by the low availability of single bedrooms
- The multi-bed configuration and more general issues pose challenges for gender segregation (e.g. patients needing to cross ward corridors to access sanitary facilities).
- Facilities that are not configured for modern healthcare, necessitating 'bolting on' additional facilities, disrupting clinical flows and wayfinding – for example, the designs pre-date MRIs, CTs, Interventional services, widespread use of day surgery, etc.
- Clinical challenges stem from inherent flaws in the basic design of the hospitals, and the difficulties of delivering modern medicine – e.g. undersized rooms and limited storage.
- Remediation works and presence of RAAC has resulted in some clinical compromises – for example, around the treatment of heavier patients in some first-floor departments, or the constraints on equipment use (e.g. hoists at Queen Elizabeth Hospital).

The inherent design and configuration challenges are not unique to the RAAC 7 hospitals. However, the RAAC 7 hospitals have the added complication of the ongoing inspection programme for RAAC adding a further level of risk and uncertainty.

Any further delay to the replacement of these facilities will compromise the benefits that will be realised by Hospital 2.0 hospitals delivered by the New Hospital Programme – the programme business case predicted a benefit cost ratio of more than 3:1 and it is therefore paramount that they are replaced without further delay.

## 7.3 Operational Impacts of RAAC Monitoring

Regular inspections are recommended for RAAC installations. These inspections are specific to RAAC hospital sites given the lack of reliable data on the longevity of RAAC. The inspection is more frequent and detailed than surveys for non-RAAC hospital sites and therefore have increased operational impacts, particularly in departments that operate 24 hours (removing the option of 'out of hours' inspection).

The frequency varies depending on the remediation approach employed, ranging from annual to 3-yearly inspections.

Typically, inspections are well planned, therefore associated temporary disruption could be aligned with scheduled routine maintenance and deep cleaning activities to minimise impacts; for example in theatres. Unplanned inspections may occur should a reportable event occur, such as a roof leak; these would lead to unplanned disruption.

Based on engagement with the Trusts, the table below outlines key operational and timing impacts of RAAC monitoring on a department basis. These impacts have been equated to loss of revenue costs per day using a range of metrics, including published NHS standard costs (e.g. for inpatient bed-days). The costing methodology is set out at **Appendix D**.

Note these costs are for planned inspection only; any identified further remediation would be in addition (see below).

### Table 7.2: Key Operational and Timing Impacts

| Service/Department | Operational Impact | Duration | Loss of revenue Cost per day |
|---|---|---|---|
| Adult Inpatients | • Closure of relevant bedded areas during the inspection<br>• This would be a phased process, with closure of one multi-bed bay or single room at a time to complete the inspection (6-bed bay assumed)<br>• Decant of patients or reduction in bed usage during inspection | • Whole ward would take 5 days 0 assume 1 day for inspection per 6-bed bay<br>• This enables inspection and subsequent deep clean | £2,556 (6-bedded bay) |
| Catering | • Out of hours inspection assumed | • The time required would depend on department size<br>• Full deep cleaning would be required afterwards | £0 – assume out of hours |
| Central Sterile Services Department (CSSD) | • Out of hours inspection is assumed, to minimise operational disruption | • Costs would be nil based on assumption of out of hours clean<br>• Full deep cleaning would be required afterwards | £0 – assume out of hours |
| Emergency Department (ED) | • Will require phased closure of relevant bedded and assessment areas<br>• It is assumed 4 rooms are inspected at a time (to minimise operational disruption) | • Would be phased to minimise disruption<br>• Full deep cleaning would be required afterwards | £21,994 (4x rooms) |
| Intensive Care Unit (ICU) | • Closure of relevant bedded areas during the inspection<br>• This would be a phased process, with closure of one multi-bed bay or single room at a time to complete the inspection<br>• Decant of patients or reduction in bed usage during inspection | • Assume 3 days for inspection of the entire unit<br>• Assume maximum of 4x beds at any time (typically a unit has c.12x beds)<br>• This enables inspection and subsequent deep clean | £9,477 (4x beds) |
| Maternity & Birthing Unit - *Antenatal outpatients* | • Out of hours inspection assumed, to minimise operational disruption | | £0 – assume out of hours |
| Maternity & Birthing Unit – *Ante- and Post-natal ward* | • See Adult Inpatients | • See Adult Inpatients | £2,556 |
| Maternity & Birthing Unit – *Birthing unit* | • Closure of relevant bedded areas during the inspection<br>• This would be a phased process, with closure of one birthing room at a time | • Assume 1 day per room for inspection per unit<br>• This enables inspection and subsequent deep clean<br>• Cost per day is based on average numbers of births per room | £3,762 |
| Neonatal unit (NICU) | • Closure of relevant cot areas during the inspection<br>• This would be a phased process, with closure of one multi-cot bay or | • Assume 3 day for inspection for the entire unit<br>• Assume 2x cots inspected at a time<br>• This enables inspection and subsequent deep clean | £2,613 (2x cots) |

| Service/Department | Operational Impact | Duration | Loss of revenue Cost per day |
|---|---|---|---|
| | single cot room at a time to complete the inspection<br>• Decant of patients or reduction in cot usage during inspection | | |
| Outpatients | • Out of hours inspection is assumed, to minimise operational disruption | | £0 – assume out of hours |
| Paediatric Inpatients | • Closure of relevant bedded areas during the inspection<br>• This would be a phased process, with closure of one multi-bed bay or single room at a time to complete the inspection<br>• Decant of patients or reduction in bed usage during inspection | • Assume 1 day for inspection per ward<br>• As with adults, 6-bed bay assumed to be inspected at any time<br>• This enables inspection and subsequent deep clean | £2,566 (6-bed bay) |
| Pathology | • Out of hours inspection is assumed, to minimise operational disruption<br>• Note that urgent (hot lab) activities will need to continue 24/7<br>• This would need to be coordinated with the relevant services to minimise disruption | • The time required would depend on department size<br>• Full deep cleaning would be required afterwards | £0 – assume out of hours |
| Theatres | • Either phased closure of Theatres or out of hours inspection<br>• Typically, the phasing would be 1 or 2 theatres at a time – 1x assumed for costing | • Typically, a theatre would take around a day to inspect – excluding ancillary accommodation (e.g. recovery, etc.)<br>• The inspection could be timed to coincide with planned maintenance e.g. to air handling<br>• This would have a service impact of closing each theatre for a day, unless done out of hours | £13,150 (1x Theatre) |

## 7.4 Impacts of Further Remediation

There is a risk that regular RAAC inspections identify further remediation. The operational and service impacts will be significantly greater as such works are likely to be unplanned. Extended closures or decanting will be required, leading to disruption across affected areas.

The table below outlines assumptions made for process and implications of further remediation on a department basis. The time allowance is based on discussions with the Trusts and their previous remediation programmes, as well as assessments of the work involved.

It includes an allowance for post-works clinical clean. The final actual time and cost will depend on the scale of the necessary works.

**Table 7.3: Operational Impact by Department**

| Service/Department | Operational Impact | Duration | TOTAL loss of revenue cost for works (periods vary). |
|---|---|---|---|
| Adult Inpatients | • Closure of relevant bedded areas where remediation work is required<br>• This would be a phased process, with closure of one multi-bed bay or single room at a time to complete the remediation<br>• Decant of patients or reduction in bed usage during remedial works | • Could close one bay at a time (6 beds)<br>• Assume 5 days per ward for remediation if ward is closed | • 6 beds: £12,831<br>• Ward closure (assume 36-beds): £76,984 |
| Catering | • Assume service would be provided by external provider | • As required | • N/a |
| Central Sterile Services Department (CSSD) | • Requires full decant or redirection of services to a neighbouring site | • Assumes 5 days to complete remediation for the whole department | • 13 theatres closed (average unit size): £447,720 |
| Intensive Care Unit (ICU) | • Requires a full decant to complete remedial works<br>• If not able to fully decant, this would result in severe disruption<br>• Challenges of maintaining appropriate adjacencies with Theatres and UEC should the service fully decant | • Assume 5 days per ward (if fully vacated) for remediation<br>• If not full vacating of ward, one day per cot / bay area: approximately 8-9 days per ward | • 12-beds closed (average size of unit): £142,156 |
| Maternity & Birthing Unit - *Antenatal outpatients* | • Remediation would be completed out of hours to minimise operational disruption | • As required | • N/a |
| Maternity & Birthing Unit – *Ante- and Post-natal ward* | • See Adult Inpatients | • Could close one bay at a time (6 beds)<br>• Assume 5 days per ward for remediation | • 6 beds closed: £12,831<br>• Ward closed (assume 36-beds): £76,984 |
| Maternity & Birthing Unit – *Birthing unit* | • Closure of relevant bedded areas where remediation work is required<br>• This would be a phased process, with closure of one multi-bed bay or single room at a time to complete the remediation<br>• Challenges of maintaining appropriate adjacencies with Theatres and Neonatology should the service fully decant | • Assume 1 day per room for remediation if phased: typically, around 8-9 days for the whole unit<br>• Assume 5 days for remediation if whole unit vacates | • £3,762 for one room for one day<br>• 9 days at one room at a time would therefore equal £33,858<br>• 5-day closure of 5-room unit is £94,050 |
| Neonatal unit (NICU) | • Requires a full decant to complete remedial works<br>• If not able to fully decant, this would result in severe disruption<br>• Challenges of maintaining appropriate adjacencies | • Assume 5 days per ward (if fully vacated) for remediation<br>• If not fully vacated, one day per 2-cot room/area: approximately 9 days per ward for remediation (maximum 2 cots at any time) | • Average unit size of 11 cots: full closure would be £71,848<br>• £23,508 for phased shut down |

| Service/Department | Operational Impact | Duration | TOTAL loss of revenue cost for works (periods vary). |
|---|---|---|---|
| | with Maternity should the service fully decant | | (1 room (2 cots) at a time) |
| Outpatients | • Remediation would be completed out of hours to minimise operational disruption | • As required | • N/a |
| Paediatric Inpatients | • Closure of relevant bedded areas where remediation work is required<br>• Decant of patients or reduction in bed usage during remedial works | • Could close one bay at a time (6 beds)<br>• Assume 5 days per ward for remediation if ward is closed | • 6 beds: £12,831<br>• Ward closure (assume 36-beds): £76,984 |
| Theatres | • Phased closure of theatres<br>• Typically, the phasing would be 1 or 2 theatres at a time | • Assume 5 days per theatre for remediation (1 theatre at a time) | • 5 days (1 theatre): £65.750 |
| Pathology | • Requires full decant or redirection of services to a neighbouring site | • Assumes 5 days to complete remediation for the whole department (based on 20,000 tests/day) | • 5 days: £25,259 |
| Emergency Department (ED) | • Will require phased closure of relevant bedded or assessment areas<br>• Bedded and assessment areas could potentially be decanted fully | • Assume 1 day to remediate a block of 4 cubicles (c.2-3% of total activity)<br>• Assumes 5 days to complete remediation for the whole department | • 4 cubicles for one day: £21,994<br>• Full closure (5 days): £479,392 |

## 7.5 Lessons Identified and Knowledge Sharing

Managing the RAAC remediation process has identified key lessons, which can be applied to any similar future disruption or incident. The lessons are common across the RAAC 7, and the knowledge gained could be shared across the wider NHS.

The key lessons identified can be summarised as follows:

- The importance of joint working, to enable services to plan for any disruption.
- Learnings around how to adapt services to work around disruption, including changing clinical timetables; this has given the Trusts greater resilience and operational flexibility that has become second nature.
- The importance of communication – particularly internally between departments – has been shown, with the sites reporting the benefits of dialogue between clinical, operational and estates teams.
- Identified points of contact has been shown to be key; all Trusts now have clear routes for dialogue and management of the RAAC programme ('knowing where to turn for help'); in addition, the 4 Trusts in the East of England now benefit from a dedicated NHSE team.

Experience of managing the RAAC disruption has enabled the Trusts to manage significant operational challenges. Whilst not an easy process, the learnings are valuable and we recommend that this learning is shared with the wider NHS, to:

- Inform future remediation planning, where required,
- Strengthen strategies for ongoing inspection and maintenance,
- Ensure any potential disruption is minimised for patients and staff,
- Reflect the depth of organisational learning and resilience developed through the programme,
- Support wider resilience against service disruption.

