Colonial mine tailings, July 2006

Department of Industry and Resources &

Department of Local Government and Regional Development

Management of Asbestos Contamination in Wittenoom

Non-Technical Summary

November 2006

Non-Technical Summary

1. Introduction

Blue asbestos (crocidolite) deposits occur naturally for hundreds of kilometres in the Pilbara's Hamersley Ranges. Approximately 150,000 tonnes of asbestos was extracted commercially from three mines (Yampire, Wittenoom and Colonial) between 1937 and 1966 and the town of Wittenoom was established for the mine workers and their families. The waste ore (known as tailings) left after most of the asbestos had been extracted was estimated to be over 3 million tonnes. These tailings, which can contain around 5% asbestos, were used in the construction of Wittenoom town, the airstrip and amenities. The natural forces of wind and water have also spread the asbestos wastes, such that they now cover an area of approximately 10 square kilometres.

Asbestos is made up of fibres, that give it useful chemical and heat resistance properties but which, if inhaled, also can cause potentially fatal health problems. Several hundred people who worked or lived in Wittenoom have died of asbestos related diseases. Since the late 1970s the Government has been phasing down Wittenoom to the extent that in October 2006, there were 8 residents remaining and the decision to close the town has been taken. Other user groups including tourists, Aboriginal people, mining and exploration workers, road users and construction and remediation workers continue to be potentially exposed to asbestos fibres.

GHD and Parsons Brinckerhoff were appointed by the Department of Industry and Resources (DoIR) and the Department of Local Government and Regional Development (DoLGRD) to provide a risk based strategy for managing the health risk posed by asbestos tailings in the Wittenoom area of the Pilbarra.

The objectives of the DoIR / DoLGRD study were to undertake a field survey of the extent and nature of the asbestos contamination, develop a risk assessment process and identify and evaluate options for the management of any risk identified. The cost for demolishing infrastructure and residences in Wittenoom was also required.

This Non-Technical Summary aims to simplify and communicate the findings of the Study in brief to the various stakeholders involved.

2 The Risk Assessment Process

2.1 Approach

The enHealth report on Management of Asbestos in the Non-Occupational Environment[1] provides information on the risks posed by asbestos and the management of asbestos. It indicates that a qualitative assessment of risk should be undertaken for sites that are contaminated with asbestos.

For the purposes of assessing the risk posed by asbestos in the study area, the semi-quantitative assessment process outlined in Figure 1 has been adopted. The approach is based on determining the concentration of asbestos in an area, and the exposure that various user groups are likely to incur, and therefore the level of risk that the asbestos is likely to pose to the various user groups. The concentrations and exposure potential are each quantified using a simple ranking approach, as outlined in Figure 1, with the magnitude of the risk being a multiplication of the concentration and exposure potential. The enHealth guidance on health impacts has been based on a conservative approach because of the current community perception of risk from asbestos, noting that in an urban environment there is commonly a zero tolerance attitude to any asbestos. Hence, the acceptable levels are potentially low relative to the actual health impact, and the Table 1 descriptor "imminent risk of exposure to harmful levels" refers to the fact that the potential for illness is higher than it can be expected that the community might accept, rather than it might be expected actual illness would result and would be observed. The levels of risk used for the Study are provided in Table 1:

Table 1. Risk Classification and Response

Risk classification	Descriptor	Indicative Response
16 – 24	Extreme	Land not suitable for proposed/current use, remediation is required or conditions applied to control activities at the site for other use Imminent risk of exposure to harmful levels.
9-15.9	High	Land not suitable for use unless remediation is carried out or conditions are applied to control the activities at the site
4 – 8.9	Medium	Land may be suitable for use, consider whether remediation may be required or conditions applied to control activities at the site
1-3.9	Low	Land suitable for use without conditions

2.2 Field surveys and data collation

For the purposes of assessing the risk, the project area was divided into seven Study Areas (See Figure A) and the users of the area split into twelve groups (see Table 2).

