

Title of Report: Publication of the Final Report of the Incident Management Team; “Carbon Dioxide Incident in Gorebridge Midlothian April 2014”

**Report by: Kenneth Lawrie
Midlothian Council Chief Executive**

1 Purpose of Report

The purpose of this report is to advise Council of the publication of the Final Report of the Incident Management Team (IMT), dated November 2017, into the incident involving the ingress of carbon dioxide (CO₂) into houses at Newbyres Crescent, Gorebridge, Midlothian.

The Report details the investigations conducted by the IMT and provides conclusions and recommendations which, if accepted, will require a variety of agencies, including Midlothian Council, to take action.

The Executive Summary of the IMT Report is attached at appendix 1 to this report and a full copy of the Report has been provided in the Members' Library.

2 Background

In April 2014 NHS Lothian set up an Incident Management Team (IMT) to investigate reported cases of ill health affecting a number of the residents of a recently built housing development of 64 dwellings, in the previous mining area of Gorebridge, Midlothian.

The Incident Management Team is required to investigate such incidents in accordance with the guidance document; '*Management of Public Health Incidents: Guidance on the Roles and Responsibilities of NHS led Incident Management Teams - October 2011 (Updated July 2013)*'. The principal focus of the IMT is the protection of public health. Membership of the core IMT comprised a Consultant in Public Health Medicine NHS Lothian, as chair, with representatives from Health Protection NHS Lothian, Health Protection Scotland, Midlothian Council and SEPA. Scottish Government attended as observers with agencies including The Coal Authority and Midlothian Council consultants attending by invitation.

The Environmental Health Manager of the local authority, where the incident is occurring, is a full member of the core IMT.

Midlothian Council were actively involved in the incident as owners of the affected properties and this has previously been reported to Council in papers:

- Cabinet Report, dated 22 April 2014, Item No 17
- Special Council Report, dated 20 May 2014, Item No 4
- Special Council Report, dated 17 June 2014, Items 3A and 4
- Midlothian Council Report dated 4 November 2014 Item no 15.

The Final Report of the Incident Management Team including the conclusions and recommendations is brought before Council for information and necessary action.

3 Report Summary

The IMT established that 22 residents from a total of 165 in the affected area made contact with healthcare services between September 2013 and September 2014. The most common complaints were headaches, dry coughs, dizziness and anxiety. The IMT concluded that the seepage of CO₂ into the houses was a significant risk to the health of residents and thus warranted intervention.

The migration of CO₂ into the houses was thought to have been associated with a number of potential 'pathways' including ungrouted disused mine shafts, natural cracks in the ground and manmade interventions over time such as investigation drill holes, grouting work for the Borders rail link, the installation of deep drainage and the presence of vibro stone columns introduced during construction to stabilise the ground for house building. These ground openings could have provided preferential pathways for gas migration into spaces below the foundation slabs.

No gas membranes or other specific mitigation measures had been installed during the construction of the houses, which meant that there was a route for CO₂ through service (utilities) access points in the foundation slabs.

The initial pre-development mine gas risk assessment at the site classed the risk as low and therefore not requiring any mitigation measures. The implication was that this assessment had been insufficiently precautionary given the evidence of potential risk available at the time.

The potential for mine gas migration into the properties was further increased by the floor slab design of the properties, which facilitated ingress of CO₂ especially under amplifying weather conditions of low pressure and high winds.

The IMT considered possible remediation measures and recommended that these should seek to eliminate the recurrence of a similar risk to public health from the mine gases. The IMT found no published evidence to confirm that retrospective remedial action, designed to prevent migration of mine gases into houses constructed without gas membranes, would be guaranteed to prevent migration of mine gases into the houses in the long term.

The IMT identified, and provided to the Council, criteria against which any long term options for the affected houses should be assessed.

Having reviewed five main remediation options in detail, Midlothian Council decided to re-house all the residents and demolish the 64 properties on the site to safeguard the future health of the local residents.

4 Midlothian Council

In September 2016 a second incident of carbon dioxide affecting recently constructed residential properties in Gorebridge was identified. In light of that incident the Midlothian Council Building Standards service have implemented measures deemed appropriate to secure the health and safety of potential home owners in the Gorebridge area.

