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Understanding and Ending the Lethal Asbestos Legacy

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Abstract: The Victorian Asbestos Eradication Agency (VAEA) was established to develop a long-term plan for the prioritised removal of asbestos containing materials (ACMs) from Victorian government-owned buildings. The safest and most sustainable way to end the lethal asbestos legacy is through prioritised, planned, and safe removal of ACMs from the built environment. In this article, we describe our consolidated asbestos register (AIRSystem); our custom risk assessment model that informs prioritised removal, and our work towards ending the lethal asbestos legacy.

Keywords: asbestos; asbestos containing materials (ACMs); hazardous materials; risk assessment; built environment; workplace health and safety; asbestos registers; asbestos surveys; occupational health and safety

1. Introduction

Asbestos is a known carcinogen that causes fatal and debilitating diseases. It kills approximately 4000 Australians every year, with approximately 75% of those being due to asbestos-related lung cancer, 19% being due to malignant mesothelioma, and the remaining six percent being due to larynx cancer, ovarian cancer, or asbestosis [1]. The pervasive use of asbestos over the last 100 years has resulted in a lethal legacy of asbestos containing material (ACM) in government, commercial, industrial, and residential buildings. ACMs in such buildings are subject to damage and weathering; they are degrading and are at or nearing the end of their product lifespan [2].

Planned ACM removal is safer and more cost effective than unplanned or emergency removal; it reduces the risk of contamination of buildings and the environment by damaged or degrading ACMs [3]. The Victorian Asbestos Eradication Agency (VAEA) was established to develop a long-term plan for the risk-based, prioritised removal of asbestos from Victorian government-owned buildings. To support the development of this plan, the VAEA consolidated information on the location and condition of ACMs in state-owned buildings, assessing the risk posed by those ACMs, and making risk-based recommendations for their prioritised removal. Victoria is the second most populated state within Australia with a large number of buildings owned by government. The VAEA's scope covers ten portfolio government departments with over 3400 sub agencies within those departments. The role of the VAEA has since evolved to include maintaining and updating the consolidated building and asbestos register, the ongoing implementation of a prioritised asbestos removal program, and providing advice on best practice for asbestos removal.

2. Understanding Australia's Asbestos Legacy

Asbestos is a naturally-occurring mineral fibre used extensively in building and consumer products until the late 1980's in Australia. Asbestos was mined as a raw mineral, processed (crushed/milled), and incorporated into a wide variety of construction materials in Australia during this time [1]. Until the mid-1980s Australia had one of the highest rates of asbestos use per person in the world [4].

Asbestos was mined in Australia until 1984 (the last asbestos mine, the Woodsreef mine in NSW ceased production of chrysotile asbestos in 1983) [1] and 1.5 million tonnes of as-

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bestos was imported between 1930 and 1983 [4]. By 1990, Victoria was using 60% of Australia's asbestos imports [5]. Asbestos was used extensively because of its sound absorption; tensile strength; resistance to fire, heat, electrical, and chemical damage; and its durability and affordability. Asbestos fibres were mixed with a range of materials including cement, vinyl, and bitumen to manufacture over 3000 different products. Examples of common asbestos products are: cement roofing, cement sheet, electrical components, thermal and acoustic insulation products, textiles, rope, gaskets, and vinyl tiles.

Asbestos is a known carcinogen that causes serious illnesses and diseases such as malignant mesothelioma, asbestosis, and lung cancer. The International Agency for Research on Cancer (IARC) states that there is no safe threshold for exposure to asbestos and all types of asbestos are classified by IARC as hazardous to human health [6]. Because of its hazardous nature, the manufacture and use of asbestos and ACMs in Australia was progressively phased out and banned. At the end of 2003, chrysotile asbestos, the only form of asbestos still being used, was banned at a national level, resulting in a complete ban of the use of any type of asbestos in Australia [4].

While the ban on use of asbestos has been in place for nearly 20 years, ACMs remain in the built environment and are a potential hazard to the health of workers and the broader community. Approximately 6.4 million tonnes of ACM are currently estimated to remain in the Australian-built environment [2]. The widespread use and consumption of asbestos in Australia presents a lethal legacy that needs to be addressed by removing ACMs from our buildings to prevent future asbestos exposure [2].

Across Australia, the direct primary healthcare costs associated with treating asbestos-related diseases (ARDs) (which have latency periods of typically 20–40 years) is estimated to be more than AUD 192 million each year [7]. The largest component of these expenses is for patients admitted to hospital, with a cost of approximately AUD 54 million incurred each year. [7] Indirect costs (these costs relate to an individual's ability to continue participating in the workforce, and are generally the result of premature death, or the onset of disability) to the Australian economy associated with asbestos exposure are estimated to total approximately AUD 321 million each year [8].

3. Managing Australia's Asbestos Legacy

In 2010, a national review of asbestos management (the Review) was established by the Australian government to improve asbestos management. The final 2012 report of the Review concluded "Prioritised removal and risk management are not mutually exclusive depending on the level of risk it poses, all in situ ACMs [should] be progressively removed within defined periods" [7]. The Review emphasised that prioritised ACM removal programs can support the ongoing opportunistic removal of ACMs.

The Review recommended the establishment of the Asbestos Safety and Eradication Agency (ASEA) and the development and implementation of the National Strategic Plan for Asbestos Awareness and Management (Asbestos National Strategic Plan).

The VAEA's work sits under the Asbestos National Strategic Plan, which recommended the following to Australian governments: consolidate the workplace asbestos registers for buildings they own and lease; develop plans for safe, risk-prioritised removal of asbestos; and improve awareness of asbestos hazards for workers and tradespeople. The VAEA also monitors the progress of asbestos removal from government buildings and co-ordinates Victoria's reporting on actions to achieve the Asbestos National Strategic Plan. In the VAEA's experience, the asbestos removal performance across government in Victoria is varied. Some agencies have been very proactive removing asbestos from buildings they own. At the end of 2020, the Victorian School Building Authority completed its five-year prioritised asbestos removal program in public schools. The risk prioritised removal program safely removed asbestos categorised as high risk and asbestos which may pose a risk in the future from 1287 schools. Other agencies use a basic compliance approach which avoids asbestos removal and manages ACMs on site.

