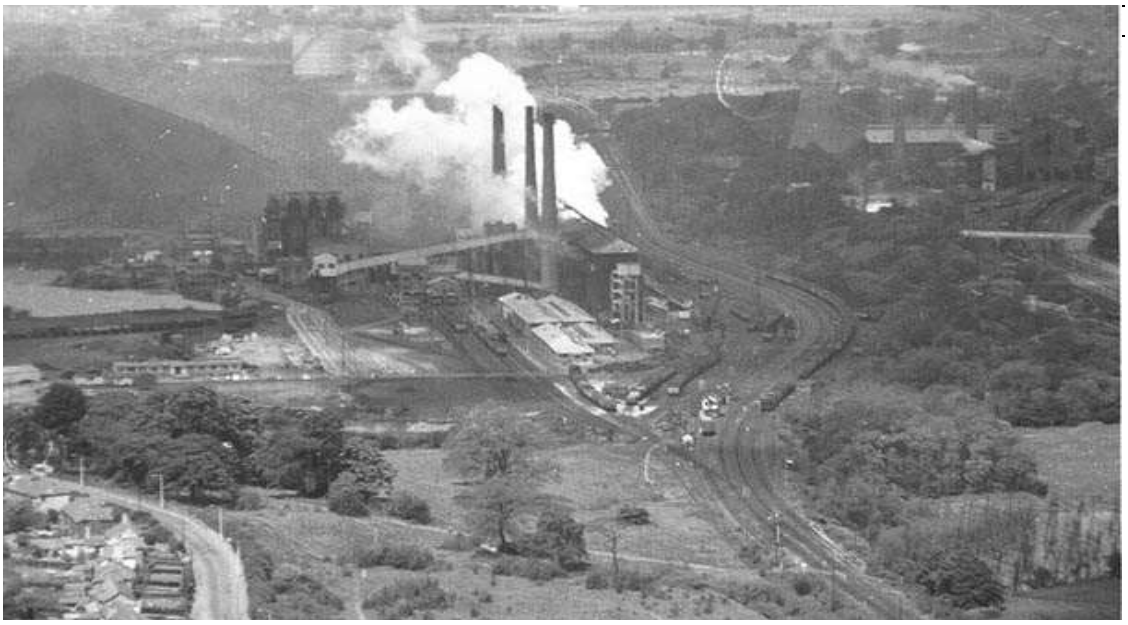
Health Impact Assessment of Land Remediation Options:

Site of the former Phurnacite Factory at Abercwmboi



by

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Executive Summary

A collaborative Health Impact Assessment of land remediation options for the former site of the Phurnacite Factory at Abercwmboi took place during the first quarter of 2003. The likely impacts of the processes involved on the physical and mental health of the community were examined in terms of the relevant scientific and medical literature, the history of the site and the evidence of local people.

Though all remediation options were likely to have some adverse health effects, these could be mitigated by making choices based on the best evidence. The Steering Group concluded that the adverse effects of remediation would be relatively short term and could be justified by the medium to long term benefits of removing toxic substances.

Full community involvement in decisions regarding development of the site should be a requirement for future planning. Recommendations for action appear at the end of this report and will be supported by formal advice from the National Public Health Service for Wales.

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Background

The site formerly occupied by the Phurnacite Factory is located in the Cynon Valley, one mile northwest of Mountain Ash at Abercwmboi. The site is close to housing and is traversed by a railway line and a river.

Before the advent of natural gas, smokeless fuel manufactured from coal was the main source of energy for domestic heating and heavy industry. The Phurnacite Plant produced smokeless fuel by carbonisation of coal at Abercwmboi between 1942 and 1991 when the plant closed. The process involved crushing the coal and mixing it with melted pitch to form briquettes, which were carbonised by heating at high temperatures. The process generated large amounts of gas, tar, ammonia and other polycyclic hydrocarbons. The process was self-perpetuating as the gas was used for heating tar tanks and for firing carbonisation ovens, which would generate more gas. Such processes are associated with a higher than expected incidence of cancer, particularly respiratory cancer among workers.[1,2] A report produced by Bro Taf Health Authority[3] following a complaint from ex-workers confirmed that this was the case locally. The Phurnacite Factory was a major employer and the legacy of ill health has naturally left a mood of mistrust among the community and a wish to see all traces of the industry removed from the site.

A further complaint of excess cases of lung and breast cancer in the area surrounding the plant was the subject of detailed epidemiological investigations by the health authority[4]. No gradient was found in mortality rates for areas closer to the plant compared with those further away and it was concluded that excess deaths could not be attributed to atmospheric pollution, but were more likely to be due to the underlying socio-economic deprivation. (Abercwmboi is situated in the Aberaman South ward which is within the most deprived 100 wards in the Welsh Index of Multiple Deprivation.)