Development within the Gorebridge area, within an agreed geographical area, will require to adhere to the following interim policy;

- a. Within the designated geographical area, new applications for building warrant are required to provide gas protection measures which meet a minimum 'characteristic situation 2 level' with the provision of a gas membrane and ventilation layer, even where the applicant has undertaken ground investigations which have shown no indication of likely gas migration.
- b. For developments with a building warrant but are yet to start or whose development is unfinished within the Gorebridge designated geographical area, the Council now recommends that gas protection measures which meet a minimum 'characteristic situation 2 level' are provided with the provision of a gas membrane and ventilation layer.

All other properties proposed under building warrant applications within the Midlothian area which fall out with the geographical area of Gorebridge will continue to be asked to take cognisance of Midlothian's prevalent mining history and where required, undergo the current peer review process for the purpose of establishing reasonable enquiry in accordance with associated contaminated land guidance, relative to the building regulations and guidance in force at the time of the building warrant application.

5 Recommendations of the Final Report of the Incident Management Team

- 5.1** The recommendations are set out in Chapter 11 of the Report and summarised in the Report's Executive Summary, a copy of which is attached at Appendix 1 to this paper.
- 5.2** The Incident Management Team has made a series of 26 recommendations which, if accepted, will require actions by a variety of agencies including Midlothian Council, NHS Boards, IMT partners and Scottish Government.

Recommendations 1-3 specifically relate to the incident and site and require action by Midlothian Council. These 3 recommendations are:

1. A robust mechanism should be implemented to limit public access to the site at Gorebridge, to limit the potential for unauthorised occupation of the affected houses until the houses are demolished.

This recommendation has been complied with in that the site was secured to prevent unauthorised access and demolition was completed in early 2016.

2. Before any redevelopment, efforts should be made to ensure that there is no ongoing threat to public health associated with a recurrence of the mine gas migration problem.

This recommendation is actively being pursued through the site investigation and development processes being undertaken in consideration of redevelopment of the site. Consultation regards redevelopment will take place with NHS Lothian Public Health at the appropriate time.

3. A long term monitoring strategy for any houses built on the site in future should be set out as part of the redevelopment plan, to provide objective evidence for public reassurance, and to confirm that there is no gas migration into any new properties.

This recommendation is actively being pursued. The findings of the site investigation and the determination regards the gas protection measures to be implemented on site during redevelopment, will inform the future monitoring strategy.

Further recommendations are made relating to:

- Management of Future Incidents Nos 4-11
Nos4-7 & 9-10 applicable to all local authorities,
No8 specific to NHS Board and
No11 specific to Scottish Government regards the funding of specialist technical advice.
- National Policy and Guidance on Mine Gas Migration Risk, Nos 12-20
No 12 specific to the UK Department for Business, Energy and Industrial Strategy,
Nos 14-16 and 18-20 specific to Scottish Government, and
No 17 applicable to all local authorities.
- Research Needs, Nos 21-26
Specific to Scottish Government.

6 Report Implications

6.1 Resource

In complying with the recommendations of the IMT report the resource implications include:

- i) the resource required for the current and ongoing protection of human health regards the individual site at Newbyres Crescent Gorebridge. This can be met from within existing local authority resource;
- ii) ensuring sustainable infrastructure and funding of resilience within Midlothian Council to enable an expert response and timely management of environmental hazards to human health.

6.2 Risk

Environmental public health incidents can occur suddenly and adversely affect the health of local residents and visitors to the area. Such events require significant input of resources from across the authority and as such the risk of insufficient capacity within Midlothian Council to respond to incidents and to sustain an effective and appropriate response without compromising other aspects of the service should be recognised.

Continued implementation of the specific recommendations regards the site will reduce the risk of human health being adversely affected by this matter.

6.3 Single Midlothian Plan and Business Transformation

Themes addressed in this report:

- Community safety
- Adult health, care and housing
- Getting it right for every Midlothian child
- Improving opportunities in Midlothian
- Sustainable growth
- Business transformation and Best Value
- None of the above

6.4 Key Priorities within the Single Midlothian Plan

Adopting the relevant recommendations contained within the IMT report will further protect public health and contribute to the key priorities.

6.5 Impact on Performance and Outcomes

There is no identified impact on performance measures and outcomes.

