Chapter 6

# Site remediation

## 6.1 Approach

Remediation options that minimise the potential for exposure to airborne asbestos fibres and also minimise the amounts of contaminated material that are removed to landfill are preferred. Complete excavation and removal will remove the potential for any future exposure and does not require any ongoing management. However, the feasibility of safe removal, transport and disposal and sustainability of landfills should be considered in decision making.

Note that the *Environmental (Controlled Waste) Regulations* **must be complied with** for any movement of asbestos contaminated soils outside of the reported site boundary (i.e. controlled waste transport and disposal). This requirement also applies to large redevelopment sites that involve more than one land parcel.

The main remediation options include management in situ, treatment on-site, and removal of the contaminated soil from the site. Consideration may also be given to changing the final intended use or redesign of development plans (e.g. locations of building, hard surfaces and open spaces) to better manage the risk in perpetuity.

**Containment of asbestos contamination eliminates the exposure pathway. Remediation involving minimal disturbance, such as containment and management in situ, is often preferable to large scale handling, removal and transport of asbestos contaminated soils.**

All feasible options for remediation must be considered and presented to the site owner/occupier. Options may include a combination of methods. The preferred option should be supported by strong argument when compared with the others. Although cost, time, sustainability, convenience and future owner perception will be important considerations, the arguments presented for selection should be primarily stated in terms of public health and worker protection.

Most options presented relate primarily to bonded ACM unless FA or AF is specifically referred to. The proponent is free to propose other remediation measures through reasonable argument and/or precedent.

Compliance with WHS legislation, equipment operation and decontamination, vehicle movements and dust control during sampling and monitoring regime and remediation activities must be carefully managed.

**Early stakeholder engagement in remediation options is expected. Where, following remediation, the control of the land will pass on to a new owner or entity (e.g. local government) to manage, these parties and individuals must be included in the decision making process. Where on-site containment and management of the contamination at the site will be required in perpetuity, consideration must be given to preventing disturbance of contamination during routine maintenance work.**

In addition, site remediation activities will need to comply with any other licences or approvals required by State and local government (e.g. mechanical screening activities).

For example, for treatment of large volumes of soil, there may be a requirement under the *Environmental Protection Act 1986* (EP Act) to obtain a works approval, pollution prevention licence or licence amendment to undertaken clean-up. Such requirements should be identified in any remediation action plan.

**Management options that are available for the remediation of reported contaminated sites are not implicitly endorsed or approved for other situations (e.g. illegal surface dumping, asbestos removal work, treatment of waste, sale or supply of asbestos contaminated products) where prevention or removal of asbestos contamination is a priority.**

Important considerations for the DOH in assessing the acceptability of any remediation proposal consists of:

- minimisation of contaminated soil disturbance
- minimisation of contaminated material/soil moved to landfill
- minimisation of risks associated with transportation
- written agreement from parties with responsibilities for temporary, interim or perpetual site management.

The object of any remediation strategy and site management approach is to:

- prevent and protect individuals and communities from exposure that could lead to asbestos-related diseases
- provide information to individuals and communities about WHS and public health risks.

## 6.2 Presence of other contamination

The presence of other contaminants may affect the approach taken to or the timing of asbestos remediation. The following considerations may be important:

- Do other contaminants present an immediate threat to health or the environment?
- Will the proposed asbestos remediation option mobilise or compromise the other contaminants or vice versa?
- Is a single option or combination of remediation options available to treat both asbestos and the other contaminants?

For contamination contained on-site, the restrictions on use will include the requirement for procedures to be in place for any excavation work beyond the clean surface layer. A site management plan must also be implemented for the following circumstances:

- containment in public open spaces (parks, ovals and playgrounds) at less than 1 m depth
- containment for all other uses, including residential, commercial, natural bushland/reserve, at less than 0.5 m depth

## 6.3 Site management plan

Site management plan (SMP) refers to the plan for proper control of any asbestos contamination remaining at the site and the communication of relevant information to site owners/occupiers, users and persons who may encounter asbestos contaminated material as part of future site works.