The concentration of asbestos present in the various Study Areas was determined through field surveys, laboratory testing and a review of aerial surveys and previous studies.

The use of each area by user groups was determined by a desk based review to identify the activities undertaken by users, supported by evidence from the field survey.

[1] enHealth (2005) Management of asbestos in the non-occupational environment.

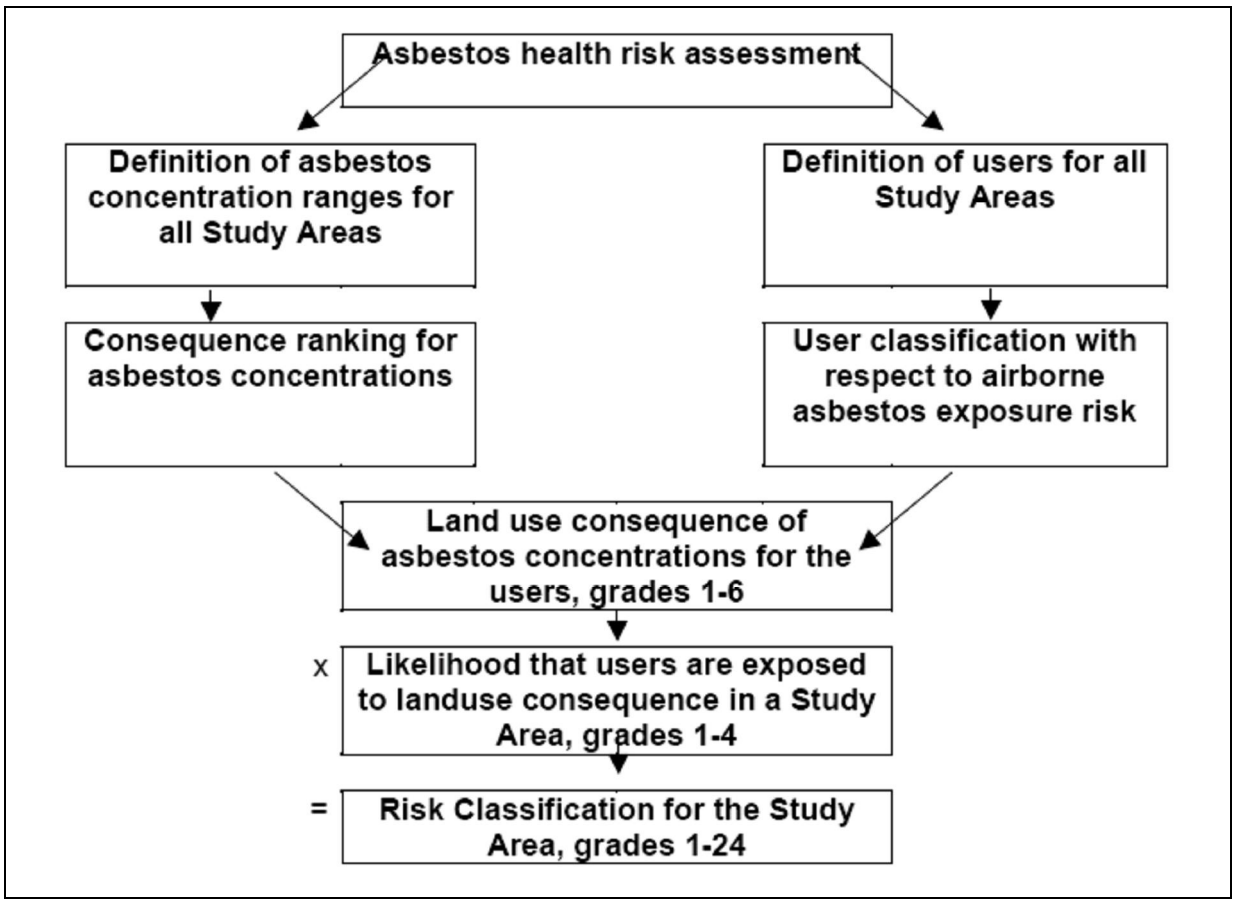

Figure 1: Risk Assessment Process

Table 2. Classification of Users of the Wittenoom Area

User	Areas used	Season	Demographic	Approx. Number	Activities
Aboriginal people	Gorges, townsite, floodplains	All year (more in summer)	All ages	40 regular up to 200 during ceremonies	Hunting and eating food cooked in creek banks, ceremonies, swimming and fishing, driving on roads with tailings exposed.
Tourists	Townsite, gorges	All year but majority in winter	All ages	Potentially 40 a day	Driving on tailings, swimming and fishing in gorge, camping, shopping in townsite, souvenir gathering of asbestos.
Authorities / Utilities	No longer visit area (power removed in July 2006, no telephone)				
Remediation workers	Townsite and gorges	Winter	Adults	Teams of up to 10	Removal and burial of asbestos containing material and infrastructure.
The Press	Townsite, gorges	All year	Adults	1-2	Recording of major events (i.e. power shut down)
Mining Industry	Floodplain airstrip, townsite, gorges.	All year	Adults	Teams 2-6 people	Survey, exploratory drilling
Pastoralists	Floodplains	All year (mustering in winter)	Adults	1-6 per month, more during mustering	Tending to cattle, repair of infrastructure, musting of cattle.
Residents	Townsite, gorges and floodplain	All year	Adults over 50.	8	Driving on roads with tailings exposed, repair of buildings, operating businesses in town, swimming and fishing in gorges
Delivery drivers	Townsite	All year	Adults	Unknown	Driving on roads with tailings exposed
Transitory road users	Townsite and road connections	All year – more in Winter	All ages	Upto 100 cars a day	Driving on roads with tailings exposed
Pedestrians	Townsite and roads	All year – more Winter	All ages	Unknown	Walking next to roads where asbestos disturbed by vehicles