The belief that one has been exposed to toxic substances seems to be a strong predictor of poor self-reported health and it is possible that this may be, in some part, due to media coverage. There have been numerous studies of self-rated health in populations living near sites that have present or past connections with toxic substances. In most of these investigations it has been found that poor self-rated health is more closely linked to belief

in the toxicity of the site rather than actual toxicity. For example, people living near a chromium contaminated site reported similar health to that of a control group, but those living near the site who believed that the chromium was harmful to health had lower health scores, indicating that low score was linked to perception and anxiety[5]. Researchers have also studied the psychiatric effects of living near potentially hazardous sites and similarly found that morbidity was more closely linked to perception than actual exposure. It has also been reported that closure of a waste disposal site produced no major differences in prescription rates for psychiatric medication before and after.[6]

The Phurnacite factory was demolished some years ago and most traces of former use are at ground level or below in the form of low grade coal, tar pits and 'hot-spots' consisting of a cocktail of chemicals. Environmental assessments have concluded that these pollutants do not constitute a danger to human health provided that people keep off the site, which is fenced and signed. Nevertheless residents and councilors had previously rejected the 'do nothing' option and the Welsh Development Agency's (WDA) on-site containment suggestion. These options are, however given some consideration in the report.

A site appraisal was carried out in 1992 following demolition and extensive supplementary data was prepared between 1995 and 2000. The WDA has removed around 300 tons of contaminated soil that was near housing to a landfill site.

Introduction to the Health Impact Assessment Process

A Public Health Consultant with expertise in environmental hazards had been serving on the Phurnacite working group for some time. Following the experience of a previous collaborative Health Impact Assessment (HIA) involving community members[7,8], it was decided to invite members of the working group to training sessions in HIA, after which they could decide whether or not the process would be helpful in dealing with the problem of the Abercwmboi site. Some group members were sceptical at first but, following training, they decided to form a steering group to take the work forward. The HIA steering group (appendix 1) comprised community representatives (including ex-Phurnacite workers and local residents), local Assembly Member's (AM) representative, a senior environmental health officer public health personnel and a Community Liaison Officer from Groundwork Merthyr & Rhondda Cynon Taff. (Groundwork is an environmental regeneration charity that seeks to build sustainable communities through joint environmental action.)

The HIA was completed within three months and a timetable for the process appears as appendix 2. This report examines the options for remediation and discusses their likely impacts on the health of local people. Whilst noting that community representatives did not wish to consider leaving the site in its present condition or containment on site, these options are included in the report. The authors wish to emphasise that in taking this decision they are not disregarding local opinion, but feel bound to take a neutral stance and report on the likely health impacts of all available options.

The 'do nothing' option

As stated above, there was strong feeling expressed by residents' representatives that radical action should be taken to clear the site of contaminants. Table 1 sets out the health-related case for and against the 'do nothing' option.

Community representatives have served on committees over several years and there is some disillusionment with time taken for decisions to be reached. It has been reported that some members of the community are beginning to blame their representatives for inaction, prompting their withdrawal from the process. If people feel that contaminants are being 'hidden' by landscaping rather than cleared, this will add to their feelings of

alienation. However, it has been observed that due to the re-growth of plants and grasses, the site's appearance is improving and birds are returning to the area. This needs to be balanced against the disturbance that will inevitably be caused by remediation and the somewhat unpredictable end-use of the site.

Table 1

Summary of the case for and against remediation

Do nothing	Take action
It has not been possible to prove that any adverse health events have been caused by the current state of the site, provided that people do not enter and come into direct contact with contaminants.	Even if the site is securely fenced and warning notices placed, people, particularly children and teenagers, will get in and possibly come into contact with toxic substances.
Operations to remove contaminants may cause dust and fumes to be released. There will also be increased noise and atmospheric pollution from lorries transporting the waste.	Residents may decide that short-term adverse health impacts are worthwhile if, as a result, the site is thoroughly de-contaminated.
The 'do nothing' option would be beneficial to those living close to existing screening equipment at Aberaman, as this is the site most likely to be used. Residents in the past experienced noise, dust and vibration.	Options exist for carrying out screening elsewhere and health damaging exposure to residents could be avoided.
It may be possible for the site to be landscaped to an aesthetically acceptable standard without the removal of all contaminants. Residents have observed that the site is already much improved since demolition of the factory and a degree of 'natural' recovery.	Burying contaminants may be storing up problems and the question of recovering the coal and tar may be raised in the future. This would cause uncertainty for residents as the site could be disfigured again. Total remediation would open up more options for future use.
Spending vast amounts of money on total remediation is difficult to justify, if the health risks created are greater than those of leaving the site as it is.	There may be some revenue from the sale of reclaimed coal and tar. The remediation question has united residents in their view that complete clearance of pollutants is preferable.
End-use may not be compatible with the wishes of the community.	Public consultation processes may go some way to protect community interests.

Health Impact of Different Remediation Options

On-site containment

On-site containment will involve some compaction and excavation (see pages 9-10), which is likely to have negative health impacts. This has been proposed as a relatively quick and effective solution which would cause minimum disruption to the local community. The technical merits of on-site containment by stabilisation and by entombment have been examined by the working group and stabilisation was ruled out because the volume of contaminants was too great. Entombment would involve several protective layers, including concrete and plastic, constructed to surround the contaminants. The engineering consultants retained by the working group are confident that this would avoid leakage into surrounding land and water and eliminate the chance of human or animal contact. However, local residents have often received unfounded reassurances in the past and have expressed concern regarding the long-term sustainability of this option.

