Queensland Health report on the investigation into asbestos-related health concerns due to former asbestos manufacturing factories at Gaythorne and Newstead

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Queensland Government

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An electronic version of this document is available at www.health.qld.gov.au/asbestos

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The *Queensland Health report on the investigation into asbestos-related health concerns due to former asbestos manufacturing factories at Gaythorne and Newstead* details the findings of the Queensland Government's multi-agency investigation to assess and manage any ongoing risks to the community living near two former asbestos manufacturing factories in the Brisbane suburbs of Gaythorne and Newstead in Queensland.

In October 2014, there was extensive media coverage of historical asbestos exposure from the former Wunderlich asbestos factory in the Victorian suburb of Sunshine North. Later that month, local media in Brisbane reported there had been a Wunderlich asbestos factory in the Brisbane suburb of Gaythorne, as well as a James Hardie asbestos factory at Newstead. Both factories ceased manufacturing asbestos products in the 1980s.

The Queensland Government responded to the community concerns by establishing a Ministerial Task Force, supported by a multi-agency steering group, to oversee the investigation of any potential ongoing health risks, associated with asbestos, to current residents of Gaythorne and Newstead. The steering group was led by the Department of Health, and included representatives from the Department of the Premier and Cabinet, Queensland Treasury, Department of Environment and Heritage Protection, Department of Housing and Public Works, Metro North Hospital and Health Service, and Brisbane City Council.

The investigation comprised the following activities: literature review to assess asbestos exposure levels around the asbestos plants; review of the history and management of the two factory sites; an epidemiological study of mesothelioma disease in the vicinity of the two plants; monitoring for airborne asbestos to assess exposure levels to people living near the factory sites and community engagement and consultation with concerned community members. These activities were designed to provide a systematic and comprehensive approach to effectively identify and address current health risks from asbestos to the local community. This is particularly important as development of asbestos related diseases may have a latency period in excess of 40 years.

The literature review showed that any ongoing health risk in the vicinity of the former manufacturing factory sites is very low, particularly where site remediation has been undertaken.

The site history reports of the two factories were valuable in providing information about their historical operational practices including post closure remediation and development of the factory sites. These reports indicate the operational practices of the factories would have resulted in high asbestos exposure to workers as well as some off-site emissions of asbestos fibres into the surrounding area.

The epidemiological study found the number of mesothelioma cases in the vicinity of the former factory sites is consistent with what would be expected in the general Queensland population. Limitations to the analysis include the length of time between asbestos exposure and disease occurrence, case definition based on the address at the time of diagnosis and inadequate information about occupational exposure of mesothelioma cases. The epidemiological study only relates to past exposures and is not an indication of present day risk.

While the epidemiological study did not identify an excess of cases of mesothelioma, it is important to acknowledge the anecdotal reports by residents in the Gaythorne area that asbestos related disease has occurred in those who lived near the factory during its operation. It is therefore possible, cases of mesothelioma have occurred as a result of para-occupational and neighbourhood asbestos exposures which have not been able to verified by the epidemiological findings.

The asbestos monitoring, conducted between October 2014 and May 2015 in the vicinity of the factory site at Gaythorne, revealed the airborne asbestos concentration in Gaythorne is similar to the very low concentrations in other areas of Brisbane. Airborne asbestos fibre concentrations in all air samples taken from properties near the former Gaythorne factory site were less than or equal to 0.001 fibres/mL.

Trace amounts of asbestos fibres were found in a number of dust samples taken from the roof cavities of premises both within proximity to the former asbestos factory site, and homes in other areas of Brisbane. Typically, the presence of asbestos fibres in dust samples indicates a nearby source of asbestos fibres, such as the presence of asbestos in the building materials forming the ceiling cavity. Only one air sample in the Gaythorne area revealed the presence of one asbestos fibre in the ceiling cavity of a home which did not have any current asbestos materials forming the roof cavity, suggesting the fibres originated from elsewhere; possibly from legacy factory operations or nearby buildings containing asbestos. Disturbance of this roof space would not result in detectable levels of respirable asbestos fibres.

On the basis of the above findings, the investigation concluded, the ongoing risk of asbestos exposure to people living in proximity to the former asbestos manufacturing factory site at Gaythorne is no greater than that of people living in other areas of Brisbane.

It is important to note the former asbestos factory site at Gaythorne contains various sources of asbestos contamination. Workplace Health and Safety Queensland continue to work with the site owners to ensure compliance with the *Work Health and Safety Act 2011*.

Based on the results of the asbestos air monitoring at Gaythorne, monitoring was not undertaken at Newstead.

The investigation highlighted a number of asbestos related concerns from residents. Concerns identified include the possible presence of asbestos in ceiling dust from legacy factory operations resulting in an unmanaged risk during demolition, asbestos materials that may be buried in residential properties and disposal of small quantities of asbestos materials that may be discovered in residential and public places.

The monitoring results confirmed that demolition of houses in the vicinity of the factory would not create increased asbestos risk due to disturbance of dust. Current regulatory controls surrounding demolition are sufficient to manage any risks associated with demolition of these properties, with the major risk being disturbance of asbestos containing building materials. Other concerns raised relating to the ongoing management of asbestos in Queensland which may have state-wide implications will need to be addressed accordingly.

The investigation also highlighted the need for ongoing education and awareness of the risks of asbestos exposure in domestic settings, particularly when undertaking Do-It-Yourself (DIY) renovation of properties containing asbestos materials.

In conclusion the investigation has revealed that in the past there was likely to have been asbestos exposure in the vicinity of the former factories while they were operational and prior to their clean-up (which occurred in the mid-1980's). However, there is no evidence of elevated asbestos-related health risk to residents who have commenced living near the former factories sites in Gaythorne and Newstead since the mid-1980's following the clean-up of the sites.

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Recommendations

The investigation into the former asbestos factories at Gaythorne and Newstead has confirmed that there is no evidence of elevated asbestos-related health risk to residents who have commenced living near the former factories sites in Gaythorne and Newstead since the mid-1980's when final site clean-up occurred.

However, the investigation has highlighted some issues of broader significance, which have resulted in the following recommendations:

1. **Issue:** The community has raised concern about the disposal of small pieces of asbestos materials found in residential and public areas of Gaythorne. This is not only an issue in Gaythorne but is also of particular concern in local government areas where no sites are available for asbestos disposal by people other than regulated waste transporters. This issue has been identified as a common problem requiring a state-wide solution.

   Recommendation: It is recommended practical solutions that enable the safe disposal of small quantities of asbestos waste by members of the public be developed.

2. **Issue:** The investigation identified that buried asbestos waste exists at a number of sites throughout Gaythorne. While the major known sites have been inspected and were reported to be safe at the time of inspection, however there remains some concerns regarding asbestos waste that may be buried on residential properties. While the health risk from activities involving buried asbestos materials in residential areas may be low, advice should be provided to the community on how to safely deal with the buried material. Mechanisms should also be available to alert residents in areas where there is likely to be buried asbestos, such as the areas surrounding former asbestos factories or landfill sites.

   Recommendation: It is recommended that appropriate management strategies are developed for providing advice to residents in Gaythorne and in other Queensland communities where buried asbestos may be present. Residents should be made aware that buried asbestos is not a risk unless it is disturbed.

3. **Issue:** There is a need for continuing education and awareness of the risks of asbestos exposure in domestic settings, particularly when DIY renovation is undertaken at properties containing asbestos materials.

   Recommendation: It is recommended that community education and awareness strategies on safe handling of asbestos containing materials be reviewed and strengthened.

The recommendations may be referred to the Interagency Asbestos Group (IAG) which is responsible for coordination of the *Statewide Strategic Plan for the Safe Management of Asbestos in Queensland 2014-2019*.

1. Introduction

1.1 Background

In October 2014, there was extensive media coverage of historical asbestos exposure arising from the former Wunderlich asbestos factory which operated in the Victorian suburb of Sunshine North until the early 1980s. Soon after, local media in Brisbane reported that there had been a Wunderlich asbestos factory in the Brisbane suburb of Gaythorne, as well as a James Hardie asbestos factory at Newstead in Brisbane. Both factories ceased manufacturing asbestos products in the 1980s.

In response to community concerns, the Minister for Health requested that the Department of Health undertake an investigation of the ongoing health risks associated with asbestos for the local communities.

1.2 Purpose

The purpose of the investigation was to determine whether there are any ongoing asbestos-related health risks to residents currently living near to the former asbestos manufacturing facilities that were located at 51 Prospect Road, Gaythorne, and the corner of Longland Street and Breakfast Creek Road, Newstead.

1.3 Scope

The scope of the investigation was to:

- examine current asbestos exposure for people living near the sites of the Wunderlich asbestos plant, Gaythorne and the James Hardie fibrolite plant, Newstead
- establish the history of the sites, including historical practices that may have led to community exposure to asbestos, and their subsequent management as contaminated sites
- examine the likely exposure to asbestos in the community from the asbestos plants by reviewing relevant literature which assesses asbestos exposure levels around similar plants and review of other identified sources of information relating risk of exposure to asbestos to distance from an asbestos plant
- establish as far as possible the epidemiology of asbestos-related disease near the Wunderlich asbestos plant, Gaythorne and the James Hardie fibrolite plant, Newstead
- undertake community engagement and consultation with possible exposed community members
- make recommendations on health protection or mitigation measures to manage ongoing risks from past practices to appropriate agencies and the community.

1.4 Governance

A multiagency steering group was established to provide coordination and oversight of the investigation. This included ensuring that all relevant aspects of asbestos management for a range of settings (workplace, domestic dwelling or external environment) were considered, and that community concerns were adequately addressed.

The Department of Health was appointed the lead agency and had overall responsibility for the investigation and development of the final report. The steering group consisted of representatives from:

- Health Protection Branch, Department of Health
- Public Health Unit, Metro North Hospital and Health Service
- Thoracic Medicine, The Prince Charles Hospital
- Media and Communication, Department of Health
- Social Policy, Department of the Premier and Cabinet
- Asbestos Unit, Workplace Health and Safety Queensland, Queensland Treasury
- Compliance and Business Engagement, Department of Justice and Attorney-General
- Contaminated Land Group, Statewide Environmental Assessments, Department of Environment and Heritage Protection
- Building and Industry Policy, Department of Housing and Public Works
- Brisbane City Council

Terms of Reference for the investigation are provided at Appendix 1.

Periodic consultation was also undertaken with the Victorian Department of Health to enable, as far as possible, consistency in methodology and collaboration of resources and findings, including in the provision of community advice.

1.5 Asbestos regulation in Queensland

The Queensland Government has a comprehensive regulatory framework to minimise the risks of exposure to asbestos in workplaces, domestic premises and the natural environment. These laws are administered by four state government departments and 77 local councils. Other state government agencies are also involved in the management of asbestos or responding to asbestos-related incidents.

Asbestos and asbestos-related activities are regulated under a number of pieces of legislation, including the *Public Health Act 2005* which addresses the protection of human health, the *Work Health and Safety Act 2011* which addresses the protection of people from risks that arise from work practices and the *Environmental Protection Act 1994* which addresses the management of contaminated lands and transport and disposal issues. Each piece of legislation provides for the protection of human health and the environment. Further details on the regulatory framework in Queensland are provided in Appendix 2.

1.5.1 Interagency Asbestos Group

In 2009, the Interagency Asbestos Group (IAG) was formed to seamlessly deliver the government's commitment to improving asbestos safety by developing a coordinated and systematic approach to the management and regulation of asbestos in Queensland.

The *Statewide Strategic Plan for the Safe Management of Asbestos in Queensland 2014-2019* was developed to provide a structured and measurable approach to undertaking the work of the IAG.

The IAG is chaired by the Deputy Director-General, Office of Industrial Relations, Queensland Treasury. It consists of senior representatives from the following agencies that have a role in the regulation, enforcement and/or management of asbestos in Queensland:

- Workplace Health and Safety Queensland, Queensland Treasury
- Department of Health
- Department of Natural Resources and Mines
- Department of Environment and Heritage Protection
- Department of Housing and Public Works
- Department of the Premier and Cabinet
- Local Government Association of Queensland

Workplace Health and Safety Queensland has been nominated by the government as the lead agency in providing strategic oversight of the management of asbestos issues in Queensland (Queensland Government, 2014).

2. Community engagement

The first step in the investigation was to engage with the communities of Gaythorne and Newstead to inform them of the proposed work and to seek information about their knowledge on the operation of the two factories including any community exposures. Consultation with possible exposed community members was also sought. To this end, a variety of community engagement activities were undertaken.

2.1 Engagement Strategy

A community forum session was held at Gaythorne on 11 November 2014 (55 attendees) and another at Newstead on 12 November 2014 (1 attendee). The forums were advertised to the public via:

- Facebook
- media releases
- posters
- letter drops to households within a 1.5 kilometre radius of the two former factory sites.

At each session, presentations were given covering:

- the terms of reference and key elements of the investigation
- general information on asbestos uses and risks
- general information on health conditions related to asbestos exposure
- the number of mesothelioma notifications in proximity to the Gaythorne and Newstead factory sites (preliminary data).

Feedback to the investigation team and access to investigation updates were via:

- 13 HEALTH (13 43 25 84) telephone hotline
- email: asbestos@health.qld.gov.au
- a participant questionnaire
- investigation website: www.health.qld.gov.au/asbestos

Forum participants were also able to register for email updates on the progress of the investigation.

Information received through the hotline, questionnaires and email account were used to help guide some activities of the investigation team.

The following information was publicly released during the course of the investigation:

Table 1 Documents publically released

Information	Website update	Email to subscribers
Investigation terms of reference	✓	
Preliminary epidemiological data	✓	
General asbestos fact sheets	✓	

Information	Website update	Email to subscribers
Asbestos frequently asked questions (FAQ) sheet	✓	✓
Outcome of inspections of asbestos dump sites reported by community	✓	✓
Results of pilot asbestos monitoring program fact sheet	✓	✓
Epidemiological study fact sheet	✓	

2.2 Community feedback

As part of the community engagement strategy, the Department of Health sought to obtain information from local community members regarding the Wunderlich factory. In particular:

- how the Wunderlich factory operated (e.g. how asbestos products were manufactured, transported and waste was discarded)
- reported emissions from the Wunderlich factory
- reported childhood exposure to asbestos in areas surrounding the Wunderlich factory
- reported asbestos related diseases in people who either lived in Gaythorne, or worked at Wunderlich factory.

Through the above channels, members of the community provided information and raised concerns relating to the investigation. The full report containing information provided by the Gaythorne community is provided in Appendix 8.

The table below outlines community concerns and describes how they have been addressed by the investigation.

Table 2 Investigation of community concerns

Community concern	How the investigation has addressed it	Where to find more information
There are a number of historic asbestos dump sites around the Gaythorne area – do they pose a risk?	Reported dump sites were inspected by an officer from the Department of Health and the Department of Environment and Heritage Protection	Section 4.4 of this report.
Is there a possibility of further asbestos testing in the Gaythorne area?	In addition to preliminary testing in November 2014, a second round of asbestos testing was undertaken in the vicinity of the factory in April 2015. Volunteers were sought in the relevant area of Gaythorne.	Section 6.2 of this report.
What are the risks associated with asbestos fibres?	Information was provided regarding the health risks of asbestos during the course of the investigation.	Fact sheets on investigation website[1]

[1] The investigation website is: www.health.qld.gov.au/asbestos

Community concern	How the investigation has addressed it	Where to find more information
How do you identify if you might have an asbestos-related illness?	Information was provided to community members about actions they may take to address their health concerns In addition, the investigation team has provided advice to local General Practitioners whose patients may have concerns.	Fact sheets on investigation website[a]
What is the risk to people in communities where there is a lot of development occurring?	This matter will be referred to the IAG to consider management strategies for planning and development in areas where there may be buried asbestos.	Fact sheets on investigation website[a]
Are Super Six roofs safe? How should they be managed/ replaced? How should asbestos dust in roofs be managed?	Information has been provided regarding health risks of asbestos during the course of the investigation.	Fact sheets on investigation website[a]

In addition to the former factory site, the community identified a number of sites in neighbouring areas where asbestos waste may have been disposed. A search of the Environmental Management Register (EMR)[2] identified sites in the area that were either currently listed or had been listed on the EMR and were subsequently removed. Each of the identified sites was reviewed and inspected. Further discussion on the sites is described in Section 4.4.

2.2.1 Community reported asbestos-related disease

The community reported seventeen cases of asbestos related disease. Sixteen of these had been local residents and one was a relative of a resident who spent little time in the area. All local residents who developed asbestos-related disease lived within 1.5 kilometres of the Wunderlich factory and six received formal recognition of work-related disease.

Information received indicated that cases of asbestos-related disease known to the community were predominantly associated with occupational or para-occupational exposure.

[2] Further information on the EMR can be found in Appendix 2

3. Literature Review - Community exposure from former asbestos factories

This chapter provides information on health risks from asbestos and a summary of the findings of the literature review into the likely community exposure to asbestos from asbestos factories. The full literature review can be found in Appendix 3.

3.1 Asbestos

Asbestos is the collective term used for a category of naturally occurring fibrous minerals from the serpentine or amphibole groups (Krakowiak, et al., 2009). The serpentine group has one member, chrysotile ('white' asbestos) while the amphibole group has multiple members, including amosite ('brown' asbestos) and crocidolite ('blue' asbestos). Asbestos fibres are strong yet flexible, incombustible, thermally stable and resistant to biological and chemical degradation. These properties resulted in extensive commercial use of asbestos in the past.

3.2 Past use of asbestos

Asbestos was mined in Australia for over 100 years. In the 1950s Australia was the world's highest per capita user of asbestos (Leigh & Driscoll, 2003). Asbestos has been used as a component of many industrial products, including cement pipes, cement sheeting and roofing, building insulation, brake linings, textile products and floor tiles in both domestic and commercial situations.

The National Occupational Health and Safety Commission declared all forms of asbestos to be prohibited substances on 17 October 2001. The manufacture and supply of all asbestos-containing materials has been banned in Australia since 31 December 2003 (Australian Safety and Compensation Commission (ASCC), 2008). This does not extend to asbestos-containing materials in situ at the time the ban took effect. Large amounts of asbestos building materials are still present in domestic and commercial buildings across Australia.

3.3 Health risks arising from asbestos exposure

To cause disease, asbestos must be inhaled into the lungs. Fibres of particular concern in relation to asbestos-related disease are generally defined as having a length greater than 5 micrometres[3], diameter smaller than 3 micrometres and length to diameter ratio of equal to or greater than 3:1 (World Health Organisation (WHO), 2000). When inhaled, fibres of this size can deposit deeply into the lungs. All forms of asbestos are recognised as human carcinogens (International Agency for Research on Cancer, 2012). It is causally related to mesothelioma and cancer of the lung, larynx and ovary (International Agency for Research on Cancer, 2012).

Asbestos-related diseases include lung cancer, asbestosis, benign pleural plaques and malignant mesothelioma. The most common cause of lung cancer is cigarette smoking,

[3] 1 micrometre = 0.001 millimetre = 0.000001 metres = 1 micron.

and asbestos-related lung cancer has no unique clinical or pathological features that enable it to be distinguished from other lung cancers (Wright, et al., 2008). Asbestosis, inflammation and thickening of the lung tissues leading to breathlessness, requires heavy exposure to asbestos which would rarely be seen outside the occupational environment. Pleural plaques, discrete scars on the outer lining of the lung visible on x-ray, rarely affect health. Mesothelioma is cancer of the lining of the lungs (pleura) or of the lining of the abdominal cavity (peritoneum). Mesothelioma is a highly specific disease which develops as a result of exposure to asbestos in most cases (Hillerdal; 1999, Orenstein and Schenker, 2000). Due to these factors, mesothelioma is the most commonly used marker for any effect of non-occupational exposure to asbestos fibres.

Table 3 Medical conditions associated with asbestos exposure

Condition	Description	Cause
Pleural plaques	Discrete areas of fibrosis (fibrous thickening) on the pleura (outer lining of the lung) which generally produce no symptoms	Exposure to asbestos fibres most commonly, but not exclusively, in the occupational setting
Asbestosis	Inflammation and thickening of the lung tissues, leading to breathlessness	Occupational asbestos exposure (heavy exposure)
Lung cancer	Cancer of the lungs; asbestos associated lung cancers are indistinguishable from lung cancers associated with other factors such as tobacco use	Multifactorial, most common cause is tobacco use Occupational asbestos exposure (long term exposure to asbestos)
Mesothelioma	Cancer of the lining of the lungs (pleura) or of the lining of the abdominal cavity (peritoneum)	Exposure to asbestos fibres most commonly, but not exclusively, in the occupational setting

3.4 Asbestos exposure sources

Sources of exposure to asbestos have changed over time, particularly since the closure of mines and factories and the ban on asbestos production and use throughout Australia. Historically, occupational exposure was a major source of exposure to asbestos. Non-occupational exposure included para-occupational exposure and neighbourhood exposure. These are the likely historic exposures for those living in the areas surrounding the former factory sites during the time of their operation.

Various types of asbestos exposure are explained in Figure 1. The focus of this investigation is on determining any possible ongoing asbestos health risks to current residents as a result of living in proximity to a former factory site.