These insights include:

- Decanting preferred over in-situ remediation
  - While logistically complex, decanting was widely seen as the safer and less disruptive option. It significantly reduced exposure to noise, dust, and safety risks compared to maintaining operations during live remediation, particularly in sensitive areas like maternity and theatres.
- Collaborative working is essential
  - Effective and less disruptive remediation was consistently underpinned by close collaboration between estates, clinical, and operational teams. Clear and consistent communication was repeatedly cited as essential to maintaining safety, morale, and operational continuity.
- Standardised decant processes improved efficiency
  - Trusts that adopted a structured, repeatable approach to ward or bed bay decants experienced smoother transitions and reduced disruptions. Standardisation helped streamline planning and execution, particularly during high-pressure periods.
- Balancing competing pressures
  - Trusts faced the ongoing challenge of balancing RAAC remediation with other financial and operational demands, including staffing pressures, infrastructure upgrades, and winter capacity planning.

As well as these shared themes, individual Trusts also demonstrated flexibility and innovation in addressing site-specific challenges. Some key examples include:

- Post-remediation adaptation at QEH
  - Reduced ceiling heights post-remediation interfered with the use of hoists. The Trust introduced lower beds to mitigate this, which in turn required new manual handling protocols to address emerging risks.

- Catering model shift at JPUH
  - To maintain food services during remediation in catering areas, the Trust transitioned from a fresh cook model to chilled prep. While this introduced operational complexity and some dissatisfaction, it ensured continuity of service.
- Out-of-hours remediation at West Suffolk
  - To preserve surgical throughout, the Trust scheduled weekend theatre sessions and prioritised cases. This approach helped mitigate delays cause by infrastructure constraints and Acro prop installations.
- ICU decant strategy at Airedale
  - The ICU was relocated to a new space not adjacent to Theatres or Diagnostics, which enabled critical remediation works to proceed without compromising patient safety.

The common key themes emerging from the review are summarised below.

**Figure 7.1: Key Operational and Management Observations**

## Leadership and Management

**Coordinated leadership**

- Unified, calm, and clear communication has been essential in maintaining trust and direction during uncertainty
- Value of consistent, central coordination of the remediation programme
- Cross-functional collaboration has flourished – bringing together clinical, estates, and contractor teams in new and effective ways
- Earlier dialogue between the RAAC hospitals would have been beneficial
- Adaptability, resilience and contingency planning have improved through the process
- The focus on RAAC mitigation and management has detracted from other strategic improvements e.g. relocation of Renal at Airedale

## Estates and Delivery

**Flexibility and infrastructure readiness**

- The programme created net benefits to hospital infrastructure, enabling broader estate upgrades that would have otherwise been delayed
- Each Trust approached remediation differently, shaped by local needs, but in the absence of established guidance this led to inconsistent delivery models and learning gaps
- Difficult decisions have been required around timing, phasing, and whether to decant or work in situ
- The importance of having sufficient headroom and decant capacity to enable responsive and safe delivery
- The hospitals remain dated and undersized

## Staff Perspective

**Supporting workforce**

- A "can do" attitude and remarkable resilience have been consistently demonstrated by staff in the face of prolonged adversity
- Maintaining a positive patient and staff experience during RAAC works has been challenging, requiring constant adaptation and emotional labour
- While there is limited evidence of adverse impact on recruitment and retention, the cumulative strain managing both COVID and RAAC has pushed staff hard
- Teams have drawn on learning from COVID, applying them to navigate disruption
- There is a sense that continued morale is reliant on the new hospitals
  - *"Light at the end of the tunnel"*

# 8 Objective 4 – Options for Phased Approach for Replacement

## Objective Aim and Summary Response

***Define, describe and assess options for a phased approach to replacement at a programme and individual site level to minimise risk from RAAC plank failure, operational impact, and other backlog maintenance risks (high and significant).***

## Summary Response:

Building on the responses to Objectives 1, 2 and 3 in Sections 5, 6 and 7, this section evaluates where there is a feasible opportunity of early delivery of specific departments across the seven RAAC hospitals.

The analysis to date recognises that while remediation has responded to the immediate structural risks, the continued presence of RAAC, combined with ageing infrastructure and outdated clinical environments, presents ongoing challenges. Full hospital replacement remains the only sustainable long-term solution.

A phased approach to the redevelopment may be used to further reduce ongoing risk from RAAC panels, infrastructure failures and reduce backlog maintenance investment. This needs to be balanced with creating functional healthcare facilities that provide appropriate operational links / adjacencies between departments and not create workforce challenges – ensuring phasing aligns with the site masterplan and national programme priorities.

The table below recognises the proposals made within the UK Governments 10-year plan for England (July 2025)[8]. This plan acknowledges the move from hospital to community, developing a new operating model with support from digital interventions to place less reliance on acute hospitals. Where applicable, this has been referenced.

**Table 8.1: Department Suitability for Phased Development**

| Service / Department | RAAC Present above department | Suitability for phased delivery | Potential for standalone unit? | Impact on risk reduction* | Commentary | Required typical adjacencies/links |
|---|---|---|---|---|---|---|
| Pathology | LH, AH | High | High | High | Could be provided as a standalone unit.<br>Would require appropriate pathways to the current and future hospitals for urgent samples. | Could potentially be off-site if an on-site presence for urgent sample testing is maintained ('Hot labs') |
| Sterile Services (CSSD) | HH, QEH, LH, AH | High | High | High | Can be a standalone facility, but would require links to site-wide heat, light, power. | Supply routes to theatres and Outpatients |

[8] https://www.gov.uk/government/publications/10-year-health-plan-for-england-fit-for-the-future/

| Service / Department | RAAC Present above department | Suitability for phased delivery | Potential for standalone unit? | Impact on risk reduction* | Commentary | Required typical adjacencies/links |
|---|---|---|---|---|---|---|
| Outpatients | WSH, FPH, JPH, QEH, LH, AH | High | High | Medium | Could be provided as a standalone unit, potentially as part of a wider Outpatient facility.<br><br>Opportunities for changes in delivery model to provide some services in the community may be explored (NHS 10year plan). | If part of wider Outpatient facility, imaging, and diagnostics |
| Catering (Kitchens) | HH, WSH, JPH, QEH, LH, AH | High | High | Medium | Catering requires large volumes of material movements.<br><br>The size and scale of facility will depend on the service model. Changes to current practices may support size reduction or location off site. | This provides a service to a number of hospital department, including Adult and Paediatric Inpatients wards, Maternity, other patients, staff, and visitors.<br><br>A standalone facility would require robust logistical arrangements to support continued clinical operations in the main hospital |
| Physiotherapy | HH, WSH, FPH, JPH, QEH, LH, AH | High | High | Medium | Could be provided as part of a wider Outpatient facility – on or off site.<br><br>May need to maintain adjacency with inpatients wards. | Diagnostic and Imaging<br><br>Inpatients wards for rehabilitation |
| Endoscopy | No | High^^ | High | Medium | Could be provided as a standalone unit if used for planned ambulatory Endoscopy.<br><br>Would require separate entrance and access e.g. parking. | Will be serviced by CSSD and Pharmacy but does not need direct adjacency.<br><br>Emergency Endoscopy would be provided in Theatres |
| Admin | All | High | High | Low | Opportunities for changes in admin staff location and model to provide some services outside of the acute hospital site may be explored. | N/A |
| Facilities Management | All | High | High | Low | | N/A |
| Pharmacy | AH | High | Moderate | Medium | Inpatient Pharmacy would need to have close proximity to Wards.<br><br>Outpatient departments typically have a separate dispensing Pharmacy – this can be a retail pharmacy. | Adult Inpatients<br><br>Outpatients (separate service) |

| Service / Department | RAAC Present above department | Suitability for phased delivery | Potential for standalone unit? | Impact on risk reduction* | Commentary | Required typical adjacencies/links |
|---|---|---|---|---|---|---|
| | | | | | Aseptic Pharmacy (if provided) to supply various clinical services, including Oncology Day patient (Chemotherapy).<br>Pharmacy requires large volumes of material movements. | |
| Adult Inpatients | HH, WSH, FPH, JPH, QEH, LH, AH | High | Moderate | Medium | Potentially could be delivered as an early phase – either all wards or a proportion. Physical links to the existing hospital would be required. | Theatres; UEC; Critical Care |
| Maternity & Birthing Unit | HH, WSH, FPH, JPH, QEH, LH, AH | Moderate | Moderate | High | Would require easy access and all relevant services (Antenatal, Birthing Unit, maternity theatre, triage/ward), and Neonatal Unit. | UEC and Neonatal Unit<br>Needs to incorporate (maternity) theatre – this is essential for this to operate as a standalone unit |
| Neonatal unit (NICU) | HH, WSH, FPH, JPH, QEH, LH, AH | Moderate | Moderate | High | Neonatal services would need to relocate with Maternity due to the direct adjacency requirements. | Maternity services including Birthing and theatre |
| Paediatric Inpatients | HH, WSH, FPH, JPH, QEH, LH, AH | Moderate | Low | Medium | Adjacencies with other clinical departments are more important than for adult Inpatients. | UEC.<br>Theatres.<br>Outpatients |
| Theatres | HH, WSH, FPH, JPH, QEH | Low | Not suitable | High | Will require links to various services and frequent patient movements. | UEC; ICU<br>Relevant Inpatient wards<br>Maternity would require access to a theatre (potentially within the department, although not best practice) |
| Urgent and Emergency Care (UEC) | No | Low | Not suitable | High | Will require links to various services and frequent patient movements. | ICU<br>Theatres<br>Maternity<br>Adult Inpatients |
| Intensive Care Unit (ICU) | HH, WSH, JPH, QEH | Low | Not suitable | High | Would require co-location with other departments. | Theatres.<br>UEC.<br>Inpatients |

*Risk reduction defined within Section 6.6.4.

The ability for each site to accommodate a phased delivery depends on the site context. The following table provides a high-level review of each site, based on a high-level review outside of the individual Strategic Outline Case (SOC).

**Table 8.2: Summary of Difficulty of Phased Delivery**

| Site | Difficulty of phased delivery |
|---|---|
| Hinchingbrooke | Medium |
| West Suffolk | Medium |
| Frimley | High |
| James Paget | Low |
| Kings Lynn (QEH) | Medium |
| Leighton | Low |
| Airedale | High |

For a phased redevelopment to be a viable, the replacement approach would need to deliver facilities quicker than the current New Hospital Programme plans / timeframe.

Re-evaluating the existing New Hospital Programme plans to consider an alternate phased approach would likely be disruptive and cause delays at this stage, negating the benefits of phasing.

However, should the delivery of the new hospitals under the New Hospital Programme be delayed beyond the current construction timeline set out in in the New Hospital Plan for Implementation (construction expected to start between 2027-2029) phasing opportunities should be reconsidered.

Finally, it is recognised that, given the learnings identified through the previous sections, if a similar component or material with similar structural implications was discovered in the future, a phased approach to removal should be implemented from the start.

# Background to Objective 4 Response

## 8.1 Background

### 8.1.1 Mitigations and Strategic Considerations

The earlier sections of this report have outlined a set of mitigations for each of the RAAC 7 hospitals. These include structural interventions, RAAC plank remediation using end-bearing and full-span support systems, protective coatings for RAAC wall panels, and targeted surveys of the primary structural frame.

Critical mechanical and electrical infrastructure upgrades have been identified within individual site reports to address risks associated with ageing systems, single points of failure, and limited resilience. These measures are designed to reduce the likelihood of structural or service failure and to extend the safe operational life of each hospital until full replacement facilities can be delivered.

Mitigations are not a long-term substitute for modern, purpose-built healthcare environments. The presence of RAAC, combined with outdated layouts and infrastructure nearing or exceeding its design life, presents ongoing challenges to service delivery, patient safety, and staff wellbeing.

There remains a strong strategic rationale for exploring opportunities to accelerate the delivery of new hospital infrastructure particularly through the early replacement of high-risk or high-impact departments.

### 8.1.2 Rationale for Early Phase Delivery

The scale and complexity of the risks identified highlights that a phased approach to hospital redevelopment may offer a pragmatic and risk-informed solution. By delivering specific departments or functional areas of the future hospital ahead of the main build, Trusts can reduce operational risk, improve resilience, and begin to realise the benefits of modern healthcare environments sooner.

Phased delivery can also support service transformation by enabling new models of care to be piloted in modern facilities, (see section 8.2.4). For example, early delivery of ambulatory care or diagnostics hubs could support a shift toward same-day treatment and reduce pressure on inpatient beds. This approach has already been adopted at James Paget Hospital where the concept ward is being used to trial new single room working practices.