An engineering consultant's report on the 1996 Remediation Proposal was of the opinion that the repository described at that time had an unpredictable lifetime and was unlikely to provide a permanent solution. In the course of this HIA, residents quoted a recent newspaper report[9], which cited failure of the plastic underlining at the Cwmrhydyceirw landfill site near Swansea. The containment proposed at Abercwmboi is different from that at the landfill site in that it will consist of several layers, specially engineered to deal specifically with the contaminants that are present. If this option is pursued, residents will have to be assured that the entombment will be constructed so as to permanently exclude the possibility of leakage. Uncertainty about the future and worries about leakage will cause further anxiety in the community (see page 17).

Screening (Coal)

There is a considerable amount of coal remaining on site, but this is of low grade and would need to be screened to remove grit and earth before it could be used. The opinion has been expressed that this would be commercially viable, but viability would probably depend on the cost of screening. It is unclear whether or not the coal would need to be washed after recovery. Screening at three different sites was considered.

Option 1 - Existing screening facilities, very close to a residential area

There are existing screens and a washery at Aberaman but these have not been used for around ten years, so may need some renovation. If this site were used, road transport would be necessary and this would have implications for population health (see pages 13-16). However, this equipment is in very close proximity to housing (see photograph page 8) and, when last in use, caused a great deal of disturbance to residents including noise, vibration and dust. Two members of the Steering Group have submitted evidence based on personal experience, which appears below. Bearing this in mind, together with evidence of stress caused by noise (see page 20) the Steering Group considered that the option of using the Aberaman site should be rejected.

Option 2 – Existing facilities at Tower Colliery

It has been suggested that Tower Colliery might accept coal from the site to be screened using their equipment. The option has not been examined in detail because a preliminary approach by a steering group member to Tower Colliery staff was not encouraging. This lack of enthusiasm may be because machinery would have to be re-calibrated to deal with the different make-up of coal from the mine and from the site: Tower coal would be mostly coal with a little waste whereas coal from the remediation site would be the reverse.

One of the attractions of this option was that both the remediation site and Tower Colliery adjoin the railway line and thus there would be a possibility of avoiding the negative health impact of road traffic if it were possible to use rail (see page 16).

Option 3 - Mobile plant on remediation site

The preferred option was to import a mobile screen and deal with the coal on site. Again, this would avoid the transport impact of taking the coal elsewhere to be screened, and would have less noise impact on residents than the Aberaman site. The blending site, where it was proposed the screens should be located, is some distance from housing and there is some existing bunding that would screen noise further. However it was not known whether the coal would need to be washed after recovery. The amount of coal would probably not justify building a washery, so it may need to be transported elsewhere for washing.

Although treatment on site was the preferred option for dealing with the coal, this would probably be more expensive than using existing facilities, and might render recovery commercially non-viable.

Table 2

Potential positive and negative health impacts of coal recovery from the site

Positive	**Negative**
Improve appearance of the site	Dust when coal is disturbed
Remove a potential fire hazard	Air pollution and risk of accidents if road transport is used
Provide a small number of temporary jobs	Raise the questions of undesirable end-use if rail links are improved
Generate capital which could be used to enhance the area	Extreme noise and dust for residents at Aberaman if this screening facility is used

The following evidence relative to the Aberaman site was submitted to the Steering Group by a residents' representative:

Witness 1:

"The siting of this facility caused considerable concern from the outset, as it seemed to be sited more for convenience than thought to the public's well-being. It is sited in close proximity to local housing, subjecting the families to all the noise etc of this operation.

"When the washery was erected in 1990 there was no thought given by the planners to our homes being so close to the site. It was an extremely unpleasant few years to live in Foundry View. It was difficult to hear the radio, television or telephone in the house. You could not enjoy yourself in the garden. It definitely had an impact on our health. The noise made you feel stressed and the fumes were so unpleasant that it made you feel nauseous."

"When the washery was working in the 1990s we were reasonably fit and could go out and about to have a break from the noise and pollution, but now thirteen years later my wife's health has deteriorated a great deal, she is virtually housebound as she suffers from heart failure, angina, COAD, insulin dependent diabetes and arthritis. It affects your health just thinking about being in that environment once again."

View of washery from bedroom window in Foundary View

"The running of these machines causes considerable exhaust emissions which would be detrimental to elderly people and young children especially. Dust would be a major problem, especially during a dry spell, even with dust suppression equipment which, in my opinion based on 20 years in the coal industry, is never adequate."

Removal without re-use – Coal

Removal without re-use would have similar health impacts to screening, but without the possibility of financial benefit and with fewer jobs.

Compacting/burial – Coal

Compacting alone may not be effective as this could mean that a fire risk remains. Compacting and burial might be feasible, provided that oxygen could be completely excluded to avoid fire risk. Though burial would improve the appearance of the site, residents felt that it was not an acceptable option as the possibility of recovery could be raised at some time in the future, rendering the site vulnerable to further disturbance.