6.6 Adopting a Preventative Approach

Continued compliance with the recommendations of the IMT report as they specifically relate to the Newbyres Crescent site will protect human health and contribution to the wider report recommendations will seek to address a more sustainable process for future sites.

6.7 Involving Communities and Other Stakeholders

Engagement with communities and stakeholders took place throughout the incident with the implementation of an exemplary Care for People Group. In accepting and actioning the recommendations Midlothian Council will continue with stakeholder engagement as required. Specific engagement with NHS Lothian Public Health Team will be undertaken at the appropriate time.

6.8 Ensuring Equalities

As there are no revisions or changes since the production of the last equality assessment report, no further equality assessment report is required to accompany this report.

6.9 Supporting Sustainable Development

The outcome to this local situation will influence local policy, and potentially national guidance, particularly with regards to the future development of brownfield sites, in ensuring that any of Midlothian Council future housing developments are not adversely affected by ground gases.

Midlothian Council has introduced an interim policy to secure the health and safety of potential home owners in the Gorebridge area by requiring new applications for building warrant to provide gas protection measures in all cases and applications outwith Gorebridge continue to be asked to take cognisance of Midlothian's prevalent mining history and where required, undergo the current peer review process for the purpose of establishing reasonable enquiry in accordance with associated

contaminated land guidance, relative to the building regulations and guidance in force at the time of the building warrant application.

In addition, all new build carried out by the Council will have gas membranes installed, irrespective of the level of risk assessed within the Site Investigation Report.

6.10 IT Issues

There are no IT implications arising from this report.

7 Summary

The Final Report of the Incident Management Team into the Carbon Dioxide Incident in Gorebridge Midlothian has been completed and published. The report details the investigations of the IMT, the conclusions and recommendations.

There are three recommendations specifically for Midlothian Council regards the incident and site and these are either completed or under active pursuance.

Wider recommendations for a variety of stakeholders, including Scottish Government are also made.

8 Recommendations

Council is recommended to:

- i) note the publication of the Final Report of the Incident Management Team into the Carbon Dioxide Incident in Gorebridge;
- ii) commend the work of the Incident Management Team and partner agencies in the investigation of this incident;
- iii) recognise the work of the Care for People Group, established by Midlothian Health and Social Care Partnership together with NHS Lothian and Midlothian Council, as a model of good practice;
- iv) note the IMT recommendations as detailed in the Executive Summary of the 'Carbon Dioxide Incident in Gorebridge, Midlothian, April 2014' report;
- v) support the report findings in taking forward the recommendations made by the Incident Management Team (IMT), and note the ongoing implementation of those recommendations (numbered 1 to 3) which specifically require action by Midlothian Council; and
- vi) support implementation of the recommendations for action by any future local Incident Management Teams.

Date 29 November 2017

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Appendix 1**NHS Lothian****Carbon Dioxide Incident in Gorebridge Midlothian, April 2014
Final Report of the Incident Management Team, November 2017****Executive Summary****The incident**

In April 2014, NHS Lothian set up an Incident Management Team (IMT) to investigate reported cases of ill health affecting a number of the residents of a recently built housing estate in the previous mining area of Gorebridge, Midlothian. The IMT was set up following notification to the Health Protection Team (HPT) from a general practitioner (GP) and hospital doctor who had seen patients with complaints that they associated with carbon dioxide (CO₂) exposure. It was later established that the incident had been going on since September 2013 when two households were first affected.

Safeguarding the health and safety of the residents throughout the incident was a priority for the IMT. From the start the IMT ensured that the situation remained under close surveillance and recommended measures to the NHS Lothian HPT and Midlothian Council to minimise the acute risk to residents. This included alerting local GPs to the incident, ensuring that adequate and appropriate health related information was provided to residents and the public, and advising on the installation of alarm monitors in all houses, supported by a dedicated 24-hour council response team, evacuation and rehousing, and adequate and continuous monitoring of mine gases.

Investigation and Risk Assessment

A total of 22 residents from a total of 165 in the affected area made contact with healthcare services between September 2013 and September 2014. The most common complaints were headaches, dry coughs, dizziness and anxiety. The IMT concluded that the seepage of CO₂ into the residential houses was a significant risk to the health of residents and thus warranted intervention.

