

# CAIM

## Background information

**Mine Name:** Caim

**Mine District:** Caim

**Alternative Names:**  
Caime; Ballyhighland

**Elements of interest:**  
Pb, Zn, Cu, S, Sb, Mn

**Project Prefix:** CAI-

**County:**  
Wexford

**Townland:**  
Ballyhighland

**Grid Reference:**  
E288549, N140967



## Site Description and Environmental Setting

Caim is set in rolling farmland 9km west of Enniscorthy in Co. Wexford. The land is a mixture of pasture and tillage, with the latter forming a much higher proportion of farmland than is typical around mine sites in Ireland. The proximity of the area to Enniscorthy and the main Dublin-Wexford road has led to a significant increase in the number of single dwellings in recent years. At least two new houses have been built adjacent to the site since 2005.

The mine site now comprises two distinct sections: the northern part, where most of the mining activity occurred, is largely overgrown with trees and shrubs, notably gorse, while the southern part is the site of a large heap of processing waste containing particularly high concentrations of Pb (photo, right). The original boundaries of the site are not readily discerned



but the boundary marked on Fig. 1 encloses just under 8ha.



Mine structures marked on old plans include an adit, shafts, an opencast pit, two chimneys (photo, left: south chimney) and several other mine buildings. The adit is covered over but a drainage stream on the southwest side of the site appears to be a discharge from it. The shafts are either overgrown and inaccessible or filled-in. The opencast is also now largely filled in by dump material and if there are any remains of the mine buildings than they are hidden in the thick undergrowth. The two chimneys are still standing.

Estimates of the volume of spoil in the three heaps shown on Fig. 1 are given in Table 1.

**Table 1 Area and volume of spoil heaps at Caim**

Waste ID	Area (m <sup>2</sup> )	Volume (m <sup>3</sup> )
CAI-SP01a	3250	4529
CAI-SP01b	248	248
CAI-SP01c	8431	19500

## Geology and Mineralization

The bedrock is purple-green siltstones and slates of the Lower Palaeozoic Ordovician Oaklands Formation. The mineralization includes galena, chalcopyrite, sphalerite and pyrite in a quartz-carbonate vein-breccia. The galena contains some silver. Carbonates include Ca-, Mg-, Mn and Fe-carbonates. The ore was mined from a northwest-southeast-trending vein/breccia that cuts the regional cleavage at a high angle (Geraghty 1991). This narrow, near-vertical zone extends downwards from the surface for at least 18m. It comprises two veins that join in a Y-shape. Highest ore grades were encountered in the zone of intersection where the mineralized zone was 4m thick (Geraghty 1991).

## Production and Mining History

Cole (1922) quotes Weaver to the effect that the mine opened a few years before 1818 by which time "24 tons of copper pyrites" and a "few hundred" of galena had been shipped. The shaft then reached 24 fathoms (43m). The Mining Company of Ireland reopened it after 1835, producing hundreds of tons a year, with a peak of almost 600 tons in 1842, but the mine only rarely made an annual profit. At peak production, around 130 persons worked on the site. The galena yielded 75% Pb and was smelted at Ballycorus in south Dublin (Cole 1922). Production was inhibited by faulting that repeatedly cut out the mineralized zone and this finally led MCI to suspend production in 1846. Total published MCI production between 1835 and 1854 was around 3000 tonnes.

**Fig. 1 Caim: mine features**

## Geochemical assessment

### 1. Surface water

Surface water was observed on the site only during the winter water sampling campaign in December 2006. The on-site water included leachate from the main soil heap (SP01a), possible discharge from the covered adit on the west side of the spoil heap and surface drainage, possibly from a spring, that originated in a field across the road from the site to the east. Most of these waters drained into the channel that runs south along the eastern boundary of the site to the stream that forms the southern boundary. Some of the drainage, notably that from the suspected adit, appeared to flow south through the overgrown area that lies between the spoil heap and the stream. This water has not been observed flowing into the stream and may seep into the ground.

There is no evidence for any significant AMD problem on the site. The pH values of on-site surface waters range from 4.88 to 6.36 (median 6.15); acidity is low (maximum 64 mg/l  $\text{CaCO}_3$ ). EC ranges from 0.12 to 0.36 mS/cm. However, all surface waters on the site, whether adit discharge or spoil leachate, have high metal concentrations, notably Pb, Zn, Cu and Mn. (Table 2). The stream into which this water discharges has much lower though still elevated metal concentrations. The downstream sample, taken 10m below the discharge point to the stream (Fig. 2), had 50  $\mu\text{g/l}$  total Pb, while the samples taken upstream of this point had 2-3  $\mu\text{g/l}$  total Pb. The downstream sample exceeds both the Draft EC Environmental Objectives Regulations for surface water (7.2  $\mu\text{g/l}$  Pb) and the Drinking Water Standard (25  $\mu\text{g/l}$  Pb) but, with dilution, these levels can be expected to decrease significantly further downstream.

