CHAPTER 7

Conclusions

7.1 Environmental conclusions

The conclusions in this section incorporate the work that was carried out to examine the chemical characteristics of each of the mine sites and their impact on human and animal health and the environment.

Conclusion 1

Ireland possesses an abundance of historic mine sites dating from the Bronze Age to the late 20th century.

Conclusion 2

The HMS-IRC scoring system provides an effective ranking of mine sites in terms of their potential to affect human or animal health or to have an impact on the environment. Based on their scores, sites are assigned to one of five classes ranging from I (high priority) to V (low priority).

Conclusion 3

The three Class I sites are Silvermines, Tynagh and Avoca.

Conclusion 4

The Class II site is Glendalough–Glendasan.

Conclusion 5

The two Class III sites are Caim and Glenmalure.

Conclusion 6

The four Class IV sites are Ballycorus, Gortdrum, the Leinster Coalfield and the Slieve Ardagh Coalfield.

Conclusion 7

The seventeen Class V sites are Clements, the Connacht Coalfield, Kilbricken, Allihies, Abbeytown, Tassan, Ballyvergin, Ballyhickey, Keeldrum, West Cork Copper–Barium District, Clare Phosphate (Doolin), Bunmahon, Hope, Clontibret, Glentogher, Benbulben and Hollyford.

Conclusion 8

Lead is the single most important contaminant on Irish mine sites in terms of its toxicity, the concentration in which it is found, the quantity of Pb-enriched material, and its geographical dispersion on and around mine sites. It is present in high concentrations in 13 out of 27 districts investigated, not only in solid waste but also in mine waters and in surface waters and stream sediments downstream of mines. Mine districts and sites most severely contaminated by Pb include Caim, Clare Lead Mines, Glendalough, Silvermines and Tynagh.

Conclusion 9

The routes that have the dominant effect on the final scores are the surface water and groundwater pathways.

Conclusion 10

Acid mine drainage is characterised by low pH and high acidity, and when generated in metal or coal mines is typically rich in metals such as Fe, Mn, Al, Cu, Pb, Ni and Zn, and therefore potentially toxic to aquatic organisms. At Avoca mine, AMD has had a major impact on the Avoca River. Low pH and high acidity are also found in some mine waters at the Slieve Ardagh, Leinster and Connacht Coalfields. However, only in the Connacht Coalfield is there volumetrically significant discharges of AMD. Relatively high concentrations of Al, Ba, Cd, Fe, Mn and Ni are present in water in these mine districts.

Conclusion 11

The sites of the former ore processing plants at Gortdrum, Silvermines and Tynagh are significantly contaminated by heavy metals. In all three cases, the sites are being utilised by new businesses. Contaminants include not only the metals produced from the site, such as Pb, Zn and Cu, but also minor constituents of the ore that have become concentrated during processing. These minor constituents include As and Hg, which have been found in concentrations exceeding 1,000 mg/kg. Arsenic is also present in high concentrations in solid waste outside of processing areas at both Avoca and the Clare Pb Mines. Despite its occurrence at high concentrations in solid waste, As has not been detected in surface waters downstream of mine sites at concentrations in excess of the Draft EC Surface Water Regulations.

Conclusion 12

Draft EC Surface Water Regulations set low limits for some metals that occur in significant concentrations in surface water downstream of Irish mine sites. These metals include Cd, Cu, Pb and Zn. They pose risks to aquatic ecosystems even at low concentrations and may require inclusion in surface water monitoring programmes.

Conclusion 13

Concentrations of Cu in stream sediment are very high downstream of some sites, notably Allihies, Avoca and, in West Cork, at Glandore and Ballycummisk. The potential for impact on the aquatic ecosystem may warrant further investigation. The total Cu concentration in surface waters downstream of mines indicates significant impact on water chemistry from mine discharges at some sites. However, numerous upstream surface water samples and even some groundwater samples also contain Cu in excess of regulatory levels, indicating that mine waste is one of a number of sources of elevated Cu in surface water and groundwater.

Conclusion 14

High concentrations of Zn in solid mine waste pose no threat to human health. However, high concentrations of Zn in stream sediments and/or downstream surface waters at Avoca, Glendalough, Silvermines and Tynagh pose a risk to livestock and the aquatic environment.

Conclusion 15

Selenium is a common component of phosphate rock and the shales that typically host it. Leaching of Se from solid waste heaps at phosphate mines in the USA has led to significant downstream Se contamination of aquatic organisms, mammals, birdlife and grazing animals. The concentration of Se in solid waste from the Clare Phosphate deposits (18–30 mg/kg) falls within the range of concentrations reported for US phosphate mine waste. While there is no evidence for leaching of Se into the aquatic environment, a large part of the former mine site is now used as grazing land and may pose a risk of Se toxicity to grazing animals.

Conclusion 16

Some mine waters have very high concentrations of both total and dissolved Al. There is an inverse relationship between pH and Al concentration, with those mine districts with low-pH water, such as Avoca and the three coalfields, having the highest concentrations of Al in mine water and downstream surface waters. Concentrations of total Al measured in surface water downstream of these sites are typically in excess of both drinking water standards and Canadian guidelines for the protection of the aquatic environment.

Conclusion 17

Nickel is enriched in mine water, downstream surface water and stream sediments at some sites in the Irish coalfields. It is also found in excess of the Draft EC Surface Water Regulations downstream of mines such as Avoca and Tynagh.

Conclusion 18

The following site-specific issues were identified during the course of the project

Abbeytown

- Pb- and As-rich leachate from the tailings pond enters the estuary at Ballysadare Bay.

Avoca

- Measured Pb concentrations exceed 1% in solid waste at Connary, a site where sheep graze.

Ballycorus

- Pb concentrations exceed 1% in solid waste at Ballycorus in an area popular with walkers and horse riders.

Caim

- Pb concentrations exceed 5% in a solid waste heap at Caim, used by quad bikers and others.

Clare Pb District – Ballyvergin

- Pb concentrations in excess of 20% were measured in fine-grained mine waste in an area used by cattle for feeding at Ballyvergin.

Glendalough

- Measured Pb concentrations exceed 10% in solid waste at the Hero Processing site, at the head of the Glendasan Valley. The site is very popular with tourists.
- High concentrations of Pb and Zn were measured in stream sediments in Glendasan River downstream of the mines.

Glenmalure

- Measured Pb concentrations exceed 10% in solid waste at Ballinafunshoge, Glenmalure, a site popular with quad bikers.

Gortdrum

- Very high concentrations of Hg (>0.5%) and As (> 1%) were measured in solid waste at the site of the former processing plant, now the site of an active business.

Silvermines

- Very high concentrations of Pb (>2%) and As (>0.1%) were measured in solid waste at the site of the former processing plant in Garryard, now the site of an active business.

Tynagh

- Very high concentrations of Pb (>2%) and As (>0.1%) were measured in solid waste at the site of the former processing plant, now the site of an active business.
- A Cd-rich discharge from a waste heap crosses grazing land and seeps underground, potentially affecting groundwater.