The IMT conducted systematic investigations using the source-pathway-receptor model to assess risks to health, and to identify appropriate options for action to manage those risks in the short and long term. The process involved obtaining copies of previous relevant investigations and background reports provided by Midlothian Council, obtaining independent expert advice to inform its decisions, sampling gas from the houses and mine gas, monitoring the levels of CO₂ in the affected houses and surveillance of interaction of the residents with health services.

The investigation by the IMT was heavily reliant on the support of agencies including SEPA and the Coal Authority, as well as on the findings of technical investigations undertaken by commercial consultants commissioned by the local authority. The cumulative evidence from all these investigations lead the IMT to conclude that the CO₂ detected in the properties was of historical coal mine origin.

The source of the ground gas was considered most likely to be the abandoned coal workings containing elevated levels of oxidising coal deposits, creating carbon dioxide, which migrated to the surface as a result of changes in atmospheric pressure and other factors. This hypothesis was supported by the findings of radiocarbon analysis carried out on behalf of the IMT, that the CO₂ from the houses was of geological origin and similar to that originating in the areas abandoned coal mines.

The migration of CO₂ into the houses was thought to have been associated with a number of potential pathways including ungrouted disused mine shafts, natural cracks in the ground and manmade interventions over time such as investigation drill holes, grouting work for the Borders rail link, the installation of deep drainage and the presence of vibro stone columns introduced during construction to stabilise the ground for house building. These ground openings could have provided preferential pathways for gas migration into spaces below the foundation slabs. No gas membranes or other specific mitigation measures had been installed during the construction of the houses, which meant that there was a route for CO₂ through service (utilities) access points in the foundation slabs.

The evidence from the Coal Authority (**Appendix 1 and Appendix 2** [of the Final report]) also identified that the initial pre-development mine gas risk assessment at the site classed the risk as low and therefore not requiring any mitigation measures. The implication was that this assessment had been insufficiently precautionary given the evidence of potential risk available at the time. The initial assessment was heavily dependent on very limited measurements of gas concentration and flow. The assessment did not apparently anticipate the additional risk associated with the impact of ground treatment measures used to stabilise the site, including extensive grouting of the area and use of vibro stone columns to provide support to the house foundations. The potential for mine gas migration into the properties was further increased by the floor slab design of the properties, which facilitated ingress of CO₂ especially under amplifying weather conditions of low pressure and high winds.

Risk Management

The IMT recognised early that whatever solutions were devised to address residents' exposure to potentially harmful levels of CO₂, substantial engineering work would be required. A plan for residents to leave their homes had to be developed. The IMT recommended that Midlothian Council and NHS Lothian put in place a Care for People Group (CPG) to look after the health, social and mental wellbeing of the residents as they were relocated while investigations continued. The group addressed the individual resident's issues and situations and was very helpful in the successful resettlement of residents in new homes.

The IMT considered possible remediation measures and recommended that these should seek to eliminate the recurrence of a similar risk to public health from the mine gases. In this incident, the Coal Authority deemed that it did not have legal liability for the migration of the mine gas due to the circumstances surrounding the construction of the estate. Responsibility for managing the situation therefore fell to Midlothian Council. However, where it does determine that it has liability for a mine gas migration problem in residential property, the response by the Coal Authority for managing similar situations is usually to demolish the property and rebuild.

The IMT found no published evidence to confirm that retrospective remedial action, designed to prevent migration of mine gases into houses constructed without gas membranes, would be guaranteed to prevent migration of mine gases into the houses in the long term.

Conclusions

The seepage of carbon dioxide into the houses in Gorebridge was a rare, complex and costly incident associated with old coal mine workings. This incident is, to date, probably the most serious such CO₂ related incident in Scotland. The IMT has made recommendations to the Scottish Government on areas where national level review, research and guidance are required. It has also made recommendations for action by local authorities that are likely to have housing developments on similar sites.

For the long-term use of the site, the IMT recommended that before any future developments took place, the council should ensure that all statutory procedures were taken plus appropriate advice from bodies with expertise in relevant technical fields. This will ensure that there will be no possible recurrence of the problem, and no future threat to public health.