### 8.1.3 Site and Infrastructure Dependencies

The feasibility of early-phase delivery is highly dependent on the location and configuration of the proposed new hospital. Many services, particularly those involving emergency care, surgery, or critical care, require close proximity to other departments and cannot be delivered in isolation.

For these services, early delivery would only be viable if the new hospital is located adjacent to the existing site, allowing for shared infrastructure, staffing, and patient flows. Without this proximity, the operational risks, and inefficiencies of splitting services across sites may outweigh the benefits of early delivery.

Standalone delivery is contingent on the availability of suitable land, free from existing buildings or constraints, and with access to essential utilities. Enabling works such as power upgrades, drainage, and road access may be required before construction can begin. These factors must be carefully considered in the planning process, as they can significantly affect the cost, timeline, and viability of early-phase projects. A clear understanding of site conditions and infrastructure requirements is essential to avoid delays and ensure that early delivery is both practical and cost-effective.

### 8.1.4 Opportunities for Community-Based Services

There may be opportunities to relocate certain services away from the acute hospital site altogether and into community settings. This approach aligns with the NHS Fit For the future; 10-year health Plan for England[9], which emphasises integrated care and a shift toward out-of-hospital services; moving towards a neighbourhood Health Service model.

Services such as diagnostics, outpatient consultations, and rehabilitation are particularly well-suited to community delivery, where they can be more accessible to patients and reduce demand on the main hospital estate; supported by a digitally by default approach.

Relocating services into the community can also support broader system goals and NHS 10-year Health Plan goals, such as reducing health inequalities, improving patient experience, and enabling more proactive and preventative care and locating care as close to patients homes as possible.

This approach requires careful coordination with primary care, community providers, and local authorities to ensure that facilities are appropriately located, staffed, and equipped. It also requires investment in digital infrastructure and care pathways to ensure continuity of care across settings. Where feasible, neighbourhood-based delivery should be considered as part of the early-phase strategy, particularly for services that do not require acute hospital infrastructure.

### 8.1.5 Capacity and Integration Considerations

While early-phase delivery offers clear benefits, it also places additional demands on local teams - both clinical and non-clinical teams. Designing and delivering interim facilities while simultaneously planning for a full hospital replacement requires significant capacity, coordination, and leadership. Trusts must ensure that they have the resources and governance structures in place to manage both workstreams effectively, without compromising quality or delaying progress.

Early phases should be developed as part of the overall hospital redevelopment strategy, with shared design principles, infrastructure, and delivery teams. This integrated would ensure that early investments contribute to the long-term vision and avoid duplication or misalignment.

The cost-benefit of early delivery must also be carefully assessed. In some cases, the time required to plan, procure, and construct early-phase facilities may mean they become operational no sooner than the main hospital, particularly if enabling works are complex. In such cases, early delivery may not offer the intended benefits and could risk delaying the overall programme if not carefully managed.

### 8.1.6 Fast-Track Delivery and Standardisation

To maximise the benefits of early-phase delivery, early developments should use the standardised H2.0 layout, modular construction techniques, and pre-approved design templates. This standardisation should be simplifying procurement, reduce design risk, and support consistency across sites, particularly where multiple hospitals are being redeveloped under the New Hospital Programme (NHP).

However, for certain departments, a standardised approach may not be appropriate or available.

[9] https://www.gov.uk/government/publications/10-year-health-plan-for-england-fit-for-the-future

## 8.2 Site Analysis

The ability for each site to accommodate a phased delivery depends on the site context. The following table provides a high-level review of each site.

It is recognised that parking is a significant challenge throughout the NHS, therefore although most sites benefit from substantial surface parking, redevelopment in these areas would require consolidation of parking, with a Multi-Storey-Car-Park (MSCP) being required to accommodate a similar number of vehicles in a smaller surface footprint.

NOTE that this review is based on our understanding from our site visits, aerial photography and published data. We have not been provided with or reviewed the individual Strategic Outline Case (SOC) documents, nor have we considered the logistic or financial constraints (such as land ownership).

**Table 8.3: Difficulty of Phased Delivery**

| Site | Difficulty of phased delivery | Commentary |
|---|---|---|
| Hinchingbrooke | **Medium** | The hospital site has multiple entrances and exits from the access road that runs along the west of the site.<br><br>The hospital has green spaces and surface carparks that may be utilised to consolidate parking, unlocking space for phased development.<br><br>Redevelopment opportunities existing to the south-east corner and north-west to western edges, running alongside existing access roads.<br><br>The north-west to south-east strip would allow the redevelopment of patient facing spaces, such as out-patients or stand-alone diagnostics spaces.<br><br>The low-level buildings and carparking to the east of the site would provide space for non-client facing spaces – which could be linked to the recent theatre redevelopment and estates department / function.<br><br>Fields exist to the north and east. The ownership of these is not known but could be explored to allow significant redevelopment without phasing. |
| West Suffolk | **Medium** | The hospital has a two entrance points to the north of the site.<br><br>Surface carparking is located to the north and west, with additional parking located to the south-west. The main carpark is located to the north.<br><br>Existing residences are located to the north-west of the site – constructed using RAAC walls and roofs.<br><br>The surface carparks that may be utilised to consolidate parking, unlocking space for phased development – particularly to the west of the site which is expansive and would allow access to the front and rear of the site. This would give opportunities for patient and non-patient spaces.<br><br>The residences could be removed to allow further redevelopment – with new residences constructed offsite to remove the RAAC risk.<br><br>A substantial field exists to the east. The ownership of this is not known but could be explored to allow significant redevelopment without phasing. |
| Frimley | **High** | The hospital is constrained on all sides by roads and residential accommodation. A multi-storey has already been developed to the south of the site, with surface carpark exists to the rear.<br><br>A single access is used to the south-east of the sit, using a roundabout (A325). This accesses the MSCP to the south which is considered over-utilised at present. Any phased development may remove visitor car parking that is unlikely to be acceptable. |

| | | |
|---|---|---|
| | | Demolition of previous residences to the north of the site has created additional surface carparking and the potential to create new development. However, given the location away from the main entrance – this is most suited to non-patient facing spaces. The extent to development is constrained by the M3 motorway to the north.<br><br>The existing Frimley site is considered very constrained. |
| James Paget | **Low** | James Paget hospital has a single access to the east of the site from the A47.<br><br>Although constrained to the north and south, surface carparking exists to the east and west which may allow space for parking consolidation and phased development of the hospital.<br><br>Surface parking to the west is disrupted by the solar-field – this could be replicated above parking to mitigate the loss of space. This would increase potential space for redevelopment which could be used for non-clinical / non-patient facing activity – given the location away from the main entrance.<br><br>Small pockets of redevelopment space to the north and south, directly adjacent to the existing hospital which could be used for patient-facing activity that could connect to existing patient facing clinical services. Particularly the staff parking areas.<br><br>A substantial field exists to the west. The ownership of this is not known but could be explored for decant parking facilities. |
| Kings Lynn (QEH) | **Medium** | The site is constrained to the north, south and west, but has significant surface carparking to the eastern edge, and wrapping around to the south, which may allow space for redevelopment.<br><br>The primary site entrances are located to the south of the site meaning developments to the south-east corner for out-patient services may be appropriate – this space currently occupied by surface carparking.<br><br>Significant parking is located to the east of the hospital site, running adjacent to the A149. This space could be used for large-scale phased redevelopment but would require relocation of existing parking.<br><br>Back-of-house services could be located to the rear of the site, maintaining links with the existing estates and facilities compound and taking advantage of the orbital road. |
| Leighton | **Low** | The site is surrounded by green fields on all sides. However, we understand that these spaces are already allocated to housing developments, except for the northern field that has been procured by the trust.<br><br>This northern field will allow the full redevelopment of the whole hospital without phasing.<br><br>However, there are elements of the whole hospital that could be developed ahead of the whole hospital – such as non-patient facing facilities such as CSSD services. However – the location of such services in response to the masterplan would need careful consideration given the distance from the site to the existing hospital building. |
| Airedale | **High** | The site is constrained on the east and west by existing housing developments and the south by the primary access road. To the north green fields of unknown allocation.<br><br>The hospital site has a number of surface carparks which may be consolidated to allow a MSCP to unlock development spaces. Directly adjacent to the existing hospital there |

| | | |
|---|---|---|
| | | is little available space – meaning removal of parking, decant, demolition and rebuild is the most likely phasing strategy.<br><br>The phased redevelopment could commence at the south-east of the site to allow patient facing activities (outpatients and diagnostics) to benefit from new development. Small pockets of surface parking to the north of the site could be used for non-patient facing spaces.<br><br>A substantial field exists to the north. The ownership of this is not known but could be explored for decant parking facilities. |

The approach to progressive redevelopment should be review by each of the RAAC 7 hospital Trusts and design teams.

# 9 Objectives Conclusions

## 9.1 Objective One

***For each of the 7 hospital sites determine, from assessment of RAAC condition and other structural elements, backlog maintenance risks (high and significant) as well as planned and current mitigations the remaining expected life of:***

***A. The whole hospital site, and***
***B. A reasonable area-by-area breakdown of each hospital site (e.g. building by building).***

The lack of reliable data suggests continued inspection is required to monitor for changes of condition that may impact on the assumed stability of the constituent materials of RAAC planks. The inspection regime being more frequent than for other construction products that are better understood.

The RAAC 7 Trusts have undertaken significant remedial works and their programmes are due to complete by 2029 at the latest. These remedial works have reduced the significant risks associated with RAAC across the RAAC 7.

It is not reasonably practicable to remediate all RAAC planks for all sites. Upon completion of the current remediation programme, it is estimated that between 1% and 6% of planks will remain un-remediated depending on the site. These planks may present an increasing risk of failure over time without ongoing risk management and reduction. Trusts should satisfy themselves that they have identified the location of such planks, have considered the risk and impact of plank failure and implement risk management and reduction measures to minimise the risk and impact of potential plank failure.

Infrastructure across the sites is significantly degraded, with many systems already beyond their design life. For all sites, electrical infrastructure is being addressed under planned maintenance, alongside continued monitoring and management of legacy systems.

The mechanical infrastructure at many of the sites is in poor condition and significant investment will be required to ensure they remain in operation or replaced. Due to the age of the infrastructure, issues exist such as ventilation systems not complying with HTM's, overheating, and water systems subject to Legionella issues and leak. Leaks may directly impact the longevity of RAAC planks. Without continued investment - particularly in areas where failure poses a substantial risk to the building fabric.

Despite these challenges, with ongoing management and maintenance, it is expected that RAAC planks and panels may technically remain serviceable beyond 2030 and in the long-term (2030 + 10 years). However, practically costs and risks are expected to increase as RAAC planks and panels are retained beyond 2030 and in the medium term (2030 + 6years). This statement is applicable to all departments containing RAAC planks.

It is therefore recommended that the replacement of the RAAC hospitals continues as a priority.

**Key Message:**

- **RAAC remediation has stabilised the risk – but not eliminated it. The hospitals can operate safely to 2030 and beyond – but with conditions.**
- **Mechanical infrastructure is a critical weakness.**

## 9.2 Objective Two

***Establish whether there are additional mitigation works that could be put in place to extend the sufficiently safe use of the whole hospital site or areas of the hospital site, and the associated costs of doing so.***

The RAAC 7 hospitals have had significant investment, in excess of £500m, as part of the RAAC remediation programme and other emergency funding streams; mitigating some of the most significant risks across each of the hospitals.

A further circa [redacted] is expected to complete the RAAC remediation works to 2030 bringing the total for RAAC remediation to circa [redacted].

These costs are set to rise with a potential further [redacted] in the medium term (2030 plus 4-6 years).

All Trusts have progressed at pace to complete the remediation by 2029/ 2030, in line with the originally targeted RAAC hospital redevelopment / removal timeframes.

Continued funding and management will be required to mitigate the compounded effects of ageing infrastructure and residual RAAC risks upon completion of the RAAC remediation programme.

Whilst RAAC remediation across the RAAC 7 hospitals has addressed immediate structural risks, continued and additional mitigation measures will be required to ensure safe and sustained operation through to hospital replacement. These measures span both physical interventions, such as roof repairs, access walkways and additional structural supports, and non-physical management strategies, including ongoing inspections, risk assessments and dedicated RAAC oversight teams.