Table 3

Potential positive and negative health impacts of coal compacting/burial

Positive	Negative
Improve appearance of the site	Dust when coal is disturbed
Provide a small number of temporary jobs	Possibility of on-going fire risk
	Vulnerability to future site disturbance

Excavation - Tar pits and hot spots

Whatever end disposal method is used, excavation is necessary as a first step. Health impacts will be mainly for on-site workers and include exposure to vapours and/or chemical splashes when hazardous materials are disturbed. Most hazards of this type should be covered by health and safety regulations, but it was reported that during recent site investigations a worker was splashed and suffered burns.

Though evidence to the working group suggested that harmful vapours were unlikely to be a problem, local residents say that they can smell the tar in hot weather and this is likely to be aggravated when the tar pits are disturbed. In the case of the 'hot spots' the exact constitution of these sites is variable and not fully documented, so any effects of disturbance must be somewhat unpredictable. From the planning point of view, it is necessary to deal effectively with the hot spots as the pollutants may re-act with concrete. The ammonia content of these deposits will prevent the growth of grass and foliage.

The following is a quote from a former Phurnacite worker:

Witness 2:

"During the cold winter period tar becomes a hard solid mass that is quite brittle and would splinter when hit with an object such as a hammer. In this solid state it is possible walk on it without any difficulties. ... However, the exact opposite can be said of the consistency of tar in the warmer weather and in particular during the summer months. The tar becomes very soft and malleable in texture, with a fluid consistency. In this state it is not possible to support or sustain any weight, as it will sink into the soft mass. During the warm weather, especially when the sun is hot, there is a pronounced tarry smell and vapours coming from the tar."

The above evidence on the brittleness of the tar during cold weather raises the question of an additional hazard to those carrying out remediation work. It is likely that tar pits also contain some discarded asbestos that was used for lagging and insulation at the plant. If this material is embedded in tar, there is a danger that asbestos fibres could be released if the tar is broken up when in its brittle state. Disposal when the tar is viscous should avoid the danger of contact with asbestos fibres. This hazard should be dealt with under occupational health regulations.

Bio-remediation

Bio-remediation would be a long process and is unsuitable for the large-scale use on majority of the site, due to the proximity of housing. Health would be put at risk by the release of aeroallergens and toxins and this option should therefore be rejected for the tar pits. Bioremediation may, however, be suitable for dealing with the hot spots as these small volumes could be dealt with in sealed containers.

Published reports suggest that though bioremediation is a promising strategy particularly using genetically modified organisms, it is as yet unproven technology. In one review of bioremediation of polycyclic aromatic hydrocarbons, such as the tars in the two tips on this site, the authors conclude, "Total field bioremediation is often a difficult task whether using genetically enhanced microbes or intrinsic microorganisms." They go on to comment that it is hard to establish how much of the apparent benefit is due to other factors such as "chemical transformation and volatilization"[10]. The use of genetically

modified organisms in an un-contained environment is currently against the Welsh Assembly Government's policy.

The importance of air losses in volatile components is demonstrated in another paper, which though dealing with soil contaminated with diesel fuel found significant increases of diesel in the air around the site[11]. Whilst this study is not strictly relevant to the Abercwmboi site the principle is demonstrated that in land farm systems large amounts of volatile compound are given off. In view of the nature of the locality and the particular contents of the tips, it is not inconceivable that the operation of land farming of the tip contents would result in air quality standards being breeched.

Another study raised a further interesting issue, which was that those living away from a contaminated land site are more strongly in favour of bioremediation than those directly exposed to the site. The authors suggest that this is due to the realisation of the local population that bioremediation whilst offering a long-term solution may enhance short term risks and certainly does not offer any short-term benefits[12]. For dispersed contaminants the role of bioremediation is established, and offers worthwhile benefits for groundwater contamination.[13]

Pyrolysis - Tar

It is theoretically possible to dispose of the tar by pyrolysis, i.e. decomposition by heat, either on or off site. This would leave an inert end product of lesser volume, which would be easier to deal with. Current advice suggests that portable equipment is available but that set up costs would be high. There is a possible risk that once the equipment was *in situ*, the site could be used for disposal of waste products from elsewhere.

Table 4

Potential positive and negative health impacts of pyrolysis

Positive	Negative
Conversion to an easily disposable inert product	Possible toxic by-products of pyrolysis
Avoidance of large scale road traffic pollution	Protracted process
Improved appearance of site after equipment is removed	Risk of equipment being retained for future use on site against residents' end-use preference
	Off site – see table 2 comment on road and rail transport

Re-cycling – Tar

It has been suggested that the tar could be re-cycled for road surfacing or other uses. This is theoretically possible, but other contaminants would have to be removed to render this viable. As with pyrolysis, it would be possible to bring equipment on site to do this, but the same reservations remain around health impacts, cost and the likelihood of retention for future use. It has also been suggested that the amount of end product would not justify the investment.

Disposal off-site without re-use/recycling

Any or all of the contaminants could be disposed of off site, but this would be a massive operation involving fleets of lorries travelling long distances. There are suitable facilities both at Poole (incineration) and at Bedford (landfill), but both of these options would involve removing tons of material, probably by road and the importation of replacement soil. Furthermore, it is possible that with imminent changes to landfill regulations disposal of the waste at the Bedford site may no longer be an option. There would be on-site noise over a long period, plus noise and pollution from heavy vehicles. However, this seemed to be the option favoured by local people, as it has the greatest potential to completely remove contaminants from the site.