The current procedure for mine gas risk assessment gives the primary responsibility, for assessing the risk and determining what mitigation if any is required, to the site developers. The IMT concluded that this is unsatisfactory, unsafe and not consistent with a precautionary approach designed to protect public health. The investigation identified fundamental flaws in the present system creating the potential for failure to assess the risk correctly or to adopt adequate mitigating measures when necessary at the time of property construction. The IMT therefore considered that, at the very least, there should be a comprehensive review and revision of the current risk assessment and mitigation process.

A review is also justified in view of information provided by SEPA that as time progresses groundwater levels in abandoned mining areas gradually rebound to their pre-mining state. Monitoring of groundwater levels in abandoned mine areas is often undertaken by the Coal Authority. Rising groundwater levels are known to be associated with an increased risk of mine gas migration. Hence, in any abandoned mining area where the water table level has not yet reached an equilibrium point, there is likely to be additional uncertainty in future mine gas migration risk prediction. This is another reason to encourage a more highly precautionary approach to mitigation measures.

An additional environmental cause of mine gas risk uncertainty relates to future change in precipitation associated with predicted climate change in Scotland. It is possible that climate change may cause alterations in rainfall patterns in future however how this will be reflected in groundwater levels is currently unclear. As ex-mining areas complete their groundwater rebound phase, the relative impact of any such change will increase over time. The consequential impact of any climate change related effect on mine gas migration risk is uncertain but could act to increase the overall risk. This is therefore yet another source of uncertainty making mine gas risk prediction more imprecise and another reason for advocating the adoption of a more highly precautionary stance to future proof mine gas mitigation measures.

The IMT concluded that a review and revision of the present mine gas risk assessment and management process is necessary. However, the IMT was not persuaded that a change to the risk assessment process alone would be sufficient to guarantee that a similar incident could not occur in future. The IMT was convinced that any process that leaves the primary responsibility for mine gas risk assessment and management to the site developers is likely to fail at some point. The process is therefore not "fail safe"; the risk of failure in terms of the

potential harm to public health is unacceptable and the costs of remediation works are unsustainably wasteful.

The final position of the IMT was that mandatory use of mitigation measures in new build developments would be the only effective way to minimise the risk of a recurrence of the problems identified in the Gorebridge incident.

The IMT therefore concluded that installing mine gas mitigation measures should be made mandatory in all new residential and similar developments at the time of construction, in all areas of Scotland designated by the Coal Authority as former mining areas.

Recommendations

The IMT has made a series of 26 recommendations on:

- The Gorebridge incident and future site management
- The management of future incidents
- National policy and guidance on mine gas risk assessment and risk management
- Future research needs in relation to the problem of mine gas migration

The Gorebridge Incident and Site

1. A robust mechanism should be implemented to limit public access to the site at Gorebridge, to limit the potential for unauthorised occupation of the affected houses until the houses are demolished.

Action: Midlothian Council (N.B. demolition was completed in early 2016).

2. Before any redevelopment, efforts should be made to ensure that there is no ongoing threat to public health associated with a recurrence of the mine gas migration problem.

Action: Midlothian Council

3. A long term monitoring strategy for any houses built on the site in future should be set out as part of the redevelopment plan, to provide objective evidence for public reassurance, and to confirm that there is no gas migration into any new properties.

Action: Midlothian Council

Management of Future Incidents

4. Agencies should notify each other of any relevant potential public health incident at the earliest suspicion.

Action: all relevant agencies involved in managing EPH incidents (NHS boards, local authorities, SEPA, FSS etc).

5. IMT representatives should inform their parent agencies of the principles that govern the operation of an IMT as defined in Scottish guidance on managing public health incidents.

Action: NHS boards (Chairs of IMTs) and IMT partners.

6. Roles and responsibilities of each IMT member should be clarified at each IMT meeting to ensure that members understand each agency's roles.

Action: NHS boards (Chairs of IMTs) and IMT partners.

7. Joint training and exercising by partners and familiarisation with each other's methods of work is recommended to improve the effective working of IMTs.

Action: NHS boards (Chairs of IMTs) and IMT partners.

8. Consistent and good quality administrative support is required for an IMT especially in complex incidents (such as this), which may need to be managed over a long time period.

Action: NHS boards (Chairs of IMTs).

9. The communication teams of all agencies represented on an IMT need to work closely with each other to ensure consistency in message content and in the timely release of messages for the public.