The management plan must include probable exposure scenarios for the relevant land use(s) whereby asbestos fibres may become airborne and pose a human health risk.

Site management strategies should aim to alert future workers or site users to asbestos and protect them from exposure to airborne fibres during activities that may disturb the contamination.

For commercial sites, depending on organisational arrangements, the location and extent of remaining contamination and how it may impact future site workers, it may be relevant to integrate the SMP into existing asbestos registers and asbestos management programs.

### 6.3.1 Restrictions on use

Where bonded ACM remains on the site and is managed, the land will be classified accordingly (external site). The final classification is likely to be 'remediated for restricted use' or 'contaminated – restricted use'. The 'restrictions on use' would relate to informing site users that asbestos remains on-site and any precautions required to prevent exposure.

Potentially affected parties, including current and known future users, should be informed of the contamination and the arrangements in place to protect them, including through the Basic Summary of Records and the SMP. All parties who are subject to its implementation and those who have roles and responsibilities allocated by the SMP should be involved in the decision making for on-site containment provisions (see Section 6.4).

Note that:

- on-site containment options must be designed such that there is minimal impact on routine activities at the site, such as landscaping, maintenance or gardening works.
- a site that has only implemented interim containment measures may retain a classification for requiring remediation until the long term measures have been confirmed to be in place.

### 6.3.2 Elements of a site management plan

A site management plan developed and implemented on a long-term basis must consider the following elements:

- agreement from all parties involved regarding the remediation plan and management arrangements proposed for the site
- agreed timeline for implementing long-term management solutions to ensure interim measures are not extended beyond their ability to prevent future exposure.
- description of the nature, degree, quantity and location of asbestos contamination remaining at the site
- description of engineering or institutional controls for any asbestos contamination remaining in situ
- authorisation arrangements for any ground disturbance/site works
- WHS provisions for workers
- integration with any existing corporate asbestos management plans used by the organisation and with any:
  - authorisation/permit to work process
  - existing procedures associated with inspection of cover materials (e.g. turf management)

- proof of arrangements to maintain the integrity of the covering barrier of the contaminated area if there is any possibility of it being disrupted, for instance, if the barrier is in the form of a vegetative cover, scheduling surface inspections (e.g. regular schedule and/or following periods of heavy rainfall)
- surface water runoff that may erode cover, particularly after heavy rainfall
- a safe system of work for anyone undertaking future work (including regular inspections)
- and repairing any damage to the barrier
- development of an information and communication strategy for existing or prospective owners, occupiers and users of the site
- where needed, procedures for how to deal with asbestos that may be encountered by various persons using or working at the site
- the periodic review and audit of management provisions and stakeholder engagement to ensure in perpetuity management of the asbestos contamination.

The stakeholder communication/training should include details of:

- results of site investigations
- restrictions on-site use to protect from exposure
- any responsibilities they hold with regard to the management arrangements
- where additional information may be obtained.

## 6.4 Containment and long term management

Effective long term containment with a restricted use classification is a sustainable outcome. Containment primarily involves the isolation of the contaminated area with barriers and covers so that it cannot be readily disturbed. The cover usually includes a layer of clean soil. This fill should be demonstrated to be free of contamination, and some form of visible barrier (e.g. contrasting/coloured geotextile fabric, crushed rock layer) can be included to identify and prevent mixing of the clean and contaminated soil layers. Long term management measures, including containment and a memorial on the certificate of title (CoT), would be expected for any asbestos-containing material remaining at the site.

The advantages of on-site containment include:

- minimal disturbance of asbestos contaminated soil
- minimisation of sampling and investigative works required with potentially lower costs, time delays and greater confidence of outcomes.