Transportation

By Road

If screening of coal is to take place off site, and if the contents of tar pits and hot spots are to be excavated and removed for processing elsewhere, then the issue of transport must be considered. If substances are to be removed by road, the impact of noise, vibration and fumes from heavy lorries is a potentially important health issue.

The following is a quote from a resident when referring to the transportation of coal for screening at Aberaman:

Witness 3:

"The intention of transporting the material to the present screening facility will necessitate the use of an already busy road system. This road has been the site of some fatal accidents over the years. It is also the road that takes most of the through traffic of the valley."

A European study published in 2001 made a critical assessment of 15 reviews of published studies linking air pollution and adverse health affects and concluded that the associations were both valid and causal[14]. Although the individual health risks of air pollution are relatively small, the public health consequences are considerable[15].

In the UK, motor vehicles are responsible for 46-61% of nitrogen dioxide in outside air and 25% of PM_{10} (potentially harmful particulate) emissions.[16] However, emission regulations are becoming more stringent.[17] Congestion exacerbates emissions per vehicle[18] and, this may be a problem if heavy goods vehicles are using non-motorway roads. There will be increased emissions resulting from stopping and starting during short journeys to and from the site. Air pollution is associated with a rise in hospital admissions and deaths[19], morbidity and mortality[20]. Transport causes 25% of UK carbon dioxide emissions, contributing to climate change and subsequent affects on health. A recent study has shown that long term exposure to fine particle air pollution is an important risk factor for lung cancer[21]. The conclusion must be that the total effect of pollution generated by road transport is probably greater than the sum of the parts. Table 5 summarises pollutants from road transport and their health affects.

Table 5

Road traffic pollutants and their health effects

Pollutant	Health Effect	Comment
Benzene	Carcinogen (petro-chemical workers, e.g. pump attendants)	No evidence of general traffic affect, but any amount may be hazardous to health
Carbon monoxide	Cardiovascular disease (CVD)	Some effect, but greater exposure from passive smoking
Nitrogen dioxide	Lung function, response to allergens, CVD	Definite association but difficult to quantify - may be a marker for others, e.g. fine particles
Ozone	Respiratory symptoms, lung function	Ozone affect appears at some distance from the traffic source
Fine particles	Respiratory, asthma, CVD, myocardial infarction, carcinogen	Definite effect of fine particles from motor fuel, especially diesel
Sulphur dioxide	Respiratory, CVD	Definite association, but difficult to quantify

High-risk groups for adverse affects of particulates include the elderly, infants and those with existing acute respiratory infection or cardiovascular problems[22]. Many of the men who live in close proximity to the site are ex-miners and/or ex-phurnacite workers, many of whom already have respiratory or cardiovascular problems, rendering them more vulnerable to the effects of particulates. There is increasing evidence that elevated levels of particulate matter can exacerbate existing asthma, but only limited evidence for its induction[23]. The evidence of a causal affect for asthmatic symptoms is not conclusive, as a study of road traffic and wheeze in children found that traffic activity was not a major determinant.[24]

In evidence to the Alconbury Health Impact Assessment[25] based on 8500 traffic movements per day linked to industrial development, it was stated that the main affects of emissions occur within five metres of the source, decreasing to almost undetectable levels at 2000 metres. To calculate the maximum possible health effect using WHO figures on

death/illness rates, it was assumed that the total local population of 4270 was within five metres of the pollution source for 24 hours a day for one year. Using these assumptions, the estimates of adverse health effects were low (table 6) and the acute effects of transport linked to remediation activities are likely to be much less than this, as there would be far fewer traffic movements per day.

Table 6

Estimates of acute adverse health effects based on 8500 traffic movements per day and maximum exposure to emissions

Event	Maximum occurrence per year
Long term mortality (age 25 years or more)	0.3 deaths per year
Respiratory hospital admissions (all ages)	0.3 admissions per year
Cardiovascular hospital admissions (all ages)	0.4 admissions per year
Chronic bronchitis incidents (age 25 years or more)	0.5 attacks per year
Bronchitis (age under 15 years)	1.3 cases per year
Exacerbation of asthma (age under 15 years)	0.6 attacks per year
Exacerbation of asthma (age 15 years and over)	6.5 attacks per year

Source: Adapted from Alconbury Health Impact Assessment

The overall health impacts on the local population of pollutants caused by emissions from vehicles are likely to be small. However the geographical position of the Cynon Valley may increase the effects of pollution and the roads that would be used for transporting contaminated waste are very close to many houses that do not have front gardens.

Accidents and injuries

In 1992 39% of accidental deaths were associated with road traffic, with cyclist and pedestrian injuries higher in the UK than in most other Western countries[26]. There is high correlation between deprivation and pedestrian injury[27,28] and childhood pedestrian mortality, though declining, shows a steep social class gradient.[29] Children from disadvantaged families are less likely to have access to a car and are therefore more likely

to be exposed to risk as pedestrians[30]. It would be fair to say that accidents are likely to increase if the volume of heavy traffic using roads that are also routes to school increases.