Construction contractors	Townsite	All year	Adults	Unknown	Building maintenance works etc.

2.3 Results of the Risk Assessment

The risk assessment indicated that the gorges in particular could present a high or extreme risk to certain user groups (see Table 1 for explanation of risk classes).

Other areas of concern were the floodplain, and in particular contaminated creek beds, used by Aboriginal People and pastoralists and the townsite where residents, pastoralists and construction contractors may be at high risk from exposure to respirable fibres.

The assessment approach has generally assumed the highest observed concentrations apply throughout the area; for example, in the case of the flood plain asbestos was generally only identified in creek beds, and these concentrations have been assumed to apply across the whole of the flood plain. As such, the assessment approach can be expected to be conservative and to represent the worst conditions encountered in each of the study areas.

Table 2: Summary of Risk Classifications for Study Areas (see Figure A for areas)

Users	**Study Area**						
	Wittenoom Mine	Colonial mine	Yampire mine	Wittenoom Gorge	Floodplain	Airstrip	Town site
Aboriginal people	High	Extreme	High	Extreme	Extreme		High
Tourists	High	Extreme	High	Extreme	Medium		Medium
Remediation workers	Medium	Medium	Medium	Medium	Low	Medium	Medium
The Press	Medium	Medium		Medium			Medium
Mining Industry				High	Medium		Medium
Pastoralists					High		High
Residents							Extreme
Delivery drivers							Medium
Transitory road users							Low
Road users (pedestrian)							Medium
Construction contractors							High

3 Migration Studies

The asbestos material can be moved by water, wind and human activity, and the potential for migration has been assessed using a “source-pathway-receptor” concept to describe where asbestos material is coming from, how it is being carried and where it is being deposited.

This assessment showed that the most significant source and migration pathway of asbestos is erosion by water, particularly from the Colonial Mine Site tailings dump. The Yampire and Wittenoom Mine dumps are showing evidence of stabilisation and this reduces the potential for migration from these areas.