The disadvantages include:

- asbestos will need to be properly managed in perpetuity
- level of the site may need to be raised
- the site will remain classified with an associated memorial on the CoT, which could adversely affect purchaser perceptions

The feasibility of site containment and management should consider:

- the depth of the asbestos contaminated material and its likely future disturbance
- the CSM and potential for exposure to identified receptors (e.g. routine maintenance workers)

- distribution and coverage of asbestos contamination and the ability to effectively and practically delineate, treat and/or remove the contamination
- the risk and controls required for removing high concentrations of FA or AF and whether these can be managed
- the final use, design and layout of the site, including the location of hardstand covers, building or other hard surfaces
- the site works required, including whether the site is to be covered by clean fill for geotechnical or other purposes
- likely associated requirement for an MOT and the necessity for a future site owner/ manager (e.g. local government authority) to effectively implement an SMP

Other management measures not described in these Guidelines are possible, such as cement injection stabilisation, which effectively encapsulates the asbestos material.

### 6.4.1 Excavation and re-burial

Consultation with DWER is recommended for on-site re-burial. The excavation and re-burial of asbestos contaminated soil within an engineered containment cell may be a feasible and preferred option for some sites. The containment cell must be within the asbestos contaminated area or at least within the boundary of the reported site. An important advantage of this approach is that it can provide for the location of the containment cell to be delineated by an Interest Only Deposited Plan (see contaminated sites guidelines (external site) for more information), with remaining areas of the site free of restrictions. For example, a redevelopment site may situate a containment cell under buildings or hardstands or within an area of a redevelopment that is controlled by an entity that can apply institutional controls on a site, allowing more vulnerable parts of the site (i.e. sensitive land use or low integrity cover) to be decontaminated with no restrictions on site use.

Another advantage of using an engineered on-site containment cell is that it eliminates risks and costs associated with taking the material off-site and disposing of it at a licensed waste facility and allows limited licensed asbestos waste facility space to be reserved for asbestos waste arising from the removal of asbestos-containing building products.

The boundaries of the area from which excavated contaminated soil is taken should include consideration of additional lateral and vertical excavation to account for any uncertainty in the contamination delineation during site investigations and site excavations works and/or the sides and base of the excavation be validated as uncontaminated.

### 6.4.2 Design elements

The depth of the clean cover should be sufficient to prevent access to and disturbance of any buried asbestos-containing material. The depth of required fill should consider:

- current and future site use
- the integrity of the final top surface cover (e.g. hardstand, gravel, turf)
- potential for damage/erosion of the cover through human activity, surface water movement or other causes
- ability to inspect/maintain cover over the long term
- safe access to below-ground infrastructure, including irrigation systems and underground service.

The need for surface water drainage also needs to be assessed and included in the remediation plan.

As DOH considers, the deeper the contamination the lower the potential for extended current or future contact with the contamination; greater than 1 m of clean cover will require classification and restriction on excavation. However, under most site-use scenarios is unlikely to require active ongoing management control (e.g. SMP). A restriction on use will be applied that will require implementing appropriate controls if and when future contact with the material occurs. An SMP for the site is required where disturbance of the contamination is probable during normal use or maintenance related to current and future site uses.

Where possible, the depth of cover should be sufficient to address any access to or future installation of utility and underground services. Alternatively, underground services may be isolated from other buried contaminated material with a marker layer and backfilled with clean fill. The planning, size and design of buried services and/or service trenches should accommodate future maintenance or installation of additional services (e.g. allow sufficient clean area for additional services and/or room for re-excavation of trenches adjacent to buried services).

Contamination associated with high concentrations of fibrous asbestos may require a greater depth of clean fill or more frequent inspection of cover, depending on site circumstances.

**Remediation Plans and long term management measures must be agreed to and endorsed in writing by the entity that will have control of the site.**

#### 6.4.2.1 Separation and/or isolation of the contaminated soil

A geotextile barrier provides a warning of the presence of soil contamination. Where possible, the barrier should be a contrasting colour to the surrounding soils. Specialised or improvised geotextile fabrics may be used, meeting the following conditions:

- water permeable
- high visibility
- rot-proof and chemically inert
- high tensile strength
- coverage of the contaminated area and at least 0.5 m beyond boundary if practical
- parallel sheets and adjoining sheets to be fixed together or overlap by at least 20 cm.