In the VAEA's experience, while ACMs are regularly removed from government-owned buildings, the ACMs removed are generally not prioritised according to risk. The VAEA refers to this approach as 'business as usual'. Over the past six years in the state of Victoria, the implementation of prioritised removal programs and large infrastructure projects have resulted in greater quantities of asbestos being removed than through business as usual removal.

The cost of ARDs on the Victorian economy is significant and will continue to rise if ACMs remain present and continue to be at risk of disturbance in our built environment. The safe, prioritised removal of these materials will see less Victorians impacted by asbestos-related diseases, which result in disability and premature death.

4. Developing a Long-Term Plan for Victoria's Asbestos Legacy

The VAEA is an independent state body, reporting to the Minister for Workplace Safety and a subsidiary of WorkSafe Victoria. It was established as an independent body to give it the ability to collect information from all government departments and agencies, to make recommendations on prioritised asbestos removal and provide best practice advice on asbestos removal.

The VAEA was required to complete all its initial data collection, risk assessments, and recommendations for prioritised removal within 24 months of establishment.

The first 12 months of the VAEA's operation focused on agency start up, data collection, research, and development of the consolidated asbestos register—the Asbestos Identification and Rating System (AIRSystem)—and entry of data into AIRSystem. The second year focused on development and testing of the asbestos risk model and risk algorithm, development of prioritised removal phases, the schedule for removal, and preparing the initial report to the government, setting out the long-term plan for prioritised asbestos removal. The VAEA employs occupational hygienists, policy advisors, project officers, and data entry staff.

4.1. Workplace Asbestos Registers

In Victoria, an employer or person who manages or controls a workplace has a duty to eliminate or reduce a person's exposure to airborne asbestos fibres [9]. Duty holders are required under the Victorian Occupational Health and Safety Regulations 2017 (the Regulations) to implement a range of measures intended to prevent and control asbestos exposure within the workplace. The Regulations include the requirement to identify and record ACMs in a workplace asbestos register, detailing its location, type, friability (friability refers to material that when dry, or as the result of a work process, may be crumbled, pulverised or reduced to a powder by hand pressure), condition, and likelihood of sustaining damage or deterioration. A workplace asbestos register must be regularly reviewed and record any changes to ACMs such as condition, removal, or repair at minimum every five years. An asbestos register must also be reviewed prior to any demolition or refurbishment of a building to ensure all ACMs likely to be disturbed, are identified and removed, so far as it is reasonably practicable, prior to the commencement of any building works.

The information that must be recorded in a workplace asbestos register is used to assess the risk of asbestos exposure, and whether an ACM requires removal or other risk controls such as enclosure or sealing. Victoria's workplace health and safety regulator, WorkSafe Victoria, stipulates that the person undertaking asbestos identification and developing the asbestos register must have the requisite knowledge, skills, and experience to assess the likelihood of the presence of asbestos and to conduct the asbestos survey safely [10]. An occupational hygienist or "competent person" can conduct an asbestos survey in accordance with the Regulations. Occupational hygienists use science and engineering to measure the extent of worker exposure to hazards, and to design and implement appropriate control strategies to prevent ill health caused by the working environment.

4.2. Improving Workplace Asbestos Registers

Limitations on the quality, accuracy, and detail of information in asbestos registers are a widely recognised challenge [11]. Workplace asbestos registers are an administrative health and safety control, developed at a point in time and intended to provide information on the location and condition of ACMs to prevent asbestos being damaged and asbestos fibres being released. The VAEA's analysis of asbestos registers for almost 13,000 buildings confirms that the quality, consistency, and accuracy of information in asbestos registers varies and can be improved. Traditional asbestos registers are generally compiled in a large spreadsheet or PDF document, and identifying the relevant ACM information can be cumbersome and time consuming. Registers may vary in approaches to assessing and describing ACM friability, condition, and potential to be disturbed. They may include assumptions about the presence of ACMs, may not be informed by representative or thorough sampling, and may contain no historical information from previous surveys or asbestos removals.

In the hierarchy of control of hazards and risks, administrative controls provide a lower level of protection and have less reliability because they do not remove or eliminate the hazard [12]. Until ACMs are removed (i.e., the hazard is eliminated) asbestos registers need to be an effective administrative health and safety measure.

ACMs are not static; they degrade over time, they can become friable with ageing, deterioration, disturbance, or damage and release asbestos fibres. Buildings are also not static and are subject to changes in building layout, fit out, use, and ownership.

Asbestos registers need to be kept continually current, often more frequently than just at the point in time of an asbestos survey and they need to be readily accessible (refer Section 4.8). Having an easily accessible, live, and consolidated asbestos register such as the AIRSystem improves the efficacy of asbestos registers as an administrative risk control.

4.3. The VAEA's Consolidated Asbestos Register—Asbestos Identification and Rating System (AIRSystem)

In order to plan for the prioritised removal of asbestos from Victorian government-owned buildings, the VAEA developed and maintains the AIRSystem. The initial data collection undertaken by the VAEA (from 2017 to 2018) covered almost 13,000 buildings. The VAEA reviewed and consolidated the asbestos registers for each building, and created a customised database within the Salesforce environment.

The variations in the content and layout of asbestos survey reports, asbestos registers, and the terminology used necessitated the development of data quality controls and procedures to mitigate inconsistencies. This included the use of standardised terminology in the VAEA data collection template, data collection, and data entry policies and procedures, guidance manuals, and multiple, layered quality assurance processes.