The steepness of the Colonial tailings and the undercutting by stream action is serving to feed asbestos material into the Fortescue River catchment that will continue, if unchecked, for hundreds of years. Asbestos material was observed to be deposited by water in creek beds, pools and floodplains as far as the Fortescue River. These deposits are widespread due to the temporary shifting drainage channels and asbestos deposits may remain undisturbed for centuries as the stream alignments change with each flood event. In the future, the mass of asbestos in the Fortescue River system and the proportion of hazardous particles of respirable size is likely to increase if the erosion of the tailings dumps is unchecked.

Wind erosion and transport of asbestos is less significant than waterborne migration in terms of the mass of material that can migrate, although windborne asbestos can be more significant in terms of the health risk associated with respirable fibres in air. Previous studies have indicated that there is little correlation between wind speed and direction and concentration of airborne fibres because there are a variety of sources and the potential for windborne release is highly dependent on the activities occurring and the nature of the material. Important sources of windborne asbestos are likely to be dry creek beds and other unvegetated areas on the floodplain, the Townsite (although this is becoming more protected by vegetation) and the Airstrip, where the tailings in the aggregate are becoming increasingly exposed.

Migration of asbestos can also occur through disturbance of tailings material by human activities such as disturbance by vehicles and cattle mustering, and activities that result in loss of vegetation and the potential for increased vulnerability to erosion by wind and water. These impacts will increase in the future if not addressed.

The assessment indicates that the priority should be to stabilise the Colonial mine site, and to reduce the risk to human health by isolation or remediation of areas with high concentrations of asbestos which is a form which can be subject to release to air.

Further study could provide more information on the rates of migration and aid identification of sources, pathways and receptors. This could include, for example, a topographic survey to quantify the remaining tailings at the primary sources, sampling downstream along the Fortescue River with the objective of characterising the asbestos concentration during flood events, and periodic surveys (eg every 5 years) to determine whether there have been changes in the extent of asbestos contamination and vegetation cover from that determined in the July 2006 survey.

4 Strategic Management Options

In order to determine an appropriate approach for managing the risk posed by the asbestos, a range of possible options were first identified. This process identified 29 options (referred to as a “long list” of options), involving the following approaches:

» Reduction of the sources of contamination (both primary sources, and secondary sources which have been deposited by water/wind);

» Management of the pathways to reduce movement of contamination; and

» Management of the user groups to reduce exposure to contamination.

Each of these options was assessed with regard to technical feasibility for application in each study area, and some options were excluded from further consideration. The remaining shortlisted options were assessed to determine whether there could be combinations of options that together could lead to a more effective management response. These options were then assessed to determine if they reduced the risk classification of each Study Area over the short (1-10 year), medium (11-50 years) and long (51 –100 years) term.

The shortlisted options were evaluated against the following criteria:

» **Cost**: Magnitude of the capital cost involved;

» **Health and safety**: Risks from implementation (i.e. to workforce, third parties);

» **Social acceptability**: i.e impact on the Aboriginal people given that the townsite is being phased down and that tourists and visitors are able to utilise alternative locations for their purposes;

» **Impact on physical processes/systems**: i.e. disruption to surface hydrology with impacts downstream; and

» **Impact on natural processes/systems**: i.e pollution of ecosystems, impacts on rare/endangered ecology.

4.2 Preferred Options

The options that were determined through this process as being preferred are presented below and illustrated on Figure A:

Wittenoom Mine and Eastern Gorge Tailings Dump - Cap the tailings dump with rock fragments and vegetate to improve the stability of the cap. Current erosion of the base of the tailings should be minimised by constructing a channel or diverting the creek away from the base of the tailings and/or armouring the base of the tailings with larger rocks. Access to the tailings dump should continue to be obstructed, coupled with the placement of warning signs.

Colonial Mine Tailings Dump - This is an important source of risk and the dump should be capped and vegetated. The dump is currently unstable and this needs to be addressed through reshaping the dump to produce a more natural slope angle, and avoidance of stream erosion at the base by armouring and construction of a channel. The existing obstruction to access to the Colonial Mine site is ineffective and should be replaced with a large rock obstruction and the placement of warning signs.