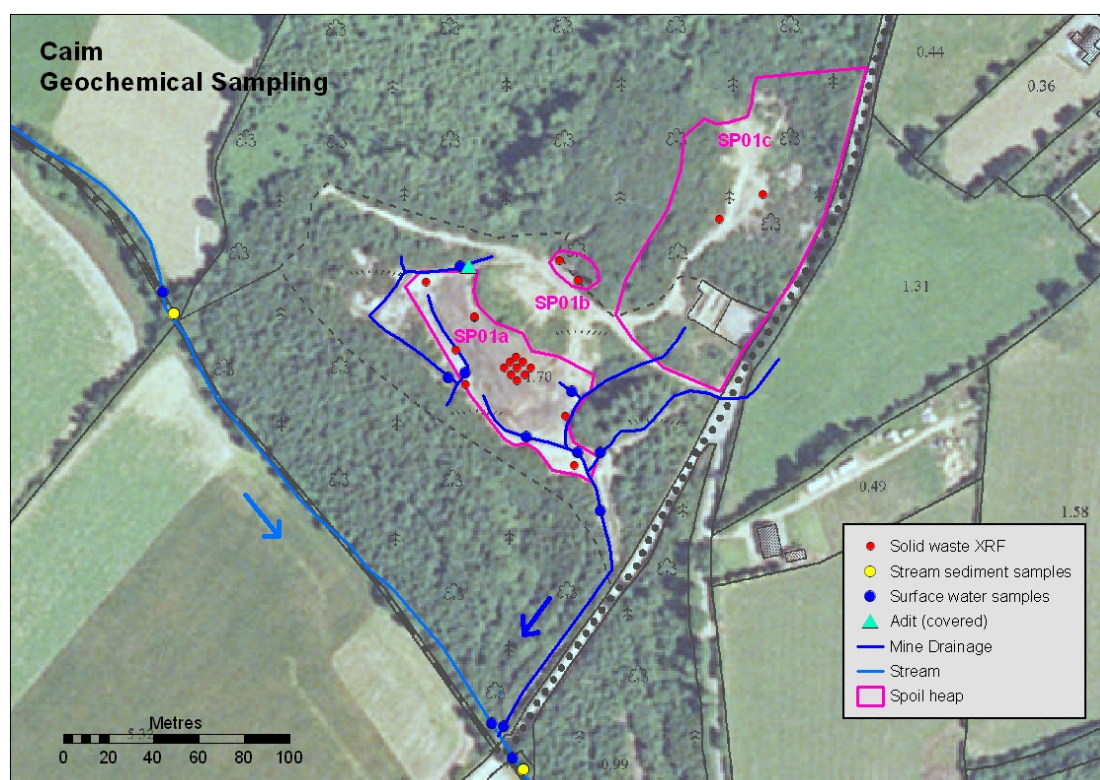
**Table 2: Summary statistics for surface water analyses, Caim**

$\mu\text{g/l}$	Pb(tot)	Zn(tot)	Cu(tot)	SO4	Sb (tot)	Mn (tot)
n	9	9	9	9	9	9
Minimum	256	248	24	15	0.5	87
Maximum	12470	31680	3315	167	40	12260
Median	2231	2268	249	24	0.5	700
Mean	4943	7596	636	55	15	2249

### 2. Groundwater

No groundwater sources were sampled. A leachate extract of a composite sample from SP01a contained 23290  $\mu\text{g/l}$  Pb, 253  $\mu\text{g/l}$  Zn and 381  $\mu\text{g/l}$  Mn. As and Sb were below the 1  $\mu\text{g/l}$  limit of detection. The spoil at Caim thus has the potential to contaminate groundwater.





**Fig. 2 Caim: Geochemical sampling sites**

### 3. Stream sediments

Stream sediments downstream of the mine site show enrichment in Pb and Zn relative to an upstream sample. However, the difference is not as pronounced as might be expected because the upstream sample is itself somewhat enriched in these elements, particularly Pb, relative to the regional background (Table 3). Nevertheless, the impact of the mine on stream sediments is clear with Pb concentration exceeding 2000 mg/kg 1km downstream of the site (location not shown on Fig. 2). Among the other elements analysed for, only Zn and Cu show obvious, albeit modest, enrichment. The concentration of Pb in stream sediments downstream of the mine could pose a risk to livestock entering the streams to drink water (EPA 2004).