Action: IMT partners from all relevant agencies involved in managing Environmental Public Health incidents (NHS boards, local authorities, SEPA, FSS etc).

10. The need for a Care for People Group (or equivalent) should be considered during any such incident, to provide a focus for coordinating advice and action on the needs of affected people.

Action: NHS boards and local authorities

11. Arrangements for funding highly specialist impartial expert scientific and technical advice that is beyond the competence and expertise of the public sector agencies represented on the IMT needs to be considered further, with a view to providing clear guidance to IMTs in future.

Action: Scottish Government.

National Policy and Guidance on Mine Gas Migration Risk

12. With respect to the Coal Authority, in addition to fulfilling its statutory responsibilities, the potential role of the Coal Authority to assist public health led IMT investigations into future mine gas incidents should be reviewed. A mechanism should be established to facilitate the active participation of the Coal Authority as an IMT member, irrespective of the Coal Authority's own liability.

Action: UK Department for Business, Energy and Industrial Strategy.

13. The potential for the Coal Authority to adopt a more active role in quality assuring the adequacy of pre-development mine gas risk assessments and ensuring the adoption of adequately precautionary gas migration mitigation measures, should be explored.

Action: The Coal Authority

14. Relevant Scottish Government directorates should be made aware of this incident, its implications and the potential scale and significance of the IMT findings.

Action: Scottish Government.

15. The potential for increases in mine gas migration risk linked to water table rise should be flagged to relevant Scottish Government Directorates as a concern in terms of both the ongoing natural water table rebound phenomenon in former mining areas and in terms of the potential consequences of future climate change.

Action: Scottish Government.

16. Developers, land use consultants and planning authorities should be made aware of the content of this report.

Action: Relevant Scottish Government Directorates to advise developers, consultancies, local authority planning and environmental health departments.

Action: Scottish Government.

17. Local Authorities (LAs) in Scotland reviewing proposals for the development of land with a history of former mining activity should review the adequacy of any accompanying mine gas risk assessment with added care. LAs should determine if an assessment has considered the potential risk of gas migration in the short, medium and the longer term future.

Action: All Local Authorities.

18. The existing Scottish Government arrangements for licensing access to British Geological Survey (BGS) mapping data should be reviewed to enable increased free access to British Mine Gas Risk maps by public sector bodies in Scotland. Improved access to these datasets is needed to improve the capacity of local authorities and other public sector agencies to more easily independently evaluate the adequacy of mine gas risk assessments carried out by developers in their areas.

Action: Scottish Government

19. To protect the health of existing or future occupants of a property where persistent mine gas has been identified as a problem, there is need for a mechanism to require the owner to take appropriate action which may include demolition or closure of the property if it is considered that remediation works will not guarantee the future protection of public health.

Action: Scottish Government

20. Mine gas mitigation measures should be made mandatory in all new residential and similar developments, in all areas of Scotland designated by the Coal Authority as former mining areas, irrespective of their current designation as either low or high risk.

Action: Scottish Government.

Research Needs

Further research is needed to investigate specific issues identified in this incident.

21. An assessment is required to determine the impact that natural rebound of groundwater levels is having in ex-mining areas in Scotland in terms of the effect on altering the risk of mine gas migration.

Action: Scottish Government.

22. An assessment is required to determine the impact of predicted increases in rainfall and severe weather events, associated with climate change, on the risks of mine gas migration.

Action: Scottish Government.

23. A systematic review is required of the evidence in relation to the options for and efficacy of retrospective mitigation measures to control the ingress of mine gas, including CO₂, to existing developments (properties).

Action: Scottish Government

24. Specific research studies are required and should be funded to investigate the utility and efficacy of retrospective measures to control CO₂ ingress and levels in CO₂ affected properties in Scotland.

Action: Scottish Government

25. Research should be conducted in former mining areas across Scotland to determine if mine gas migration is occurring in housing developments similar to that constructed in Gorebridge, where no mine gas mitigation measures have been incorporated in their construction.

Action: Scottish Government

Independent Expert Review of Mine Gas Risk Assessment and Mitigation in Scotland:

26. Scottish Government should consider establishing an independent expert group to review the processes and guidance for mine gas risk assessment and mitigation in Scotland.

Action: Scottish Government