Mechanical infrastructure presents the greatest challenge, with many systems already underperforming and requiring significant investment to avoid service disruption. Electrical systems, though more stable, still demand resilience improvements. The implementation of these mitigations is expected to reduce the risk of unplanned downtime and infrastructure failure, lowering the overall risk to hospital longevity beyond 2030.

In the Short-term (2030 plus 1-3 years), these works may be considered as continued maintenance, surveying and vigilance. In the Medium-term to Long-term (2030 plus 4 – 10 years) enhanced maintenance and equipment replacement may be required – particularly for mechanical systems.

**Key Message:**

- **Significant investment has already been given to reduce risks.**
- **Delays to hospital replacement increase cost and risk.**

## 9.3 Objective Three

### *Set out the clinical operational impacts on the running of the hospital and the associated costs, of opening the replacement hospital after the estimated life of the current hospital site or 2030, whichever is sooner.*

The Trust staff and their contractors have responded to the considerable challenges of maintaining operational service delivery during the remediation process in a highly professional manner. The close teamwork between operational staff, estates and contractors has been a common theme across all seven sites, and a lesson for the wider NHS on how to deliver challenging projects.

On the completion of the RAAC remediation across the RAAC 7 hospitals, it is considered that the hospitals may continue to deliver services to patients despite the presence of RAAC, provided the fabric of the building is maintained and RAAC planks and panels are routinely inspected, and further remediated implemented as required. Trusts also must deal with ageing infrastructure, outside of the challenges of RAAC mitigation.

Despite the success of the RAAC remediation programme, the hospitals still face the ongoing challenges of degrading infrastructure, ageing and increasingly acute patient population, and the configuration issues inherent in the outdated current hospital designs - limited single bedrooms, under-sized rooms, etc.

Any further delay to the replacement of these facilities will compromise the benefits that will be realised by Hospital 2.0 hospitals delivered by the New Hospital Programme – the programme business case predicted a benefit cost ratio of more than 3:1 and it is therefore paramount that they are replaced without further delay.

RAAC concerns followed on from the COVID pandemic, the last few years have been a highly stressful time for staff, patients, and visitors alike. Unsurprisingly, therefore, one common single message that was consistently repeated across the sites is that the new hospitals represent *'the light at the end of the tunnel.'*

The combined residual uncertainty and risk resulting from the presence of RAAC and infrastructure remains – particularly where there remains inaccessible RAAC planks. Therefore, early replacement of these hospitals remains a priority.

**Key Message:**

- **The hospital trusts have responded to considerable challenges, but see the new hospitals as the light at the end of the tunnel.**
- **Remediation is not a substitute for replacement.**

## 9.4 Objective Four

### *Define, describe and assess options for a phased approach to replacement at a programme and individual site level to minimise risk from RAAC plank failure, operational impact, and other backlog maintenance risks (high and significant).*

Remediation works have bought time but are not considered a substitute for renewal. Continued investment in maintenance, risk management, and infrastructure resilience is essential to safeguard patient safety and service delivery.

There is opportunity to reduce short to medium term risk through targeted early-phase delivery of selected departments. Services such as Outpatients, Pathology, CSSD and Catering could be suitable for early delivery, particularly where adjacency requirements are minimal. These departments can be delivered as standalone units, provided they are aligned with future hospital masterplans and there is suitable existing infrastructure capacity to support the additional loads.

A focus on a Neighbourhood Health Service, with Outpatient and Diagnostic activity being located close to home would also support phased development – moving activity away from the acute hospital sites. This aligns the UK Government's NHS Fit For the future; 10-year health Plan for England[10].

Critical services such as theatres, intensive care units, and maternity require co-location with other departments and are not suitable for isolated early delivery.

Phased development needs to consider a Value for Money (VfM) assessment, determining whether and how the overall programme of works would be impacted and if this realises gains in efficiency / delivery. The replacement approach would need to deliver facilities quicker than the current New Hospital Programme plans / timeframe. Re-evaluating the existing New Hospital Programme plans to consider an alternate phased approach would likely be disruptive and cause delays at this stage, negating the benefits of phasing.

Should the delivery of the new hospitals under the New Hospital Programme be delayed beyond the current construction timeline set out in in the New Hospital Plan for Implementation (construction expected to start between 2027-2029) phasing opportunities should be reconsidered.

**Key Message:**

- **Delivery of the new hospitals should be prioritised over phasing, but this should be reevaluated if delays are expected**

[10] https://www.gov.uk/government/publications/10-year-health-plan-for-england-fit-for-the-future

## 9.5 Lessons Learnt

The discovery and remediation of RAAC within the RAAC 7 hospitals highlights several lessons learned that may be considered for future programmes although there is no suggestion that there is ‘another RAAC’ system at present. The key lessons are as follows:

**Remediation vs replacement:** the RAAC remediation works may be considered sunk costs (and embodied carbon), with remediation being removed as part of demolition of the overall hospital. Acceleration of replacement of hospitals would reduce ‘sunk costs’ for future programmes.

**Identification:** the lack of understanding of construction methods used to construct our existing NHS hospital buildings has meant identification of RAAC impacted hospitals has taken time. Gathering existing building data in advance would support ongoing management of the existing hospital estates.

**Condition:** this report identified a range in condition data and maintenance approaches across the RAAC 7 hospitals. This highlighted that existing 6-facet survey systems and risk assessment process do not always adequately capture the structural risks that may exist. Consideration to a review of the 6-facet survey, in particular facet 1, may be beneficial.

**Divergence:** the divergence in approaches between surveyors / engineers across the RAAC estate led to variance in approaches taken across the RAAC 7 hospitals. A consistent approach across surveying, remedial works and data capture would be beneficial for future programmes.

**Information:** this study identified delays between data capture, assessment and reporting. This can leave Trusts without the latest guidance on management of their estate. Data capture guidance, including timeframe KPIs, would be beneficial in future.

## 9.6 Holistic Summary

The seven predominantly RAAC hospitals (the RAAC 7), as a result of the remediation programme, can remain open beyond 2030. However, the need to deliver the replacement hospitals as soon as feasibly possible remains. The RAAC remediation programme for the RAAC 7 hospitals has and will, once completed, reduce the majority of risks of RAAC plank collapse, protecting patients and staff from the greatest risks. However, between 1% and 6% of RAAC planks are inaccessible and while plank locations are known and have risk mitigation strategies in place, their inaccessibility and lack of remedial works means such planks will continue to present a risk.

Continuing to operate these hospitals is operationally costly, all 7 perform poorly and the benefits to be realised through Hospital 2.0, won’t be realised until they are replaced. The need to deliver the replacement hospitals as soon as feasibly possible therefore remains a high priority.

# A. Clinical Glossary and Methodologies

## A.1 Glossary

This glossary provides definitions of key terms used throughout this document.

| Term | Abbreviation | Description |
|---|---|---|
| Adult | | Patients aged 18 and older |
| Ambulatory Care | Ambulatory | Ambulatory Care refers to care provided for patients who are not admitted to the hospital, but are provided with same day care that may involve one or more treatments, interventions, etc.<br>Ambulatory Care often refers to longer duration care, which may be a series of repeated appointments, for example, Chemotherapy or Renal Dialysis. |
| Bed | | Overnight care areas i.e. where the patient stays in for periods typically of over 24 hours. |
| Emergency Department | ED | Also known as Accident and Emergency (A&E), this is the centre for unplanned care in some hospitals. |
| Intensive Care Unit | ICU | Also known as Critical Care, this is high acuity care for more seriously ill patients (Level 2 and Level 3[11]). |
| Maternity | | Maternity care relates to all care provided before (ante-), during and after (post-) the birth of the baby or babies. This may include ante-natal outpatient care (e.g. Ultrasound scans), the birth itself, care provided for complications before birth, and care after the birth – typically the post-natal care is focused on the mother, assuming healthy baby or babies.<br>This may also include birth by Caesarean Section (C-section), caried out in Theatres. |
| Neonatology<br>(also, Neonatal Intensive Care Unit or Special Care Baby Unit) | NICU or SCBU | Neonatal care is the type of care a baby born premature or sick receives in a neonatal unit.<br>Units are a part of hospitals which provide care for babies soon after they are born. The word 'neonatal' means newborn, or the first 28 days of life.[12] |
| Outpatient | | Planned, short-duration ambulatory care for non-admitted patients for minor treatment and consultation |
| Paediatrics | | Patients aged up to 18 (from age 0). |
| Theatres | | Department where surgical procedures take place, typically in rooms known as Operating Theatres – note that 'Theatres' can mean the whole department, including ancillary accommodation, including recovery. |

11 Intensive Care Society | Levels of care

12 From the Bliss website, What is neonatal care? | Bliss

## A.2 Service Line Rationalisation

### Hospital departments (high level)

| | | | |
|---|---|---|---|
| Emergency | Urgent and Emergency Care (UEC) | | |
| Ambulatory | Outpatients | Ambulatory Care (e.g. Chemo) | |
| Adult inpatient | Adult Inpatients | (Adult) Intensive Care Unit | |
| Women & Children | Maternity (Ambulatory, Birthing unit, inpatients) | Paediatrics (Ambulatory, Inpatients, PICU) | Neonatology |
| High-tech core | Theatres (incl. IR and Endoscopy) | Diagnostics & Imaging | |
| Support (FM, CSSD, Other) | FM (Soft and Hard) | Clinical Support Services | Other (Offices, Staff Support, Main Entrance) |

Service line rationalisation e.g. ED, neonatology etc.

### Support departments – further details

#### FM (Soft and Hard)

- Estates workshops
- FM loading area
- Materials Management
- Waste Management
- Catering Services
- FM offices & staff support
- Housekeeping
- Laundry services
- Portering services

#### Clinical Support Services

- Sterile Services (CSSD)
- IT
- Medical Education Centre
- Medical Records
- Mortuary
- Pathology
- Pharmacy Services
- Research
- Biomedical Engineering (EBME)
- Medical Photography

#### Other

- Clinical & Non-clinical Offices
- Command Centre
- Main Entrance
- Multi Faith Centre
- Patient Lounge
- Retail and Support
- Security
- Occupational Health
- Staff Change
- Plant

## A.3 Assessment of Early Delivery of Whole Departments

To support an early delivery, each department has been reviewed to assess the suitability of its clinical services for early-phase delivery. This assessment considers a range of factors, including the presence of RAAC above the department, the condition of supporting infrastructure, operational dependencies, and the potential for standalone delivery.

### A.3.1 Adult Inpatients

RAAC is present in many adult inpatient areas, making them a high priority for early intervention. Inpatients are typically the largest service by area; hence they bear a higher proportion of the RAAC risk.

Wards are often located in older parts of the estate with significant structural and infrastructure risks. Delivering new inpatient accommodation as part of an early phase could not only significantly reduce operational risk but could also improve patient experience and support modern models of care – for example, H2.0 wards are planned as 100% single beds, with benefits to privacy and dignity, gender segregation and infection control.

Inpatient wards do have some key adjacencies, including theatres, urgent and emergency care (UEC), and critical care. While a standalone inpatient facility is feasible, it would require robust physical links, such as covered walkways or service tunnels, to ensure safe and efficient patient transfers. Without these connections, the ability to manage deteriorating patients or post-operative care would be compromised.

### A.3.2 Intensive Care Unit (ICU)

ICU services are typically located at the heart of the hospital due to their critical role in supporting a range of patients, both planned and unplanned. Although many current ICUs suffer from RAAC, the key inter-dependencies between ICU and other services (particularly Theatres, ED, and Imaging) means that ICU is not suitable for standalone delivery.

Phased delivery is limited unless it is part of a broader redevelopment that includes adjacent essential services. ICU requires highly specialised infrastructure, including medical gases, ventilation, and continuous monitoring systems. Any attempt to deliver ICU early would need to ensure adjacency to diagnostics, theatres, ED, and inpatient wards, which is difficult to achieve without full co-location.

### A.3.3 Urgent and Emergency Care (UEC)

Although RAAC is not typically present in UEC areas, the department’s operational model relies on rapid access to ICU, theatres, maternity, and inpatient wards. UEC is not suitable for standalone delivery due to the high volume of patient movements and the need for integrated clinical pathways.

Phased delivery is challenging unless it is part of a larger redevelopment that includes adjacent services. Delivering UEC in isolation would risk fragmentation of emergency care and compromise patient safety. The department also requires robust infrastructure for imaging, triage, and resuscitation, which are difficult to replicate in a temporary or standalone setting.