AIRSystem provides a comprehensive ACM and building database that details the following: the condition, location, and disturbance potential of ACMs in government-owned buildings; specifications and location of the buildings in which the ACMs are located; and departments and agencies that own each building. High standard data security and user authorisation processes are incorporated into AIRSystem and information can be accessed by users authorised by the relevant department or agency.

In addition to providing comprehensive information on identified ACMs, AIRSystem is able to produce detailed aggregated and disaggregated reports, dynamic data visualisations of a building, agency, department, or whole of government asbestos legacy. It plots the location of buildings containing ACMs geospatially, can generate QR code labels for each building and each ACM and generate removal pricing estimates.

AIRSystem is an ongoing repository for relevant documents relating to identification, assessment and removal of ACMs, including the full asbestos survey reports, registers, available floor plans, photos, certificates of clearance where ACMs have been removed, and waste transport certificates where ACMs have been disposed following removal. This creates a baseline of ACM data, allows continued improvement in the quality of

asbestos registers and creates an ongoing record and history of ACM location, condition, and removal.

AIRSystem's functionality enables the VAEA and departmental and agency users to understand the asbestos legacy within government buildings and make informed decisions about their prioritised removal, as well as the safe management of ACMs until they are removed.

By continuing to progressively update the AIRSystem annually, the information included in asbestos registers for government buildings continues to improve in quality, consistency, and accuracy.

The VAEA has recently developed an asbestos survey application, AIRTracker, which is accessible for authorised users through both Apple and Google app platforms. This allows an occupational hygienist (refer Section 4.1) to enter the results of an asbestos survey directly into AIRSystem, using the existing asbestos register and survey report as a baseline for the next asbestos survey. This streamlines the asbestos survey process, supporting systematic and thorough entry of ACM data during the survey while retaining other historic information and documentation.

4.4. The VAEA's Risk Assessment Model

To ensure ACM removal was objectively prioritised based on risk, the VAEA looked for an existing risk assessment tool in 2017. The VAEA found that there is no widely accepted or consistent method for the risk assessment of ACMs in the Australian occupational health and safety (OHS) sector.

Although a variety of asbestos risk assessment models of both public and proprietary nature exist, independent research for the VAEA concluded that no consistent risk assessment model for large scale prioritised asbestos removal programs existed. As a result, the VAEA developed a fit for purpose risk assessment model in consultation with Victorian OHS regulators, occupational hygienists, licensed asbestos removers, trade unions, and employer representatives.

The VAEA risk model incorporates the risk factors reflected in the Regulations and the common factors of international risk models reviewed [13,14] to settle four weighted risk factors: ACM friability, ACM condition, ACM disturbance potential, and building rating (see Figure 1).

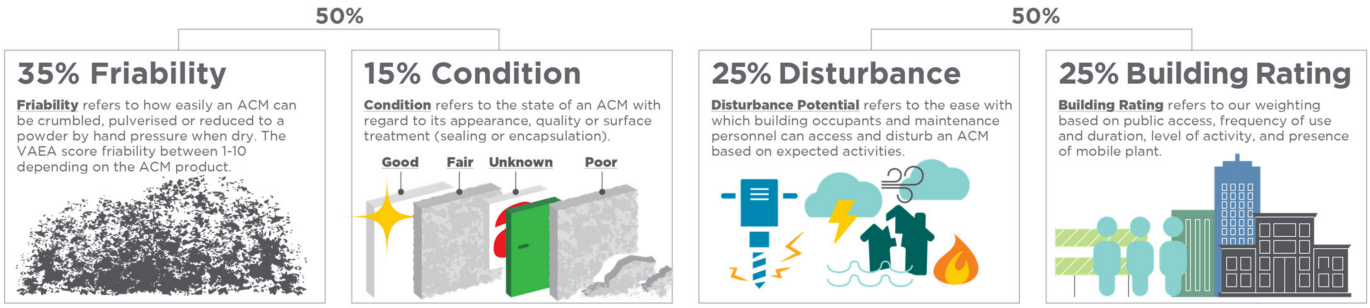

Figure 1. Overview of the VAEA risk assessment model and risk factor weightings.

ACM friability and ACM condition are based on information from the survey assessment of each ACM, and contribute 50% towards the final risk assessment score. ACM friability is weighted at 35% (the most significant factor in the risk model) as friability increases the risk of fibre release. ACM friability is attributed a risk weighting of up to 35% from a friability scale based on the ACM product type. As shown in the bottom of Figure 2, levels 1–5 of the ACM product type are ACMs that are generally considered non-friable and levels 6–10 of the ACM product type are friable. The condition of ACMs contributes a weighting of up to 15%.