Yampire Mine Site – The Yampire tailings dump appears to be stable with the material being covered by rock fragments and having a low relief, and no fibres have been detected in the creek beds downstream, suggesting minimal migration of the contamination. The area should be fenced and a warning sign placed, and the current degradation of the route into the gorge from the south should be allowed to continue. The track from the Munjina Wittenoom Road to the entrance to Yampire should be removed, and appropriate warning signs should be placed.

Wittenoom Gorge - Some small scale reshaping and vegetating should be carried out of the stream deposits in the Wittenoom Gorge, and asbestos material in the stream beds / pools should be removed and placed either in the mine site areas or in areas where erosion will not occur, with reshaping of the areas to reduce the potential for future erosion. The creek may need to be formed into a channel in places. Access to the gorge entrance should be prevented with local roads removed. Warning signage should be placed at the road network connections where the gorge access roads have been removed.

Floodplain - Visible asbestos material should be removed from targeted areas (ie. areas used by Pastoralists) with landuse management to maintain or increase the level of vegetation on the floodplain.

Townsite – The Town should be closed and the residents relocated, and all above ground buildings and infrastructure (except graveyards) removed. Asbestos contaminated material should be buried *in situ* or at the airport. The site should be reported under the *Contaminated Sites Act (2003)*. The townsite should be isolated by re-routing roads and removing the name from regional road signs.

Airstrip - The surface of the airstrip should be ripped to encourage vegetation, and access roads should be closed.

For all options an education / awareness raising program to reduce the numbers of people visiting the area should be implemented. Alternatives should be provided that will satisfy the objectives of people who might visit the area, for example provision of a memorial and heritage experience in a nearby town, and provision of challenging 4WD and wilderness experiences at other locations. Planning restrictions should be enforced to stop any future development that might increase the number of people using the area.

630000 640000 650000

7550000 7540000 7530000

WITTENOOM - ROEBORNE ROAD

Fortescue River

MUNJINA - WITTENOOM ROAD

Vampire Gorge

All Sites: Implement education / awareness raising program. Alternatives for visitors to be provided including a memorial and heritage experience. All contaminated sites to be reported under the Contaminated Sites Act (2003) to manage future developments in the area.

Remove visible asbestos from targeted areas (i.e. creek beds used by people). Maintain or increase vegetation cover and density. Implement education program and development restrictions.

5

Rip the surface of the airstrip to encourage vegetation and close / remove the access roads.

6

Close the Townsite and relocate residents. Remove all above ground buildings and infrastructure (except graveyards) and bury asbestos contaminated material in situ or at the airstrip. Report the site under the Contaminated Sites Act (2003).

Remove the road from the Townsite to the Gorge, obstruct access and place warning signage.

7

Isolate the former Townsite and airstrip by re-routing the roads and remove 'Wittenoom' from regional road signs.

Remove majority of asbestos material from the creek beds and pools and place back on the mine dumps (or away from erosion).

4

Maintain obstruction to Eastern Gorge. Cap and vegetate the tailings and protect from stream erosion.

2

1

Obstruct access to tailings. Reshape and stabilise the dumps and protect from water driven erosion. Cap and vegetate the tailings.

Remove access road from the main road to the gorge and allow road in the gorge to continue to degrade.

3

Fence off the mine tailings and place warning signs.

N

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LEGEND

1. Wittenoom Mine and Eastern Gorge Tailings Dump
2. Colonial Mine, Mill & Tailings
3. Yampire Mine & Mill
4. Wittenoom Gorge
5. Floodplain
6. Wittenoom Airstrip
7. Wittenoom Townsite

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS
AERIAL PHOTOGRAPHY SOURCED FROM DLI, MAY 06 - WITTENOOM MOSAIC 2004

SCALE

1.2 0 1.2 2.4 3.6Km

1:120,000 at A3

LOCALITY MAP

CREATED BY	CHECKED	APPROVED
ME		

HORIZONTAL DATUM:	PROJECTION:	100%
GDA 94	MGA ZONE 50	
HEIGHT DATUM:	**FILE LOCATION**	**METADATA RECORDED:**
DATE		
04.10.2006	N:\61\17763\gis\mxds\6117763-G3_map8.mxd	
REVISION	**DRAWING NO**	
0	6117763-G3	

Department of Industry and Resources

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Management of Asbestos Contamination In Wittenoom

Figure A Summary of Preferred Strategy

5 Management Options Implementation

The following is a suggested task list for potential implementation. The list is in approximately chronological order with some items happening concurrently. More information is given in the Study Report.