### A.3.4 Maternity & Birthing Unit

RAAC is present in many of the hospitals’ maternity departments (including antenatal and postnatal wards, maternity theatres, triage, and the neonatal unit (NICU)).

Many current hospitals operate with standalone maternity services; however, the NHP model typically involves locating maternity theatres within the main theatre unit. Any standalone unit would need to incorporate dedicated theatres and NICU, and would need to be externally accessible 24/7, and have access to UEC. Consideration would also be needed for access to ICU for the rare events where the mother suffers serious complications (although theatre recovery can act as a proxy environment).

The complexity of these interdependencies means that while early delivery is possible, it must be carefully integrated into the wider hospital redevelopment. The emotional and clinical needs of birthing patients also require a calm, well-supported environment, which may be difficult to achieve in a fragmented estate.

NICU services are intricately linked to maternity and birthing units, particularly for high-risk births. RAAC is present in many NICU areas, and while early delivery is moderately suitable, standalone delivery is only feasible if maternity services are also relocated.

NICU requires specialist infrastructure and environmental controls, including temperature regulation, infection control, and emergency access. Its effectiveness depends on proximity to birthing suites and paediatric support. Therefore, NICU should be considered for early delivery only as part of a combined maternity and neonatal phase.

### A.3.5 Outpatients

Outpatient services are among the most suitable for early and standalone delivery, although generally RAAC is not prevalent in outpatient areas. Provided the service range is appropriate, and access to diagnostics and imaging is provided, outpatient services are potentially suitable for standalone facilities. These could be off-site or on the hospital perimeter, potentially as part of a wider ambulatory care hub.

If integrated with diagnostics and imaging, it could significantly reduce pressure on the main hospital and align with system-wide goals for community-based care. Outpatients also offer opportunities for digital innovation, such as virtual consultations and self-check-in, which can be more easily implemented in a new-build environment.

Relocation of some activity offsite would align with the UK Governments 10-year plan for England (July 2025)[13].

### A.3.6 Paediatric Inpatients

RAAC is present in paediatric inpatient areas, and whilst it is feasible to incorporate paediatric wards in early phase delivery, it is not suitable for standalone delivery. Paediatric services require adjacency to theatres, UEC, and outpatient clinics.

Children often require multidisciplinary care, and the need for family-friendly environments and safeguarding considerations further complicates standalone delivery. Early phase would need to ensure these adjacencies are preserved, and the design would need to accommodate play areas, family accommodation, and specialist equipment.

### A.3.7 Sterile Services (CSSD)

There is potential for CSSD as an early-phase and standalone department. Although RAAC is present in limited areas, CSSD can be relocated to a separate facility provided it maintains reliable supply routes to and from theatres and outpatient procedure areas.

A standalone CSSD could also serve multiple sites if designed with sufficient capacity and logistical support. This would reduce risk in the existing hospital and support future flexibility. The facility would need to meet strict infection control standards and be integrated with the hospital’s logistics and tracking systems.

[13] https://www.gov.uk/government/publications/10-year-health-plan-for-england-fit-for-the-future/

### A.3.8 Theatres

Theatres are not suitable for standalone delivery due to their essential adjacencies with ICU, UEC, and inpatient wards. RAAC is present in many theatre areas, making them a priority for replacement, but they must be delivered as part of a broader clinical service spectrum.

Theatres incorporate not only the actual theatres themselves, but also essential accommodation including recovery areas, and they have significant storage needs. Any standalone development would need to encompass the entire patient pathway, including pre-procedure (Day of Surgery Arrivals), and relevant staff support including staff change.

Phased delivery is possible but must be carefully sequenced to avoid disrupting emergency and elective surgical pathways. Any early delivery would need to include associated support spaces and ensure continuity of surgical services.

### A.3.9 Catering (Kitchens)

Catering services are suitable for early and standalone delivery. RAAC is present in many kitchen areas, and relocating catering to a new facility could reduce risk, although the supply pathways and logistics would require careful planning.

A standalone kitchen would require robust infrastructure for food delivery, waste management, and compliance with hygiene standards. It must also be able to serve multiple departments efficiently, including inpatient wards, maternity, and staff areas.

The facility could however support future flexibility, such as centralised production for multiple sites or services (e.g. nursing homes).

### A.3.10 Physiotherapy

Physiotherapy services are well-suited to early and standalone delivery. RAAC is present in some areas, and relocating physiotherapy could improve access and reduce risk.

These services could be integrated into a wider outpatient or rehabilitation hub and may require adjacency to diagnostics and inpatient wards for continuity of care. A standalone facility could also support community-based rehabilitation and reduce demand on the acute site. Design considerations should include accessibility, therapy spaces, and equipment storage.

### A.3.11 Endoscopy

Endoscopy is highly suitable for early and standalone delivery, particularly for planned ambulatory procedures. RAAC is not typically present in endoscopy areas, and the service can operate independently with appropriate support from CSSD and pharmacy.

Emergency endoscopy would still need to be provided in theatres, but a standalone elective unit could reduce pressure on surgical capacity and improve patient flow. The facility would need to include recovery areas, decontamination rooms, and appropriate patient pathways.

### A.3.12 Pathology

Pathology services are suitable for early and standalone delivery, especially for non-urgent sample processing. RAAC is present in limited areas, and a new facility could be located on or off-site.

However, urgent testing (e.g. hot labs) would still need to be maintained on-site or within close proximity. A standalone pathology hub could also serve multiple hospitals, improving efficiency and resilience. The design would need to accommodate specialist equipment, sample tracking, and secure storage.

### A.3.13 Pharmacy

Pharmacy services are suitable for early delivery, with moderate potential for standalone operation. Inpatient pharmacy must remain close to wards, but outpatient dispensing could be relocated to a retail-style unit.

Aseptic pharmacy services, if provided, would need to maintain links to oncology and other clinical services. Standalone delivery is feasible for outpatient and retail functions, but inpatient and aseptic services require careful integration. The facility would need to meet regulatory standards for storage, compounding, and distribution.

# B. Space Typology Definitions

Colour grading is in line with HTM 6-01 Distribution Strategy department grading:

| Non-essential | Low priority | Essential | Key | Critical |
|---|---|---|---|---|
| E | D | C | B | A |

## Main Departments

| | | | |
|---|---|---|---|
| Emergency | Urgent & emergency Care | | |
| Ambulatory | Outpatients | Ambulatory Care | |
| Adult Inpatients | Adult Inpatients | Intensive Care Unit | |
| Women & Children | Maternity | Paediatrics | Neonatal |
| High-Tech core | Theatres | Diagnostics & Imaging | |
| Support | FM (Soft & Hard) | Clinical Support Services | Others |

## Support Department Breakdown

| FM (Soft & Hard) | Clinical Support Services | Other |
|---|---|---|
| Estates Workshops | CSSD | Clinical and non-clinical offices |
| FM Loading Area | IT | Command centre |
| Materials management | Medical Education | Main entrance |
| Waste Management | Medical Records | Faith centre |
| Catering Services | Mortuary | Patient Lounge |
| FM Offices and staff support | Pathology | Retail and support |
| Housekeeping | Pharmacy Services | Security |
| Laundry services | Research | Occupational health |
| Portering services | EBME | Staff Change |
| | Medical Photography | |

# C. RAAC Background Information

## C.1 Background to RAAC Expanded

Typical characteristics of RAAC are outlined below:

Strength: RAAC panels typically have a compressive strength of around a sixth of traditional concrete. This is reflected in its flexural, shear and tensile strengths.

Density: RAAC is significantly less dense than traditional concrete, typically a quarter of the density. It is also less dense that water, meaning in its dry state it can float.

Bond: The low strength of the AAC material and the use of smooth coated reinforcement means there is little to no bond between the reinforcement and the AAC material. This means that transverse anchorage reinforcement is required to mobilise the strength of longitudinal reinforcement and provide the flexural and shear strength.

Reinforcement: AAC gives little corrosion protection to the embedded reinforcement, meaning bars were coated to provide initial corrosion protection.

Permeability: AAC is highly permeable, so cover to the reinforcement does not protect against environmental conditions in the same way as with traditional concrete.

Elasticity and Creep: the aerated nature and lack of coarse aggregate means that RAAC panels experience a greater degree of creep and long-term deflection when compared to traditional concrete.

Roof Planks: RAAC Flat Roofs

Wall panels – load-bearing and non-loadbearing infill panels.

## C.2 2030 Statements

Following the related SCOSS alert in May 2019, the individual Trust Structural Engineering advisors have been asked to provide an estimate of residual life of the RAAC installations. Quotes are included below. It should be noted that these came from a single engineering consultancy that at the time was providing services to 3 of the Trusts.

“For the extended period (potentially up to 2045/2050) the integrity of all of the RAAC panels is uncertain and it should be assumed that the panels will not be in a serviceable condition. Therefore, all RAAC panels need addressing.”

“In response to the SCOSS Alert, an extensive review of the panels at West Suffolk Hospital has been undertaken. The construction of the two hospitals is identical and with the hospitals of a similar age, the panels are in a similar structural condition. The result of the assessment was that the future serviceable life is unlikely to extend beyond 2030 and in the interim the introduction of failsafe support is a reactive and proactive manner needed.”

“With the management plans being developed, the risks can be kept under review but based on the recorded condition it is now considered that without structural strengthening works, a serviceable life span of the buildings beyond a 5-to-10-year period is unlikely. It should therefore be planned to replace the building by 2030.”

“The report [2018/2019] concluded that the prediction of the future life of the building is difficult due to the lack of information about RAAC panels. However, if a “Do Nothing” approach is followed, the panels could possibly become weakened and unsafe in a 10-year period i.e. by 2030.”

"The condition of the roof panels was investigated in 2010 and have been subject to ongoing consideration since that time."

"The roof has been recovered over much of the hospital since 2010 and insulation laid to falls has been added. These actions help to remove excess weight off the roof from ponding water and keeps the panels dry but other deficiencies remain."

"At the time of the commencement of the re-roofing it was estimated that the works may extend the life of the structure for a about a 20-year life (i.e. to about 2030)."

## C.3 RAAC Surveying Approaches

The consistency of RAAC surveying across the RAAC 7 hospitals vary significantly depending on the appointed consultant. While all sites aim to align with the Institution of Structural Engineers (IStructE) 2023 guidance, the methodologies, inspection frequencies, and data recording practices differ, which impacts the comparability and reliability of risk assessments across the estate.

[redacted]

[redacted]

[redacted]

The variation in RAAC surveying methodologies across the RAAC 7 hospitals presents challenges in standardising risk assessments and comparing data. While Castons and WSP semi-align approaches, GCE's methodology diverges significantly. All surveying approaches pre-date the IStructE further guidance (2023) - however, the methodologies all identify the risk factors associated with the planks in line with this guidance, namely water ingress, cracking, and displacement.

The critical bearing assessments for planks have generally been undertaken separately to the regular plank surveying. Therefore, the plank data collected does not generally consider transverse reinforcement / bearing risk for each plank. In most instances separate bearing investigations and risk assessments have been undertaken and applied to the entire installation of planks. This approach is not considered unreasonable given the challenges with locating transverse reinforcement for each plank, and aligns with the IStructE guidance on investigating RAAC planks

## C.4 RAAC Longevity

### C.4.1 Degradation

All construction materials, regardless of type, are susceptible to degradation when subjected to prolonged water ingress or exposure to aggressive atmospheric conditions. This includes commonly used structural materials such as timber, steel, masonry, and concrete. The extent and rate of degradation are influenced by the material properties, the nature of the exposure, and the criticality of the affected structural element.

For example, water ingress at the bearing of a primary timber beam into a solid masonry wall can lead to rot and structural compromise. In contrast, corrosion of reinforcement in a non-structural concrete mullion, while undesirable, may have limited structural implications. Therefore, the impact of degradation must be assessed in the context of the material's role within the structural system.

The longevity of any structural system is closely tied to the maintenance of protective finishes and detailing. These finishes—whether coatings, membranes, or sealants—serve as the first line of defence against environmental ingress. Their deterioration can accelerate the degradation of the underlying structural components. This principle applies universally across materials and systems.