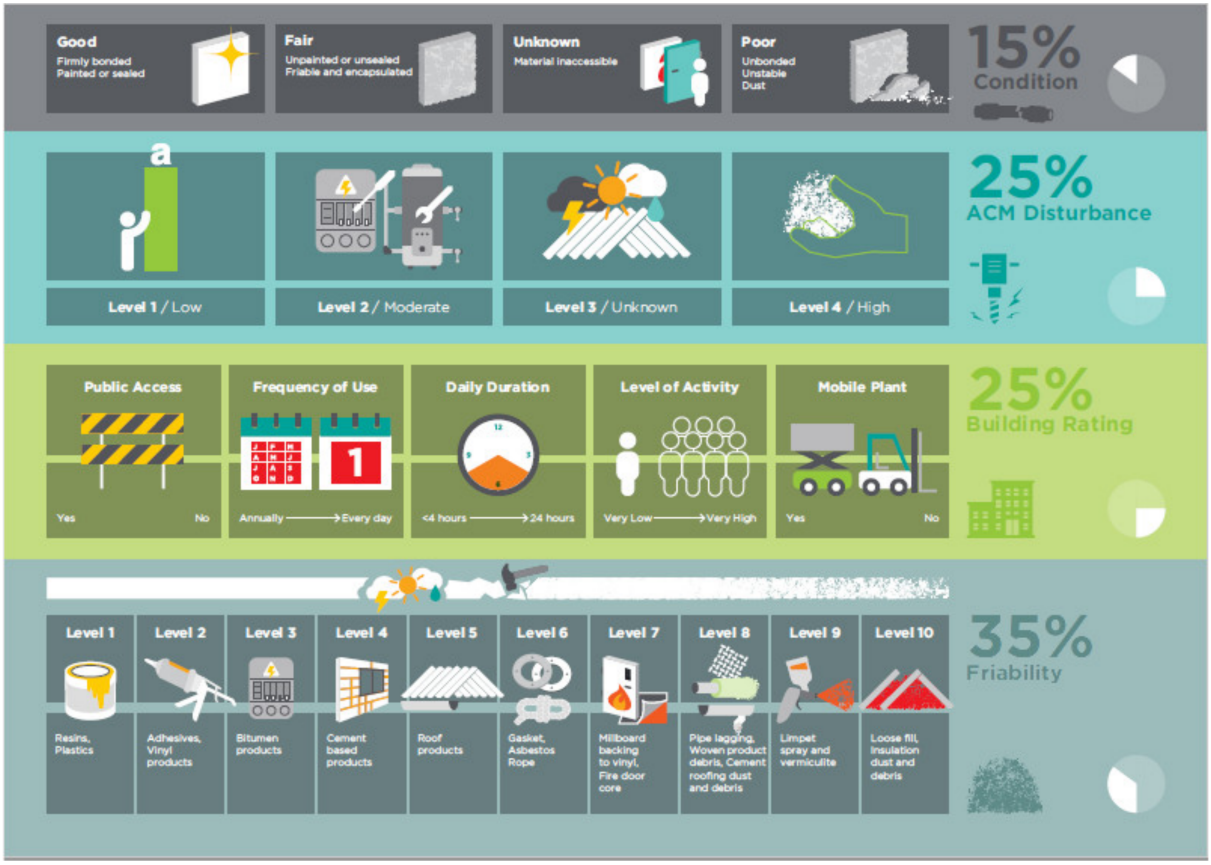

Figure 2. Overview of VAEA risk model risk factors.

Disturbance potential (refers to the ease with which building occupants and maintenance personnel can access and disturb an ACM based on expected activities) and building rating risk factors account for the built environment where the ACM is located. These contribute 50% of the weighting for the final risk assessment score. Disturbance potential is categorised into four levels and contributes up to 25% of the overall risk score (refer Figure 2). The building rating is assessed based on the building use, public access, nature and frequency of access, building type and operation of mobile plant equipment such as industrial lift trucks, forklifts, powered pallet trucks, cherry pickers, and contributes the remaining 25% of the overall risk score.

As there is no known safe level of exposure to asbestos, assessment of each risk factor has a numeric value that contributes to the overall risk score—no risk factors have a zero score. A precautionary approach was applied to give a higher risk weighting to assumed ACMs, where condition, disturbance potential, or friability are listed as 'unknown' in a register.

The calculation of the four risk factors and their weighting results in a minimum possible risk score of 19 and a maximum possible risk score of 100.

This approach of attributing a consistent percentage weighting for each of the four risk factors to develop an overall risk score, provides a more objective approach to assessing ACM risk.

4.5. Schedule for Prioritised Asbestos Removal

The risk model and risk score calculation are programmed into AIRSystem and applied to all ACMs in the database to generate a schedule for prioritised removal. Priority for removal ranks the ACMs into five phases to allow for long-term, planned removal (see Figure 3).

REMOVAL PHASE	RISK CATEGORY	INDICATIVE ACM DESCRIPTION
PHASE 1	MOST HAZARDOUS ACMs	Friable, poor condition, moderate to high disturbance potential, high use buildings
PHASE 2	MOST HAZARDOUS ACMs	Friable, unknown or fair condition, low to moderate disturbance potential, high use buildings
PHASE 3	ACMs THAT MAY BECOME MORE HAZARDOUS	Non-friable, fair to good condition, low to moderate disturbance potential, high use buildings
PHASE 4	LESS HAZARDOUS ACMs	Non-friable, well bonded, good condition, low to moderate disturbance potential, high use buildings
PHASE 5	LESS HAZARDOUS ACMs	Non-friable, well bonded, good condition, low disturbance potential, low use buildings

Figure 3. Prioritised removal phases.

The highest-priority ACMs for removal are those identified as most hazardous (Phase 1 and 2) as they pose the greatest health risk. These ACMs make up the smallest proportion of ACMs in AIRSystem.

Next priority ACMs for removal are those that pose a lower health risk; ACMs that may become hazardous if they are damaged or disturbed (Phase 3). These represent the most prevalent ACMs in the AIRSystem, the majority of ACMs in this category are cement products. These ACMs should be prioritised for removal, once higher-priority ACMs have been removed, or if they are damaged or disturbed.

Lower priority for removal are less hazardous ACMs (Phase 4, 5). These ACMs are well-bonded and non-friable with a low potential to be damaged or disturbed.

Additional risks posed by health and safety hazards associated with installed ACMs, such as working at height, electrical, plant, or heat hazards should be controlled as part of asbestos management and removal plans.

4.6. Adoption of the AIRSystem across Victorian Government

Part of the VAEA's ongoing role is to maintain and update the AIRSystem and prioritised schedule for removal. The VAEA also contacts targeted agencies throughout each year to gather information on changes to their asbestos legacy, including asset management changes such as new acquisitions, disposal, demolition or renovations, and name or address changes. Updates on ACM removals and any additional documentation such as asbestos clearance certificates and waste transport certificates are also collected every year.