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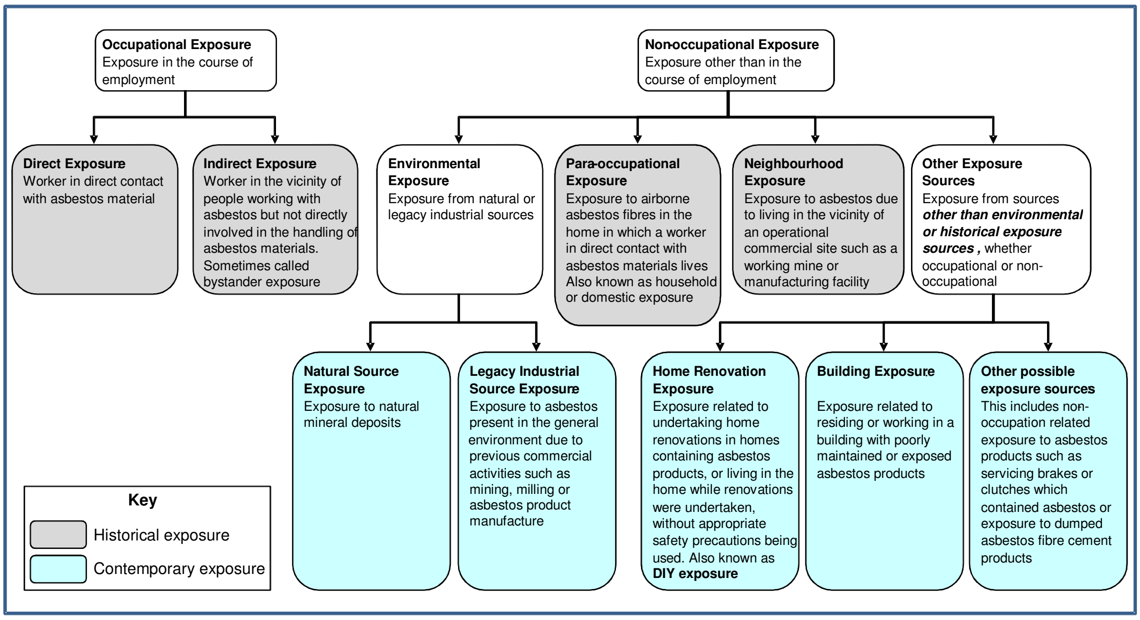

Figure 1 Types of asbestos exposure

3.5 Health risks resulting from legacy industrial source exposure

There are low concentrations of asbestos fibres in the environment and in the lungs of much of the population. From this, it is clear that everybody is exposed to asbestos in low concentrations. This is due to past industrial use of asbestos and naturally occurring asbestos.

There is limited literature reporting risk of exposure due to legacy industrial exposure to asbestos cement manufacturing facilities. Site remediation significantly reduces the risk of exposure to asbestos at higher than expected background levels. Where adequate site remediation has been undertaken, the level of exposure to asbestos at former asbestos factory sites is expected to be extremely low.

Literature shows that environmental background asbestos levels at legacy sites are generally many orders of magnitude lower than occupational exposure levels. The risk of mesothelioma at these lower exposures is not able to be reliably or accurately derived. No study has yet been able to demonstrate a direct link between background levels of exposure and mesothelioma (Jamrozik, et al., 2011).

Although the literature refers to models that have been developed to estimate risk at low exposure levels, they have been developed with the use of many un-validated assumptions. This makes their usefulness questionable (Siemiatycki & Boffetta, 1998) and the risks, while real, may be impossible to measure.

4. Site History

This chapter provides information on the history of the Gaythorne and Newstead factory sites and their subsequent management, including historical practices that may have led to community exposure. The full site history reports can be found in Appendices 4 and 5. In addition, Brisbane City Council has provided a development history report for each of the former factory sites, which can be found in Appendices 6 and 7. Primary information sources for compilation of the historical information were the Queensland State Archives, Workplace Health and Safety Queensland and the Department of Environment and Heritage Protection.

4.1 Wunderlich factory site history (Gaythorne)

The Wunderlich factory, located at 51 Prospect Road, Gaythorne, opened in October 1936 for the manufacture of asbestos cement and was subsequently purchased by James Hardie & Coy Pty. Limited (James Hardie) in July 1977. Asbestos production ceased in December 1982.

The factory was situated on a seven acre block of land adjacent to the railway, a short distance past the Gaythorne railway station. Processes associated with manufacturing onsite in 1953 and 1954 included monthly delivery of bags of asbestos. The bags were emptied into a 'pulveriser' or 'fibreriser' to break up and tease out fibres. Broken up fibres were blown through pipes to a storage hopper and then conveyed via monorail to mixing machines to form the cement slurry that was cured into sheeting. Trimmings or broken pieces of sheeting were taken to the dry grinding shed to be ground and reused. Recorded concentrations of airborne particles ranged from 60 to 3700 particles/mL, depending on processes being undertaken. Although no official standard regarding minimal fibre/dust concentrations existed at the time, the recommended standard was around 400 particles/mL.

Modifications to processes between 1954 and 1962 eliminated much of the dust formerly generated; although records indicate that exposure levels within the factory still exceeded recommended safe workplace standards in the 1960s. A sample result from 1966 of 150 particles/mL was accepted as below the reasonable average for the time. A range of further safety measures were instituted during this time, including rotation of workers from hazardous to non-hazardous positions, wearing of face masks, enclosure of processes, and provision of air supply hoods where specific dusty jobs were undertaken.

There is no record of measurements of airborne asbestos levels off-site during the operational phase of the factory. Anecdotal evidence from the community suggests asbestos dust from the factory impacted the surrounding area. This is supported by details of the factory operation and in particular the presence of a large exhaust fan on a factory side wall that is most likely to have caused dust contamination in the vicinity, particularly in the early years of the factory's operation. Further anecdotal details of possible community exposures are recorded in the community consultation section in Appendix 8.

With the exception of a small sand milling operation, the factory ceased production in December 1982. James Hardie undertook environmental sampling of airborne dust in

November 1984 that showed the concentration of airborne fibres was below the workplace exposure standard in place at that time (0.1 fibres/ml of air). Based on this result, James Hardie sought to have the Asbestos Rule[4] no longer apply to the site. It appears that this occurred, however, no formal record could be found. Tests around the time of the factory closure revealed very low levels of airborne asbestos, and it was considered that no further remediation work was required at that time.

In 1984, to identify the depth of fill around the site, James Hardie commissioned soil sampling around the factory site, including under the current buildings. This investigation identified that asbestos was buried throughout the factory site at varying depths.

With the introduction of the *Contaminated Lands Act 1991*, and subsequently the *Environmental Protection Act 1994*, land that was used for asbestos production and manufacture was required to be included in the EMR. The factory site was listed on the EMR in 1998. A site investigation in 2009 confirmed large amounts of buried asbestos throughout the site. The site remains on the EMR and any future site development will require a full site investigation and a site management plan approved by the Department of Environment and Heritage Protection. Current day-to-day site risks are managed under the *Work Health and Safety Act 2011*, in addition to requirements under the *Environmental Protection Act 1994*.

Historical records indicate that only nine people lived on Bellevue Avenue in 1921, increasing to 17 houses by 1946. Currently, Bellevue Avenue properties to the east of the factory and properties south of the factory across the railway line are a mix of low density residential, low-medium density residential and character residential houses.

4.2 James Hardie factory site (Newstead)

The James Hardie factory, located on the corner of Longland Street and Breakfast Creek Road in Newstead, commenced the manufacture of asbestos cement products in 1935. The factory was originally on a 2.5 acre block of land.

Processes undertaken on the site in 1954 include: receipt of bags of asbestos from the wharf; asbestos fed from bags into a revolving drum for teasing and blowing to a hopper; asbestos loaded from the hopper into a barrow and then transferred to the machine where asbestos cement slurry was produced. Results of airborne dust counts[5] taken in 1954 with a thermal precipitator showed counts from 150 to 2,000 particles/mL.

Although there were no official standards, around 400 particles of asbestos dust per cubic centimetre was recommended as the safe standard. It is noted that the highest

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[4]Made under the *Factories and Shops Act 1960* on 11 July 1971, Rule 9, or "The Asbestos Rule", placed requirements on businesses and workers, in relation to notification, exhaust ventilation, protective equipment, cleaning and medical examination.

[5] Assessment of worker exposure to asbestos was historically undertaken by doing a particle in air count rather than a fibre in air count. When considering asbestos exposure data; a) Measurements of fibres and particles (whether contemporaneous or not) cannot easily be compared: and b) historic fibre counts cannot be compared with current fibre counts due to i) improvements to technology resulting in improved sensitivity in measuring and identifying asbestos and ii) improved understanding of risk and the adoption of a standard definition of respirable fibres, better reflecting individual worker exposure.

sample from the Newstead factory site was significantly less than the highest sample at Gaythorne (3700 particles/mL) at a similar time.

There are a number of records of airborne asbestos dust monitoring taken at the Newstead factory site in 1955. At this time, the allowable standard for asbestos-containing dust was indicated to be in the vicinity of 500-700 particles/mL [6]. High airborne dust counts were obtained in some of the processing areas and as a result a number of recommendations were provided by regulators. Further test results from 1966 indicate dust levels ranging from 10 to 750 particles/mL. Recommendations provided to improve worker safety included use of face masks (respirators), fans or air suction devices and use of vacuums rather than sweeping.

Nevertheless, it was recognised from previous evidence that these levels were likely to be exceeded on many occasions. To help reduce the hazard, further recommendations included:

- Rotation of men between hazardous and non-hazardous positions
- Where possible, absolute enclosure of all processes by use of engineering solutions
- Compulsory wearing of face masks at all times in areas where contamination was assessed as moderate
- Supply of air hoods where specific dusty jobs were undertaken for short periods.

Site investigations undertaken in 1970 and again in 1975 indicate a progressive downward trend in the airborne dust levels in the work environment. By 1975, all test results had airborne fibre counts at less than 2 fibres/mL.

In 1986, James Hardie advised regulators that asbestos had not been used as a raw material since November 1983 and that the factory had ceased handling and warehousing asbestos sheeting in February 1984. As cleaning and air monitoring had been undertaken since that time, they sought the non-application of the Asbestos Rule[7] to the Newstead factory site.

A Government investigation was carried out to confirm these findings. As a result, the factory was removed from the list of asbestos processing plants and the provisions of the Asbestos Rule no longer applied to the site. The factory continued to operate using cellulose based products until further redevelopment in 1992.

In 1992 James Hardie commissioned a variety of site investigations to determine the extent of site contamination and provide recommendations on works required to manage the site. In September 1994 a site contamination management plan was developed to protect worker health and safety and ensure proper excavation and disposal of contaminated soil.

In 2000, a site assessment concluded that asbestos fill was present across most of the former factory site. Later that year, a Remediation Action Plan was submitted to the

[6] For the purposes of comparison, results are shown in this report as particles/mL. In the original documentation, results were shown as particles per cc (cubic centimetre).
[7] Made under the *Factories and Shops Act 1960* on 11 July 1971, Rule 9, or “The Asbestos Rule”, placed requirements on businesses and workers in relation to notification, exhaust ventilation, protective equipment, cleaning and medical examination.

Environmental Protection Agency[8] for remediation of the site to a level suitable for unrestricted use. In May 2001, a validation report concluded that the site had been successfully remediated with the exception of a small portion of land. The site was removed from the EMR with the exception of one parcel, which was removed in June 2001. The removal of all the land from the EMR means that the Department of Environment and Heritage Protection are satisfied the land is no longer contaminated.

The redevelopment of the former factory site was part of a larger redevelopment of the area known as Newstead Riverpark. This redevelopment involved the removal of a number of buildings and contaminated soil from an area bounded by Waterloo and Longland Streets, and Breakfast Creek Road. The later stages of this redevelopment saw remediation or management of the remaining sites by April 2008, with three sites removed from the EMR, and site management plans approved for the remaining 10 sites.

In recent times, there has been a changing landscape around the factory site. From mainly residential in 1946 to mixed industrial and residential by 1969. By 1980, with the exception of a section to the northwest of the factory, very few residential dwellings remained. More recently, further development has taken place in the area with a transition to high density residential, while still including industrial premises.

4.3 Risk assessment of the two sites

The site histories found that recorded airborne asbestos levels at Gaythorne Wunderlich factory were generally higher than those recorded during the operation of the Newstead factory. The Gaythorne factory site is still listed on the EMR due to the presence of buried asbestos material. The James Hardie factory site, at Newstead, has been fully remediated and subsequently removed from the EMR. For this reason, it was decided that asbestos monitoring would not be undertaken in the vicinity of the Newstead factory site unless the monitoring at Gaythorne indicated an increased risk of asbestos related disease associated with living in proximity to the former Gaythorne factory site.

The findings of the site history studies were used to inform a risk assessment of the former factory sites.

Table 4 Risk assessment for Gaythorne Wunderlich factory and Newstead James Hardie factory sites.

	Gaythorne	Newstead
Maximum operational exposure levels[9][10]	3,700 particles/mL	2,000 particles/mL
Length of ACM manufacture	46 years	48 years

[8] This agency is now known as Department of Environment and Heritage Protection
[9] Maximum operational exposure levels represent the highest recorded level from air monitoring undertaken within the factory site during the factory operation.
[10] Assessment of worker exposure to asbestos was historically undertaken by doing a particle in air count rather than a fibre in air count. When considering asbestos exposure data; a) Measurements of fibres and particles (whether contemporaneous or not) cannot easily be compared, and b) historic fibre counts cannot be compared with current fibre counts due to i) improvements to technology resulting in improved sensitivity in measuring and identifying asbestos, and ii) improved understanding of risk and the adoption of a standard definition of respirable fibres, better reflecting individual worker exposure.

Time since end of ACM manufacture	32 years	32 years
Evidence of building clean-up post ACM manufacture	Yes	N/A - building removed
Site status on EMR[11]	Listed	Removed[12]
Other local or related EMR sites	Yes	No
Residences within 500m prior to cessation of ACM manufacture	Yes	Yes (however, many have since been demolished)
Likelihood of risk relative to Gaythorne	N/A	Lower

4.4 Asbestos dump sites

In addition to the factory sites, buried asbestos dump sites were identified from community feedback and a search of the EMR.

Details of the review and inspections of these sites are found in the table below.

Table 5 Gaythorne asbestos dump sites

Sites listed on the EMR		
Site name	**Description**	**Site inspection outcome**
Hoben Street, Mitchelton (street and nearby creek)	A check of records maintained by DEHP has revealed that multiple lots on Hoben Street are listed on the EMR as a notifiable activity, namely asbestos manufacture or disposal, has taken place on the site. The sites are currently used as parkland.	No asbestos materials were found at either the Hoben Street parkland or the nearby creek (located approximately south-east of the parkland). The caps at both sites also appeared intact.
Hurdcotte St, Enoggera (between Our Lady of Assumption and Mott St)	1. The site containing Our Lady of Assumption School and the adjacent former Mount Maria Junior on South Pine Road is listed on the EMR for the notifiable activity of asbestos manufacture or disposal, as well as another notifiable activity. The site has been classed as managed, i.e. a site management plan is in place to ensure that asbestos contamination on the site presents a low risk to the people who use the site.	No asbestos materials were found at this site. There was also no evidence that the cap has been breached.
Sites identified anecdotally by the community and not listed on the EMR.		
Site name	**Description**	**Site inspection outcome**
Glen Retreat Road, Mitchelton (earlier	Previously a large lot was listed on the EMR for asbestos manufacturing or disposal. The lot has since been subdivided and the large lot removed	There is some evidence that erosion has occurred along the banks of a creek at this location (situated adjacent to the southern end of Mitchelton State

[11] Environmental Management Register

[12] This site has been completely remediated prior to the removal from the EMR. The removal of this land from the EMR means that the Department of Environment and Heritage Protection (DEHP) are satisfied the land is no longer contaminated.

creek, and Mitchelton State Primary School)	from the EMR. DEHP has advised that a site investigation report by a qualified person found that the site is no longer contaminated.	Primary School); however there was no indication that the cap at this site has been breached. Several small pieces of fibro, likely containing asbestos, were found along the banks of the creek. The asbestos pieces were found lying on the surface, rather than embedded in the ground, which indicates that they were more likely the result of illegal dumping. Brisbane City Council has now removed and disposed of the loose asbestos.
Duke St, Gaythorne: Nearby creek	A large parcel of land on Duke St was previously listed for notifiable activity asbestos manufacture or disposal but has since been deleted from the EMR. DEHP has advised that the site was deleted on the basis that it was found not to be contaminated.	This site has been fully developed, with houses now located along the entire street. Furthermore, there was no evidence of a creek, suggesting it has been covered over with landfill. There was also no evidence suggesting that the cap at this site has been breached.
Creek located at the end of Lade St Gaythorne	The creek is not listed on the EMR. A large base parcel of land in this area was formerly listed for asbestos manufacture or disposal. This lot has since been subdivided and the large lot removed from the EMR. DEHP has advised that a site investigation report by a qualified person found the site is no longer contaminated.	The creek at the end of Lade St appears to be a man-made channel. No asbestos materials were observed at this site. There was also no evidence that the cap at this site has been breached.
Kedron Brook Gaythorne: Landfill along creek contained waste	The creek is not listed on the EMR. Information received from the public indicates that asbestos dumped along the creek may have been concentrated on the banks behind Kedron Brook Hotel, located at 167 Osborne Rd, Mitchelton. The investigation into former factories that is currently underway will investigate community concerns and take risk based actions to mitigate risk from asbestos materials along the creek bank. This site is listed as an investigation site in Figure 2.	Several small dinner plate-sized pieces of fibro material, likely containing asbestos, were observed at two locations along the banks of this creek. Although Kedron Brook Creek appears to have experienced some soil erosion, there was no further evidence of asbestos contamination. As is the case with Glen Retreat Road above, the asbestos pieces were found lying on the surface, rather than embedded in the ground, indicating these were more likely the result of illegal dumping. Brisbane City Council has now removed and disposed of the loose asbestos.
McConaghy St, Mitchelton: former farm	A large parcel of land in this area was formerly listed on the EMR for asbestos manufacturing or disposal. The lot has since been subdivided and the large lot removed from the EMR. DEHP has advised that a site investigation report by a qualified person found that the site is no longer contaminated.	Due to the lack of detail provided in relation to the specific location of the farm, it is difficult to pinpoint exactly where along McConaghy Street it was situated. There is currently a pony club at 171 McConaghy Street (at the far northern end of McConaghy Street, next to Kedron Brook Creek), which comprises a sizeable field (approximately 200 m x 80 m), and was considered the most likely site for a farm. There was no evidence that the cap at this site has been breached, nor were any asbestos materials observed. There was no evidence of any other

		likely asbestos dumping sites located anywhere else along McConaghy Street.
Enoggera Memorial Park, Hurdcotte St	It was claimed that the sports fields at the rear of Hillbrook and Our Lady of Assumption schools contain asbestos waste. This site is listed as an investigation site in Figure 2.	No asbestos materials were found at this site. No evidence was uncovered suggesting this was an asbestos dumping site.
Additional site identified at a later date		
Site name	**Description**	**Site inspection outcome**
Australian Catholic University	This site is located immediately adjacent to the former factory site to the north. The site was placed on the EMR in 2003. Part of the site was remediated and removed from the EMR in 2005. The remaining portion is a managed site on the EMR. All asbestos is within containment cells and the site is subject to a site management plan.	No site inspection undertaken.

Figure 2 **Map of dump sites identified by Gaythorne community and inspected in December 2014**

These sites are identified on the map (Figure 2) as either on the EMR, removed from the EMR, deleted from the EMR or investigation sites. Investigation sites are sites identified by residents where no evidence of past or present asbestos exposure has been found. All eight sites inspected were considered to be safe, with no evidence of any caps being breached. Capping involves placing a cover over contaminated materials to isolate them and avoid any spread of contamination. Where sites are regarded as no longer contaminated, the cap would consist of a protective soil layer[13].

Importantly, no asbestos 'seams' were found, which would be expected if a cap had experienced significant erosion. Several small pieces of asbestos fibro were observed along Kedron Brook Creek and the creek located near Glen Retreat Road, Mitchelton during the investigation. This is not an uncommon occurrence in either this area or around Queensland. It is possibly the result of illegal dumping as the pieces were lying on the surface, rather than emerging from the soil.

4.5 Other issues

Throughout the investigation, it was identified buried asbestos waste may exist at a number of sites throughout Gaythorne. While the major known sites have been inspected and noted to be adequately remediated or managed, there remains some concern regarding minor asbestos waste deposits on residential premises.

Another issue is the discovery of asbestos materials at residential and public areas by members of the public and its subsequent disposal. Discovery of buried asbestos materials and disposal of asbestos are not unique to residents of Gaythorne. These sources have been identified as issues requiring a state-wide solution. The management of buried asbestos waste on domestic premises is likely to be an ongoing challenge due to past practices where building rubble was often used as fill in yards and other areas. The management of buried asbestos waste on public land will need to be managed to ensure weather events don't remove the soil capping. Management will need to be considered as a part of the state-wide asbestos agenda under the IAG.

Ensuring practical options for the community to dispose of small amounts of asbestos waste requires further work.

[13] Where sites are regarded as no longer contaminated, a full site assessment has been undertaken to confirm any asbestos material has been removed, and test results have confirmed the absence of asbestos contamination.

5. Epidemiological study

Queensland Health conducted an epidemiological study of mesothelioma incidence[14] in the areas close to the Gaythorne and Newstead factory sites to determine whether there has been a higher incidence in these areas compared to the rest of Queensland. As identified in Section 3.3, mesothelioma is the most commonly used marker for any effect of non-occupational exposure to asbestos fibres among the asbestos-related diseases. As such, mesothelioma is the most appropriate disease for epidemiological evaluation in order to identify potential health impacts from the former factories.

Assessments such as these seek to understand whether, retrospectively, there has been a greater than expected number of cases of a specific disease within a group of people, in a geographic area, or over a specified period of time. This is often a challenging and complex process. Many epidemiological analyses fail to demonstrate a conclusive association between an exposure and disease. In this instance, the time between exposure to asbestos and development of disease, the migration of people into and out of the area of interest, and the fact that a number of community members worked in the factory and were exposed at work, were particular issues. A lack of data on the potential confounding risk factors, such as smoking and employment history, further impacts on the findings. The full epidemiological report is available in Appendix 9.

5.1 Methodology

A case was defined as anyone living within one, two or three kilometres of the factory sites at the time of diagnosis with mesothelioma between 1986 and 2013. Mesothelioma cases were identified primarily through interrogation of data provided by the Queensland Cancer Registry (QCR). The patient's address at time of diagnosis was used to determine whether cases met the case definition.