Reinforced Autoclaved Aerated Concrete (RAAC) is not unique in its sensitivity to environmental exposure. Like other materials, its performance is contingent on:

- Appropriate specification for the intended environment
- Effective detailing and protection
- Ongoing maintenance

There have not been extended studies on the longevity or lifespan of RAAC. However, Statements suggesting a fixed 30-year lifespan for RAAC, as occasionally reported in media or professional commentary, are not supported by technical evidence. The Institution of Structural Engineers within their RAAC Frequently Asked Questions (FAQs), suggest the following:

*"We are aware of these statements, and they are misleading. We believe they relate to correspondence exchange in The Structural Engineer, (which is the IStructE magazine) in 1995, there is no specific data that we can point to that supports the stated 30-year lifespan.*

*If manufactured correctly, installed correctly, and appropriately maintained (for example no overloading and managing water ingress) throughout its in-use life then RAAC should perform comparably with similar materials.*

*The lifespan of RAAC will depend on how it was manufactured, constructed, and maintained, including whether there has been any water ingress, as this can add to the dead weight, induce corrosion of the steel reinforcement, and weaken the strength of the AAC.*

*The risk of sudden failure can stem from RAAC planks with inadequate bearing (support) length. It is therefore important that the bearings of the RAAC planks are inspected and measured."*

As demonstrated in recent assessments, RAAC planks in service for over 60 years have shown limited structural degradation, particularly where protective measures have been maintained. Corrosion of embedded reinforcement, while a concern due to RAAC's porosity, has been shown to result in modest section loss over decades—typically not sufficient to compromise structural integrity.

### C.4.2 AAC Degradation

Autoclaved Aerated Concrete (AAC) has been used for nearly 100 years and has demonstrated durability across diverse climates and chemical environments.

AAC is chemically stable due to the formation of Tobermorite, a well-crystallized calcium silicate hydrate (C-S-H) phase formed during autoclaving. This mineral is less reactive than the calcium silicate hydrate in traditional concrete, making AAC more resistant to chemical degradation such as carbonation and sulphate attack under normal conditions.

One of the primary concerns for AAC is its resistance to freeze-thaw cycles. Its closed, spherical pore structure and low capillary suction means AAC typically resists frost damage well. However, if the material becomes saturated—due to hydrostatic pressure, prolonged exposure to rain, or poor drainage—freeze-thaw damage can occur. In such cases, the 1970s Siporex Design Manual highlighted the need to provide a protective coating that would resist rain penetration but remain permeable to water vapour.

AAC shows moderate resistance to chemical attack. It is vulnerable to strong acids and acid-forming gases, which can degrade the calcium silicate hydrate phases. Organic acids tend to be more aggressive than inorganic ones. However, AAC is generally unaffected by alkaline substances and many organic solvents, which may temporarily reduce strength but do not cause permanent damage. Again, protective coatings are adopted in chemically aggressive environments.

AAC is susceptible to shrinkage and cracking when exposed to high concentrations of carbon dioxide, such as in fermentation rooms or fruit storage facilities. While this does not compromise structural integrity, it may affect appearance and surface performance. Sulphur dioxide, especially in humid conditions, can also lead to slow degradation. In such environments, gas-proof coatings are essential to maintain durability. Note that sources of sulphur dioxide and excess carbon dioxide within a hospital setting are likely to be exhausts from fossil fuel burning.

AAC has excellent thermal insulation and is non-combustible, withstanding temperatures over 1200°C. This makes it highly durable in fire-prone environments and contributes to the longevity of buildings.

Due to its inorganic composition and high pH, AAC is initially resistant to mould, fungi, and pests, which supports its long-term durability in various environments. The pH will reduce over time meaning this resistance reduces.

To summarise:

- AAC is durable under normal conditions but requires protection in aggressive environments.
- Proper design, detailing, and surface treatment are essential to maintain long-term performance.
- External treatments and coatings are critical in harsh conditions.

**Reference**

*Autoclaved Aerated Concrete – Properties, Testing and Design by S. Aroni et al*

### C.4.3 Reinforcement Corrosion

Unlike traditional concrete, RAAC is highly porous and lightweight which makes it lack the dense matrix that typically provides a protective barrier for embedded steel reinforcement (Institution of Structural Engineers, 2023). This characteristic raises concerns about the vulnerability of steel reinforcement within RAAC and the rate of corrosion, especially in environments where airborne pollutants and moisture are present.

To mitigate this, reinforcement bars within RAAC are usually coated; however, the effectiveness and longevity of these coatings can vary depending on the type of coating used and the exposure to contaminants. Also, it is possible that coating degradation may accelerate corrosion processes (BRE Group, 2022).

Where the coating is intact, corrosion protection remains and the steel will not corrode, but where the coating has broken down, the steel will be free to corrode. Corrosion at a coating defect is more complex. The difference in rate depends on the coating type and substrate as well as atmospheric parameters.

For a typical coating, initial damage can lead to microcracks on the surface of the paint, which further causes a weakness leading to additional breakdown. In some cases, a potential difference can form between the coated and uncoated areas on the metal (Hu et al., 2022). The uncoated area of the metal becomes the anode (where the corrosion occurs) and the coated area becomes the cathode (where the corrosive reaction is completed) (Makhlouf, 2015).

This may lead to accelerated corrosion at the defect. In essence, the hole in the paint creates a more concentrated area of corrosion, making the process faster and more severe in that specific location compared to the overall atmospheric corrosion of an uncoated surface. For a round bar, this acceleration needs to be compared with more general corrosion over a larger full circumference defect.

For small coating defects, the corrosion can only eat away at one part of the bar. For full circumference defects corrosion can attack the full perimeter and hence rates of penetration reduce the radius of the bar. This is considered likely to be the method that produces the largest amount of section loss.

It is considered the cementitious coating commonly found is unlikely to prove a significant acceleration of corrosion rate at defects. It has been used as holding repairs on reinforced concrete to provide corrosion protection to steel while a full repair is planned, with no detrimental effect being reported (Field studies of the effectiveness of concrete repairs Phase 3 Report: Inspection of sites, sampling and testing at selected repair sites Prepared by Mott MacDonald Ltd for the Health and Safety Executive 2003 Research Report 184).

There are published corrosion rates for steel in concrete. Concrete society technical report 61 provides the following for steel in carbonated concrete, which illustrates the relationship between corrosion and relative humidity.

**Table C.1: Corrosion Rates in carbonated concrete at different levels of RH**

| RH | Rate of corrosion (microns per year) |
|---|---|
| RH<50% | 0.1 |
| 50%<RH<60% | 0.2 |
| 60%<RH<70% | 0.3 |
| 70%<RH<80% | 0.5 |
| 80%<RH<90% | 1.0 |
| 90%<RH<98% | 5.0 |
| 98%<RH | 0.1 |

There are also anticipated corrosion rates for steel in chloride contaminated concrete. These are higher, but not considered relevant as reinforcement in RAAC panels is generally more at risk from carbonation.

Rodriguez et al's work is reported as part of the published work resulting from BRITE EURAM Project 4062[The Residual Service Life of Reinforced Concrete Structures, Final Technical Report, Contract Reference BREU-CT92-0591, March 1996.]. Brite 4062 reports for Icorr <0.1 µA.cm-2 there is negligible corrosion. For Icorr >0.2 µA.cm-2 the reinforcement is in fact corroding. This is based on an analysis of published laboratory data. BRITE 4062 further goes on to propose that rates <0. 1µA.cm-2 are negligible.

Andrade et al[xiv] cross references the Rodriguez paper and states:

*"The experience on real structures [Rodriguez et al] has confirmed the ranges of values previously recorded in laboratory experiments. In general, values of corrosion rates higher than 1mA/cm2 are seldom measured while values between 0.1-1mA/cm2 are the most frequent. When the steel is passive very low values (smaller than 0.05-0.1mA/cm2) are recorded."*

Corrosion current densities can be converted into depths of penetration via the Faraday equation. 1mA/cm2 is approximately 10 microns per year for Iron.

Given RAAC is not as dense and significantly more porous than reinforced concrete these rates are likely to underestimate the corrosion of steel reinforcement in RAAC. It is considered that the actual corrosion rate may be conservatively represented by that of atmospheric corrosion of steel, noting this is likely to be higher than that found in RAAC as although the pore structure is more open than concrete, it will provide some protection compared to atmospheric corrosion.

ISO 9223 contains dose response formulae that allow the first-year corrosion rate of steel to be calculated based on environmental values. Exposure to sulphur dioxide (SO2); a pollutant known to exacerbate atmospheric corrosion, is a key environmental contributor to corroding steel. This is most prominent when other external conditions (high relative humidity and temperature changes) contribute. The interactions between these variables can be quantified using a dose-response function, as described in ISO 9223 (International Organisation for Standardisation, 2012). ISO 9223 provides a framework for estimating corrosion rates of metals based on environmental exposure categories and pollutant levels. The general form of the dose-response equation for the first year of the corroding rate for e.g. carbon steel is:

$$r_{corr} = 1.77\, P_d^{0.52}\ \exp(0.020\, RH\ + f_{St}) + 0.102\, S_d^{0.62}\ \exp(0.033\, RH\ +\ 0.040\, T)$$

Where:

$r_{corr} = First\ year\ corrosion\ rate$

$T = annual\ average\ temperature$

$RH = annual\ average\ realtive\ humidity\ as\ a$ %

$P_d = annual\ average\ sulfur\ dioxide\ deposition\ in\ mg/m^2 day$

$S_d = annual\ average\ chloride\ deposition\ in\ mg/m^2 day$

$$f_{St} = 0.150\ (T - 10)\ when\ T \leq 10^o C;\ otherwise\ -0.054\ (T - 10)$$

In this study, sulphur dioxide levels were obtained using the UK Government's Emissions Interactive Map (https://naei.energysecurity.gov.uk/emissionsapp/ ), while average temperature and relative humidity data were sourced from the UK Met Office.

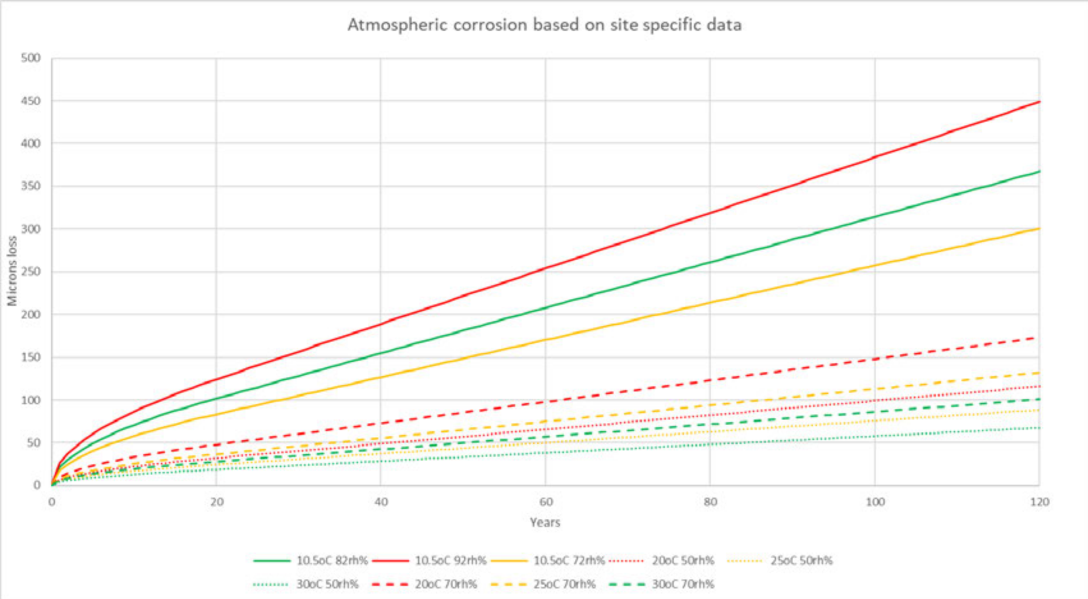
These datasets were compiled into a comparative table to identify the average temperature and relative humidity of sites. ISO 9223 calculations were then used to estimate the corrosion rate for steel reinforcement at each site. These corrosion rates were subsequently translated into projected loss of steel over time and visualised using a curve graph to identify long-term degradation trends.

The analysis revealed considerable variations across the different hospital sites, with James Pagett Hospital recording the highest sulphur dioxide concentrations at 1.947 tonnes / square km / year. The highest annual average humidity was 82% and the highest annual average temperature was 10.5oC. As this was the worst case this was used to evaluate the effects of temperature and humidity on the anticipated corrosion.

External RAAC panels were considered to corrode using mean external temperature and humidity. The sensitivity to humidity was assessed by including rates at 10% higher and lower relative humidities. Internal corrosion was assessed based on the same sulfur dioxide levels, but temperatures of 20 oC, 25 oC and 30 oC and relative humidities of 50% and 70%.