- Confirm the responsibility, funding, approvals and legislative requirements for the risk minimisation actions and develop the program of works;
- Undertake an ethnographic and archaeological study to determine the significance of the registered and unregistered Aboriginal sites in the area;
- Access to Wittenoom Gorge to be restricted;
- Evidence of naturally occurring asbestos being disturbed by tourists outside the study area to be further investigated;
- Migration control studies to icrease understand of sources, pathway and receptors;
- Yampire mine tailings area to be fenced off and signed;
- Access to Colonial tailings dump to be prevented;
- Obstruction to Wittenoom mine dump area to be maintained;
- Trial program on capping vs vegetating vs both to be instigated;
- “File Notification Area" to be placed on the land, including the wider area in line with the Section 19 Mining Exclusion Area;
- Report the site to the Department of Environment and Conservation (DEC) following commencement of the Contaminated Sites Act (2003). The DEC to enter the site on the contaminated Sites Register to restrict the potential for development;
- Formulate and instigate outreach and awareness education campaigns;
- Create a memorial to the people of Wittenoom at a location in Karijini or a nearby town;
- Rip the airstrip to encourage vegetation colonisation;
- Use Section 58 of the Land Administration Act used to permanently close local government roads;
- Townsite to be abolished under Section 26 of the Land Administration Act 1997;
- Buildings and all above ground infrastructure except the cemeteries to be demolished and buried insitu;
- Repeat monitoring of asbestos distribution every 5 years;
- Asbestos in creek beds and pools to be removed;
- Reshape mine tailings and protect toe (and potentially create channel for the creek);
- Cap and vegetate Colonial Mine and the Wittenoom Mine Eastern Gorge tailings;
- Remove road in Wittenoom gorge;
- Undertake repair work on mine tailings protection as appropriate; and
- In the longer term, the success of the migration control measures should be monitored. Ideally, the measures implemented should not require any maintenance.

6. Removal of the Townsite

An inventory of all the above ground infrastructure and buildings in the townsite has been prepared. The cost for the demolition of the Wittenoom Townsite buildings is estimated to be $1.3 Million and the removal of the infrastructure is a further $2 Million.

7 Conclusions

The asbestos mining operations in the Wittenoom area and the resulting exposures to asbestos have resulted in several hundred fatalities, and there is potential for residual exposed asbestos to pose a risk to people that might use the area.

This Study has provided a risk-based strategy for management of the asbestos tailings in each of the seven Study Areas. Each area has been subject to a risk classification process based on a review of available survey information, field evidence, and laboratory validation. An analysis has been carried out of the use of each area. Management options have been identified and each of these options and combinations of options have been evaluated on their ability to reduce the level of risk, and taking into account the requirements to reduce the future spread of contamination by water and wind.

In order to address the high and extreme risk situations, it is recommended that residents should be removed from the townsite, and the townsite building and infrastructure should be demolished and removed.

In addition, it is recommended that the major asbestos areas in the mine sites and Wittenoom Gorge be better isolated and a program undertaken to stabilise the tailings material and to avoid erosion and prevent distribution of the material. In addition, it is recommended that a program be undertaken to reduce the number of people visiting the area; this should include appropriate signage together with the provision of alternative attractions such as a Wittenoom memorial in a nearby town, and perhaps provision of challenging 4WD and wilderness experiences at other locations. Planning restrictions should be enforced to stop any future development that might increase the number of people using the area.

All of these recommendations are subject to discussion by the Wittenoom Steering Committee and individual actions will require more detailed investigation and wider stakeholder consultation.

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