The Alconbury Health Impact Assessment[25] used data from a variety of sources to calculate the likely impact of the development on traffic accidents. Based on information from the Highways Agency, Automobile Association and the Transport Research Laboratory, it was calculated that the number of injury only accidents would be between one and 19 based on the predicted 8500 movements per day. Using the same data, it was predicted that one fatal accident was likely to occur in between three and 57 years. Bearing in mind that there will be many fewer traffic movements associated with the remediation process, the accident estimate would correspondingly be much lower than in the Alconbury report. This assumes that the risks posed by the Alconbury road and those to be used during remediation are equivalent and it is possible that we may not be comparing like with like. In the local area accident estimates are bound to remain low, but some remediation options involve traffic movement over a wide area and this has broader implications for pollution and potential accidents.

Mitigation Area-wide traffic management schemes, for example 20 mph speed limits, are effective in reducing child road traffic injuries,[31] but road safety training alone is relatively ineffective.[32]

By Rail

It has been suggested that rail transportation would be preferable, and this is certainly true regarding air pollution, as each engine could pull several wagons. Although rail transport is unlikely to produce as much noise as lorries, movement would probably have to take place at unsocial hours in order to avoid interference with existing use of the line. This option would necessitate building a siding and would have to be negotiated with railway management. If this were part of a general infrastructure development, it is possible that it could attract additional investment. However, if large amounts of money are spent on connecting the site to the rail network, then it becomes more likely that the land will continue in industrial use, an outcome that the residents wish to avoid (see preferred end-use).

Other Impacts on Health

Stress

Stress, such as that caused by worry over the future of the local environment can leave people vulnerable to psychological or minor psychiatric problems, which show correlations with living in underprivileged areas[33]. It has been reported that disadvantaged areas such as the Cynon Valley make higher demands on primary care and that many of the additional contacts relate to psychological problems[34]. It is possible that there could be an increase in stress related consultations when remediation begins, especially in those most adversely affected by the process. For example, those living close to the existing screens at Aberaman are already worried about how the future use of this facility might affect their health and wellbeing.

Stress may be produced by the psychosocial environment and contribute to health inequalities between groups by raising concentrations of cortisol in the body, contributing to high blood pressure[35]. In the Caerphilly Study[36] it was found that psychological distress was a predictor of fatal ischemic stroke in men aged 45-59 years. The Whitehall II Study[37] reported that psychological distress conferred increased risk of coronary heart disease, which was not explained by health behaviours or work characteristics.

Endorphins produced during exercise can limit the damaging effects of stress and produce feelings of wellbeing, but vigorous exercise may not be possible for the many local people who are sick, disabled or elderly.

Restrictions to children

If traffic transporting waste materials uses roads that are also routes to school, this will be detrimental to children in particular. Increased traffic leads to restrictions on children's independent mobility[38]. This results in more traffic as parents transport their children and less physical activity for children, leading to associated health problems. Obesity rates in British children have trebled since 1982 and the first reported UK cases of type II diabetes in white adolescents have recently been reported[39]. The Safe Routes to School Initiative introduced in 1999/2000 aims to show children that there are alternatives to the car,

encouraging them to take regular exercise and to develop healthy travel habits for the future. This work may be damaged if traffic on school routes increases, even temporarily.

Walking and cycling

Walking and cycling can make an important contribution to improving public health. If moderate physical activity for 30 minutes on at least five days per week became the norm, about a third of coronary heart disease and strokes could be avoided, 25% of type II diabetes and 50% of hip fractures[40].

It is unlikely that anyone would wish to walk near to or cycle on roads in constant use by heavy lorries.

Social capital

Social capital can be divided into three different types, briefly described as follows:

- *Bonding* – characterised by reciprocal support within the community, sense of belonging to the neighbourhood and a wish to remain in the area
- *Bridging* – describes the relationships and connections across different interest groups within an area
- *Linking* – refers to connections between members of a community and those in positions of power and influence.

Abercwmboi is situated in a disadvantaged locality where some *bonding* social capital is present, engendered partly by opposition to the site remaining in its present state. There has been some *bridging* social capital between groups who wish the site cleared for different reasons, for example, parents who believe that the site is a danger for their children and home owners who feel that their property is devalued by the proximity of the site. There is also evidence of some *linking* social capital, whereby local residents have made connections with expert groups who have power to influence the type of remediation that finally takes place. If a solution is implemented that fails to meet the residents' aspirations, this may be detrimental to social capital (particularly linking), as people become disillusioned and feel disempowered when they are excluded from the decision making process.

The concept of social capital is based on reciprocal support, informal social networks and a sense of attachment[41]. It has been recognised that the physical environment is important

for community morale and social interaction. When people in communities affected by new developments feel that their opinions and needs are being disregarded by those in authority, this engenders feelings of powerlessness and lack of confidence[42]. In a recent study carried out in Hungary, social capital deficit was significantly associated with middle age mortality, with levels of mistrust showing the strongest association[43].