The collated output showing the likely depth of penetration is shown in the figure below.

**Chart C.1: Likely Depth of Corrosion Penetration**




As can be seen the highest corrosion rate predicted using the dose response equations would result in reduction of radius of 450 microns (0.45mm) over 120 years. IF this represented uniform corrosion around the reinforcement bar circumference this would equate to a typical 8mm diameter reinforcement bar reducing to circa 7mm diameter reinforcement bar. This represents a reduction from 51sqmm to 38sqmm, equalling 25% reduction.

Considering when a majority of the RAAC 7 hospitals were constructed circa 60years ago, the corrosion is estimated as 250 microns (0.25mm). This would equate to a residual reinforcement diameter of 44sqm (14% reduction).

For a typical 5" (125mm) RAAC roof plank with 4No 8mm diameter reinforcement bars spanning 12' (3.6m), and using the methodology set out in BS EN 12602, the corrosion of reinforcement would represent a reduction of 23% of the bending capacity and 10% of the shear capacity, with a corresponding impact on stiffness.

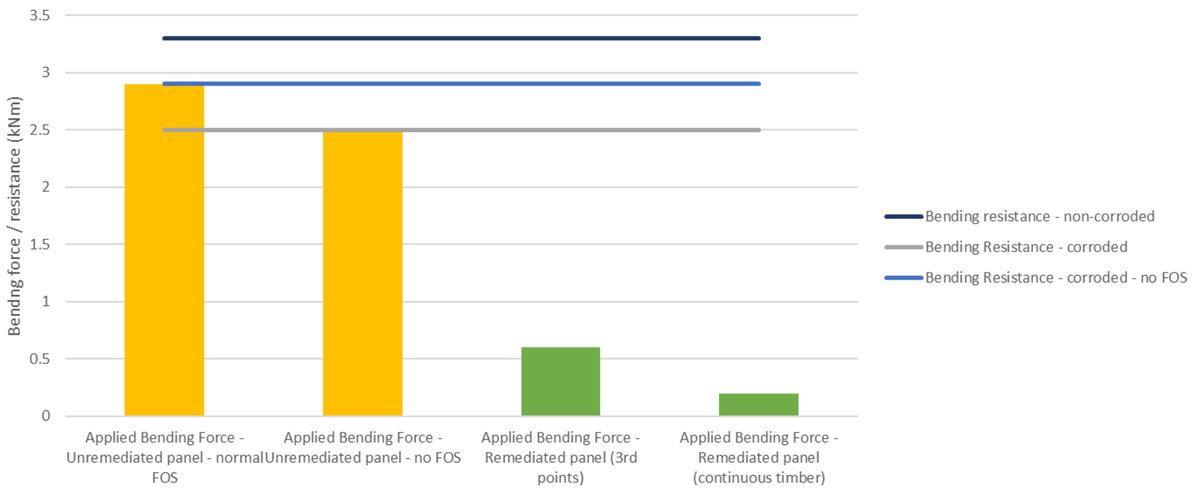
However, this reduction in capacity would be within the Factor of Safety (for loading and materials) of well manufactured and well installed RAAC planks on good bearings. We are aware that there is a significant variance in panel manufacture and installation meaning this cannot be relied upon.

For fully remediated planks, with full span support, the applied stresses are significantly reduced, circa 10% when compared with the normal bending stresses and within the allowable stresses of the reduced capacity RAAC panels.

Where end-bearing only is installed, the panel bending stresses remain as described above and therefore corrosion would impact the bending capacity (as noted above).

The impacts are described in the graph below:

**Chart C.2: Bending Stresses**




Based on the above, reinforcement corrosion is not considered to present a significant structural concern for fully remediated will full span support RAAC planks. Reinforcement corrosion for planks with end-bearing support only would present a higher risk – with a reduced factor of safety against failure.

For unremediated planks, the impacts of corrosion would significantly reduce the factor of safety against failure and present a much higher risk.

Typically, it is considered that corrosion products represent circa 6-8 times the volume of the base material; for the 0.25mm this would equate to circa 1.8mm. This may be accommodated in part within the voids that can surround the reinforcement. – therefore, corrosion may be present without visible defects being noted.

It should be noted that areas of RAAC adjacent to areas treated with salt to prevent icing are at risk of higher corrosion rates due to the presence of chlorides. Where coatings have been applied and maintained chlorides should not have penetrated the RAAC and so do not present a corrosion risk.

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## C.4.4 Structural degradation mechanisms

Deflection of a RAAC plank supported at both ends is a function of the load applied and the structural properties of the plank. For deflection to increase either the load changes or the structural properties change.

There are two main causes of long-term structural changes, creep, and fatigue.

Creep is an increase in deflection over time under a constant applied load. As unreinforced AAC has been used as load bearing blockwork for a significant period of time, there is published information on creep of AAC. BS EN 1355:1997, Determination of creep strains under compression of autoclaved aerated concrete or lightweight aggregate concrete with open structure. BS EN 12602 contains creep classes for RAAC and a design approach to consider creep. Creep is generally considered a long-term phenomenon, which operates on a logarithmic scale, and it seems unlikely that it will cause structural issues over the next ten years.

Fatigue is a phenomenon more associated with metals but occurs in concrete and is likely to occur in RAAC. Deterioration due to fatigue is typically associated with progressive cracking caused by repetitive loading of loads lower than that required to produce a structural failure. Microcracks form and as further cycles are applied, they combine. It has not been studied widely in RAAC, but where panels are subject to repeated loading it seems a possibility that a fracture plane could develop at the level of reinforcement due to the differences in structural properties of AAC and reinforcement. This results in an increased risk of spalling and a reduction in effective panel depth, which would also increase deflection. This may be associated with one of the failures identified, where a panel subject to repeated loading degraded. It is unlikely to affect RAAC that has been fail-safed, as the repeated loading would be transferred into the failsafe system, and the failsafe’s typically limit deflection preventing further crack propagation.

## C.4.5 External Factors

### C.4.5.1 Ongoing Maintenance

Poor maintenance significantly compromises the long-term performance and safety of RAAC planks.

Without regular inspection and repair, surface coatings designed to prevent moisture ingress and chemical attack can deteriorate, allowing water, pollutants, and gases to penetrate the planks. This increases the risk of saturation, reduction in AAC strength and corrosion of embedded reinforcement.

This will require ongoing capital investment to maintain weathering finishes and prevent water ingress.

### C.4.5.2 Climate Change

By 2035, climate change is expected to significantly alter rainfall patterns in England. Under the most likely scenario the mean annual temperature across northern Europe is anticipated to rise by 1.1 degrees, and average annual rainfall is anticipated to increase by 3%.

One of the most notable changes will be in the winter months, which are projected to become milder and considerably wetter. This increase in winter rainfall is likely to lead to more frequent and intense rain events.

In contrast, summers are expected to become drier overall. The general trend points toward reduced average rainfall during the warmer months, however, when rain does occur in summer, it is likely to come in shorter, more intense bursts.

These sudden downpours can overwhelm drainage systems and increase the risk of ponding at roof level and potential for roof leaks.

## C.5 RAAC Data Accuracy

This study has identified some challenges in the collection and reporting of RAAC plank data. These are described below:

### C.5.1 Alignment with IStructE Reporting

The alignment of RAAC survey data with the Institution of Structural Engineers (IStructE) guidance varies across the RAAC 7 hospitals, reflecting differences in consultant methodologies and data interpretation, as described above.

While some of the Trusts have undertaken an exercise to align their data collection with this framework, this is not always the case, and a majority maintain their risk assessments based on pre-IStructE methodologies and additional works are required to adopt a unified approach.

This variance reduces comparability across sites and may hinder national benchmarking going forward. For the purposes of aligning the data across the seven hospitals, we have in some cases made our own assessment of panel risk using the latest guidance from the IStructE.

### C.5.2 Incomplete or Limited Data

Data received from the seven hospitals has arrived in several formats, including PDF plans, excel trackers and reports. Every effort has been made to collate this information into one place; however, several assumptions have been made in this process:

- In some cases, limited information was made available on the remediation status of RAAC panels. In the case of Frimley Park Hospital, for example, comments made in the received tracker mentioned that steel supports had been added to some or all of the underside of the panels. In this case, the panels have been counted as remediated in our data.
- Estimates for panel counts at each hospital differ between reports from the Trusts and the tracker data received. This variation may result from updates as new information clarifies areas previously believed to contain RAAC roofs, which may made of other materials, or from different methods used to estimate panel numbers. The panel counts in our dataset are derived from the raw tracker data provided by each Trust.
- Data received from the Trusts, in some cases, did not give data on the condition of end bearing supports or panel deflections. This could have led to inaccuracies in panel rating based on data we have not received.

### C.5.3 Real-time Data

A significant operational challenge encountered across the RAAC 7 hospitals is the time lag between the physical surveying of RAAC elements and the subsequent classification and reporting of risk. This delay is particularly pronounced in Trusts where the surveying and risk assessment responsibilities are split between building surveyors and structural engineers. The separation of these roles introduces a multi-stage process that can delay the timely identification and mitigation of high-risk RAAC elements.

In Trusts such as West Suffolk Hospital (WSH), Queen Elizabeth Hospital (QEH), and Leighton Hospital, where Building Surveyors have led the surveying process, the workflow typically involves building surveyors conducting detailed inspections and logging defects using scoring systems. These scores are then passed to structural engineers for interpretation and risk classification. This leads to a delay between the initial identification of a defect and its formal risk rating. During this period operational decisions may be made based on outdated or incomplete information.

This issue is compounded in hospitals where the survey data is not immediately integrated into a live asset management system. In such cases, the delay between survey and risk classification can result in a misalignment between the actual condition of the estate and the recorded risk profile or in worst case result in a delay in confirming high-critical planks. This is highlighted by the variance between surveyed data and remedial works completion data.

For Trusts employing Structural Engineers directly, such as Hinchingbrooke, James Paget University Hospital (JPUH) and Frimley Park Hospital, tend to adopt a more streamlined approach. There is a direct classification of RAAC elements during the survey process, with visual assessments immediately informing the risk category. This will reduce the time-lag.

The actual time lag between RAAC surveying and risk classification varies significantly across the RAAC 7 hospitals, influenced by the consultant structure and methodology in place.

### C.5.4 Surveying and Decant Programme

Further challenges exist when attempting to ascertain the clinical impact of the RAAC plank locations. With the programme of decant and reallocation of space having changed the use of some departments, the departmental naming conventions used in RAAC plank data collection are sometimes misrepresentative of the actual current use; for example, at Hinchingbrooke Hospital, the old intensive care unit is now used as theatres storage but referred to by its old name: this changes the risk profile.

### C.5.5 Risk Assessment Alignment

The following provides an overview of the typical 5x5 risk assessment matrix adopted by NHS Trusts. Although there can be some variance in specific detail – the premise remains similar.

**Table C.2: Risk Assessment Alignment**

| | Impact/ Consequence | | | | |
|---|---|---|---|---|---|
| | Insignificant<br>1 | Minor<br>2 | Significant<br>3 | Major<br>4 | Severe<br>5 |
| Health & Safety | No injury, but a breach of statutory guidance or regulations | Minor injury (first aid or self-administered treatment. Breach of legislation | Moderate injury requiring assistance. Breach of legislation with notice issued | Major or significant injury leading to incapacity. Notice issued (prohibition) | Major or significant injury leading to incapacity.<br>Prosecution |
| Environment | Minimal or no impact on guidance or legislation | Breach of legislation | Breach of legislation with notice issued | Multiple breaches of legislation and notice issued (prohibition) | Multiple breaches of legislation.<br>Prosecution |
| Business / reputational | Minimal reputational damage | Possible complaint and reputational damage | Possible compliant with litigation. Loss of reputation / national reporting | Expected litigation with national reporting | Certain litigation with adverse national reporting |
| Operational | Minimal or no impact of disruption | Localised impact / disruption to service | Moderate impact to normal services | Major impact to normal services | Critical impact to normal service / service closed |
| Financial | Negligible financial loss. No impact on operations. | Small, manageable loss. May require internal budget adjustment. | Noticeable financial impact. May affect project delivery | Substantial loss. Impacts multiple departments or strategic goals. | Critical financial loss. Threatens organisational viability or solvency. |

| | | Regulatory | No breach; minor deviation from best practice or internal policy. | Breach of internal policy or non-statutory guidance; no external reporting required. | Breach of legislation with formal warning or improvement notice issued. | Serious breach resulting in enforcement action, fines, or temporary suspension. | Major legal violation; prosecution, license revocation, or criminal charges. |
|---|---|---|---|---|---|---|---|
| Probability / Likelihood | Rare (1) | Time to failure assumed >10years | Very low | Very low | Low | Medium | Medium |
| | Unlikely (2) | Time to failure assumed < 10years | Very low | Low | Medium | Medium | High |
| | Moderate (3) | Time to failure assumed <5years | Low | Medium | Medium | High | Very high |
| | Likely (4) | Time to failure assumed <1year | Medium | Medium | High | Very high | Extreme |
| | Almost certain (5) | Time to failure assumed <6months | Medium | High | Very high | Extreme | Extreme |

## C.5.6 Surveying Rate Alignment

To established the baseline costs and impacts for surveying of RAAC, the following table has been developed. This considers the space typology, an assumed survey panel rate, based on Mott MacDonald Data and benchmarked through the interview process / site visits.