The reference population was all those living in Queensland during the same period, who do not live within a three kilometre radius of either of the factory sites.

The study time period was from 1986 until 2013. The period was selected due to lack of available data prior to 1986.

5.2 Results

The QCR data identified eight mesothelioma cases that lived within one kilometre of the Gaythorne factory site at time of diagnosis since 1986, 24 cases living within two kilometres and 44 cases living within three kilometres. During the same time period, 2,496 cases were notified in the rest of Queensland. Notifications categorised by 5-year age groups are provided in Appendix 9. Two of the cases identified within one kilometre were female, while seven of 24 cases within two kilometres and nine of 44 cases within three kilometres were female.

[14] Incidence is a measure of the probability of occurrence of a given medical condition in a population within a specified period of time.

Three mesothelioma cases were identified as people who lived within one kilometre of the Newstead factory site at time of diagnosis since 1986, 13 cases as living within two kilometres and 35 cases as living within three kilometres. During the same time period, 2,503 cases were notified in the rest of Queensland. Of the cases identified in the Gaythorne area, females comprised one case of three within one kilometre, two cases of 13 within two kilometres, and six cases of 35 within three kilometres.

5.2.1 Comparison of mesothelioma risk in the area surrounding the Gaythorne factory with the rest of Queensland

The standardised incidence ratio (SIR) for one kilometre around the former factory at Gaythorne was 1.82 with a 95% confidence interval of 0.78 – 3.30, while the SIR for two kilometres was 1.39 (95% CI 0.89 – 2.0), and three km was 1.23 (0.90 – 1.62). The confidence intervals provide a range within which the true SIR is expected to fall, given the inherent statistical variability in epidemiological analyses. The SIR suggests a slightly higher number of cases than would normally be expected. However, in all instances, the confidence interval crosses 1.0, meaning there is no confidence that there are indeed an excess number of cases.

Table 6 Standardised incidence ratio for mesothelioma cases with address at diagnosis within 1, 2 and 3km of the Gaythorne site at time of the diagnosis and compared with the rest of Queensland

Comparison	Expected number	Maximum number of cases easily explained by chance	Observed number	SIR	95% CI
Mesothelioma cases living within 1km of the Wunderlich site compared to the rest of QLD	4.40	8	8	1.82	0.78 -3.3
Mesothelioma cases living within 2km of the Wunderlich site compared to the rest of QLD	17.32	24	24	1.39	0.89 - 2.0
Mesothelioma cases living within 3km of the Wunderlich site compared to the rest of QLD	35.74	36	44	1.23	0.9 – 1.62

5.2.2 Comparison of mesothelioma risk in the area surrounding the Newstead factory with the rest of Queensland

The SIR for one kilometre was 0.96 with a 95% confidence interval of 0.18 – 2.36. For two kilometres, the SIR was 1.11 (95% CI 0.59 – 1.79), and three kilometres 0.8 (95% CI 0.56 – 1.09). The SIR suggests a slightly lower number of cases being notified within one and three kilometres of the factory site than would be expected, and a slightly higher number of cases being notified within two km than expected. However, as the confidence interval does crosses 1.0, there is no certainty that there are an excess number of cases.

Table 7 **Standardised incidence ratio for mesothelioma cases with address at diagnosis within 1, 2 and 3km of the Newstead site at the time of diagnosis and compared with the rest of Queensland**

Comparison	Expected number	Maximum number of cases easily explained by chance	Observed number	SIR	95% CI
Mesothelioma cases living within 1km of the James Hardie site compared to the rest of QLD	2.40	6	3	0.96	0.18 - 2.36
Mesothelioma cases living within 2km of the James Hardie site compared to the rest of QLD	11.74	18	13	1.11	0.59 - 1.79
Mesothelioma cases living within 3km of the James Hardie site compared to the rest of QLD	43.79	55	35	0.8	0.56 – 1.09

5.3 Interpretation

This analysis suggests that the number of mesothelioma cases, at the time of diagnosis within the investigation area, is consistent with what would be expected. It indicates that residents in the vicinity of the Gaythorne and Newstead factory sites do not have an excess incidence of mesothelioma in comparison to the rest of Queensland. However, there are important limitations with this analysis. This analysis used address at time of diagnosis to determine whether a case was within the area of interest and therefore met the case definition. Unfortunately, this does not account for the migration of people into, or out of, the area. That is, a case who lived in the area for many years but had moved just prior to being diagnosed would not be classified as being within the study population. Conversely, a case may have been diagnosed after moving into the area, and hence would have been counted as meeting the case definition. This problem is particularly demonstrated by the relatively high turnover rate in the relevant suburbs. Data from the 2011 census suggests that up to 25% of residents in Gaythorne and Enoggera, and 19% of residents in Mitchelton had a different address one year prior to the census, with around half of the population having a different address five years ago.

A challenge in completing this analysis was obtaining accurate retrospective age-specific information using Australian Bureau of Statistics (ABS) data. The ABS organises its collection and reporting of data by a geographical organisation and classification system which has evolved over the period of the study. Extensive efforts were made to estimate the proportion of dwellings falling within specified geographies and then apply these findings to available population estimates to be as precise as possible.

The non-residential exposure history of cases is likely to be a very important confounder in this analysis. Many, if not all, of the cases will have received exposure through occupational or para-occupational avenues. This is supported by the significant gender differential in the identified cases. Robust occupational and residential history is very difficult, or impossible, to obtain. Given the length of time since the exposure of interest, it is unlikely that relatives will be able to provide the depth of information that is necessary.

5.4 Medical records search – charts of identified mesothelioma cases

To complement the epidemiological analysis, a chart review of patients identified in the analysis as living within two km of the Gaythorne and Newstead factory sites was conducted to look for evidence of individuals' exposure to asbestos. There were some important limitations to this review. Firstly, the Health Sector Retention and Disposal Schedule states that adult clinical records must be retained for 10 years after the last patient/client service provision or medico-legal action. Many of the cases identified died longer than 10 years prior to this audit, and as such, their records had been destroyed. Further, access to records of private health providers was not available and there were indications in the available charts that a considerable number of these patients received treatment at a private health facility.

Of the eight cases diagnosed while living within one kilometre of the Gaythorne factory site, charts had been destroyed in six of the cases. In one case, the chart indicated the patient had received known occupational exposure to asbestos, and in the remaining case, no records of treatment for mesothelioma were able to be found. For the 16 cases diagnosed while living within one to two kilometres of the factory site, there was evidence of occupational exposure in four cases, para-occupational exposure in one case, domestic exposure (renovations) in one case, and in six cases the charts were, or were likely, destroyed (as indicated by date of death). In the remaining four cases, the charts indicated they were treated at a private facility.

Regarding the Newstead factory site, of the three cases diagnosed while living within one kilometre of the factory site, the chart was destroyed in one case, and unable to be located in the remaining two cases. For the 10 cases diagnosed while living within one to two kilometres of the Newstead factory site, there was evidence of occupational exposure in two cases, the charts were destroyed, or likely destroyed, in six cases, there was one case for whom no record of charts was able to be found, and one case where there was indication that the patient was treated privately.

As stated earlier, this process was limited given the number of records that had been destroyed, and the number of cases that received private treatment. Nonetheless, this exercise did provide further assurance in that occupational or para-occupational exposure were responsible for virtually all cases for whom charts were able to be reviewed.

6. Asbestos monitoring

Asbestos monitoring was conducted to assess the current exposure of people living near the site of the Wunderlich asbestos plant at Gaythorne. The monitoring involved air sampling in public areas and private properties, as well as air sampling, dust sampling and building material sampling in ceiling cavities. Equivalent monitoring was undertaken in houses in other areas of Brisbane for comparison (control) purposes.

Monitoring was initially conducted at Gaythorne as the site histories of the former factory sites indicated that legacy asbestos contamination in Gaythorne was likely to be higher than that in Newstead (which had been extensively redeveloped). It was therefore decided, asbestos monitoring at Newstead would not be undertaken unless the asbestos monitoring at Gaythorne indicated the airborne asbestos concentrations in Gaythorne were higher than in other areas of Brisbane.

Asbestos fibres present a risk to health if they are airborne and inhaled in sufficient quantities. Air monitoring utilising very sensitive analytical techniques is therefore the most appropriate strategy for assessing public health risk. Two forms of testing were used:

- *Phase Contrast Microscopy (PCM)* which is the standard test used in occupational settings and can provide results down to 0.01 fibres/ml (limit of detection)
- Scanning Electron Microscopy (SEM) is more sensitive providing results at a greater level of accuracy (0.001 fibres/ml). It can also determine the type of fibre.

Surface testing was also conducted to test for the presence of asbestos in ceiling dust, which may have the potential to become airborne if disturbed.

Further technical information on the sampling methodology and analysis techniques is provided at Appendix 10.

6.1 Methodology

The sampling strategy was to sample 10 to 20 properties in the Gaythorne area (test) and a similar number in other areas of Brisbane (control), to determine if the airborne asbestos concentration was likely to exceed 0.001 fibre/mL[15]. The criteria for selecting the houses were that they:

- were built between 1930 and 1983
- were not extensively renovated
- did not have an asbestos roof.

Test and control monitoring was undertaken in private homes with three air samples taken from each property; one inside each house, one inside the ceiling cavity and one in the yard of the house. Surface dust samples were also taken from inside the ceiling cavity. Where possible, samples of ceiling or other building materials bordering the ceiling cavity were also tested to determine if asbestos was present.

Air samples were also taken on the same day as test and control sampling at two outdoor public places in Gaythorne and one outdoor public area not in proximity

[15] Published ambient airborne asbestos fibre concentrations are generally recorded as mean concentrations and may also include the standard deviation for the samples to indicate variability of the measured concentrations.

(greater than three kilometres) to the former Gaythorne factory site. This provided a further reference of background asbestos levels in Brisbane.

No soil samples were taken, as buried asbestos is not a health risk unless it is disturbed. Therefore, soil sampling would not have added to the health risk assessment.

6.2 Results

6.2.1 Air monitoring - Gaythorne ('test') houses

A total of 51 air samples were taken from the 17 test houses in Gaythorne. Total fibre concentrations for each of these samples were at or below the limit of detection of 0.01 fibres/mL using Phase Contrast Microscopy analysis. Further Scanning Electron Microscopy analysis of each of these samples indicated no asbestos fibres were present in 48 of the samples above the limit of detection of 0.001 fibres/mL. Although air sampling detected asbestos fibres in three of the samples (two of these positive results were from ceiling cavities and one was from an outdoor sample), these results are not considered significant because:

- a maximum of two asbestiform fibres was identified in each sample
- less than 10 fibres per 100 fields counted using the Membrane Filter Method are not considered statistically significant and a default value of 10 fibres is used for the calculation of the airborne asbestos fibre concentration.

Therefore, in accordance with established practices for past and current studies, these fibres were included in the default 10 fibres used in the calculation of the airborne asbestos fibre concentration.

Two of the properties where airborne asbestos fibres were identified contained building materials with the same type of asbestos. In the third property, the sampled building material was not positive for asbestos fibres. There are a number of explanations for the presence of this fibre, including a legacy of factory operations, nearby buildings containing asbestos or general background levels.

The analysis results indicate less than 10 asbestos fibres were counted in each sample. Overall, the results of air monitoring of the test houses showed the concentration of airborne asbestos fibres was less than 0.001 fibres/mL.

6.2.2 Air monitoring - Control houses

A total of 36 air samples were taken from the 12 control houses. Total fibre concentrations in the majority of these samples were at or below the limit of detection for both PCM and SEM.

SEM analysis of each of the 36 air samples did not identify the presence of asbestos fibres in 34 of the samples. Asbestos fibres were identified in two of the samples, with each sample from a different residence. In both of these positive samples, two fibres were counted. One sample was from a ceiling cavity and the second was an outdoor sample. In both of these properties, samples of onsite building materials tested positive for the same type of asbestos fibres, however, as the number of asbestos fibres was less than ten, the airborne asbestos fibre concentrations were reported as 0.001 fibres/mL.

One further sample had a total fibre concentration of 0.003 fibres/mL. This sample was collected from a ceiling cavity, however, Scanning Electron Microscopy analysis indicated the fibres were not asbestiform.

6.2.3 Surface testing - dust samples – Test and control houses

Trace amounts of asbestos were found in a number of dust samples from the roof cavities of both test and control houses. The presence of asbestos fibres in dust samples from the Gaythorne houses, indicate fibres found in the dust samples may be due to the presence of asbestos in the building materials forming the roof cavity. It is not uncommon to find asbestos fibre bundles in settled dust and/or asbestos cement sheet debris on structural and undisturbed surfaces of buildings clad with asbestos cement sheeting. Overwhelmingly, the content of the ceiling dust was non-asbestos material such as talc, ilite, iron oxide, stilpnomelane and spider webs. Appendix 11 contains a more complete list of dust components.

6.2.4 Summary of results

In summary, the results of the monitoring program demonstrate the airborne asbestos fibre concentrations, in proximity to the former asbestos factory site in Gaythorne, are consistent with low asbestos fibre concentrations found in other areas of Brisbane. On this basis, air monitoring was not undertaken at the Newstead factory site.

Appendix 11 contains detailed results of asbestos monitoring in Gaythorne houses, as well as houses in other areas of Brisbane.

7. Discussion

The investigation into the two former asbestos factories at Gaythorne and Newstead was designed to provide a systematic and comprehensive approach to effectively identify and address any ongoing health risks from asbestos to the local community. The following activities were undertaken:

- literature review to assess asbestos exposure levels around the asbestos plants
- review of the history and management of the two factory sites
- epidemiological study of asbestos-related diseases in the vicinity of the two factories
- monitoring for airborne asbestos exposure for people living near the factory sites
- community engagement and consultation with concerned community members.

This approach was particularly important as asbestos-related diseases may have a latency period in excess of 40 years.

The literature review showed the ongoing health risk in the vicinity of the former manufacturing factory sites is very low. Based on the findings of the air monitoring studies, the risk is similar to other areas in Brisbane.

The epidemiological study was limited to mesothelioma, as this disease is almost exclusively related to asbestos exposure. The study found that the number of mesothelioma cases in the vicinity of the former factory sites is consistent with what would be expected in the general Queensland population.

To complement the epidemiological analysis, a chart review of patients, identified as living within 2 km of the Gaythorne and Newstead factory sites, was conducted to look for evidence of individuals' exposure to asbestos. This process was limited, as information was only able to be accessed for patients treated in the public health system and whose records had not yet been disposed of. From the limited number of records which were able to be reviewed, there was evidence of occupational or para-occupational exposure in virtually all cases.

Nevertheless, it is important to acknowledge the anecdotal reports by residents in the Gaythorne area that asbestos related disease has occurred in those who lived near the factory during its operation. It is therefore possible that cases of mesothelioma have occurred as a result of para-occupational and neighbourhood exposure, which are not included in the epidemiological findings.

The site histories provided a great deal of information about the operation, remediation and ongoing development of the former factories. These reports, in conjunction with community feedback, indicate the operational practices of the factories would have resulted in high asbestos exposure to workers and there were off-site exposures to those living in the vicinity of the factories. Remediation and development activities in the areas mean this off-site contamination is no longer likely to be present or pose a risk to the health of current residents.

Asbestos monitoring near the former asbestos manufacturing factory site at Gaythorne involved air samples, ceiling material and dust sampling from a number of local properties (test), as well as a number of houses (control) in other areas of Brisbane. Airborne asbestos fibre concentrations in all air samples taken from test houses were less than or equal to 0.001 f/mL (the limit of detection used for the SEM analysis).

While one air sample from a control house recorded the highest reading of 0.003 f/mL, analysis revealed the fibres were not asbestos. Similar to test houses in Gaythorne, total airborne fibre concentrations in air samples taken from control houses around Brisbane were also less than or equal to 0.001 f/mL. That is, airborne asbestos concentration near the former factory in Gaythorne is the same as the low concentrations found in other parts of Brisbane.

Trace amounts of asbestos fibres were found in a number of dust samples taken from the roof cavities of premises both within proximity to the former asbestos factory site, as well as in roof cavities from homes in other areas of Brisbane. Typically, the presence of asbestos fibres in dust samples indicate a nearby source of asbestos fibres, such as the presence of asbestos in the building materials forming the ceiling cavity. Only one air sample in the Gaythorne area revealed the presence of one asbestos fibre in the ceiling cavity of a home which did not have any current asbestos materials forming the roof cavity, suggesting the fibres originated from elsewhere; possibly from legacy factory operations or nearby buildings containing asbestos.

Disturbance of this roof space would not result in detectable levels of respirable asbestos fibres.

As a result of the factory site risk assessment, it was agreed asbestos monitoring at Newstead would only be undertaken if the asbestos monitoring at Gaythorne indicated airborne asbestos concentrations in Gaythorne were higher than in other areas of Brisbane.

On the basis of the above findings, the investigation concluded that people living near the former asbestos factory at Gaythorne are at no greater risk of exposure to airborne asbestos fibres than people living in other areas of Brisbane. Therefore no asbestos air monitoring was undertaken in the vicinity of former Newstead asbestos factory. However, the former asbestos factory site at Gaythorne contains various sources of asbestos contamination and Workplace Health and Safety Queensland will continue to work with the site owners to ensure compliance with the *Work Health and Safety Act 2011.*

The overall conclusion of the investigation is that in the past there was likely to have been asbestos exposure in the vicinity of the former factories while they were operational and prior to their clean-up (which occurred in the mid-1980's). However, there is no evidence of elevated asbestos-related health risk to residents who have commenced living near the former factories sites in Gaythorne and Newstead since the mid-1980's following the clean-up of the sites.

7.1 Other issues identified by the community

This investigation also addressed a number of related concerns of residents. Community consultations revealed community concern that the operation of the former factory has resulted in the ongoing presence of asbestos dust deposits in ceiling cavities that would be disturbed during demolition. This may result in people being unknowingly exposed due to the lack of adequate asbestos control measures. The monitoring results did not support this community concern.

Despite this, it is important to note the presence of asbestos fibres in the settled ceiling cavity dust (of buildings with asbestos roofs) does not imply there is a risk of asbestos exposure, as asbestos fibres are hazardous only if they are sufficiently fine, airborne, and inhaled in sufficient quantity.

However, if a person is intending to enter a ceiling cavity they should consider all potential hazards, including the presence of asbestos and take appropriate precautions. In the case of possible exposure to asbestos, appropriate personal protective equipment should be worn, including a respirator. Appropriate precautions should also be taken when performing any works on asbestos containing material.

The investigation also identified buried asbestos waste exists at a number of sites throughout the Gaythorne community. While the major known sites have been inspected and reported to be safe at the time of inspection, there remains some concern regarding asbestos waste that may be buried on sites redeveloped as residential properties. These deposits do not pose health risk unless they are disturbed using heavy mechanised equipment or power tools. Work should cease until the extent of asbestos contamination is assessed and controls put in place.

Buried asbestos waste on public land will need to be managed to ensure weather events do not remove the soil capping. The issue of buried asbestos waste should be considered at a state-wide level to determine strategies for control and remediation of affected areas when development occurs, including provision of advice to the public.

Another issue raised by the community was the discovery and disposal of small pieces of asbestos materials in residential and public areas of Gaythorne. Issues around the discovery of asbestos materials and its disposal are not unique to residents of Gaythorne, and have been identified as issues requiring a state-wide solution. This is of particular concern in local government areas where no sites are available for disposal by people other than regulated waste transporters.

Ensuring practical options for the community to dispose of small amounts of asbestos waste requires further work. Disposal of asbestos waste is a priority item in the *Statewide Strategic Plan for the Safe Management of Asbestos in Queensland 2014-2019* (Queensland Government, 2014). Accordingly, consideration of the needs of the community to dispose of small amounts of asbestos waste can be included in this work.

The investigation has also highlighted the need for ongoing education and awareness of the risks of asbestos exposure in domestic settings, particularly when undertaking DIY (Do-It-Yourself) renovations involving asbestos materials.

8. Conclusion

The purpose of the investigation was to determine whether there are any ongoing health risks to residents who live in proximity to the former asbestos manufacturing facilities that were located at 51 Prospect Road, Gaythorne, and Corner of Longland Street and Breakfast Creek Road, Newstead.

The results of this investigation indicate that there is no evidence of elevated asbestos-related health risk to residents who have commenced living near the former factories sites in Gaythorne and Newstead since the mid-1980's when final site clean-up occurred.

The current investigation did not estimate historical community exposures associated with the factory operations. Therefore, it is not possible to draw conclusions on any health risks to people who resided in proximity to the factories sites prior to the decommissioning and clean-up of the sites in the mid-1980's.

With anecdotal reports by Gaythorne residents indicating asbestos-related diseases have occurred in those who lived near the factory during its operation, cases of mesothelioma may have occurred as a result of para occupational or neighbourhood asbestos exposures, which have not been able to be verified by the epidemiological study undertaken as part of this investigation.

This investigation has also highlighted a number of concerns of residents, such as asbestos materials buried in residential areas and disposal of small quantities of asbestos by members of public. These issues relate to the ongoing management of asbestos in Queensland and are not necessarily specific to the locations in the vicinity of former factory sites. As noted earlier in the report, these issues should be considered as part of the overall management of state-wide asbestos issues.

9. Recommendations

The investigation into the former asbestos factories at Gaythorne and Newstead has confirmed that there is no evidence of elevated asbestos-related health risk to residents who have commenced living near the former factories sites in Gaythorne and Newstead since the mid-1980's when final site clean-up occurred.

The current investigation did not estimate historical community exposures associated with the factory operations. Therefore, it is not possible to draw conclusions on any health risks to people who resided in proximity to the factory sites prior to the decommissioning and clean-up of the sites in the mid-1980's.