Alternate means of visibly identifying and separating fill may be used, e.g. a layer of crushed rock between clean soils and asbestos contaminated soils. An SMP is a recommended element whenever containment is employed; this ensures that the protective measures will be maintained and that potentially affected parties will be kept informed of possible risks.

The means of isolating and visibly identifying the layers of soils must be well documented in any SMP and specific procedures developed for any site works. The expected lifespan of geotextile barriers should also be included in the long-term management plan.

A dense vegetative barrier, such as turf, can be very useful in protecting the clean fill cover from erosion and some forms of human disturbance. In certain cases, the site may involve ongoing corporate or communal management, which will control what happens with the vegetative barrier, including its maintenance.

## 6.5 Treatment on site

Treatment on site is taken here to mean undertaking some physical treatment or manipulating the contaminated soil at the site, specifically removing surface contamination or mechanical screening of excavated soils.

### 6.5.1 Removal of surface contamination

Surface remediation is possible where the collection of bonded ACM results in removing the contamination present at the site. It must be confirmed that the impacts are confined to the surface soils, and that surface remediation will be sufficient to achieve site clean-up goals. Evidence of the depth of surface penetration will be required (see Chapter 3).

Figure 11 Hot spot of bonded asbestos cement fragments.

For the collection of surface contamination to be effective, it may be necessary to remove any covering vegetation. The removed vegetation must be clean of bonded ACM before disposal or disposed as asbestos waste. Before vegetation clearing, consideration should be given to the need for a Clearing Permit to be obtained from DWER under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004.

Guidance on surface sampling is provided in Section 5.7.1. This technique can be used to concurrently remediate and estimate the level of contamination associated with surface soils. The remediation of surface contamination must be adequately validated. At least two passes (and then as many as required) must be completed until a final validation pass results in no visible bonded ACM being found. For successive passes, if the amount found in each is quite large (such as > 0.1 % w/w asbestos) and does not show a substantial sequential reduction, then the contamination may be such that its remediation cannot be achieved by this method.

For compact or clay soils, collection or emu picking may be an option where the bonded ACM is confirmed to be only on the top surface (i.e. site investigations confirm that the contamination does not penetrate the surface soil layer above the screening criteria).

Surface scraping vs raking can be more effective where surface “hot spots” of small fragments may be present.

Very small fragments may be evidence that the material has been crushed, smashed or pulverised and collection of a soil surface scrape of the visible material and immediately surrounding surface soils would remove and eliminate any potential AF impacts that may have occurred from any in situ breakage.

Some types of FA material located on the surface may also be readily collected and removed, although additional work should be undertaken to assess and manage any associated AF.

### 6.5.2 Tilling

Tilling using mechanical means may be an acceptable methodology for remediation of loose, sandy soils. Tilling can be used to reveal bonded ACM contamination that is no deeper than the tines. The desktop study and sampling may help to support such an approach. Tilling is expected to be used together with hand-picking and will require the initial removal of surface vegetation. A grid approach should be used with a spotting, separation, weighing and calculation approach used as outlined for hand-picking (Section 5.7). Dust management measures must be in place.

The readily disturbed and accessible ground surface must be free of visible asbestos for the site to be considered remediated.

### 6.5.3 Screening

Mechanical screening is most suitable for the removal of low-level asbestos cement fragment impact in sandy soils. If undertaken with the appropriate controls, mechanical screening can be an effective tool for separating bonded ACM from soil and limit the material being disposed to landfill.

The process must include a comprehensive dust management plan (including air sampling) and community consultation. A screen of effective final mesh size of less than or equal to 7 mm x 7 mm should be used to ensure that fragments of bonded ACM panels do not pass through lengthways. The percentage of asbestos w/w can be calculated by calculating the weight of bonded ACM retrieved for a given weight of soil screened. If there are small fragments present and/or (more commonly) a larger screening size is used, sampling of the resulting stockpiles will be required to confirm that screening is effective.

Dust management and air quality monitoring are particularly important during screening procedures because they can release considerable amounts of dust and possibly asbestos fibres.