The table considers the additional clinical activities and assumptions on level of disruption that would be applicable for each space typology.

### Table C.3: Surveying Rate Alignment

| Space type | Assumed survey rate (panels per day) | Cleaning requirement | Additional clinical activities | OOH or In hours? | Assumptions | Disruption level (1-5) |
|---|---|---|---|---|---|---|
| **Theatres** | 100 | Deep clean after surveying | | Out-Of-Hours (OOH) | Assumed that over-night surveying would be required. Could tie in routine MEP maintenance | 5 |
| **ICU / CCU** | 100 | Deep clean after surveying | Local relocation of bedded patients to suit surveying (i.e. empty bay/room or ward). | In hours | | 5 |
| **Pathology** | 200 | Deep clean after surveying | | Out-Of-Hours (OOH) | Would need to take account sensitivities of equipment, etc. | 4 |
| **Pharmacy** | 150 | Deep clean after surveying | | Out-Of-Hours (OOH) | Would need to take account sensitivities of equipment, etc. | 4 |
| **Maternity - delivery** | 150 | Deep clean after surveying | Local relocation of bedded patients to suit surveying (i.e. empty bay/room or ward). | In hours | - | 4 |

| Space type | Assumed survey rate (panels per day) | Cleaning requirement | Additional clinical activities | OOH or In hours? | Assumptions | Disruption level (1-5) |
|---|---|---|---|---|---|---|
| **Paediatric IP** | 150 | Deep clean after surveying | Local relocation of bedded patients to suit surveying (i.e. empty bay/room or ward). | In hours | - | 4 |
| **ED** | 200 | Clinical clean | Vacate room(s) | Out-Of-Hours | Clean overnight as this is less busy | 4 |
| **Ward (incl. ICU and SCBU)** | 220 | Clinical clean | Local relocation of bedded patients to suit surveying (i.e. empty bay/room or ward). | In hours | Restricted access and surveying needs to be sequenced to suit patients, particularly for side rooms | 3 |
| **CSSD** | 150 | Deep clean after surveying | - | Out-Of-Hours | Would need to take account sensitivities of equipment, etc. | 3 |
| **Mortuary** | 150 | Deep clean after surveying | - | Out-Of-Hours | Cannot be done during day if PMs, etc. | 3 |
| **Diagnostics** | 200 | Deep clean after surveying | Vacate room(s) | Out-Of-Hours | Would need to take account sensitivities of equipment, etc. | 3 |
| **OPD** | 200 | General clean | Vacate room(s) | In hours | Generally free to access with some minimal relocation of surveys to suit clinical scheduling | 2 |
| **Kitchen** | 200 | General clean | None | In hours | - | 2 |
| **Restaurant** | 200 | General clean | None | In hours | - | 2 |
| **Maternity - Antenatal** | 150 | Deep clean after surveying | | In hours | See OPD | 2 |
| **Circulation** | 200 | General clean | | | - | 2 |
| **Physiotherapy** | 200 | General clean | Vacate room(s) | In hours | Generally free to access with some minimal relocation of surveys to suit clinical scheduling | 2 |
| **Estates** | 300 | Minor clean after surveying | No requirements | In hours | Free to access | 1 |
| **Admin / office** | 200 | General clean | None | In hours | - | 1 |

### C.5.7 Further References


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- 2022, Reinforced Autoclaved Aerated Concrete (RAAC) Investigation and Assessment, Institution of Structural Engineers, UK
- 2023, Reinforced Autoclaved Aerated Concrete (RAAC) Investigation and Assessment – Further guidance, Institution of Structural Engineers, UK
- 2023, RAAC Structural Modelling, A research report Deliverable (D4) for the NHS by Loughborough University.
- CROSS reports; Structural safety of reinforced autoclaved aerated concrete (RAAC) planks | CROSS

# D. Clinical Costing Methodology

## D.1 Cost of Time Lost in Key Functional Departments

These are the methodologies used to calculate the impact of loss of service based on a day's service down time

**Table D.1:Opportunity Costs**

| Service/ Department | Unit | Cost base used | Methodology |
|---|---|---|---|
| Theatres | Theatre | BMJ estimate of the cost of a theatre hour, for theatre plus staff, etc. but no procedure (uplifted cost of a theatre per hour^) | Assumed 8 hours per day, using estimate of 2x 4-hour sessions |
| Adult Inpatients | Bed day | National Cost Collection for the NHS 2023/24 | Cost per bed day, excluding any surgical procedures, diagnostics, and imaging, etc.<br>- Adults: based on Parliamentary response to question to determine the ward cost only^^<br>- ICU costed at NHS published cost rate<br>- Paediatrics costed at adult rate. |
| Adult Critical Care | Bed day | | |
| Paediatric Inpatients | Bed day | | |
| Neonatal unit (NICU) | Bed day | | Average Neonatal cost per cot day |
| Maternity | Ante-Natal | | Based on national averages for antenatal attendances; weighted for total numbers of new and follow ups; 2x 3.5-hour sessions at 90% utilisation; New appointment 60 mins, follow-up 25 mins |
| Maternity | Delivery (normal) | | Based on national averages for antenatal attendances; weighted for total numbers of new and follow ups; 2x 3.5-hour sessions at 90% utilisation; New appointment 60 mins, follow-up 25 mins (Assume remediation done out of hours so no cost incurred) |
| Outpatients | New and follow up appointments | | Weighted average normal delivery price; rate per day based on HBN09-02 birthing rooms per '000 delivery rates |
| Emergency Department | Attendances | | Based on national averages for activities with more than 100,000 attendances; weighted for total numbers of new and follow ups; New appointment 30 minutes, follow-up 15 minutes. (Assume remediation done out of hours so no cost incurred) |
| Pathology | Tests | | Based on consultant-led attendances, average price. Assumes 4x cubicles are down at a time for remediation. Based on each room being used 1-2 hours per patient (average 1.5 hours), each cubicle would see 16 patients' day. 16 patients x 4 rooms = 64 attendances a day |
| CSSD | Trays (100 instruments) | ngtp-lean-surgical-trays-v1-july-2024.pdf | Based on cost of test at national cost rates x 20,000 tests per day; it is assumed that the service would move during |

| Service/ Department | Unit | Cost base used | Methodology |
|---|---|---|---|
| | | | the weekend, with an assumption of an efficiency loss of 0.5 days' activity (i.e. 10,000 tests) |

^ See https://bmjopenquality.bmj.com/content/6/1/u219831.w8131

^^ See https://questions-statements.parliament.uk/written-questions/detail/2023-03-14/165361

## D.2 One-off Costs of Moves (e.g. ward decants)

Assume the following would be needed for each move (i.e. to and from decant facility) - based on evidence from sites

**Table D.2: Staff Bandings**

| Staff type | Grade | Comments |
|---|---|---|
| Nurse (qualified) | Band 6 | Costs based on 7.5-hour day, with on-costs (NI (employer) at 15% + Pension at 23.8% (per NHSBA website^^^) |
| Health Care Assistant | Band 3 | |
| Porter | Band 2 | |

^^^ See https://www.nhsbsa.nhs.uk/nhs-pension-scheme-employer-contribution-rates-202526

## D.3 Costing Review - short-, medium-, and long-term horizons

### D.3.1 Cost Assumptions and Exclusions

The following estimated costings are provided with the following assumptions:

- The following estimated costings are provided with the following assumptions:
- No Inflation Adjustment: All figures are presented in current-year values and do not account for future inflation, market volatility, or changes in material and labour costs over time.
- Site specific abnormals: the cost range does not take into consideration any site-specific conditions or abnormals.
- Indices and location adjustments: no allowances have been made for adjustments for any indices nor locations factors. This would need to be taken into consideration when a further detail cost analysis is undertaken at a future stage.
- Indicative Estimates: The costs are indicative and based on available data, assumptions, and professional judgement at the time of reporting. They are not derived from detailed design or tendered prices and should not be used as definitive budgets.
- Scope Limitations: The estimates reflect known and planned works related to RAAC remediation and infrastructure risk mitigation. They do not include costs for wider estate transformation, new hospital construction, or unrelated capital projects.
- Exclusions: The following are excluded unless explicitly stated.
    - VAT and other taxes in relation to public procurement rules
    - Professional fees
    - Land acquisition costs or enabling works
    - Temporary decant or relocation costs beyond those directly associated with RAAC works
    - Warranties for repairs

  - Phased working
  - Implications associated with working in a live environment

- Operational Dependencies: Some costs are contingent on operational decisions, such as the timing of decants, sequencing of works, and availability of access to clinical areas.
- Assumed Lifespans: Maintenance and replacement cycles are based on assumed asset lifespans and may vary depending on actual usage, environmental conditions, and unforeseen deterioration.
- Risk and Contingency: No explicit contingency has been included for unknown risks, latent defects, or changes in scope. A separate risk allowance should be considered in financial planning.
- Works, infrastructure or backlog related works, already completed as a part of the RAAC remediation, have within these cost assumptions.
- We have assumed that risk cannot be eradicated and the cost impact of completing remediation works on the following areas would be far outweigh the risk of further works being completed: Clinical Support Service (Pathology, CSSD, Pharmacy).
- Assumed sufficient area for contractor site set up and cranage / hoists adjacent to works area.
- Assumed temporary services (e.g. electricity, water) are available for contractor to connect into within 15m of site compound.
- All MEP costs are estimated based on an assumed technical specifications and number of items that will be required to replace.
- It is assumed that during replacement of the Generator there should be sufficient temporary backup power, and as such a Temporary Hire Cost for 2 x 750 KVA generator is added for 1 week.
- For AHU's, it is assumed that during the long-horizon works and medium-horizon works we are reusing the existing ductwork. No allowance has been made for replacement for the same.
- For Electrical LV Distribution Board, UPS, it is assumed that during the long-horizon works and medium-horizon works we are reusing the existing cables. No allowance has been made for replacement for the same.
- The estimate includes a 15% uplift for subcontractor prelims, as it is assumed the work will be subcontracted to a MEP contractor from a main works contract.
- For MEP items the estimate includes a 15% uplift for risk, as the scope is high-level.
- The confidence for this estimate is a Class 5 +50% / -20% in accordance with the AACE guidance. AACE cost ranges are applicable solely to the accuracy of estimating a defined scope and do not account for cost impacts of ongoing design development or changes in scope.

Data Reliability: The estimates rely on data provided by the Trust and third-party surveys and benchmarked cost information. Any inaccuracies or omissions in source data may affect the validity of the cost projections.

### D.3.2 Definitions

The costs are presented as follows:

- Capital costs refer to one-time, upfront expenditures incurred to acquire, upgrade, or extend the life of physical assets. In the context of the RAAC remediation and infrastructure works at HH, capital costs typically include:
  - Structural remediation works (e.g. RAAC panel replacement or reinforcement)
  - Infrastructure upgrades (e.g. replacement of electrical switchgear, boilers, or chillers)
  - Installation of new systems or equipment (e.g. generators, ventilation units)
  - Major refurbishment or construction works

- Operational costs refer to ongoing, recurring expenses required to maintain and operate the hospital's infrastructure and services. These include:
  - Routine maintenance and servicing of equipment (e.g. HVAC systems, fire alarms)
  - Regular inspections and surveys (e.g. RAAC panel condition monitoring)
  - Minor repairs and replacements (e.g. painting, re-sealing, component swaps)
  - Management and administrative activities related to estates and facilities.

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