However, the investigation has highlighted some issues of broader significance, which have resulted in the following:

1. **Issue:** The community has raised concern about the disposal of small pieces of asbestos materials found in residential and public areas of Gaythorne. This is not only an issue in Gaythorne but is also of particular concern in local government areas where no sites are available for asbestos disposal by people other than regulated waste transporters. This issue has been identified as a common problem requiring a state-wide solution.

   Recommendation: It is recommended practical solutions that enable the safe disposal of small quantities of asbestos waste by members of the public be developed.

2. **Issue:** The investigation identified that buried asbestos waste exists at a number of sites throughout Gaythorne. While the major known sites have been inspected and were reported to be safe at the time of inspection, however there remains some concerns regarding asbestos waste that may be buried on residential properties. While the health risk from activities involving buried asbestos materials in residential areas may be low, advice should be provided to the community on how to safely deal with the buried material. Mechanisms should also be available to alert residents in areas where there is likely to be significant buried asbestos, such as the areas surrounding former asbestos factories or landfill sites.

   Recommendation: It is recommended that appropriate management strategies are developed for providing advice to residents in Gaythorne and in other Queensland communities where buried asbestos may be present. Residents should be made aware that buried asbestos is not a risk unless it is significantly disturbed.

3. **Issue:** There is a need for continuing education and awareness of the risks of asbestos exposure in domestic settings, particularly when DIY renovation is undertaken at properties containing asbestos materials.

   Recommendation: It is recommended that community education and awareness strategies on safe handling of asbestos containing materials be reviewed and strengthened.

In keeping with the government arrangements for asbestos in Queensland, the IAG is recognised as the body most appropriate to oversee the progression of these recommendations under the *Statewide Strategic Plan for the Safe Management of Asbestos in Queensland 2014-2019.*

Appendix 1 Terms of Reference – Asbestos investigation

Investigation into asbestos exposure and asbestos-related disease surrounding the Wunderlich plant in Gaythorne and the James Hardie fibrolite plant in Newstead, Brisbane.

Purpose

The purpose of this investigation is to determine if there are any ongoing health risks for residents living in proximity to the site of the Wunderlich asbestos plant at Bellevue Street, Gaythorne or the site of the James Hardie fibrolite plant at Doggett Street, Newstead.

Scope

The scope of this investigation is to:

- examine current asbestos exposure for people living near the sites of the Wunderlich asbestos plant, Gaythorne and the James Hardie fibrolite plant, Newstead
- establish the history of the sites, including historical practices that may have led to community exposure to asbestos, and their subsequent management as contaminated sites
- examine the likely exposure to asbestos in the community from the asbestos plants by reviewing relevant literature which assesses asbestos exposure levels around similar plants and review of other identified sources of information relating risk of exposure to asbestos to distance from an asbestos plant
- establish as far as possible the epidemiology of asbestos-related disease near the Wunderlich asbestos plant, Gaythorne and the James Hardie fibrolite plant, Newstead
- undertake community engagement and consultation with possible exposed community members
- make recommendations on health protection or mitigation measures to manage ongoing risks from past practices to appropriate agencies and the community.

Background to the investigation

The Wunderlich asbestos plant in Gaythorne operated from 1936 until the early 1980's, while the James Hardie fibrolite plant in Newstead operated from the mid-1930's until its closure in 1983.

There has been extensive media coverage of the Wunderlich asbestos plant in Sunshine, Victoria as well as related community concern, following the release of an investigative report by a media outlet. As a result the Office of the Chief Health Officer, Victorian Department of Health, is currently undertaking an urgent investigation to examine issues related to asbestos exposure from the Wunderlich asbestos factory in Sunshine.

The Courier-Mail, 27 October 2014, contained media reports relating to asbestos exposure and asbestos-related disease linked to the Wunderlich asbestos plant in Bellevue Avenue, Gaythorne.

Asbestos interagency steering group membership

An asbestos interagency steering group (AIG), led by the Department of Health, will be assembled to undertake this investigation. It will include staff from:

- The Office of the Honourable David Crisafulli MP
- Health Protection Branch, Department of Health
- Metro North Public Health Unit, Metro North Hospital and Health Service
- Thoracic Medicine, The Prince Charles Hospital, Metro North Hospital and Health Service
- Media and Communications Unit, Department of Health
- Brisbane City Council planning
- Asbestos Unit, Workplace Health and Safety Queensland, Department of Justice and Attorney-General
- Compliance and Business Engagement, Department of Justice and Attorney-General
- Contaminated land group, Statewide Environmental Assessments, Department of Environment and Heritage Protection
- Social Policy, Department of the Premier and Cabinet
- Building and Industry Policy, Department of Housing and Public Works.

Consultation will also be undertaken with Department of Health Legal Branch and other internal and external parties as required.

Conduct of the investigation

It is planned that this investigation will be undertaken in two phases.

Phase 1 will involve:

- Epidemiological investigation of asbestos-related disease near the Wunderlich asbestos plant, Gaythorne and the James Hardie fibrolite plant, Newstead (initial report within seven (7) days)
- Preliminary information gathering including examination of the history of the sites, including historical practices that may have led to community exposure to asbestos

- Review of relevant literature which assesses asbestos exposure levels around similar plants and review of other identified sources of information relating risk of exposure to asbestos to distance from an asbestos plant
- Preliminary community engagement and consultation with possible exposed community members.

Phase 2 will involve:

- Examination of current asbestos exposure for people living near the sites of the Wunderlich asbestos plant, Gaythorne and the James Hardie fibrolite plant, Newstead
- Compilation of recommendations on health protection or mitigation measures to manage ongoing risks from past practices and forwarding to appropriate agencies and the community.

Appendix 2 Regulatory overview of asbestos in Queensland

Public Health Act 2005

The *Public Health Act 2005* aims to protect and promote the health of the Queensland public. The handling of asbestos in a non-workplace setting is regulated to reduce risks to public health. The Act also outlines requirements for appropriate training for high-risk activities.

Work Health and Safety Act 2011

The *Work Health and Safety Act 2011* regulates the handling of asbestos and asbestos related waste in workplaces or by people conducting a business or undertaking. The Act outlines appropriate training for all workers handling asbestos, licensing of high-risk activities and appropriate controls and monitoring requirements.

There are additional requirements for identification and management of asbestos in workplaces. This includes, but is not limited to, identifying the presence and location of asbestos-containing material or asbestos, keeping a register of all asbestos or asbestos-containing material in the workplace, and where asbestos or asbestos-containing material is present or likely to be present, preparing and maintaining an asbestos management plan.

Environmental Protection Act 1994

The *Environmental Protection Act 1994* (EP Act) regulates the transport and disposal of asbestos waste, and management of land contaminated by asbestos.

One way in which the EP Act manages potential land contamination is through the use of an Environmental Management Register (EMR). The EMR provides information about whether a site is, or has been, subjected to contamination or used for a notifiable activity, details of site investigations, particularly the suitable land use for the site, and requirements for contamination management. The register also acts as a land use planning tool, with developers required to undertake an assessment of the development and proposed activities on any site on the EMR, to ensure the identified contamination on the site does not pose a risk to human health or the environment. Sites listed on the EMR pose a lower risk to human health or the environment under the current land use. Listing on the EMR does not mean that the land must be cleaned up or that the current land use must cease.

Where land is listed on the EMR, and a site investigation report has been submitted to Department of Environment and Heritage Protection (DEHP), the owner or occupier (with the owner's permission) of the land may submit a draft site management plan (SMP) for approval. An SMP is a plan used to manage land listed on the EMR, because the land is contaminated. An SMP may be developed where a site investigation has shown it would be acceptable for some contamination to remain on the land provided it is properly managed. Each SMP sets out clear conditions on how the land must be managed in order to prevent the remaining contamination from causing environmental harm or posing a risk to human health.

In addition to managing lands contaminated by asbestos, the EP Act also regulates the transport and disposal of asbestos waste generated from commercial or industrial activities, or other waste, including domestic waste, at commercial quantities. This type of waste is considered a regulated waste, and requires the transporter to hold an Environmental Authority in order to transport, accept or dispose of it. This type of activity is considered an Environmentally Relevant Activity (ERA). The Act provides for conditions to be set with which an authority holder must comply.

Mining and Quarrying Safety and Health Act 1999

The *Mining and Quarrying Safety and Health Act 1999* (MQ Act) regulates mines other than coal mines, including operations in connection with exploring for, winning, or winning and treating, minerals or hard rock. The MQ Act applies to everyone who may affect safety or health of people at a mine or as a result of operations and any person whose health and safety may be affected.

In relation to asbestos, this Act will apply where asbestos is encountered during mining operations and will regulate how that is managed, including potentially off-site issues. It also regulates the management of any risks from asbestos material installed in buildings or plant at a mine. The operations of the MQ Act do not have any particular bearing on the investigation in the current context.

Table 1 Queensland's asbestos-related legislation and responsible agencies

Responsible agencies	Legislation
Department of Health (Legislative Custodian) and local councils	*Public Health Act 2005* Public Health Regulation 2005
Queensland Treasury	*Work Health and Safety Act 2011* Work Health and Safety Regulation 2011
Department of Environment and Heritage Protection (with some powers delegated to local councils)	*Environmental Protection Act 1994* Environmental Protection Regulation 2008 *Environmental Protection (Waste Management) Regulation 2000* *Waste Reduction and Recycling Act 2011*
Department of Natural Resources and Mines	*Mining and Quarrying Safety and Health Act 1999* *Coal Mining Safety and Health Act 1999* Mining and Quarrying Safety and Health Regulation 2001 Coal Mining Safety and Health Regulation 2001

Appendix 3 Literature Review

Occupational exposure to asbestos

Research has confirmed a strong association between occupational exposure to asbestos fibres and the development of mesothelioma (McDonald & McDonald, 1980). In the past, exposures for people who worked with asbestos were very high in some industries and jobs. Fibre concentrations of more than 600 fibres/mL were reported in bagger operations at Wittenoom asbestos mine in Western Australia (Major (1968) cited in Leigh & Driscoll (2003)).

Magnani et al. (2007) reported that the concentration of airborne asbestos fibres in an Italian asbestos cement plant, sampled in 1971, averaged 13.5 fibres/mL, with 11 of 22 samples greater than 20 fibres/mL and the highest level being 303.8 fibres/mL. At this same factory, following improvements in working procedures the levels measured in 1978 were in the range 0.15-1.12 fibres/mL. A study examining cancer risk for a cohort of 3434 workers at this factory found that a total of 5.4 per cent developed mesothelioma during the period 1965 to 2003, with the exposure period being between 1912 and 1986 (Magnani, et al., 2007).

Peto et al (1985) reported the prevalence of mesothelioma in asbestos textile workers exposed to approximately 1 fibre/mL over 50 years was nearly 2 per cent and accounted for approximately 8 per cent of deaths in asbestos textile workers. Overall, mesothelioma has been reported to account for over 1 per cent of all deaths in those with a history of occupational asbestos exposure (Driscoll, et al., 2005) (Rake, et al., 2009).

Like other asbestos related diseases, mesothelioma is more common in males than in females. It has been estimated that approximately 80 per cent of mesothelioma cases in males may be attributed to occupational exposure while only 40 per cent of mesothelioma cases in women can be explained by occupational exposure (Lacourt, et al., 2014) (Rake, et al., 2009). The 3rd Report of the Australian Mesothelioma Registry in 2013, found that 60.9 per cent of people with mesothelioma who were interviewed had possible or probable occupational exposure to asbestos (Australian Mesothelioma Registry, 2013).

Non-occupational exposure to asbestos

Apart from occupational sources, people can also be exposed to airborne asbestos in other situations including domestic exposure in people living with asbestos workers, living or working in asbestos insulated buildings, exposure to natural asbestos deposits, living near operational asbestos mines or manufacturing plants and release of asbestos from brake linings (Goldberg, et al., 2010). Since the ban on the use of asbestos containing products at the end of 2003 in Australia, many of these exposure sources no longer exist.

Para-occupational exposure

In terms of exposure in environments other than the occupational environment, an increased risk of developing mesothelioma has been seen in people exposed to asbestos workers in the domestic environment; for example, women who washed contaminated clothing of asbestos workers (Magnani, et al., 1993).

Studies have demonstrated the risks associated with living with people working in asbestos related industries (Linton, et al., 2012). One study reported a doubling of lifetime risk of developing mesothelioma in otherwise unexposed men and women living with an asbestos worker before the age of thirty (Rake, et al., 2009). A meta-analysis by Bourdes et al (2000) estimated the relative risks of pleural mesothelioma developing in domestically involved individuals to be in the range of 4.0 & 23.7.

An example of the potential for asbestos exposure in the home is wives beating workers' clothes to remove the asbestos dust before washing. This practice has been associated with airborne peak fibre concentrations of over 100 fibres/mL (Browne, 1983).

Neighbourhood exposure

Neighbourhood exposure relates to exposure to asbestos due to living in the vicinity of a currently operational industrial source of asbestos such as a mine or a facility manufacturing products from asbestos. Studies in Italy by Magnani et al (2001), and in Japan by Kurumatani and Kumagai (2008) have demonstrated that neighbourhood exposure to asbestos in the vicinity of operational asbestos cement plants, at levels much lower than occupational exposures, may cause mesothelioma. This excess risk has also been demonstrated in studies from Great Britain (Newhouse & Thompson, 1965), Germany (Schneider, et al., 1996), Poland (Szeszenia-Dąbrowska, et al., 2012) and Egypt (Madkour, et al., 2009).

In some situations, the level of asbestos exposure around these facilities may be much higher than would be expected simply from fugitive dust emissions from the factories, as asbestos waste materials were frequently distributed to local residents for uses such as to harden dirt tracks, driveways, yards and playing fields (Driece, et al., 2010) (Burdorf & Heederik, 2011). This was also the case in Minneapolis, Minnesota, near a vermiculite processing plant, which used vermiculite mined and processed in Libby, Montana. The vermiculite used at this site was contaminated with amphibole asbestos. Waste from the mine was widely distributed in the local community and contributed to high levels of exposure in the residents (Kelly, et al., 2006). Kelly et al. (2006) estimated exposure concentrations of 0.11 fibres/mL per event for adults handling waste from piles and up to 1.66 fibres/mL per event for children playing in waste piles.

Adgate et al. (2011) undertook modelling of community asbestos exposure near the vermiculite processing plant in Minneapolis, Minnesota. Neighbour exposure from fugitive emissions, the use of waste rock in the community and other activity-based exposures was assessed. Playing in the piles of waste rock was found to be the strongest source of estimated exposure in the study cohort. Peipins et al. (2003) and Horton et al. (2008) also found that playing in piles of waste rock contaminated with asbestos can lead to changes in lung function and is a major risk factor for asbestos-related disease.

Madkour et al, (2009) undertook an epidemiological and environmental study examining exposure to asbestos in the vicinity of an operational asbestos manufacturing plant and its relationship with mesothelioma. Radiological screening was done for 487 occupationally exposed workers, 2,913 local residents and a control group of 979 people in a community 40 miles from the plant. They diagnosed 87 cases of mesothelioma in the exposed group and one case in the control group. Of the exposed group with mesothelioma, 4 people had occupational exposure while the remaining 83 cases were in people with environmental exposure in the vicinity of the plant. Mean asbestos fibre concentrations measured around the plant ranged from 0.021 fibres/mL within 1 kilometre of the plant to a maximum of 2.16 fibres/mL 100 metres from the plant. Of the number of environmentally exposed cases with mesothelioma, 39 lived in the district within 100 metres from the plant.

Legacy industrial source exposure

Legacy industrial source exposure refers to exposure to asbestos fibres present in the environment as a result of past asbestos-related industry. There are low fibre concentrations in the urban environment and in the lungs of much of the population. From this, it is clear that everybody is exposed to asbestos at low concentrations. This is due to past industrial use of asbestos and naturally occurring asbestos. Mesothelioma in people without identified exposure to asbestos is a relatively rare occurrence. Due to this, no study has yet been able to demonstrate a direct link between background levels of exposure and mesothelioma (Jamrozik, et al., 2011) (McDonald & McDonald, 1996).

The nature of the risk due to low-level asbestos exposure is a key unresolved public health issue (Siemiatycki & Boffetta, 1998). Models have been developed to estimate risks at low exposure levels by extrapolating down from much higher occupational exposure levels. There are many un-validated assumptions required to develop these models. This makes their usefulness in the public health setting questionable (Siemiatycki & Boffetta, 1998). While real, the risks may be impossible to measure.

There is limited literature reporting risk of exposure due to legacy industrial exposure to asbestos cement manufacturing facilities. Site remediation, including the management of asbestos waste used outside the factory, significantly reduces the risk of exposure to asbestos at higher than expected background levels. Where adequate site remediation has been undertaken, the level of exposure to asbestos at former asbestos processing sites is expected to be extremely low.

Gardner and Saracci (1989) reported that cases of mesothelioma related to non-occupational neighbourhood exposure to asbestos, as have occurred to date, are likely to have resulted from past exposures much higher than those prevailing at the present time. Rake et al (2009), in a case-control study looking at mesothelioma risk based on different exposures, concluded that many apparently spontaneous mesotheliomas are likely to be due to an increase in ambient exposure that coincided with widespread industrial exposures in the 1960s and 1970s.

Outside of high risk neighbourhoods, such as near asbestos mines, naturally occurring sources of asbestos or factories processing or manufacturing asbestos containing products, the long term health effects of passive exposure to the known low background levels of asbestos are not clear (Linton, et al., 2012).

The health risks of mesothelioma related to occupational asbestos exposure levels is not disputed. However, the environmental background level at legacy sites is generally many orders of magnitude lower than occupational exposure levels. The risk of mesothelioma at these lower exposures is not easily, or more importantly, reliably or accurately able to be derived.

Bourdes, et al. (2000) undertook a review and meta-analysis of environmental exposure to asbestos and the risk of developing pleural mesothelioma. They concluded that while their study suggests a substantial increase in the risk of pleural mesothelioma following high environmental exposure to asbestos, the available data are insufficient to estimate the magnitude of the excess risk at the levels of environmental exposure commonly encountered by the general population in industrialised countries.

Kowalczyk (2014) examined the approaches taken for human health risk assessment of low level environmental exposures. The risk estimates and model developed in this paper are presented as a useful tool for prioritisation of risk management. However, as there is no threshold established for asbestos exposures, even if the risks are considered to be very low, action should be taken to ensure that any exposure is reduced to as low as reasonably practicable. The aim should be for active risk management and to remediate to at, or as close to, background levels as possible.

Asbestos in buildings

Passive asbestos exposure in buildings has been linked to mesothelioma, though the level of this risk has not been quantified and is believed to be extremely low (Goldberg & Luce, 2009). There have been case reports of teachers working in buildings containing asbestos that subsequently developed mesothelioma, and also of adults whose only identified asbestos exposure was in school (Lilienfeld, 1991).

With asbestos in place, as long as the asbestos is undisturbed the reported levels in the ambient air are frequently below 0.001 fibres/mL (below the limit of detection) (Hillerdal, 1999). However, when the asbestos product has deteriorated or is being removed, the level of asbestos in the air has been measured at 15 fibres/mL or higher (Hillerdal, 1999).

In a report to Congress, the United States Environmental Protection Agency (1988) reported the mean concentration of airborne asbestos to be 0.03 fibres/mL in schools and 0.006 fibres/mL in Federal Buildings. These figures were based on aggregating data from their own previous studies plus studies from other countries. It is important to note that in this same report it was estimated that 20 per cent of 733,000 public buildings in the United States contained friable asbestos materials, which may release fibres more rapidly than non-friable asbestos products such as wallboard (asbestos cement sheeting) and that at least two thirds of these buildings contained at least some asbestos which was already damaged.

Lee and Van Orden (2008) measured airborne asbestos in 752 buildings. When looking at fibres with a width of less than 0.5 micrometres[16] and length of greater than or equal to 5 micrometres (i.e. respirable fibres), they found an overall average of

[16] 1 micrometre = 0.001 millimetre = 0.000001 metres = 1 micron

0.00007 fibres/mL, with an average of 0.00009 fibres/mL in 317 schools, 0.00005 fibres/mL in 234 public and commercial buildings and 0 fibres/mL in 39 samples from 5 residential properties. In this study, the average outdoor air concentration from 1678 samples was 0.00002 fibres/mL.

Other exposure sources

The typical non-occupational exposure is a low or very low background concentration. Data in the literature does not allow an accurate measurement of the risk of mesothelioma following low environmental exposure to airborne asbestos (Bourdes, et al., 2000).

Occasional high asbestos exposures can occur when there is a disturbance of some kind, such as the cutting of asbestos cement sheeting with power tools without taking appropriate precautions to reduce the risk of fibres becoming airborne. These types of high level exposures may pose a health risk.

Home renovation

In a review of mesothelioma and non-occupational exposure to asbestos, Hillerdal (1999) concluded that while the risks associated with the very low background levels of airborne asbestos exposure cannot be completely dismissed, the cumulative risk of these low level exposures is probably minor and there is no way to avoid the known background levels of exposure. More important are intermittent high level exposures, such as the rebuilding or tearing down of structures containing asbestos, as these exposures can be avoided or managed using the correct techniques, equipment and expertise.

Olsen et al (2011) examined cases of malignant mesothelioma in Western Australia from 1960 to 2008. They found that, of 1,631 cases diagnosed during this time period, 87 were attributed to asbestos exposure during home maintenance and renovation, and that this is an increasing trend in both men and women. In the last four years of the period under investigation (2005-08), 8.4 per cent of mesothelioma in men and 35.7 per cent of mesothelioma in women was attributed to exposure to asbestos during home renovations.

Until the 1960s, 25 per cent of new homes in Australia were clad in asbestos cement (Leigh & Driscoll, 2003). The widespread presence of asbestos cement products in Australian homes means that cases of malignant mesothelioma may continue to rise if people undertake home renovations without taking adequate precautions to protect themselves and other household members from exposure to asbestos.