The VAEA's long-term plan for AIRSystem is for Victorian government departments and agencies to maintain their own information within the database. To reach this goal the VAEA is progressively rolling out AIRSystem access to agencies and departments. A dedicated team in the VAEA provides support to agencies and departments with face-to-face and online training, help-desk support, and a range of digital educational materials. The VAEA estimates that across government in Victoria there is a potential AIRSystem user base of up to 38,000. The VAEA is currently partnering with a major agency and their occupational hygienists using the AIRTracker app to conduct asbestos surveys of their built assets and update their asbestos registers within AIRSystem.

4.7. ACM Verification

An essential risk control for OHS as well as financial risks for the VAEA's prioritised asbestos removal program, is the verification of identified ACMs prior to the scoping and procurement of removal works. Verification is an independent assessment by occupational hygienists of the identified ACMs proposed for removal. This process includes an onsite survey to confirm the identified ACMs are still present, accessible, and able to be removed. ACMs are sampled and laboratory tested for the presence of asbestos. Confirmation of

the number and location of the ACMs to be removed, and where required, information on preferred removal methodology, are set out in a report submitted to the VAEA by an independent occupational hygienist.

The verification process ensures asbestos removal is appropriately scoped and conducted safely, program funding is allocated appropriately, and removal projects are cost effective. This approach minimises the likelihood of project variations and inadvertently disturbing any unidentified ACMs.

The VAEA's verification process was informed by research conducted by ASEA. In a case study assessment of 11 asbestos removal programs, ASEA found that one of the most important elements of planning is ensuring that fully intrusive site assessing and sampling of suspected ACMs occurs prior to the procurement of asbestos removal work [15]. Improvements in workplace asbestos registers (refer s4.2) and adoption of the AIRSystem will gradually reduce the work required during ACM verification.

4.8. Benefits of Consolidated Workplace Asbestos Registers

The VAEA has used the opportunity to create the consolidated asbestos register to improve the level of protection and reliability of asbestos registers as an administrative health and safety control. A workplace asbestos register needs to be accessible and available to the people who need it to reduce their risk of exposure to asbestos fibres. This includes workers, health and safety representatives, contractors, and maintenance staff who access areas containing ACMs and are at risk of exposure if they inadvertently disturb or damage them.

Consolidation of asbestos data and registers also has macro benefits. The existence of AIRSystem provides the Victorian government a better understanding of the size of its asbestos legacy across its buildings. AIRSystem can increase awareness of the asbestos legacy for senior leaders and government decision makers. It provides a platform for a more informed and strategic management of risk. AIRSystem can be used to improve future building and asset management and planning decisions.

AIRSystem functionality the VAEA is currently trialling includes: opportunities for information and data sharing across government for digital twin or 3D visualisation initiatives, spatial data, and building information modelling.

The AIRSystem is a model that could be readily adapted for use by other jurisdictions with similar approaches to managing information on ACMs and prioritised asbestos removal policy initiatives. The Australian Senate Economics Reference committee interim report of the non-conforming building products inquiry recommended the establishment of a national public asbestos register. In response, the Australian government noted the recommendation and advised "The Federal Government will however consider any benefits that arise from the work of the Victorian Government in developing a comprehensive register of asbestos in government buildings and in planning its removal. This test case would inform discussions by jurisdictions on the feasibility of collaborating to develop a national register." [16] Similar recommendations to improve the information on asbestos in buildings, particularly public buildings, and to create centralised registers of asbestos have been made in other countries but have not yet been implemented [17,18].

5. Understanding Victoria's Government-Owned Building Legacy

Victoria is currently the only Australian jurisdiction to have a single consolidated asbestos register for publicly owned buildings. AIRSystem allows the VAEA to gain an accurate picture of the asbestos legacy in those buildings. Such a sizeable dataset will allow the VAEA to identify trends and opportunities to improve public policy approaches in regards to identifying, assessing, and risk rating asbestos, especially for prioritised removal.

5.1. The Victorian Government Building Asbestos Profile

The consolidation of information on the asbestos legacy in Victorian government buildings provides greater visibility on the most prevalent ACMs in those buildings and in

future any changes to their condition. As at 2022, the total metric tonnes of ACMs identified in the AIRSystem is 94,700.

Figure 4 shows asbestos cement products such as flat cement sheeting and corrugated cement sheeting are the most prevalent ACMs and are in situ in building ceilings, walls, eaves, infill panels, and rooves. This reflects Victoria's, and generally Australia's, historically high consumption of asbestos cement sheeting. Based on Australia's asbestos consumption and importation trends, ACM products in Victorian government-owned buildings vary in age from at least 30 to 100 years old. The majority of ACMs were manufactured and installed between 30 to 60 years ago. It is estimated that 90% of asbestos consumed in Australia was made into cement products. The average estimated lifespan of asbestos cement sheeting from installation to removal is assessed as 40 years. As a consequence, there are a significant number of ACMs in government-owned buildings, as well as commercial and other buildings that are nearing the end of their expected product lifespan.