It is possible that opposition to the site remaining in its present state may have given residents a common interest, which can lead to greater social interaction. Involvement in such issues has been shown to unite communities. There is evidence that good social networks reduce the risk of coronary heart disease, depression and infections[44]. These social networks may persist and continue to be beneficial. On the other hand, there may be a risk of social exclusion for people who do not support the dominant opinion.

Employment

The remediation process may increase local employment opportunities, though only on a small scale. Unemployment and poverty are strongly associated with illness and premature death. This has been demonstrated notably by the Black Report[45] and more recently by the Acheson Report[46]. Though jobs may be short-term, encouraging local recruitment should contribute to work experience and future employability. Working close to home can confer both physical and mental health benefits[47], giving people more time for recreational activities. To achieve health benefits, jobs should be of good quality: minimum wage jobs may create pressure to work long hours, which could be health damaging.

It is possible that very few jobs will materialise or that workers will be drawn in from a wider area, with no appreciable benefit to local people. This may be due to local people not having the requisite skills for some remediation work. If future developments do create jobs, it should be possible to negotiate planning agreements to provide training to prepare local people for employment. It is not possible to make job creation forecasts, as they are necessarily speculative, but experience at other locations suggests that the number of jobs for local people is usually over-estimated.

Some remediation options raise questions over the future use of the site. Though it is likely that business use of various sorts would meet with opposition, this option has the potential to generate more employment than leisure use.

Mitigation: It should be possible to negotiate local labour agreements and employment pacts with future developers. This will assume greater importance if there is continuing work opportunity on the site.

Noise

There will be some disturbance to residents during the remediation process both from plant on site and from heavy goods traffic. Residents are concerned about noise at unsocial hours (early morning and night) and consequent sleep and leisure disturbance. Rail transport would probably have to take place at unsocial hours in order to accommodate current use of the line, but would produce less noise than road transport. Journeys on non-motorway roads will inevitably contribute to higher noise levels from breaking, starting and acceleration. Evidence from residents asserted that during previous use of the Aberaman site, lorries would leave their engines running outside the site when not in transit. Noise is likely to cause direct disturbance to those near the road and the background noise level will increase over a wider area.

A recent Spanish study that monitored noise levels from heavy goods vehicles in three locations found that noise was the origin of disturbance and indisposition[48]. It has been suggested that the poorer health experienced by people of lower socio-economic status may be related to chronic stress, including that caused by noise pollution[49]. It has also been shown that road traffic noise is a stressor in children with elevated resting systolic blood pressure in those exposed[50].

Mitigation: Possible measures to reduce noise include avoidance of heaviest work during unsocial hours and consultation with residents on strategies to reduce disturbance.

Future site development

The residents of Abercwmboi in general have not yet been engaged in a discussion about end-use. The preferred option for end-use expressed by community representative members of the HIA Steering Group is some type of leisure facility and suggestions have included a country park type development, a nine-hole golf course, and a building that could be used for community activities. A leisure development would be of particular benefit to non-car owning households in the area, who find it more difficult to travel to pleasant recreational areas. There is also interest from the Wildlife Trust to extend the existing Fernhill Pwll Waun Cynon nature reserve to incorporate the adjoining part of the remediated site.

In the Cynon Valley Local Plan part of the site is reserved for business and industrial development. This covers an area of 8.8 hectares from roughly adjacent to the licensed tip to the edge of the existing lake, bounded on one side by the railway line. It also covers an area of 6.3 hectares south-west of the A4059. It is stated that a new roundabout from the A4059 is needed before this site, part of what has been called the blending ground, can be developed. Other areas are designated as land reclamation sites earmarked for amenity use. These policies cover an area of 21 hectares, the Southern part of which adjoins the Pwll Waun Cynon Nature Reserve. A large part of the site is also covered by policy ENVP4, the development of a Cynon Valley River Park, which seeks to improve recreational amenity and access, suitability for wildlife and create a better aspect for other development.

The nature of any future non-leisure development is certain to have a negative aesthetic impact on pleasure in the scenery, but it has not been possible to find specific evidence of damage to the health of those whose view has been spoiled. People have claimed psychological damage following unsightly developments and it is thought that this could be due to exacerbation of an existing psychological condition[25]. An American study has shown that surgical patients whose recovery took place in a room with a view of trees had a shorter post-operative hospital stay and took less pain relieving drugs than matched patients with a view of a brick wall. Nurses made more negative comments on the state of mind of patients with the wall view, indicating that this might have a depressing effect. Natural views elicit positive feelings, reduce fear in stressed subjects and may block or reduce stressful thoughts[51].