The suitability of screening should take account of the following factors:

- Advantages
  - screened soil can be validated for re-use as uncontaminated fill, reducing the amount of soil to be moved off-site for disposal as “special waste”
  - potentially avoid a ‘restricted use’ classification with associated memorial on CoT
  - sampling can be combined with remediation;
  - hazard is eliminated.
- Disadvantages
  - less cost-effective for high levels of contamination or low volumes of asbestos contaminated soils
  - not suitable for crushed building and demolition debris
  - not suitable for compacted soils or soils with high clay content
  - in some cases, it has the potential to generate considerable dust, which requires consideration of and consultation with nearby receptors and monitoring to ensure there are no off-site impacts
  - may require additional controls (e.g. enclosure) where a sufficient buffer from sensitive receptors is unavailable.

## 6.6 Removal off-site

Removal off-site is a feasible option for asbestos contamination that is not much combined or mixed with other materials (e.g. soil or other waste), is not buried deeply and/or relatively confined, and the extent of contamination is evident and well delineated.

In some circumstances, removal is preferable or more feasible to containment or treatment options, for example, where:

- there are site constraints to asbestos contamination being contained or treated at the site
- there may be issues with or lack of stakeholder agreement in managing contamination in perpetuity
- excavations as part of land development allow for the opportunistic removal of contaminated soils
- unexpected “hotspots” are found during site works.
- Contamination is present within stockpiled material that has been brought on-site.

Removal off-site is an option where it is important to avoid a ‘restricted use’ classification, such as for residential land redevelopment.

For the excavation of any asbestos contaminated soil, it is recommended that additional material is removed in all directions beyond the measured lateral boundary of the contaminated area. The additional amount to be removed should be informed by the site investigation and may consider:

- removal of all introduced material down to the natural soil profile
- validation that the surfaces exposed by the excavation following removal of asbestos are not contaminated as outlined in Section 6.8.

Excavated contaminated material must be transported and disposed in accordance with the *Environmental (Controlled Waste) Regulations 2004*.

## 6.7 Remediation action plan

Some of the remediation measures can generate significant amounts of dust, including airborne asbestos fibre.

Possible dust-generating activities include the mechanical screening of soil and major earth excavations, and vehicle movement. Effective dust management controls are required, and air quality monitoring must be included.

A Remediation Action Plan (RAP) (see Contaminated Sites Guidelines (external site) and CRC CARE National Remediation Framework (external site)) should be developed and implemented for all activities undertaken at a site. The level of detail will depend on the nature and extent of the contamination and the type and magnitude of disturbing activities.

A RAP should include sections on dust control measures, air quality monitoring, personnel protection and training, and action levels and responses.

Available dust control measures include but are not limited to:

- wetting with an agent specifically designed to suppress the release of particulates/fibres
- using dust suppressants or covers on soil stockpiles
- installing wind barriers of a suitable height
- using sheltered areas wherever possible
- full enclosure structures around dust-generating activities
- monitoring meteorological conditions and modifying or stopping work when they are adverse
- regulating the activities at a site and/or speed of vehicles
- restricting or minimising access to contaminated areas, especially by vehicles
- implementing a community dust complaint and response system.

All persons involved in remediation works must be adequately trained. The site-specific training must include:

- asbestos awareness training
- understanding of the nature and extent of site-specific asbestos contamination
- controls and notifications to be followed
- how to prevent exposure to contamination, including
  - dust control measures
  - handling and disposal procedures
  - selection and use of personal protective equipment and clothing
  - personal and equipment decontamination procedures
  - emergency procedures.

## 6.8 Validation sampling

Validation will be necessary for remediation works. For all validation activities, no matter how simple or complex, the evaluation and reporting of a remediation methodology must be adequately recorded throughout the course of a project.

Any validation sampling should be based on the recommended sampling methods in Chapter 5. Validation to verify completion of remedial activities should be determined as part of the RAP. For example, the validation of excavated asbestos-contamination where boundaries of the waste or fill can be readily distinguished can be based on removing material until natural soils are revealed, or another change in a condition indicative of non-impacted soil is evident. The decision parameters and confirmation of remediation must be recorded.