Health risks arising from asbestos exposure

To cause disease, asbestos must be inhaled into the lungs. Biologically important respirable fibres which can be inhaled, are generally defined to have a length greater than 5 micrometres[17], diameter smaller than 3 micrometres and length to diameter ratio of equal to or greater than 3:1 (World Health Organisation (WHO), 2000). When

[17] 1 micrometre = 0.001 millimetre = 0.000001 metres = 1 micron.

inhaled, fibres of this size can penetrate deeply into the lungs. All forms of asbestos are recognised as human carcinogens (International Agency for Research on Cancer, 2012). It is causally related to mesothelioma and cancer of the lung, larynx and ovary (International Agency for Research on Cancer, 2012).

Asbestos-related diseases include lung cancer, asbestosis, benign pleural plaques and malignant mesothelioma. The most common cause of lung cancer is cigarette smoking and asbestos-related lung cancer has no unique clinical or pathological features that enable it to be distinguished from other lung cancers (Wright, et al., 2008). Asbestosis, inflammation and thickening of the lung tissues leading to breathlessness, requires heavy exposure to asbestos which would rarely be seen outside the occupational environment. Pleural plaques, discrete scars on the outer lining of the lung visible on x-ray, rarely affect health. Mesothelioma is cancer of the lining of the lungs (pleura) or of the lining of the abdominal cavity (peritoneum). Malignant mesothelioma is a highly specific disease which develops as a result of exposure to asbestos in most cases (Hillerdal, 1999; Orenstein and Schenker, 2000). Due to these factors mesothelioma is the most commonly used marker for any effect of non-occupational exposure to asbestos fibres among the asbestos-related diseases.

Table 1 Medical conditions associated with asbestos exposure

Condition	Description	Cause
Pleural plaques	Discrete areas of fibrosis (fibrous thickening) on the pleura (outer lining of the lung) which generally produce no symptoms	Exposure to asbestos fibres most commonly, but not exclusively, in the occupational setting
Asbestosis	Inflammation and thickening of the lung tissues, leading to breathlessness	Occupational asbestos exposure (heavy exposure)
Lung cancer	Cancer of the lungs; asbestos associated lung cancers are indistinguishable from lung cancers associated with other factors such as tobacco use	Multifactorial, most common cause is tobacco use Occupational asbestos exposure (long term exposure to asbestos)
Mesothelioma	Cancer of the lining of the lungs (pleura) or of the lining of the abdominal cavity (peritoneum)	Exposure to asbestos fibres most commonly, but not exclusively, in the occupational setting

Mesothelioma

Mesothelioma is a rare cancer which is mainly linked to past occupational exposure asbestos. Non-occupational exposures which have been associated with the development of mesothelioma include domestic exposure to an asbestos worker, living near a natural asbestos source, asbestos mine or in the neighbourhood of an operational asbestos processing or manufacturing facility. The background incidence rate of mesothelioma in the Australian community without occupational, domestic or neighbourhood exposure to asbestos is about 1 case per 1,000,000 person-years[18] for either sex (enHealth, 2005).

[18] Person-years is a measurement combining the number of persons and their time contribution in a study or situation. This measure is most often used as denominator in incidence rates. It is the sum of individual units of time that the persons in the relevant population have been exposed or at risk to the conditions of interest.

Asbestos fibres are highly persistent and widely distributed in the general environment. All asbestos types can cause mesothelioma; however, there is some debate in the literature suggesting the amphibole asbestos (amosite and crocidolite) may be more potent than serpentine asbestos (chrysotile). The Australian occupational airborne exposure standard for asbestos, of 0.1 fibres/mL of air, is the same for all types of asbestos (Australian Government, 2003). Most research seems to show that the heavier the exposure to asbestos the greater the risk of developing mesothelioma (Hillerdal, 1999; Iwatsubo, et al., 1998; Orenstein & Schenker, 2000).

Whether the different forms of asbestos have greater or lesser potential to cause mesothelioma is a source of ongoing debate in the published literature. In an analysis of the mesothelioma mortality data among 17 asbestos-exposed cohorts, Hodgson and Darnton (2000) estimated that cumulative exposures of 0.005, 0.01, or 0.1 fibre-years/mL[19] to crocidolite would produce about 10, 20, or 100 mesothelioma deaths per 100,000, respectively; for amosite, the respective mesothelioma risk estimates were two, three, or 15 deaths per 100,000. For chrysotile, Hodgson and Darnton (2000) concluded that mesothelioma risks were “probably insignificant”, but noted that “highest arguable estimates” were insignificant, between one and four deaths per 100,000 for cumulative exposure levels of 0.005, 0.01, and 0.1 fibre-years/mL.

Using a predictive model developed from mesothelioma data from studies of asbestos insulation workers (Peto, et al., 1982), asbestos textile workers (Peto, 1980), amosite factory workers (Seidman, 1984), and asbestos-cement workers (Finkelstein, 1983), the U.S. Environmental Protection Agency (EPA) estimated that continuous lifetime exposure to air containing 0.0001 fibres per millilitre (f/mL or fibres/mL) of asbestos would result in about 1.9 to 2.8 cases of mesothelioma per 100,000 people (U.S. Environmental Protection Agency, 1986).

The Australian age-standardised mesothelioma incidence rate in 2013 for males and females combined was 22 cases per 1,000,000 person-years according to the Australian Mesothelioma Registry (AMR). There were 6.6 per cent of cases of mesothelioma reported to the AMR in 2013 for whom an exposure assessment was undertaken and no occupational, domestic or neighbourhood exposure was able to be identified (Australian Mesothelioma Registry, 2013). This equates roughly to an incidence rate of 1.5 cases per 1,000,000 person-years, a similar figure to that presented by Australia’s Environmental Health Standing Committee (enHealth) in 2005. The slightly higher rate may reflect unrecalled or unrealised exposure to higher than background levels of asbestos. It is important to remember that current incidence rates and death rates from mesothelioma represent exposures in the past, frequently many decades ago, and that equivalent sources and levels of exposure often no longer exist (Case, et al., 2011).

Lung fibre burden studies have shown a clear dose response relationship between asbestos exposure and mesothelioma, with the risk of developing mesothelioma increasing with increased exposure to asbestos (Magnani, et al., 2007) (Marchevsky & Wick, 2003). The mean number of asbestos fibres in the lungs of patients with mesothelioma is generally much higher than that in the lungs of the general population,

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[19] Fibre years per millilitre: The number of fibres found in 1 mL of air to which a worker is exposed, for 40 hours per week over a year period.

though occasionally there are cases which lie within the same range as the general population (Hillerdal, 1999) (Tuomi, et al., 1991).

Similar to the pattern with many other cancers, studies have shown that in people who develop mesothelioma there is a long latency period, the time between exposure to asbestos and the development of the disease. A review of 21 studies undertaken by Lanphear and Buncher (1992) showed that of 1,690 patients with mesothelioma, the median latency period was 32 years, with 96 per cent being diagnosed at least twenty years after asbestos exposure. One third of the cases were diagnosed more than forty years after exposure. No cases were diagnosed in this group within ten years of asbestos exposure, and mesothelioma may develop more than 50 years after first asbestos exposure (Linton, et al., 2012).

Appendix 4 Wunderlich factory site history (Gaythorne)

The factory

The Wunderlich factory, located at 51 Prospect Road, Gaythorne, opened in October 1936 for the manufacture of asbestos cement ("Durasbestos"). The factory was purchased by James Hardie & Coy Pty. Limited (James Hardie) in July 1977 and asbestos production ceased in December 1982 (Brisbane City Council, 2014) (CSR Limited, 2012). The factory was originally constructed of brick and steel, with a floor area of approximately 50,000 square feet (approximately 4,645 square metres) on a seven acre block of land that was adjacent to the railway, a few hundred yards past the Gaythorne railway station. Prior to the opening of the plant, the Courier-Mail reported the opening of the factory as a local employment opportunity, highlighting that indirectly the new industry would provide employment to the cement industry (The Courier-Mail, 1936). This employment opportunity was considered significant during the years of the Great Depression.

Brisbane City Council records identified numerous development and building modifications, which occurred on the site between 1946 and 1981. This included approvals for engineering workshops, factory extensions, bulk storage facilities, an electrical substation and dangerous goods store, amenity and facility change rooms as well as offices (other approvals were also granted after 1981). A summary of these approvals can be found in the Brisbane City Council report, *The Former Wunderlich Factory – 51 Prospect Rd, Gaythorne Site and Development History* (Appendix 4). This report contains an aerial photo of the factory, circa 1940 (below).

Figure 1 Aerial photograph of the Wunderlich factory at Gaythorne, circa 1940. Source: Enoggera District Heritage Trail

This photo has also been brought to the attention of the Department of Health through the community consultation process mentioned in Section 2. Due to community concern around the stockpiles identified in this photo, the investigation team consulted a former Department of Health employee who had undertaken inspections of the site.

This identified that the white substance to the left of the factory in the photo is likely to be sand, and the white substance which can be seen to the rear of the factory (top of the photo) is likely to be waste.

Factory manufacturing processes

The Wunderlich factory sourced asbestos from mines in Canada, South Africa, as well as Australia. The asbestos was combined with cement sourced from Darra cement works to form the asbestos sheets. The forms of asbestos used at the factory included chrysotile, crocidolite and amosite.

A memo from the Industrial Hygiene Section to the Government Analyst, located in State Archives records (Queensland State Archives, 1954) described the processes involving asbestos at the Wunderlich factory at Gaythorne, as identified in investigations undertaken at the site in 1953 and 1954. The records noted that:

- Bags of asbestos were received about once per month from the wharves and stacked within the factory;
- The bags of asbestos were emptied into either the “pulveriser” or a “fibreriser” which broke and teased out the fibres;
- The broken up fibres were blown through galvanised pipes to a large storage hopper on the upper floor (the “beatermen’s room”). A cyclone precipitator above this room removed the dust from the effluent air;
- The coarser asbestos fibres were diverted to a re-pulveriser hopper from which they were loaded into a storage box and then refilled into the pulveriser;
- Asbestos from the central hopper within the “beatermen’s room” was placed into monorail conveyor bins which were then emptied into one of three mixing machines, which combined the asbestos fibres into the water that was added to the cement slurry. The cement slurry mixture was then cured to form the asbestos sheets;
- Any trimmings from finished sheets or broken asbestos cement pieces / sheets were taken to the “dry grinding shed.” The trimmings and broken pieces were fed into a grinding machine, where they were ground and reused in the cement slurry mix. The grinding machine was exhausted to the cyclone precipitator.

The memo provides workplace exposures[20] at a number of these plant processes. Airborne dust samples were taken using a thermal precipitator with the results presented as the number of fibres per millilitre of air. Asbestos particles in all samples had an average length of 5 micrometres[21], with the largest particles having a length of 60 micrometres[22].

The recorded airborne concentration of particles within the following factory processing areas included:

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[20] Assessment of worker exposure to asbestos was historically undertaken by doing a particle in air count rather than a fibre in air count. When considering asbestos exposure data; a) Measurements of fibres and particles (whether contemporaneous or not) cannot easily be compared: and b) historic fibre counts cannot be compared with current fibre counts due to i) improvements to technology resulting in improved sensitivity in measuring and identifying asbestos, and ii) improved understanding of risk and the adoption of a standard definition of respirable fibres, better reflecting individual worker exposure.

[21] 1 micrometre = 0.001 millimetre

[22] Respirable fibres are those equal to or longer than 5 micrometres and having diameters up to 3 micrometres with an aspect ratio equal to or greater than 3:1.

1. The “Pulveriser and Fibreriser” process area: 100-500 particles/mL.
2. The “Beaterman’s Room”: 60-3,700 particles/mL.
3. The “Dry Grinding Shed”: 350-1200 particles/mL.

At that time there were no official standards within Queensland regarding the maximum allowable concentration of asbestos within airborne dust (as recorded by a thermal precipitator). However, the Department of Public Health recommended at the time that a safe standard for asbestos measured by this instrument would be approximately 400 particles/mL[23].

The factory process described above was modified between 1954 and 1962. The new process was intended to eliminate much of the airborne dust that had been generated under the previous system. This process was as follows (Bale v Seltsam Pty Ltd, 1995; Bale v Seltsam P/L, 1996):

- The production of asbestos cement sheeting commenced with the operator opening bags of asbestos, which had been delivered by forklift from the storage area;
- The operator tipped the dry asbestos fibres onto conveyor belts which operated below floor level. A hood or cover over the conveyor belt was designed to prevent an operator putting their head directly over the belt emptied by hand onto a conveyor belt. A duct in the hood carried dust up to a dust collector;
- The conveyor belt then dropped measured amounts of asbestos fibre into a large enclosed unit called an “edge runner.” This edge runner also had an exhaust connected to a dust collector. The edge runner ground and wet the asbestos for approximately 2-3 minutes after which a hatch opened and asbestos was dropped onto a covered conveyor, which carried the asbestos across a roadway into the main factory;
- The damp asbestos was then emptied into a hopper and bagged by an operator;
- The bags were piled onto a trolley, taken to another part of the factory and stored pending use in the beater unit. If asbestos in these bags dried out before beating, the process had to be started again. The beater was a tube-like unit into which cement or ground sand and water were added mechanically and to which the asbestos fibres were added manually. A large paddlewheel pushed the mixture around for approximately 20 minutes; and
- The mixture was then dropped in a liquid state into a stirrer where it remained until going into the machine that made the sheeting (approximately 12 per cent of the blend in the sheet was asbestos).

According to the records contained within Bale v Seltsam Pty Ltd (1995), the exposure levels to airborne dust experienced within the factory during the process used during the 1960s at times still exceeded the recommended safe work-place exposure standards; however, exact measurements were not stipulated. Correspondence from the Director of Industrial Medicine to another asbestos factory operator dated 30 September 1966 identified an airborne sample result of 150 particles/mL[24] was below the accepted reasonable average. The site to which this measurement belonged is not identified in the correspondence. However, given that the recommended safe work-

[23] For the purposes of comparison, results are shown in this report as particles/mL. In the original documentation, results were shown as particles per cm^3 (cubic centimetre). 1 mL = 1 cubic centmetre (cc).
[24] For the purposes of comparison, results are shown in this report as particles/mL. In the original documentation, results were shown as particles per cm^3 (cubic centimetre).

place exposure level at this time was above 150 particles/mL of air, the levels experienced would also exceed those prescribed today, being 0.1 fibres/mL of air as an 8-hour Time-weighted average[25] (Safe Work Australia, 2011). The records of Bale v Seltsam Pty Ltd (1995) also indicated that further recommendations were made to reduce worker exposure to airborne dust within the factory. These recommendations included the rotation of workers from hazardous to non-hazardous positions, the wearing of face masks (respirators), the enclosure of processes, and where specific dusty jobs were undertaken for short periods, air supply hoods were to be provided.

There are no records of measurements of airborne asbestos fibre levels taken off-site during the operational phase of the manufacturing plant. However, anecdotal evidence obtained from the community suggests that asbestos dust was released from the factory impacting on the surrounding area. Email correspondence from a former Acting Director, Occupational Health Unit, Department of Health, who had undertaken inspections of the site identified a large exhaust fan on a side wall. This exhaust fan would most likely have caused significant dust contamination of the local environment, particularly in the early years of the factory's operation, when very little control of the airborne dust was known to have occurred. A summary of the community reports is located in the Queensland Health Report *Oral history – community reports on Gaythorne* (Appendix 7).

Factory closure

In early 1982, the factory ceased wet grinding of sand and the factory was cleaned. With the exception of a small sand milling operation, the factory ceased production in December 1982. James Hardie undertook environmental sampling of airborne dust on 14 November 1984 (James Hardie & Coy. Pty. Limited, 1984). The air sampling indicated that the concentration of airborne fibres was less than 0.1 fibres/mL of air (the workplace exposure standard in place at that time). Based on these results, and the factory no longer being in operation, James Hardie wrote to the Department of Health, indicating their view that the Asbestos Rule[26] should no longer apply to this site, and requesting a written statement from the Chief Inspector of Factories and Shops to that effect.

Correspondence from the Division of Accident Prevention indicates that the Department of Health conducted tests around the time of the factory closure which revealed very low levels of airborne asbestos, and it was considered that no further remediation work was required at that time (Queensland State Archives, 1989). No formal correspondence from the Chief Inspector of Factories and Shops, confirming the Asbestos Rule no longer applied to this site, could be located and as such an exact date of when the Asbestos Rule ceased to apply to this site is not known. However, the Asbestos Rule was later repealed from the *Factories and Shops Act 1960* on 29 July 1989.

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[25] *8-hour Time-weighted average* means the average airborne concentration of a particular substance when calculated over an eight-hour working day, for a five-day working week.

[26] Made under the *Factories and Shops Act 1960* on 11 July 1971, Rule 9, or "The Asbestos Rule", placed requirements on businesses and workers, in relation to notification, exhaust ventilation, protective equipment, cleaning and medical examination.

In 1984, around the same time as the environmental dust samples were taken, James Hardie commissioned soil sampling around the site, including under the current buildings, to identify the depth of fill around the site. This investigation identified that asbestos had been buried throughout the factory site at varying depths.

Post Closure – Site Management

With the introduction of the *Contaminated Lands Act 1991*, and subsequently the *Environmental Protection Act 1994*, land that was used for asbestos production and manufacture was required to be included in the Environmental Management Register (EMR). The Department of Environment and Heritage Protection (DEHP) maintains the EMR and administers provisions relevant to this register. The former Wunderlich factory site was listed on the EMR in 1998. In 2009, an investigation was commissioned by the site owner to determine action required to remove the site from the EMR. This investigation confirmed large amounts of asbestos buried throughout the site to varying depths. Works required to remove the site from the EMR were not undertaken, and buried asbestos remains on the site. This site remains on the EMR, and as such, prior to any future site development, a full site investigation will be required, and a site management plan approved by DEHP.

In addition to requirements under the *Environmental Protection Act 1994*, there are additional requirements to manage current risks on the site under the *Work Health and Safety Act 2011*, as identified in Section 1.5. Both of these pieces of legislation aim to protect the health and safety of all people.

Development around the factory site

The Bellevue Avenue properties to the east of the factory, and those properties south of the factory across the railway line, are a mix of low density residential, low-medium density residential and character residential houses. Most are on lots of over 600 square metres. According to Brisbane City Council, in 1921 there were nine people living along Bellevue Avenue and in 1938 this had increased to 17. An aerial photograph of the site in 1946 showed 17 houses opposite the factory in Bellevue Avenue. Further information regarding the approvals granted on and around the site can be found in *The Former Wunderlich Factory – 51 Prospect Rd, Gaythorne Site and Development History* (Appendix 4).

In addition to the former factory site, a number of sites in neighbouring areas were identified, through the EMR search or discussions with community members, as sites at which asbestos waste had been disposed. Each of these identified sites was reviewed, and where necessary, inspections were undertaken. Full details of the review and inspections of these sites can be found in Section 4.4

Another known former asbestos waste disposal site is the former Australian Catholic University site located immediately adjacent the former factory site to the north. A search of the EMR identified that this site was assessed in 2002, and in 2003 was added to the EMR. In 2005, works were undertaken to the site, and as a result, in 2005, part of the site was removed from the register following removal of contaminated soil. The remaining portion remains on the register as a managed site, as all asbestos is contained within contaminant containment cells, and is subject to a site management plan (SMP).

Appendix 5 James Hardie factory site history (Newstead)

The factory

The James Hardie factory, located on the corner of Longland Street and Breakfast Creek Road in Newstead, commenced the manufacture of asbestos cement products in 1935. The factory was originally constructed of steel and fibrolite (asbestos sheeting), with a floor area of approximately 20,000 square feet (approximately 1,858 m^2) on a 2.5 acre block of land. An article in The Courier-Mail (The Courier-Mail, 1935) covered the official opening of the factory, identifying the employment opportunities that the factory would provide, and stating that with the exception of a small number of technical men, the company was not bringing any workers from southern states. Due to the growing demand, in 1936 an additional building with a floor area of approximately 10,000 square feet was added to the site (The Courier-Mail, 1936).

Factory manufacturing processes

A memo from an employee of the Government Chemical Laboratory to the Government Analyst, dated 1 October 1954, is the earliest documentation that has been found to provide an insight into the operation of the site, detailing investigations undertaken at the factory in July 1954. The memo describes some of the process involving asbestos onsite:

- Asbestos received from the wharf in bags is stacked in the store rooms within the works. Stacking these would no doubt create dust, but this operation is intermittent and was not investigated;
- As required the bagged asbestos is fed into a revolving drum from where it is teased and blown to a hopper on the site of the beatermen's room; and
- The beatermen load the asbestos from the hopper into a barrow from where it is tipped into the machine to make the asbestos cement slurry. Both filling and emptying this barrow are sources of dust. There does not appear to be any other major source of asbestos dust in the process.

In addition to outlining the process involved onsite, the memo identifies results of airborne dust counts[27] which were taken with a thermal precipitator and identified under a microscope as asbestos. A total of seven air samples were taken throughout the factory, with counts from 150 to 2,000 particles/mL. The lowest count of 150 particles/mL was taken near the pulveriser downstairs, with one operator shovelling asbestos into the machine. The remaining samples were taken from varying positions throughout the beatermen's room, with the lowest count in this room being 600 particles/mL.

[27] Assessment of worker exposure to asbestos was historically undertaken by doing a particle in air count rather than a fibre in air count. When considering asbestos exposure data: a) Measurements of fibres and particles (whether contemporaneous or not) cannot easily be compared; and b) historic fibre counts cannot be compared with current fibre counts due to i) improvements to technology resulting in improved sensitivity in measuring and identifying asbestos and ii) improved understanding of risk and the adoption of a standard definition of respirable fibres, better reflecting individual worker exposure.