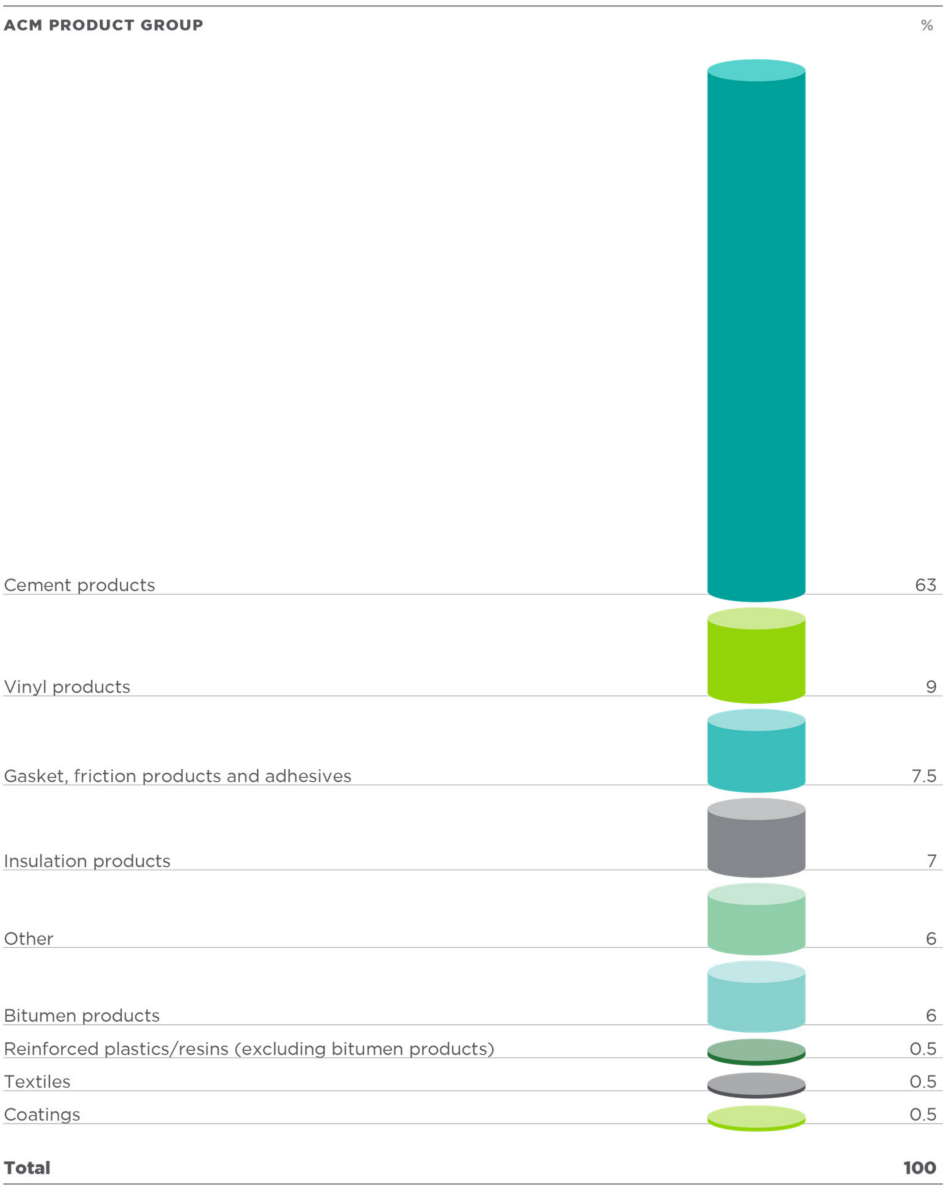

Figure 4. ACM product groups in Victorian government-owned buildings, from the most to least prevalent. Source: AIRSystem.

In particular, the systematic eradication of corrugated asbestos cement sheet roofs is not only an opportunity to reduce exposure to asbestos fibres due to the ingress and build-up of contaminated dust within buildings over time; their eradication is also an opportunity to reduce fall from height injuries and deaths where roof repair and maintenance work is required on brittle cement roofs or rooftop plant and inadequate safe work systems are deployed. The reinstatement of alternative ridged roofing materials, combined with walkways or other fall from height controls, can greatly reduce fall risks.

Figure 5 shows that as of 2022, 68.7% of ACMs in the AIRSystem have been assessed as being in good condition, 8.6% in fair condition, and less than 2% in poor condition. AIRSystem data shows that ACMs assessed as being in poor condition include the greatest proportion of friable ACMs.