Owing to the lack of information on costing, it has not been possible to consider opportunity costs in any detail, but previous research referred to earlier[5] cited residents' desire for money to be spent on amenities for the community rather than remediation. Residents on the steering group have expressed a desire for a community hall facility and it has frequently been observed that the locality is lacking in leisure facilities and modern primary care premises. To broaden the argument, it is postulated that if millions are to be spent on remediation, choosing an adequate rather than a 'Rolls-Royce' option may free enough capital to provide something that would be of positive health benefit to the community. An example of such expenditure would be the West End Health Resource Centre in Newcastle[52]. This centre provides amenities that include a creche, gym, exercise room, sauna, welfare rights and health information, arts and primary care premises. The centre is in a disadvantaged area and provides low-cost membership for 2,500 people and NVQ training in sport and recreation. In the case of Abercwmboi, perhaps additional exercise facilities would not be such an advantage, due to the proximity of a leisure center, but the Newcastle example provides a starting point for the community to consider what type of end-use would most benefit their health and wellbeing.

Discussion

The ‘do nothing’ option is likely to have fewer negative health impacts than other options. The site is securely fenced with warning signs and some residents have observed that it is becoming more attractive visually. However, many people feel that the site poses an unacceptable risk to health and that remedial action should be taken. The concept of health risk refers to the probability of subsequent adverse health events following exposure. There are differing degrees of willingness to be exposed to risk according to whether the exposure is voluntary or involuntary. Entirely voluntary activities such as playing rugby or skiing carry a high risk of injury with the possibility of permanent disability, put people can balance the risk of the activity against the enjoyment of taking part. Some workplaces such as mines and steelworks carry health risks and, though the choice of whether or not to work in such industries may be limited by lack of other job opportunities, people may decide to take the risk because they will be paid for doing so. When exposure is completely involuntary and there are no benefits to balance the equation, people are much less willing to accept even relatively small risks.

This raises the question of whether people who will be adversely affected by remediation will consider themselves to be in the first or second category. If the community members are not fully involved in informed choice, they may feel that the health impacts of remediation have been imposed on them and that they are not willing to accept the risks posed by exposure to dust, vapours, noise and traffic pollution. The ‘benefit’ of having the site cleared must be balanced against the ‘risks’ attached to the remediation process.

It is undoubtedly true that the site will look worse during the remediation process and no predictions have been given of how long the work will last for the various options. Neither have any plans or artists’ impressions of how the site should look on completion been presented. If there is a high risk that the site will not eventually be put to a use that will have a positive impact on health, residents may wish to consider other options.

Residents on the steering group were strongly opposed to any plan that does not involve removing all toxic waste products from their environment. The general population view has not been sampled as to the nature of the final scheme but local people have been made

aware of the possible options for remediation and how these options are being assessed. It is possible that most people have lost interest in what happens to the site though this could be re-kindled when after-use is being discussed. Residents on the steering group felt that the community would rather put up with some noise and atmospheric pollution in the short term, if this results in all traces of the Phurnacite era being removed from the site. Again, this might not be a representative view because extensive sampling of community opinion has not taken place and people who live adjacent to site entrances and busy roads may think differently.

This HIA process has not taken cost into account, indeed it took place in the absence of information about the costs of the various options. It should be considered alongside environmental and economic assessments when coming to a decision on the most beneficial option for remediation.

Recommendations

The health benefits that may result from different remediation options have been impossible to quantify and estimates have necessarily focussed on the direction rather than the amount of impact. This does not mean that some psychological benefits might not occur related to the removal of contaminants about which residents feel strongly. However, this must be balanced against the potential negative impacts of the remediation process and the uncertainties concerning end-use.

The HIA steering group recommends that:

1. If coal is to be re-claimed, screening should take place on-site, away from residential areas, preferably between two 'blast walls', or 'bunds' that are already in place.
2. The screens presently located at Aberaman should be removed as they are too close to housing and constitute an unacceptable health risk to residents.
3. The option of rail transport should be explored as a means of removing waste.
4. Local knowledge and experience should be considered alongside other evidence when coming to a decision.
5. The local community should be involved in decisions regarding the end-use of the site and the provision of amenities that will have a positive health impact should be explored.
6. A decision should be made as soon as possible as people are becoming disillusioned with the time taken for decisions to be made and actions to be taken.

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Appendix 1

Participants

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Matthew Easter	Research and Communications Programme Manager, Groundwork, Merthyr and Rhondda Cynon Taff
David Jones	Local Resident
David Jones	Senior Environmental Health Officer, RCT County Borough Council
Carolyn Lester	Research Fellow, Health Inequalities, Bro Taf Health Authority
Aled Morris	Local Resident
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Dr. Mark Temple (Chair)	Consultant in Environmental Public Health Medicine, Bro Taf Health Authority
Clive Thomas	Local Resident
Julie Oliver	Local Resident

Appendix 2

Timetable

First meeting, 8th January 2003

Presentations:	The options for remediation
	Residents' concerns (Community representatives)
	Health Inequality Impact Assessment Process (Health Authority)
Discussion	Scope of assessment
	Timetable and target completion date
	Positive and negative health impacts
	Evidence needed and responsibility for evidence collection

Second meeting, 12th February 2003

	Presentation of evidence
	Agreeing arrangements for production of draft report, circulation to members and response dates

March 2003

	Circulating draft report to Steering Group
	Receiving responses
	Amending draft

Third meeting, 24th March 2003

	Presentation of final draft
	Discussion of amendments
	Agreeing final report and its format
	Agreeing arrangements for presentation to the Remediation Working Group and Stakeholder group, publication and distribution