Whilst this correspondence did not include comment on the acceptability of these levels, correspondence located in relation to another former factory identified that at that time there were no official standards within Queensland regarding the maximum allowable concentration of asbestos within airborne dust (as recorded using a thermal precipitator). However, the Department of Public Health recommended at the time that a safe standard measured by this instrument would be approximately 400 particles of asbestos dust per cubic centimetre (cm^3)[28] of air. It is noted that the highest sample from the Newstead site was significantly less than the highest sample at Gaythorne at a similar time, which returned a result of 3,700 particles/mL.

On another occasion of monitoring on 20 September 1955, airborne dust samples were taken when workers were unloading a truck of asbestos from Grafton. This process took approximately 40 minutes, and was said to take place once or twice every week. Three samples were taken during this time, with samples returning results of 1,700, 2,800 and 1,600 particles/mL.

A later memorandum from the Director of Industrial Medicine to the Director-General of Health and Medical Services dated 2 December 1955 summarised these two investigations, including medical assessment of fifteen employees. The memo outlines that no dangerous amounts of airborne dust[29] were present in the vicinity of the pulveriser downstairs, although it was noted that high counts were obtained in the beatermen's room. At this time, the allowable standard for asbestos-containing dust was indicated to be in the vicinity of 500-700 particles/mL of air [30]. This information was reported to James Hardie by the Director-General of Health and Medical Services, on 12 December 1955, recommending functions of the beatermen's room be reviewed to bring about a reduction in airborne dust concentrations.

An internal memorandum to the Director of the Government Chemical Laboratory in 1966 outlines results of tests undertaken at the Newstead factory site on 15 August and 24 August 1966. Sampling was undertaken by midget impinger[31], and the following airborne dust results were returned:

- In the area where asbestos was being debagged and shovelled into the rotary mixer by one workman – 25 particles/mL [32]
- In the area where asbestos sheets were being cut by two workmen using a grinding wheel machine – 10 particles/mL (made up of asbestos and cement)
- In the area where asbestos was being loaded from a chute into a hopper and into the mixing machine (old plant) – 25 particles/mL
- In the area where asbestos bags were being stacked by three workers on the first floor (Canadian asbestos) – 150 particles/mL
- Ground floor during cutting of sheets of asbestos by a grinding wheel machine – 25 particles/mL

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28 1 cubic centimetre = 1 millilitre
29 Contemporary views would conclude this statement to be incorrect based upon what is now known about asbestos related disease
30 For the purposes of comparison, results are shown in this report as particles/mL. In the original documentation, results were shown as particles per cc (cubic centimetre).
31 A midget impinger is a piece of equipment used for collecting airborne hazard samples. It is noted in this correspondence that this method was alleged to give low results. However it was the most satisfactory method for counting, and evaluating the size of, particles.
32 For the purposes of comparison, results are shown in this report as particles/mL. In the original documentation, results were shown as particles per cm^3 (cubic centimetre).

- In the area where a worker operates a saw bench on the floor above the area where the sheets are trimmed – 20 particles/mL
- In the area where an operator was using the sanding machine to trim wet pipes on the floor above the area where the sheets are trimmed – 15 particles/mL
- In the area where an operator was using the sanding machine to trim corrugated roof capping pieces – 750 particles/mL.

The following recommendations were made in this memo:

(a) That the workers unloading bags of asbestos should either wear dust masks or that a high volume fan be used in the area during stacking operations;

(b) Better suction should be provided for the machine where the sheets are being cut;

(c) Better suction should be provided for the sanding machine on the upper floor; and

(d) Industrial type vacuum cleaning equipment should reduce the air borne dust in the factory area and should prove more satisfactory than sweeping.

These results were outlined in correspondence dated 30 September 1966 from the Director of Industrial Medicine to the Factory Manager. It was identified in this correspondence that the result of 150 particles/mL [33] was below the accepted reasonable average. However, it was noted, that these results were only representative of concentrations at the time of the tests, and from observations, the Director of Industrial Medicine had 'no doubt that these (levels) were exceeded by an unspecified factor on many occasions as we know from our previous readings'. The correspondence continued that 'personal observation at the present time is sufficient to say that visually there is sufficient asbestos fibre floating around to be a hazard over many years exposure'. The correspondence identified the following principles to help reduce cases of asbestosis:

1. Rotation of men from hazardous to non-hazardous positions;
2. Absolute enclosure of all processes as far as possible from the engineering point of view;
3. Compulsory wearing of face masks at all times in dusty situations where contamination is moderate; and
4. Where specific dusty jobs are undertaken for short periods air supply hoods should be supplied.

The next correspondence which could be located in relation to monitoring at the site is a memorandum from the Director and Chief Inspector of Explosives to the Director of Industrial Medicine, dated 21 August 1970. This memo outlines a site investigation undertaken by two employees of the Government Chemical Laboratory on Tuesday 11 August 1970. The airborne fibre and dust concentration results from the investigation were as follows:

- Asbestos Elevator

[33] For the purposes of comparison, results are shown in this report as particles/mL. In the original documentation, results were shown as particles per cm^3 (cubic centimetre).

  - Fibre Count – 1.9 fibres/mL[34]
  - Total asbestos count – result was illegible in document
- Mixing Plant, ground floor
  - Fibre count – 0.2 fibres/mL
  - Total asbestos count – 0.3 particles/mL
- Mixing Plant, upstairs
  - Fibre count – 5 fibres/mL
  - Total asbestos count – 15 particles/mL
- Wall panel Trimming
  - Fibre count – 150 fibres/mL
  - Total asbestos count – 3.5 particles/mL

This memo noted that the Mixing Plant samples were the only samples representative of the operator breathing zone, with the other samples taken at a point closer to the machinery than the operators would generally approach.

The final correspondence which could be located in relation to site investigations during the plant's operations is a letter from a former Medical Officer to the Queensland Manager, James Hardie, dated 15 May 1975. This correspondence identifies an investigation undertaken on 3 April 1975, summarising that all samples taken at the Newstead site, except for the operator in the linishing[35] area, were well within a proposed standard of 2 fibres/mL. The following processes and airborne concentration results were attached to this correspondence:

- Asbestos feeder – plastic bags containing the asbestos fibre are cut open and emptied into an extracted feeder
  - Asbestos fibre count (static sample, 30-50 feet/minute air movement) – 0.99 fibres/mL
  - Asbestos fibre count (static sample, 150 feet/minute air movement) – 0.88 fibres/mL
- Asbestos feeder operator – loading the asbestos in the feeder
  - Asbestos fibre count (personal sampler) – 1.43 fibres/mL
- Mixing plant – operators at control panel
  - Asbestos fibre count (static sample) – 0.90 fibres/mL
- Linisher – Cleaning the edges on corrugated mouldings
  - Asbestos fibre count (personal sampler) – 3.9 fibres/mL
- Linishing Area – General area including hand filing. Work pieces being rubbed down with a dry dusty cloth.
  - Asbestos fibre count (following hand filer) – 1.35 fibres/mL
- Double docking saw – operator trimming corrugated sheeting
  - Asbestos fibre count (static sample) – 0.44 fibres/mL

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[34] For the purposes of comparison, results are shown in this report as per mL. In the original documentation, results were shown as per cm^3 (cubic centimetre).
[35] Linishing is the process of using grinding or belt sanding techniques to improve the flatness of a surface.

- Barge mould saw – trimming the ends of angle pieces, and cleaning off the cut ends with a dry rag
  - Asbestos fibre count (following operator) – 1.12 fibres/mL
- Trim saw – Trimming the ends of corrugated sheeting and stacking the sheets
  - Asbestos fibre count (following operator) – 0.45 fibres/mL
- Cover strip machine
  - Asbestos fibre count (operator zone) – 0.24 fibres/mL
- Surround saw
  - Asbestos fibre count (operator zone) – 0.28 fibres/mL
- Upstairs wet moulding – moulding of roof capping, cones, corrugated sheeting
  - Asbestos fibre count (static sample) – 0.18 fibres/mL
- General area downstairs wet moulding – some sweeping observed
  - Asbestos fibre count (static sample) – 0.12 fibres/mL

Factory closure

On 18 March 1986, James Hardie corresponded with the Assistant Director, Occupational Health Unit, Queensland Health. This correspondence outlined cessation of the use of asbestos as a raw material in November 1983, and cessation of the handling and warehousing of asbestos-containing sheeting in February 1984. The correspondence continued to outline the cleaning processes and air monitoring which had been undertaken since the cessation of asbestos processing, concluding that it was believed that the Asbestos Rule[36] should no longer apply to the Newstead site.

As a result of this correspondence, staff from the Government Chemical Laboratory undertook an inspection of the factory on 27 May 1986, at which time environmental samples were taken for light and electron microscopy analysis. A memorandum from the Director Government Chemical Laboratory to the Director, Occupational Health Unit, Queensland Health outlined this process, and identified that all samples returned results of <0.01 fibres/mL, the limit of detection at the time. It was noted that only three samples contained fibres with asbestiform morphologies, none of which had elemental compositions consistent with any well-known forms of asbestos. This correspondence also confirmed the cessation of use of asbestos, and the production of cellulose-based products following the removal of asbestos-handling equipment, and factory cleaning.

On 31 July 1986, the Assistant Director, Occupational Health Unit wrote to the Chief Inspector of Factories & Shops advising of this inspection, and it was recommended that the factory be declared free of asbestos, the provisions of the Asbestos Rule no longer be applied, and the factory be removed from the list of asbestos processing plants. A copy of this correspondence was also forwarded to James Hardie advising of these recommendations. No correspondence from the Chief Inspector of Factories & Shops acceding to these recommendations could be located and as such, an exact date of when the Asbestos Rule ceased to apply to this site is not known. However, the

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[36] Made under the *Factories and Shops Act 1960* on 11 July 1971, Rule 9, or "The Asbestos Rule", placed requirements on businesses and workers, in relation to notification, exhaust ventilation, protective equipment, cleaning and medical examination.

Asbestos Rule was later repealed from the *Factories and Shops Act 1960* on 29 July 1989. The factory continued to operate using cellulose-based products before redevelopment of the site commenced in 1992.

Post closure – site management

Throughout the operation of the site, a significant quantity of damaged asbestos-based product was used onsite as pavement base, particularly during wet weather. Over time, this pavement was progressively built up with other materials (D.J. Douglas & Partners Pty Ltd, 1994). Before commencement of redevelopment activities, James Hardie commissioned a variety of site investigations, commencing in May 1992, to determine the extent of site contamination and provide recommendations on works required to manage the site.

In September 1994 a site contamination management plan was developed to ensure that the health and safety of construction workers was protected, the health and safety of future staff and the public was not at risk and any contaminated soil excavated was handled and disposed of properly and with all necessary approvals. In regard to asbestos, this plan required compliance with relevant regulations, Australian Standards and codes of practice (D.J. Douglas & Partners Pty Ltd, 1994).

In March 2000, a Stage 2 Site Assessment was drafted, concluding that asbestos fill was present across most of the site (AGC Woodward-Clyde Pty Limited, 2000). In November 2000, a Remediation Action Plan (RAP) was submitted to the Environmental Protection Agency[37] for approval, with the intention of remediating the site to a level suitable for unrestricted use, and therefore removing it from the Environmental Management Register (EMR). The RAP identifies the methods that were to be followed to safely remediate and validate[38] the land and protect the health and safety of those involved in the remediation of the site and surrounding community (URS Australia Pty Ltd, 2000).

Following works undertaken in February and March 2001, a validation report was finalised concluding that the site had been successfully remediated to a level suitable for unrestricted use, with the exception of a small portion of land which was still occupied by an Energex Sub-Station (URS Australia Pty Ltd, 2000). The site was subsequently removed from the EMR in May 2001, with the exception of one parcel, which was removed in June 2001. The removal of this land from the EMR means that the DEHP is satisfied the land is no longer contaminated.

Development around the factory site

The redevelopment of the former factory site was a small stage in a larger redevelopment of the area known as Newstead Riverpark, which included the Newstead Riverpark Remediation Project. This redevelopment involved the removal of a number of buildings and contaminated soil from an area bound by Waterloo and

[37] This agency is now known as Department of Environment and Heritage Protection
[38] In accordance with the *Environmental Protection Act 1994* a 'validation report' is required to be submitted to the Department of Environment and Heritage Protection (the administering authority) following site remediation works. If the administering authority is satisfied the land is no longer contaminated, the land is removed from the EMR.

Longland Streets, and Breakfast Creek Road, formerly housing a Council depot and gasworks. The later stages of this redevelopment saw remediation or management of the remaining sites by April 2008, with three sites removed from the EMR, and site management plans approved for the remaining 10 sites.

Review of aerial photos show a changing landscape around the factory site. In 1946, there appears to be a large number of small residential properties surrounding the factory. By 1969, a number of these dwellings had been replaced with larger industrial type buildings, although some residential properties remained. In 1980, it can be seen that very few residential dwelling can be identified, with the exception of the hill to the north west of the factory. In the most recent aerial photos available on Google maps, further development can be seen around the site, with new unit dwellings built on the hill, and a number of industrial premises being removed or redeveloped surrounding the sites.

Appendix 6 Brisbane City Council – Site and development history – Gaythorne

Appendix 7 Brisbane City Council – Site and Development History Newstead

Appendix 8 Oral history – community reports on Gaythorne

Purpose

As part of the community engagement strategy, the Department of Health sought to obtain local community accounts of practices relating to the Wunderlich factory. The purpose of this report is to provide a summary of these verbal accounts. In particular, this paper focuses on information relating to:

- how the Wunderlich factory operated (e.g. how asbestos products were manufactured, transported, how asbestos waste was discarded, etc.);
- reported emissions from the Wunderlich factory;
- reported childhood exposure to asbestos in areas surrounding the Wunderlich factory; and
- reported asbestos-related diseases in people who either lived in Gaythorne, or who worked at Wunderlich factory.

Methodology

The information in this report was primarily collated from community members who contacted 13 HEALTH (13 43 25 84), with additional sources including referrals from other Queensland Government departments, including Workplace Health and Safety Queensland and the Department of Health. Media statements by the Department of Health encouraged people with information relating to the Wunderlich factory in Gaythorne to contact Queensland Health's 13 HEALTH hotline (13 43 25 84). These community members were subsequently referred to the Metro North Public Health Unit, and interviewed by Environmental Health Officers. Interviews were conducted by telephone between 1 November 2014 and 28 November 2014. A total of 64 calls were received in this time period, 40 of which provided pertinent information that has been used in this report. Details of each interview were recorded on a pro forma. Most callers had lived within one kilometre of the Wunderlich factory while it was operating, the majority of whom had lived in Gaythorne along Bellevue Avenue, Duke and Lade Streets in Gaythorne.

Factory operation

In total, nine callers provided information relating to the operation of the Wunderlich factory. The following is a summary of the information that was provided:

- One caller stated that a sibling worked at the factory for a period of two years in the 1970s; their main role was carrying sacks of asbestos.
- Asbestos was mixed in large pits, which produced a type of asbestos 'slurry'. These pits were filled with water, cement and asbestos, and were used to produce the asbestos sheeting. The waste 'slurry' created by this process was discarded at various sites throughout the factory, including in a large pipe that ran through the

factory (which was supposedly large enough that a person could walk through while only slightly crouched).

- When Wunderlich ceased operations in 1983, the asbestos mixing pits were remediated by covering over with soil.
- One caller reported that asbestos waste was trucked out and discarded at night time.
- An ex-Wunderlich employee advised never having worn personal protective equipment while working. Their role consisted primarily of forming angles and mouldings. In particular, the caller remembered that the environment in the factory was 'very dusty'.

Reported emissions from Wunderlich factory

In total, 21 callers reported emissions from the Wunderlich factory (see 0 below for individual accounts). The following is a summary of the accounts provided by callers:

- 15 reported high levels of dust in areas around Gaythorne and Mitchelton, eight of whom reported high levels of dust inside their house. The chief concern community members had with this dust was that it may have contained asbestos fibres. Callers largely attributed this dust to the Wunderlich factory, although most were unable to describe exactly how this dust was released from the factory. The following excerpts illustrate the extent of the 'dust contamination' in the areas surrounding the factory (see Table 1 below for a summary of individual reported dust emissions from Wunderlich):
  - A resident, living less than 100 metres from the Wunderlich factory, owned a truck that was always covered in a 'fine baby powder-like' substance – suggested to have originated from the Gaythorne factory. The dust was severe enough that the truck would have to be cleaned weekly to remove the dust;
  - A resident, living approximately 1.2 kilometres from the Wunderlich factory, reported that when the wind blew south to south-east, dust could be seen blowing from the factory over the Mitchelton area (caller did not recall the inside of the house being particularly dirty);
  - Dust from the Wunderlich factory allegedly reached as far as Blackwood Street in Mitchelton (located approximately 700 metres west to north-west of the Wunderlich factory);
  - Clouds of dust used to come from the Wunderlich factory despatch area into a house of a nearby resident. According to the resident 'the house was so dusty that the dining room table would have to be wiped each morning due to the build-up.'
  - Another caller living in close proximity to the Wunderlich factory advised that a coloured dust was prevalent throughout the house, which was particularly noticeable when the floor was swept.
- Three callers reported that one of the sources of dust in the Gaythorne area was the trucks that drove in and out of the Wunderlich factory, which dragged dust on their tyres, spreading it along Bellevue Avenue. One caller recalled that Gate 5 had a lot of traffic and was a particularly dusty area.

- The factory allegedly conducted a 'release' at regular intervals on certain days. While some referred to this release from stacks as dust, others described it as smoke. One respondent, who could see the factory stacks from home, recalls the stacks releasing dust three times per week. However, this was contradicted by another nearby resident, who confirmed that the factory conducted a 'release', but suggested that it did not contain dust. A further two of the respondents described this release as 'smoke', one of whom was concerned it may have contained asbestos fibres (see Table 2 below for individual accounts relating to reported smoke and odour emissions from the Wunderlich factory).
- Six respondents, all of whom resided in Gaythorne, recall Kedron Brook was heavily contaminated with a white substance, which they believed to be asbestos. One in particular recalls the banks of the creek being 'white like snow'. Another respondent described the creek as being 'creamy in colour', while yet another caller described the creek as having a 'white crust'. One caller referred to a similar contamination at a creek located at the end of Hoben St, Mitchelton, describing it as being filled with 'the white stuff' (see Table 3 below for individual accounts of waterways reported to have been contaminated with asbestos).
- Two of the callers described that an 'odour' used to emanate from the Wunderlich factory, one of whom described it as 'pungent'. No information was given suggesting the likely cause of this odour.

Table 1 Reported dust emissions from Wunderlich factory

Location of residential property from Wunderlich[39]	Reported dust emissions[40]
North-east	Noticed a lot of dust in the Gaythorne area, which was particularly bad in winter. Westerly winds would blow the dust into their house. It is suggested this dust came from the Wunderlich factory.
North-east	Number 5 Gate at the Gaythorne factory had a lot of traffic, mostly trucks, driving in and out. Truck tyres used to be covered with asbestos, which they spread throughout the street.
North-east	The streets around the Wunderlich factory were always covered in dust.
North-east	Gaythorne area was quite dusty, suggesting this may have contained asbestos.
South-west	Truck parked at home was always covered in a fine 'baby powder-like' substance – suggested to be dust from the Gaythorne factory. This was severe enough that the truck would have to be cleaned weekly. Wind would blow dust from the factory throughout the house.
South-west	Noticed white dust on the window sills in the family home.
South-west	A coloured dust was prevalent throughout the house, which was particularly noticeable when the floor was swept.

[39] The Wunderlich factory was divided into four quadrants from the centre of the factory; these were north-east, north-west, south-east and south-west. Residential properties were then assigned to one of the four quadrants depending upon location in relation to the factory.

[40] Each row in the table relates to a different caller.

Location of residential property from Wunderlich[39]	Reported dust emissions[40]
South-west	Recalls clouds of dust would come from the factory despatch area into the house. The house was so dusty that the dining room table would have to be wiped each morning due to the build-up of dust.
South-west **North-east**	Trucks used to drive in and out of the Wunderlich factory dragging dust, possibly containing asbestos, along Bellevue Avenue. In particular, recalls the house being very dusty.
South-west	Recalls house windows were always caked with asbestos.
South-east	Recalls a white powder that covered the windows of the house.
South-east	Recalled that dust released from the Wunderlich factory was significant. A car brought to work and parked on Bellevue Avenue used to be covered in dust by the end of the day. The windscreen would have to be washed before driving home as the build-up of dust made it impossible to see through.
North-west	From the house, was able to see the factory stacks, which operated three times a week. If the wind blew south/south east, dust could be seen blowing from the factory over the Mitchelton area (although the inside of the house was not particularly dirty).
North-west	Recalls laundry would get covered in a grey dust when on the clothes line. Once the sheets were dry, they were shaken out and then the beds were made.
North-east **South-east**	Recalls seeing white dust on the road along Bellevue Ave – likely spread by trucks coming in and out of factory. Dust from the factory reportedly reached as far Blackwood St, Mitchelton. At the end of most days, there was a release of dust and steam from the factory. Depending on the wind direction, it would cover their house or travel over to Mitchelton.

Table 2 Reported smoke and odour emissions from the Wunderlich factory

Location of caller where emissions could be observed[41]	Reported smoke and odour emissions[42]
South-east	Smoke could be seen rising from the stacks at the Wunderlich factory. Caller was concerned that this smoke may have contained asbestos fibres.
North-east	Recalls clouds of smoke used to emanate from the factory
South-west	The Wunderlich factory used to conduct a 'release' on certain days. The caller did not believe that this release contained dust, but recalls being able to smell it as it had a 'pungent' odour.
South-east	Recalls being able to smell the Wunderlich factory while playing sport on the Mitchelton Oval (across the road from the Gaythorne RSL).

[41] The Wunderlich factory was divided into four quadrants from the centre of the factory; these were north-east, north-west, south-east and south-west. The location of the caller where the emission could be observed was assigned to one of the four quadrants depending upon location in relation to the factory.
[42] Each row in the table relates to a different caller.