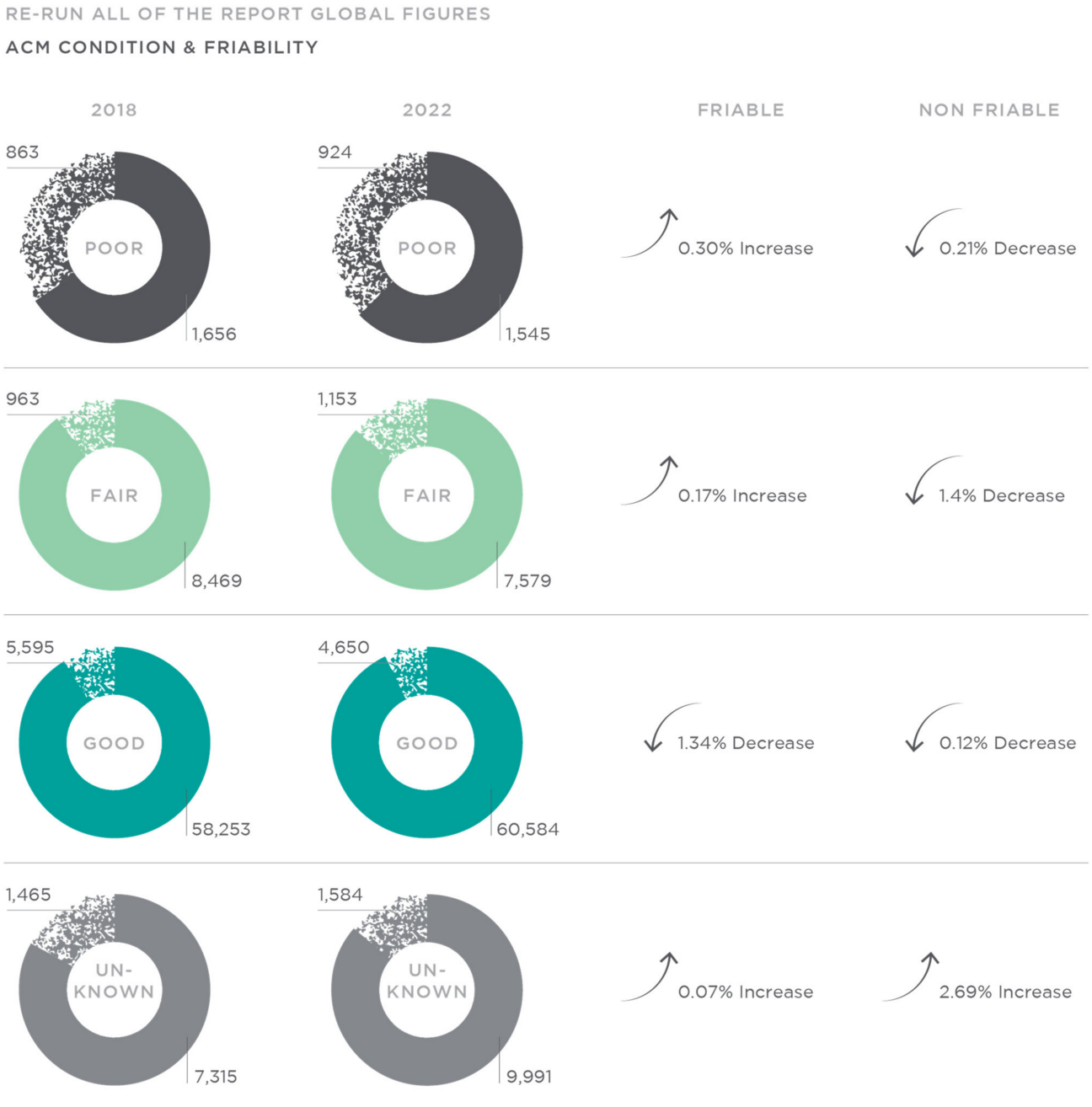

Figure 5. Breakdown of ACM friability and condition, 2018 vs. 2022 comparison. Source: AIRSystem.

Whilst trends on condition and friability of identified ACMs are not significant enough at a macro level to attribute conclusions, the VAEA is working towards longitudinal datasets to track any change at a government-wide level, at an organisation level, and at an ACM level, particularly for those ACMs nearing the end of their expected product life.

5.2. Improving Assessment of Asbestos Containing Materials

In addition to improving consistency in how ACMs are identified, assessed, and described, our ACM data analysis has shown a key opportunity for improvement in the quality of information in registers is in relation to ACMs that are assumed to be present. ACMs are assumed to be present either because they were not visually assessed or sampled during an asbestos survey. The Regulations allow for asbestos to be assumed present if there is uncertainty if a material contains asbestos, or if there are inaccessible areas likely to contain an ACM. It is an important precautionary safety principle and assumed ACMs must be identified in the workplace asbestos register and managed as if they contain asbestos. However, 9.95%, or almost 1 in 10, of the ACMs in AIRSystem are recorded as not being able to be accessed at the time of the survey and are recorded as assumed ACMs.

To continue to inform long-term prioritised asbestos removal and to improve the quality of asbestos registers, future asbestos surveys should minimise assumptions on the presence of asbestos and confirm its presence or otherwise through an appropriate sampling strategy and survey planning.

This can be achieved by developing consistent standards for asbestos surveys and asbestos registers, as well as addressing any restrictions to access prior to a survey. Additionally, within the AIRSystem, assumed ACMs and those that have an 'unknown' element, such as ACM name, product type, condition, or disturbance potential, are automatically badged as requiring re-inspection. This means a department or agency planning their five yearly asbestos survey, can run a report on all the ACMs in their buildings that require re-inspection, plan, and go to market for a survey and sampling strategy that fills those information gaps. Use of the AIRTracker app to conduct asbestos surveys will automatically identify whether an ACM in the AIRSystem has been sampled and any risk factors that are assessed as 'unknown' to encourage those information gaps to be addressed whilst surveying on site.

Figure 6 shows the proportion of four key criteria required to identify and risk assess asbestos; the identified or suspected ACM (ACM product, ACM name), condition, and disturbance potential that have been recorded as 'unknown' in asbestos registers in the AIRSystem. These occur where ACMs could not be accessed, visually inspected and/or sampled, and an occupational hygienist might make assumptions about the presence of ACMs. Of the ACMs assumed to be present, over 45% have their condition recorded as unknown and over 30% have their disturbance potential recorded as unknown.

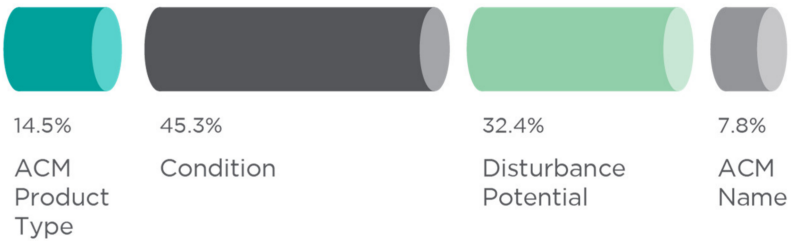

Figure 6. Proportion of asbestos risk assessment criteria recorded as 'unknown' by hygienists in our asbestos register dataset. Source: AIRSystem.

As detailed in s4.7, the VAEA conducts verification of all identified ACMs and sampling of assumed ACMs before removal. In the VAEA's experience through undertaking verification projects, one in five of the identified ACMs prioritised for removal tested negative for asbestos after sampling. This experience indicates there needs to be an improvement in sampling approaches for asbestos surveys. This will better inform prioritised

removal and prevent assumed, potentially non-asbestos materials, having to be managed as if they contain asbestos.

The VAEA's ability to analyse such a large asbestos data set is unique. No other government asbestos data set of this size exists. This analysis can provide factual, evidence-based ways to improve the quality of asbestos registers and asbestos risk assessments.