Table 3 Waterways reported to have been contaminated with asbestos

Reported contaminated waterways[43]
The banks of the creek at the rear of the factory were reported to be ‘white like snow’, due to contamination from the factory.
The creek behind the factory that runs to the bottom of Bellevue Ave was all white (this was believed to be Kedron Brook).
Used to walk across a dry creek bed at the end of Bellevue St, Gaythorne (Kedron Brook), which was covered in a ‘white dust’.
Recalls playing in the creek behind the house (may have been Kedron Brook), which was ‘creamy’ in colour.
Surface of Kedron Brook had a white crust (believed to contain some quantities of asbestos).
The Kedron Brook used to have a white coating along the bottom.
Slurry from the Wunderlich factory was discarded at various sites around the factory, including a creek located within the factory compound (which caller believes no longer exists).
Creek at end of Hoben St, Mitchelton, was filled with ‘the white stuff’, which may have been asbestos waste (Note: this is a different creek to Kedron Brook).

Childhood asbestos exposure

In total, 18 callers reported possible childhood exposure to asbestos fibres while either playing at the Wunderlich factory, in nearby creeks or on dumps (see Table 4 below for individual accounts). All callers that reported childhood exposure to asbestos lived either in Gaythorne or Mitchelton while the Wunderlich factory was operating.

Eight callers recalled playing at the Wunderlich factory as children. The following excerpts describe some of the activities children engaged in while playing at the Wunderlich factory:

- Fell into a ‘slurry mixture’ at the Wunderlich factory (caller was unsure if the ‘slurry’ contained asbestos);
- Played in piles of blue asbestos dust inside the factory;
- Every weekend skated through ‘sludgy asbestos dust’ and used to bring home coloured pieces of asbestos to play with; and
- As a child, recalls climbing up and looking into a ‘vat’ containing what was believed to be asbestos.

Seven callers remember playing in creeks, reported by some to have been heavily contaminated with asbestos:

- Six of these callers reported having played in Kedron Brook. Four of them recall the creek being heavily contaminated with a white substance, believed to be asbestos. The creek was described as being ‘creamy in colour’ or as having a ‘white sludge’, while another stated that the banks of the creek were ‘white like snow’.

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[43] Each row in the table relates to a different caller.

- One played in ‘Mitchelton Creek’, which was described as having ‘pieces of asbestos littered throughout’ (the caller does not believe that this creek is still in existence);

Six callers advised of having played in asbestos dumps, five of whom played at a dump located in Hoben St, Mitchelton. The sixth caller played with asbestos that had been discarded next to the Wunderlich factory.

Table 4 Reported childhood asbestos exposure

Childhood asbestos exposure[44]
From 1954 to 1956, played with broken sheets of asbestos that had been discarded at the back of the Wunderlich factory next to the train line.
Used to play in the Wunderlich factory grounds as a child. Recalls smashing up asbestos sheeting. Played in a creek at the rear of the factory. The banks of this creek were reported to be ‘white like snow’, due to contamination from the factory.
Played in a creek in Mitchelton as a child (which the caller believes no longer exists) that had pieces of asbestos littered throughout. Unable to recall creek location. Used to burn asbestos in his backyard as a child. Asbestos pieces would explode, releasing pieces of asbestos into the air.
Used to walk across a dry creek bed at the end of Bellevue St, Gaythorne (Kedron Brook) which was covered in a ‘white dust’.
Played with sheets of discarded asbestos with other children in the area. As a baby, used to suck on pieces of asbestos as it had a ‘sweet taste.’
Played at a dump on Hoben St, Mitchelton which contained discarded asbestos.
As a child, played on an asbestos dump that was located on vacant land between Hoben and Hay Streets in Mitchelton. Recalls a lot of children used to play with asbestos that had been dumped at this site.
Played in the creek near the Wunderlich factory as a child (caller was likely referring to Kedron Brook). Used to cut through the factory grounds to get to the creek. Once fell in a ‘slurry mixture’ at the Wunderlich factory (does not know if this mixture contained asbestos
Used to play in piles of blue asbestos dust inside the Wunderlich factory as a child.
Swam in Kedron Brook (this site has been highlighted by other callers as an asbestos dumping site).
Played at the Wunderlich factory as a child, stealing pieces of asbestos from the factory to play with. Played in the creek behind the Wunderlich factory which contained a white sludge, possibly containing asbestos. This was also a dumping ground for asbestos.
Attended Mitchelton State School. Offcuts of asbestos were discarded next to one of the school buildings in a creek. Caller used to collect the asbestos offcuts with other children in the area to build cubby houses.
Played on the factory grounds as a child, and played in the creek located at the end of Bellevue Ave in Gaythorne (i.e. Kedron Brook).
Recalls playing with fibro, using it to slide down hills in Mitchelton.
Asbestos used to be discarded in a creek that ran through 8 Hoben St, Mitchelton. As a child,

[44] Each row in the table relates to a different caller.

Childhood asbestos exposure[44]
caller played on the asbestos that was dumped here.
Played at the Wunderlich site as a child, where caller would skate through 'sludgy asbestos dust'. Also used to bring back coloured pieces of asbestos fibro to play with. Used to play in the Kedron Brook Creek that was 'creamy in colour'.
Used to walk through the Wunderlich factory to visit friends. Played in the drain exiting the Wunderlich factory as a child
Caller played in an asbestos dump that was located in Mitchelton near Hoben St.
Caller, whose father worked at the Wunderlich factory, recalls going to the Wunderlich Christmas parties and climbing up to look inside a large 'vat' containing what was believed to be asbestos powder.

Asbestos related diseases

Seventeen accounts of asbestos related disease were provided by community members. Sixteen of these had been local residents and one a relative of a resident who spent little time in the area. The following summary pertains to cases in local residents, all of whom lived within 1.5 kilometres of the Wunderlich factory, and six of whom had received formal recognition of work-related disease.

There were ten cases of mesothelioma discussed, five in men with a history of occupational exposure, including work at James Hardie Co or James Hardie freight handling at Hamilton Wharf (2), the Wunderlich factory (1), a powerhouse (1), and a plumbing firm (1). Three men had no definite occupational exposure identified by the community member. These included two who worked at a wharf, possibly Hamilton Wharf, and who also lived in a household with multiple Wunderlich factory employees. One man's only identified occupational or para-occupational source was a household member who was a builder. Two cases were described in women, both of whom had regularly washed work clothes of their male household member who worked at the Wunderlich factory.

It is notable that three of the above mesothelioma cases occurred in male siblings of one family who were resident locally for six years. The parent (unaffected) had worked at the Wunderlich factory for many years, bringing home dusty work clothing. One affected sibling worked at the Wunderlich factory in addition to other locations where asbestos exposure was a possibility. The two other affected siblings worked on a wharf, possibly at Hamilton, however the nature of their work was not known.

There were three cases of asbestosis discussed. Two of these were males, who had worked in ships in proximity to lagged pipes, and one was a female for whom occupational and para-occupational exposures were not provided in telephone discussion.

In addition, there were three cases of unspecified 'asbestos related disease' described in a single household of long-time residents of the area. Three males, a parent and two siblings, had all worked at the Wunderlich factory.

Information gathered indicates that cases of asbestos-related disease known to the community were predominantly associated with occupational or para-occupational exposure to asbestos.

Appendix 9 Epidemiological Analysis of Mesothelioma Associated with Former Asbestos Factories in North Brisbane

Appendix 10 Monitoring

Monitoring for the presence of asbestos was conducted to assess the current exposure to people living near the site of the Wunderlich asbestos plant at Gaythorne. The sampling involved air sampling in public areas and private properties, and air sampling, dust sampling and building material sampling in ceiling cavities to determine if ongoing asbestos health risks in Gaythorne are different to other areas of Brisbane.

Sampling Methodology

Test and control monitoring was undertaken in private homes with three air samples taken from each property; one inside each house, one inside the ceiling cavity and one in the yard of the house. Surface dust samples were also taken from the inside ceiling cavity. Where possible, bulk samples of ceiling or other building materials bordering the ceiling cavity were also tested to determine if asbestos was present.

Air samples were also taken at two outdoor public places in Gaythorne and one public area, not in proximity (greater than three kilometres) to the former Gaythorne factory site on the same day as monitoring. This provided a further reference of background asbestos levels in Brisbane.

No soil samples were taken, as buried asbestos is not a health risk unless it is disturbed. Therefore, soil sampling would not have added to the health risk assessment.

Air sampling

The procedure for air sampling was in accordance with the *Guidance note on the membrane filter method for estimating airborne asbestos fibres* (the Membrane Filter Method) (2nd Edition), published by the National Occupational Health and Safety Commission in 2005. Following collection, airborne samples were analysed using:

- phase contrast microscopy (PCM); and
- high resolution scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS).

The filters were initially analysed using the Membrane Filter Method (MFM) which normally uses an Optical Phase Contrast Microscope (PCM) to determine the size of any fibrous minerals and whether they meet the criteria for a respirable fibre (fibres with a width less the 3 µm, length more than 5 µm and an aspect ratio of length to width more than 3:1). Even though all fibres that meet the fibre counting criteria are counted and reported as asbestos fibres, it is important to note that non-asbestos fibres are also counted. Further, the MFM notes:

- that analysis of unused filters may identify one or two fibre-like artefacts present on the filters
- as the analytical method only examines a portion of the filter and fibres may not be uniformly distributed across the filter, the minimum number of fibres that can be distinguished from fibre-like artefacts on unused filters is ten fibres, which is used in the calculation of the limit of detection for the analysis

Therefore, if less than 10 fibres are counted during analysis the fibre concentration is reported as being less than the detection limit.

The SEM analysis was performed without knowing the results of the PCM analysis.

The PCM cannot determine the composition of fibres (asbestos or non-asbestos) on the filter meets the counting criteria of a respirable fibre on the filter. The MFM was developed a long time ago when asbestos was still used in many products (from 2003 all remaining uses of asbestos were banned in Australia). The MFM was used to determine exposure to asbestos fibres meeting the counting criteria for respirable fibres. In industries where asbestos was used, nearly all the fibres counted would have been asbestos, but when this method is used for industries or environments not using asbestos, the fibres can be inorganic non-asbestiform fibres as well as organic fibres.

SEM is a much more superior form of analysis compared to PCM and can magnify to higher levels and, using EDS on each fibre, allows the determination of the composition/speciation/characterisation of any inorganic fibre. EDS cannot determine what the composition of any organic fibre, but it can show it is an organic fibre.

The minimum fibre width that can be viewed using PCM is about 0.2 µm and the PCM count represents only a proportion of the total number of fibres present. Therefore the count is only an index of the numerical concentration of fibres and not an absolute measure of the number of fibres present. However, high resolution SEM is capable of viewing fibres less than 0.2 µm in width.

The SEM analysis was performed without knowing the results of the PCM analysis.

Sample volumes and flow rates were selected to obtain a limit of detection using SEM for airborne asbestos fibres of 0.001fibres/mL. This corresponded to a sample volume of about 1,000 litres and counting of 500 SEM fields. The rationale for the detection level was based on typical reported asbestos fibre concentration levels[45] in Australia. In contrast, for an air sample of 1,000 litres, the limit of detection using PCM is 0.01 fibres/mL, an order of magnitude less than that for SEM. Historically, PCM counts have been used in epidemiological studies investigating the health effects of asbestos. In these studies, the results are only valid for fibres conforming to the size of fibres countable by PCM. Therefore, the SEM results have been reported in terms of PCM equivalent fibres.

[45] Environmental Health Standing Committee (enHealth) - The management of Asbestos in Non-occupational - Final Report 2014– Prepared for the Department of Health and Aging by Monash University.

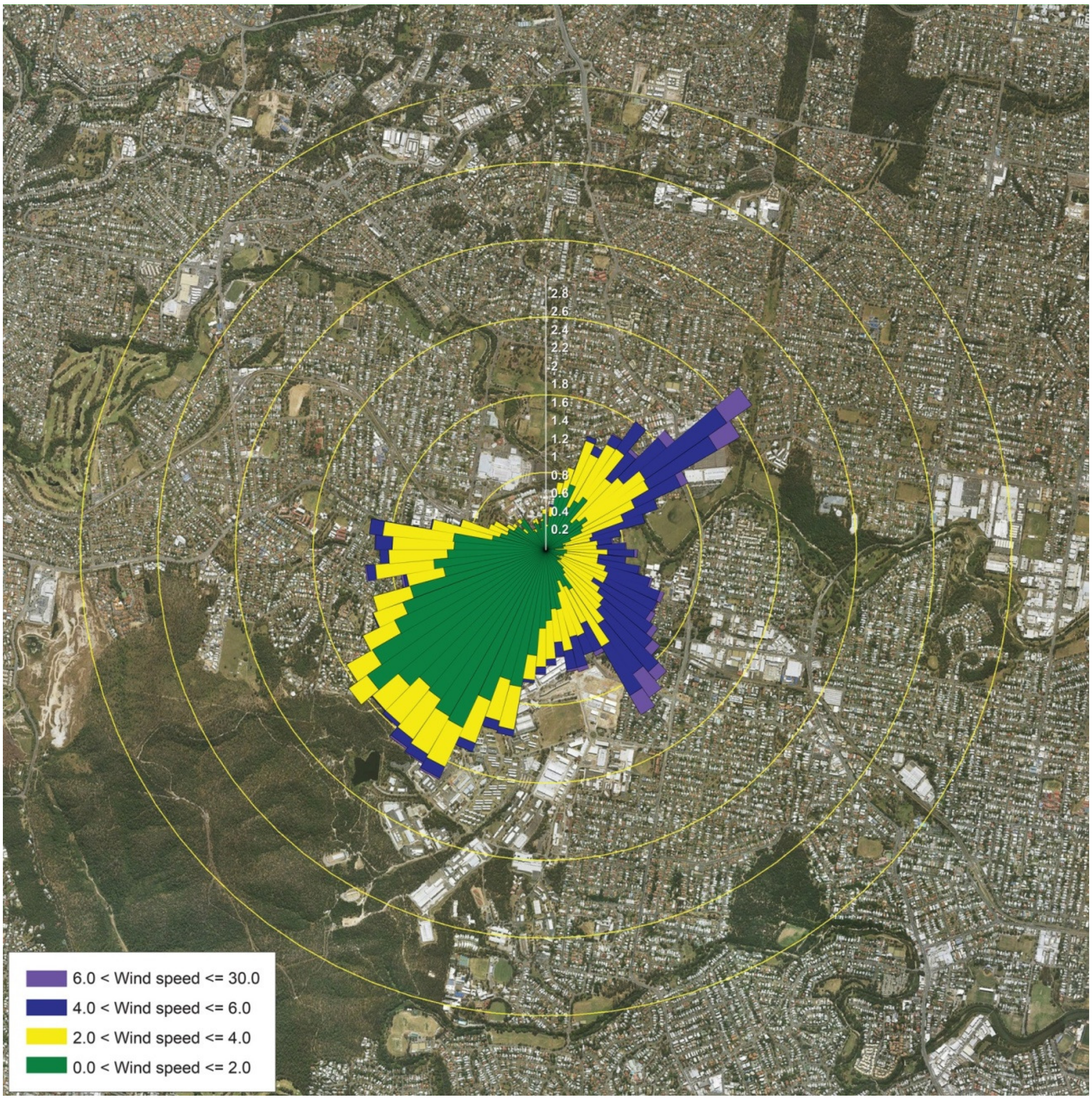

Figure 1 Meteorological data from 2008 to 2013

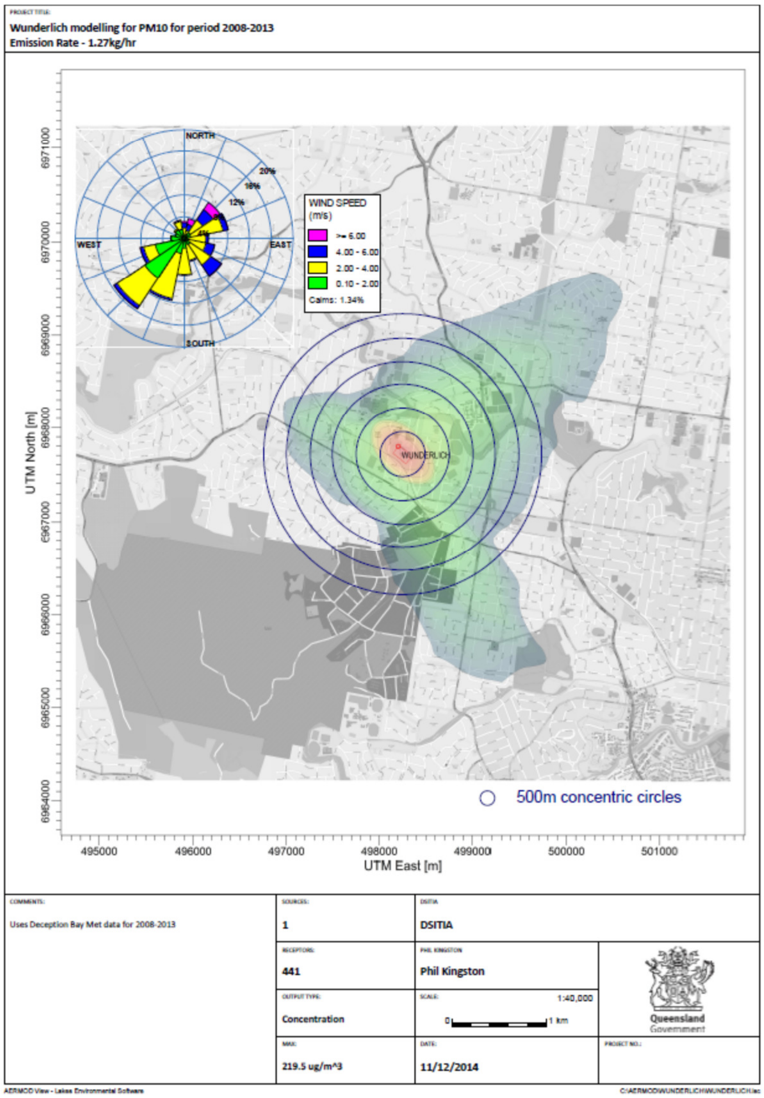

Figure 2 **Wunderlich modelling for PM10 for period 2008-2013, overlayed with 500 metre diameter concentric circles**

Surface testing – dust samples

Surface sampling of settled ceiling dust in roof spaces for identification and analysis of asbestos type was undertaken in accordance with Method – *Australian Standard AS 4964-2004: Method for the qualitative identification of asbestos in bulk samples*.

Polarised light microscopy (PLM) and SEM with EDS were used to analyse the dust samples.

Analysis methodology

A variety of techniques was used to analyse samples collected from houses throughout Brisbane. This appendix outlines in further technical detail the methods of analysis used.

Phase contrast microscopy

Phase contrast microscopy (PCM) is the most common analytical method for counting fibres, but cannot identify fibre types. Any particle having a length to width ratio greater than 3:1, length of 5 micrometres or greater and width less than 3 micrometers is counted as a fibre. PCM is commonly used in occupational settings for samples collected in areas known to have sources of potential airborne concentrations of asbestos fibres, such as during asbestos removal work. Air is drawn through a filter using a sampling pump and fibres collected on the filter are counted via specific counting criteria using an optical phase contrast microscope. As PCM is an optical counting method, it is not specific for asbestos. Therefore, all fibres meeting the criteria (length to width ratio and length) are counted as possible asbestos fibres. The resolving power of an optical microscope is limited, such that fibres with a diameter of less than approximately 0.2 micrometres cannot be detected. Therefore, smaller fibres that may be present are not counted. PCM cannot distinguish between inorganic or organic fibres.

Polarised light microscopy

The analysis of bulk asbestos samples was undertaken by polarised light microscopy (PLM) and dispersion staining techniques. The term bulk sample includes samples of building materials, dust and soil.

Australian Standard AS 4964 “Method for the Qualitative Identification of Asbestos” is the method most NATA accredited laboratories follow when undertaking analysis of bulk samples for asbestos. This method does not allow for a quantification estimation of the amount of fibre present within samples. Analysis of dust samples reports the presence or absence of asbestos as per AS4964, including the dimension of asbestos fibre in the sample given.

High Resolution Scanning electron microscopy (SEM) and Energy Dispersive X-ray Spectroscopy (EDS)

High resolution scanning electron microscopy (SEM) permits detailed examination and identification of asbestos fibres. Air is sampled using the same sampling method as for PCM. The SEM analytical method detects and measures both small and large fibres and permits differentiation between asbestos and non-asbestos fibres and types of asbestos (including the three commonly used commercial types of asbestos – chrysotile, amosite, crocidolite). A scanning electron microscope scans a focused electron beam over a surface to create an image. The electrons in the beam interact with the sample, producing various signals that can be used to obtain information about the surface topography and composition. Compared to PCM, SEM can magnify to higher levels and, using x-ray Energy Dispersive Spectroscopy (known as EDS) on each fibre, allows the identification of any inorganic fibre (asbestos is an inorganic fibre). SEM cannot determine the composition of any organic fibre, but it can show it is an organic fibre. In addition, SEM can detect thinner fibres compared to PCM.

Selection of sites for monitoring

Department of Science, Information Technology, Innovation and the Arts (DSITIA)[46] used meteorological data for 2008 to 2013 to determine the predominant wind directions for Gaythorne. The predominant wind direction was south westerly. A dispersion model for dust less than 10 micrometres (μ) in diameter (PM_{10}) was developed by DSITIA, using an assumed emission source on the former Wunderlich factory site, to predict areas of high dust concentrations and potential asbestos contamination. The results of the dispersion model were plotted for Gaythorne as isopleths of equal ground level PM_{10} concentrations. Figure 2 indicates that the highest ground level PM_{10} concentrations occur within 500 metres of the former Wunderlich factory site.

The sampling strategy was to sample 10 to 20 properties in the Gaythorne area and also in other areas of Brisbane, to determine if the airborne asbestos concentration was likely to exceed 0.001 fibre/mL[47]. This was based on the premise that at least one property (if one existed) in the sample of properties in Gaythorne or other areas of Brisbane was likely to be in the top 20% of airborne asbestos concentrations occurring in these areas.

The criteria for selecting the houses were that they:

- were built between 1930 and 1983
- were not extensively renovated
- did not have an asbestos roof.

Owners of houses in the Gaythorne area meeting these criteria were sent a letter requesting permission to undertake asbestos monitoring on their properties. Eighteen home owners living within 500 metres of the former Wunderlich factory site agreed to the request. One property owner only consented to dust sampling, therefore air samples were unable to be taken from this property. Houses in other areas of Brisbane belonging to employees of Workplace Health and Safety or Queensland Health and meeting the selection criteria were used for the comparison sample.

Samples of the ceiling materials, dust within the ceiling cavities and air samples (from within ceiling cavities, inside and outside houses) were collected between 24 November 2014 and 6 May 2015. Samples were collected from 18 residential properties and two public areas at Gaythorne and 12 residential properties and one public area in other parts of Brisbane.

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[46] Now called Department of Science, Information Technology and Innovation (DSTI)
[47] Published ambient airborne asbestos fibre concentrations are generally recorded as mean concentrations and may also include the standard deviation for the samples to indicate variability of the measured concentrations.

Appendix 11 Monitoring results

Table Consolidated, de-identified results of asbestos monitoring in Gaythorne properties and controls (properties not located near to known asbestos manufacturing sites).

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 1	0001	Ceiling dust	Positive – traces[52] of asbestos. Mainly plant debris, wood dust, mineral dust.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 0.001 <0.001	Magnesium amphibole Mica Illite Inorganic fibres Quartz Chlorite Feldspar		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[53].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are at or below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane that are not near any known asbestos manufacturing or disposal sites.

[48] A sample of dust on the surface of the battens inside the roof cavity
[49] A sample of the actual material was collected and analysed
[50] Phase contrast microscopy
[51] Scanning electron microscopy. No asbestos or asbestiform fibres were detected
[52] Scanning electron microscopy result. 'Traces' in this context means that 1-3 fibres/bundles were seen in the fields examined.
[53] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 2	0002	Surface sample – Ceiling dust (x2)	Positive – traces[54] of asbestos. Dominated by mineral dust and plant debris. Lesser amounts plant char and white rust.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 0.001 <0.001	Gypsum Hailite Chlorite Actinolite Mica Talc Inorganic fibres		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[55].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are at or below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane that are not near any known asbestos manufacturing or disposal sites.

[54] Scanning electron microscopy result. 'Traces' in this context means that 1-3 fibres/bundles were seen in the fields examined
[55] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 3	0003	Surface sample – Ceiling dust Bulk sample - Bathroom Ceiling Sheet	Positive – occasional[56] asbestos. Dominated by organic fibres, both cellulosic and synthetic textile types, wood dust, plater dust, plant and insect debris. Positive for asbestos.	N/A	N/A	N/A	N/A	Occupants of this house did not agree to air monitoring being conducted	Surface testing inside roof cavity revealed occasional asbestos fibres.	Occasional amounts of asbestos found during surface testing is likely to be linked to asbestos present in the building materials of the house.

[56] Scanning electron microscopy result. 'Occasional' in this context means that 10-20 fibres/bundles were seen in the fields examined.

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 4	0004	Bulk sample – Piece of manhole cover Surface – Ceiling dust Bulk sample –Ceiling insulation	Positive for asbestos Positive – traces[57] of asbestos. Mainly wood dust, plant and insect debris. Positive for asbestos	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Talc Illite Iron oxide Stilpnomelane		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were less than 0.001f/mL. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[58].	Trace amounts of asbestos found during surface testing is likely to be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane that are not near any known asbestos manufacturing or disposal sites.

[57] 'Traces' in this context means that 1-3 fibres/bundles were seen in the fields examined.
[58] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 5	0005	Bulk sample – Piece of manhole lid Surface sample – Ceiling dust	Positive for asbestos Positive – traces[59] of asbestos. Mainly plant debris, wood dust, insect debris and mineral dust.	Outside house Inside house Ceiling cavity	<0.01 <0.01 Pump failure	<0.001 0.001 0.001	Talc Mica Chlorite Quartz Illite	Pump failure (ceiling cavity air testing) result not valid	1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[60].	Trace amounts of asbestos found during surface testing is likely to be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are at or below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane that are not near any known asbestos manufacturing or disposal sites.

[59] 'Traces' in this context means that 1-3 fibres/bundles were seen in the fields examined.
[60] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 6	0021	Bulk Sample – Ceiling sheeting around manhole Ceiling Dust (Ceiling cavity, arms reach into manhole – above kitchen)	No asbestos detected. No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 0.001 <0.001	Feldspar Quartz Gypsum Stilpnomelane Talc Inorganic Clay Illite Calcite Chlorite		1. All airborne fibre concentrations were 0.001 f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[61].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Test House 7	0022	Bulk sample – Ceiling sheeting around manhole Bulk sample – Vermiculite wall coating in garage Ceiling Dust (Ceiling cavity, arms reach into manhole – above bedroom)	No asbestos detected. Positive – Chrysotile, Amosite No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 0.001 <0.001	Quartz Feldspar Stilpnomelane Chlorite Calcite Inorganic	2 pumps used to collect entire sample	1. All airborne fibre concentrations were 0.001 f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[62].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[61] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[62] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 8	0023	Bulk sample – Ceiling sheeting Ceiling Dust (Ceiling cavity, arms reach into ceiling cavity)	Positive – Chrysotile, Amosite No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 <0.001 0.001	Illite Quartz Stilpnomelane Inorganic Glass Actinolite[63] Mica Feldspar Calcite Fe Metal	Pump failure @ 19 min	1. All airborne fibre concentrations were 0.001 f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[64].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Test House 9	0024	Bulk sample – Ceiling above sun room Ceiling Dust (Ceiling cavity, arms reach into manhole)	No asbestos detected. No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 0.001	Quartz Glass Mica Inorganic Feldspar Inorganic Actinolite[65]		1. All airborne fibre concentrations were 0.001 f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[66].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[63] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[64] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[65] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[66] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 10	0025	Bulk sample – Next to manhole Bulk sample – Wall sheeting in laundry Ceiling Dust (Arms reach into ceiling cavity through manhole – above kitchen)	No asbestos detected. Positive – Chrysotile No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 0.001 0.001	Quartz, Glass Actinolite[67] Calcite Feldspar Inorganic Mica Talc Iron Oxide Chlorite Ilmenite Illite Limonite		1. All airborne fibre concentrations were 0.001 f/mL. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[68].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[67] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[68] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 11	0026	Bulk sample – Ceiling sheeting around manhole Ceiling Dust (Ceiling cavity above laundry)	No asbestos detected. Positive – Chrysotile[69]	Outside house Inside house Ceiling cavity	<0.01 0.01 <0.01	<0.001 <0.001 0.001	Talc Quartz Inorganic Mica Amosite Calc Silicate		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001 f/mL or less. 3. Some respirable fibres were identified. One of the respirable fibres on one filter (ceiling cavity) was asbestiform[70] amosite. The uncertainty in regards to the concentration would be high because of the low number of fibres.	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[69] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.
[70] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 12	0027	Bulk sample – Laundry ceiling sheeting Bulk sample – Sheeting inside old switch board Ceiling Dust (Arms reach into ceiling cavity through manhole – above laundry)	Positive – Chrysotile, Amosite Positive – Chrysotile, Amosite, Crocidolite Positive – Chrysotile, Amosite[71]	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Stilpnomelane Inorganic Mica Illite Actinolite[72] Halite Quartz Feldspar Crocidolite		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were less than 0.001 f/mL. 3. Some respirable fibres were identified. One of the respirable fibres on one filter (outdoor sample) was asbestiform[73] crocidolite, and one actinolite. The morphology of these fibres was that they may be too thick to be true asbestiform without higher resolution SEM. The uncertainty in regards to the concentration would be high because of the low number of fibres.	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[71] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 13	0028	Bulk sample – Ceiling sheeting in hallway Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite, Crocidolite Positive – Chrysotile[74]	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 0.001 <0.001	Clay Fe Metal Quartz Mica Chlorite Feldspar Inorganic Kyanite Fe Oxide		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001 f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[75].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples were below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[72] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[73] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[74] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.
[75] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 14	0029	Bulk sample – Next to man hole in laundry area Ceiling Dust (Arms reach into ceiling cavity through manhole)	No asbestos detected. Positive – Chrysotile, Amosite[76]	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Feldspar Quartz Actinolite[77] Mica Epidote Chlorite Gypsum Illite Clay		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were less than 0.001 f/mL. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[78].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[76] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.
[77] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[78] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 15	0030	Bulk sample – Ceiling sheet next to manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite Positive – Chrysotile[79]	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Calcite Feldspar Illite Chlorite	Pump stopped at 319 mins	1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were less than 0.001 f/mL. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[80].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[79] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.
[80] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 16	0031	Bulk sample – Ceiling sheet next to manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite Positive – Chrysotile[81]	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 0.001 0.001	Kyanite Quartz Mica Inorganic Illite Clay Zn Metal Calcite Chlorite Glass Actinolite[82]		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001 f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[83].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[81] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.
[82] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[83] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 17	0032	Bulk sample – ceiling sheeting beside manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite Positive – Chrysotile[84]	Outside house Ceiling cavity Inside house	<0.01 <0.01 N/A	<0.001 0.001 N/A	Chlorite Mica Actinolite Chrysotile Feldspar Celestite Stilpromelane Calcite Quartz Clay	Pump stopped at 43 mins – could not restart. Sample not collected	1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001 f/mL or less. 3. Some respirable fibres were identified. Two of the respirable fibres on one filter (ceiling cavity) were asbestiform[85] chrysotile. The uncertainty in regards to the concentration would be high because of the low number of fibres.	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[84] Hand-picked refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material.
[85] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Test House 18	0033	Bulk sample – ceiling sheeting beside manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite, Crocidolite No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 <0.001 <0.001	Mica Quartz Actinolite[86] Clay Chlorite Illite		1. All airborne fibre concentrations were 0.001 f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[87].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Control House 1	008	Bulk Sample – Manhole cover Ceiling Dust (Ceiling cavity, arms reach into manhole)	No asbestos detected. No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 0.001 0.001	Gypsum Feldspar Quartz Inorganic Clay Rutile Stipnomelane Actinolite[88] Fe Metal		1. All airborne fibre concentrations were 0.001f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[89].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[86] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[87] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[88] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[89] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 1	0008	N/A	N/A	Outdoor control Outdoor ambient[90]	<0.01 <0.01	<0.001 <0.001	Sylvite Halite Inorganic Calcium Silicate		3. All airborne fibre concentrations were 0.001f/mL or less. 4. Some respirable fibres were identified however none of these were asbestos or asbestiform[91].	The levels of airborne fibres in the tested samples are at or below the level of detection. Certificate of analysis (PCM): results of <0.01 are consistent with background levels of asbestos.
Control House 2	009	Bulk sample – Ceiling sheeting Ceiling Dust (Ceiling cavity, arms reach into manhole)	No asbestos detected. No asbestos detected by PCM. Traces of Amosite and Chrysotile by SEM.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 0.001 0.001	Fe Oxide Quartz Actinolite[92] Mica Gypsum Inorganic Gypsum/Halite Chlorite Halite Fe Clay Feldspar		1. All airborne fibre concentrations were 0.001f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[93].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[90] The control sample was taken on the same day as sampling at Gaythorne, whilst the ambient was taken on a random day (ie not at same time as the Gaythorne samples).
[91] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[92] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[93] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 3	0010	Ceiling Dust (Ceiling cavity, arms reach into manhole)	No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.08	<0.001 <0.001 0.003	Inorganic Gypsum Mica Chlorite Calcite	Pump failure @ 19 min	1. Two airborne fibre concentrations were less than 0.001f/mL. 2. One airborne fibre concentration was above the limit of detection used, however uncertainty is high, due to the low concentration, and small sample size as a result of a pump failure. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[94].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[94] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 4	0011	Bulk sample – Roof seething in bathroom Ceiling Dust (Ceiling cavity, arms reach into manhole in hallway)	No asbestos detected. Positive[95] - Chrysotile	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 <0.001 0.001	Glass Feldspar Halite Inorganic Mica Gypsum Mica Hornblende Rutile Quartz Stilpnomelane		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[96].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Control House 5	0012	Ceiling Dust (Arms reach into ceiling cavity through manhole – on top of insulation)	No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.04	<0.001 <0.001 <0.001	Actinolite[97] Inorganic Feldspar	Pump failure @ 39 min	1. All airborne fibre concentrations were less than 0.001f/mL. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[98].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[95] Refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material. Ceiling dust sample contains no detectable respirable fibres as per AS4964-2004 Clause 9.4.
[96] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[97] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[98] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 6	0013	Bulk sample – Piece of sheeting beside manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite Positive[99] – Chrysotile, Amosite	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Amosite Gibbsite Mica Quartz Inorganic		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were less than 0.001f/mL. 3. Some respirable fibres were identified. Two of the respirable fibres on one filter (outdoors sample) were asbestiform[100] amosite. The uncertainty in regards to the concentration would be high because of the low number of fibres.	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[99] Refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material. Ceiling dust sample contains no detectable respirable fibres as per AS4964-2004 Clause 9.4.
[100] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 7	0014	Bulk sample – ceiling material beside manhole Bulk sample – external wall sheet Ceiling Dust (Arms reach into ceiling cavity through manhole)	No asbestos detected. Positive – Chrysotile, Amosite No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Amosite Inorganic Actinolite[101]	Pump failure @ 115 min	1. All airborne fibre concentrations were less than 0.001f/mL. 2. Some respirable fibres were identified. One of the respirable fibres on one filter (ceiling cavity sample) was asbestiform[102] amosite. The uncertainty in regards to the concentration would be high because of the low number of fibres.	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[101] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[102] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 8	0015	Ceiling Dust (Arms reach into ceiling cavity through manhole)	No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 0.001 0.001	Actinolite[103] Chlorite Feldspar Inorganic Calc-silicate Clay Mica Quartz Sylvite Halite		1. All airborne fibre concentrations were 0.001f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[104].	The levels of airborne asbestos fibres in the tested samples below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Control House 9	0016	Ceiling Dust (Arms reach into ceiling cavity through manhole)	No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	0.001 <0.001 <0.001	Mica Fe Metal Gypsum Actinolite[105] Chlorite Mica Inorganic Fe Clay Sylvite		1. All airborne fibre concentrations were 0.001f/mL or less. 2. Some respirable fibres were identified however none of these were asbestos or asbestiform[106].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[103] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[104] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[105] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.
[106] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 10	0017	Bulk sample – Ceiling sheet on manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile, Amosite Positive[107] – Chrysotile	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 0.001	Talc Glass Inorganic Gypsum		1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[108].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Control House 11	0018	Ceiling Dust (Arms reach into ceiling cavity through manhole)	No asbestos detected.	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Fe Metal Talc Inorganic	Pump failure @ 114 min	4. All airborne fibre concentrations were less than 0.001f/mL. 5. Some respirable fibres were identified however none of these were asbestos or asbestiform[109].	The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.

[107] Refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material. Ceiling dust sample contains no detectable respirable fibres as per AS4964-2004 Clause 9.4.
[108] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos
[109] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Control House 12	0019	Bulk sample – ceiling sheeting beside manhole Ceiling Dust (Arms reach into ceiling cavity through manhole)	Positive – Chrysotile Positive[110] – Chrysotile	Outside house Inside house Ceiling cavity	<0.01 <0.01 <0.01	<0.001 <0.001 <0.001	Mica Actinolite[111] Gypsum	Pump failure @ 192 min	1. Surface testing inside roof cavity revealed traces of asbestos fibres. 2. All airborne fibre concentrations were less than 0.001f/mL. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[112].	Trace amounts of asbestos found during surface testing may be linked to asbestos present in the building materials of the house. The levels of airborne asbestos fibres in the tested samples are below the level of detection. This is consistent with airborne asbestos levels in other areas of Brisbane.
Kedron Brook Bikeway	0020	N/A	N/A	Kedron Brook Bikeway	<0.01	<0.001	Mica Fe Oxide Actinolite[113]			

[110] Refers to small discrete amounts of asbestos distributed unevenly in a large body of non-asbestos material. Ceiling dust sample contains no detectable respirable fibres as per AS4964-2004 Clause 9.4.

[111] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.

[112] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

[113] Actinolite can be of the asbestiform or non-asbestiform in habit. Analysis identified respirable actinolite fibres in these samples as cleavage fragments of non-asbestiform massive actinolite.

LOCATION	CODE	SURFACE[48] AND BULK[49] TESTING		AIR TESTING				COMMENTS	OVERALL RESULT	CONCLUSION
		Samples location	Result	Samples location	Result – PCM[50] (f/mL)	Result – SEM[51] (f/mL)	Airborne fibre identification			
Park east side of Wunderlich plant, Gaythorne. Approximately 5 metres from site fence, but inside park	0006	Bulk sample of small pieces of fibre cement sheeting in drain in park	Positive for asbestos	Boundary of park and former Wunderlich site	<0.01	<0.001	Halite Quartz Chlorite Inorganic		1. Testing of fibre cement fragments in drain revealed traces of asbestos fibres. 2. All airborne fibre concentrations were 0.001f/mL or less. 3. Some respirable fibres were identified however none of these were asbestos or asbestiform[114].	The levels of airborne fibres in the tested samples are at or below the level of detection.
Park near creek next to 124 Bellevue Avenue, Gaythorne	0007	N/A	N/A	Outside in Park, near creek, next to 124 Bellevue Ave Gaythorne	<0.01	<0.001	Calcium Silicate Clay Halite Organic			The levels of airborne fibres in the tested samples are at or below the level of detection.

[114] Material having the mineralogical fibrous habit and features of asbestos with similar potential health effects to asbestos

Abbreviations

ABS	Australian Bureau of Statistics
ASCC	Australian Safety and Compensation Commission
CI	Confidence Interval
DEHP	Department of Environment and Heritage Protection
EDS	Energy dispersive X-ray spectroscopy
EHO	Environmental Health Officer
EMR	Environmental Management Register
enHealth	Australian Environmental Health Standing Committee
IAG	Interagency Asbestos Group (see section 1.5.1)
km	Kilometre(s)
mL	Millilitre(s)
NATA	National Association of Testing Authorities (Australia)
NOHSC	National Occupational Health and Safety Commission
PCM	Phase contrast microscopy
PLM	Polarised light microscopy
QCR	Queensland Cancer Registry
RAP	Remediation action plan
RI	Refractive Index
SEM	Scanning electron microscopy
SIR	Standardised incidence ratio
SMP	Site management plan
TEM	Transmission Electron Microscopy
WHSQ	Workplace Health and Safety Queensland
µm	Micrometre(s)

Glossary

Asbestos	A group of naturally occurring silicate minerals that are capable of producing thin, flexible fibres when crushed. The produced fibres have extraordinary tensile strength, conduct heat poorly and are relatively resistant to chemical attack. The principle varieties of asbestos are the serpentine mineral, chrysotile and the amphibole minerals, which include crocidolite and amosite.
Asbestosis	Lung fibrosis (scarring) as a result of inhalation of asbestos fibres.
Background exposure	Two types of background levels may exist for asbestos: (a) naturally occurring levels: ambient concentrations of asbestos in the environment, without human influences (b) anthropogenic levels: concentrations of asbestos present in the environment due to human-made sources e.g. mining activities. Background ambient levels of respirable asbestos fibres may range in rural areas from below 0.0001 fibres per millilitre (f/ml) to 0.000001 fibres per millilitre. Background levels in typical urban environments range from 0.001-0.0001 fibres per millilitre.
Epidemiology	Epidemiology is a scientific field that is concerned with understanding the patterns of disease in the population.
Et al	And others
f/mL	Fibres per millilitre (of air).
f/mL-years	Fibres per millilitre-years. Fibres per millilitre (of air) multiplied by the number of years of exposure.
f-yr/mL	Fibre years per millilitre. The number of fibres found in 1 mL of air to which a worker is exposed, for 40 hours per week over a year period.
Fugitive emissions	Emissions of gases or vapours from pressurised equipment due to leaks; and other unintended or irregular releases of gases, mostly from industrial activities.
Incidence	Incidence is a measure of the probability of occurrence of a given medical condition in a population within a specified period of time.
Latency period	The period of time between exposure to a disease causing agent and the development of the disease.
Legacy industrial source exposure	Exposure to asbestos resulting from previous commercial activities such as mining, milling or asbestos product manufacture.
Lung cancer	A cancer that forms in tissues of the lung, usually in the cells lining air passages.
Mesothelioma	A cancer of the lining of the lungs (pleura) or, alternatively, of the lining of the abdominal cavity (peritoneum).
Micrometre	One thousandth of a millimetre, 0.001 millimetre. Also one millionth of a metre, 1×10^{-6} m. Also known as a micron.
Neighbourhood exposure	Exposure to asbestos due to living in the vicinity of an operational commercial site such as a working mine or manufacturing facility.
Para-occupational exposure	Exposure to airborne asbestos fibres in the home in which a worker lives. Also known as household or domestic exposure.

Person-years	A measurement combining the number of people and their time contribution in a study or situation. This measure is most often used as denominator in incidence rates. It is the sum of individual units of time that the people in the relevant population have been exposed or at risk to the conditions of interest.
Phase contrast microscopy	A technique for counting fibres in air, dust and bulk samples..
Polarised light microscopy	A technique for identifying asbestos in bulk and dust samples.
Remediation	The act or process to: (a) rehabilitate the land (b) restore the land or (c) take other action to prevent or minimise serious environmental harm being caused by the hazardous contaminant contaminating the land.
Scanning electron microscopy	A technique for counting and identifying fibres in air and dust samples.

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