5.3. Tracking the ACM Cycle, Predictive Modelling and Planning

The VAEA has recorded ACM removals from Victorian government-owned buildings since 2019. The proportion of the most hazardous ACMs, phases 1 and 2 (refer Figure 3) removed in this time frame accounts for a small to moderate proportion of total removals. In 2019, 18.8% of ACMs removed were in the most hazardous category, in comparison to 2020 and 2021, with 2.24% and 12.58%, respectively. The greater percentage of removal of most hazardous ACMs have been when prioritised removal projects have been at scale and without those projects asbestos is not being removed according to risk.

The AIRSystem also has capacity to house documentation associated with ACM removal, including details of licensed removers, disposal contractors, associated regulatory documents, and insurance records. This allows the full cycle of an ACM to be tracked from its identification, management and removal through to disposal.

The AIRSystem, and the access it provides to a large dataset, can in future be used for developing predictive models for an ACM's remaining product life, trends in changes to ACM condition and ACMs that were non-friable at manufacture becoming friable. Deterioration trends tracked over time using the AIRSystem can identify future ACM removal to be prioritised and planned before further deterioration occurs, or non-friable ACMs become friable, thus limiting their exposure risk and the costs required for removal.

Predictive modelling can also inform the future timing of removal expenditure and waste disposal needs, thereby assisting policy-makers to plan for the location and capacity needs of future disposal facilities or the rate and volume of asbestos removal. Assessing asbestos risk can evolve to include broader environmental risks by incorporating natural hazard maps such as bushfires and flood zones.

5.4. Environmental Protection and Sustainability Improvements from Asbestos Removal and Prevention of Asbestos Contamination

Damage to buildings and structures containing asbestos from storms, fires, and floods present current and future risks of asbestos exposure. These emergency events disturb ACMs left in situ and contaminate the surrounding environment, impact clean up and disposal of damaged materials, and present a potential health risk to communities, emergency workers, and volunteers.

The 2009 Black Saturday fires in Victoria illustrated the impact of not removing identified ACMs from the built environment and fire prone areas. As many as 400 individual fires were recorded, destroying over 3500 structures across regional areas. This resulted in the disturbance of asbestos on a large scale, with contamination spread over a vast area.

Inspection of bushfire-affected sites found contamination from asbestos debris, which presented government with a range of challenges. This included health and safety risks in relation to exposure, adhering to legislative requirements for the removal of asbestos, ensuring emergency service workers were undertaking clean-up activities in a safe environment, and balancing efficiency of removal works while ensuring residents could safely return to their homes as quickly as possible [19].

The 2019–2020 Victorian bushfires further illustrated the impact of not proactively removing ACMs from the built environment, causing contamination at levels exceeding the 2009 Black Saturday fires.

Bushfire waste was required to be treated as asbestos-contaminated, and could only be removed by licensed, qualified asbestos removers with an independent occupational hygienist required to provide clearance of the removal of asbestos fibres. ACMs that were non-friable prior to fire damage became friable after fires. Sites were required to be

monitored for asbestos particles daily. Waste was hosed down, bagged, and transported in plastic-lined trucks and sent to local waste facilities to dispose of it safely. In Victoria, only licensed landfills are approved to take asbestos waste. These landfills are regulated by the Environment Protection Authority to ensure they meet the Environment Protection (Industrial Waste Resource) Regulations 2009 and relevant provisions of the Environment Protection Act 2017.

The 2020 clean-up program was funded by the Australian and Victorian governments and required clearance of 75,000 tonnes of asbestos-contaminated waste, 2500 individual structures, and all destroyed or damaged buildings on 736 properties across Victoria. Asbestos surveys were conducted for properties in bushfire prone areas. In East Gippsland alone, nine average truckloads of waste were produced per property. Soil validation challenges were also encountered due to the potential for asbestos fibres in soil. As a result, bushfire clean up included the removal and landfilling of the top 100 mm of soil [20].

These recent bushfire events in Victoria serve as prescient examples. Other natural disasters such as the 2022 floods in Queensland, NSW, and Victoria highlight the continued potential asbestos exposure ramifications and additional costs from the failure to proactively prioritise and remove identified asbestos. These impacts and costs will continue to increase in future as natural disasters and extreme weather events increase in frequency and/or severity due to climate change [21].

AIRSystem data can be accessed in future by authorised departments and agencies to show the location of buildings with ACMs to inform preventative and remediation approaches in locations at risk or affected by natural disasters.

6. Conclusions

The VAEA's approach to consolidating asbestos registers for Victorian government-owned buildings has benefits for both whole of government and individual agencies. It builds a baseline of information on ACMs and buildings which is updated during subsequent asbestos surveys, to build a history of each buildings' asbestos legacy, registers, and removal.

Victoria is the only jurisdiction that has a large-scale dataset that assists us to understand the implications of legacy asbestos and how to plan for its removal. The custom-made risk assessment algorithm developed by the VAEA has potential for further applications and broader asbestos risk assessment. Understanding the type, amount, location, and associated risk rating of ACMs in government buildings and prioritising their removal will prevent exposures to asbestos fibres and reduce the risk of asbestos-related diseases.

Having a proactive, prioritised, and planned approach to asbestos removal is consistent with research, evidence, and legislative requirements and is the only way to end the legacy of ACMs in our built environment. Accessible, consistent, and up to date identification of the location and condition of ACMs is critical to the success of any management and awareness programs until ACMs are removed. Regulated, safe removal of ACMs is the most effective way to eliminate the risk of asbestos exposure and reduce asbestos-related diseases.

Business as usual, ad hoc ACM removal, and current approaches to managing asbestos in situ are not working fast enough to reduce the asbestos legacy, almost twenty years after asbestos was banned in Australia.

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