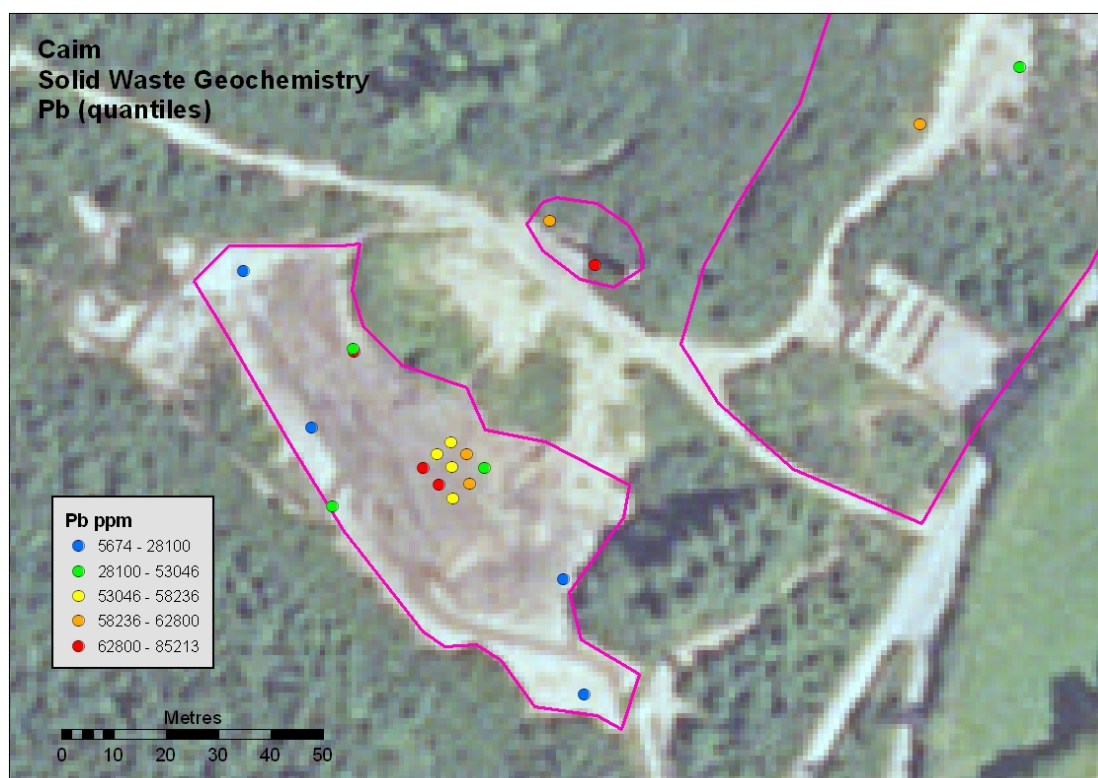
**Table 3: Summary statistics for stream sediment analyses, Caim**

mg/kg	Pb	Zn	Cu	S	Sb	Mn
Upstream	556	146	< DL	< DL	< DL	2866
10m downstream	893	222	48	< DL	< DL	2567
1km downstream	2582	280	67	< DL	< DL	2686
Regional median*	56	128	31	n/a	1.5	1900

\*Samples from streams overlying Oaklands Formation, GSI Southeast Ireland Regional Geochemistry programme (n = 101) – note lower detection limit (DL) of 1 mg/kg Sb for latter analyses.  
n/a: not analysed

### 4. Solid Waste

Solid mine waste at Caim includes the main spoil heap on the southern part of the site (SP01a), a small concentration of material around the southern-most chimney (SP01b) and spoil that forms the largely overgrown waste covering part of the northern half of the site (SP01c) (Fig. 2, 4). SP01a is fine-grained and is some kind of mill waste, SP01b mainly slag waste and SP01c general spoil.



**Fig. 3 Caim: Solid Waste Field XRF Geochemistry: Pb**

All samples of solid mine waste at Caim had in excess of 0.5% Pb when measured *in situ* by XRF with a maximum value in excess of 8% Pb (Fig. 3). Similarly high values were measured for other elements of interest (Table 4). Reanalysis of four samples in the lab yielded a maximum Pb value of 12.6%. Raw XRF data for As also suggest high concentrations (up to 1700 ppm) of this element in solid waste but in four laboratory check samples the As was present in concentrations below 100 ppm. The reason for the elevated As in XRF analysis is likely to be the very concentration of Pb. In samples with more than 0.5 – 1% Pb, false high values of As can be expected in XRF analyses owing to peak interference (see Appendix B). In consequence, As is omitted from Table 4.

**Table 4: Summary statistics for field XRF solid waste analyses, Caim**

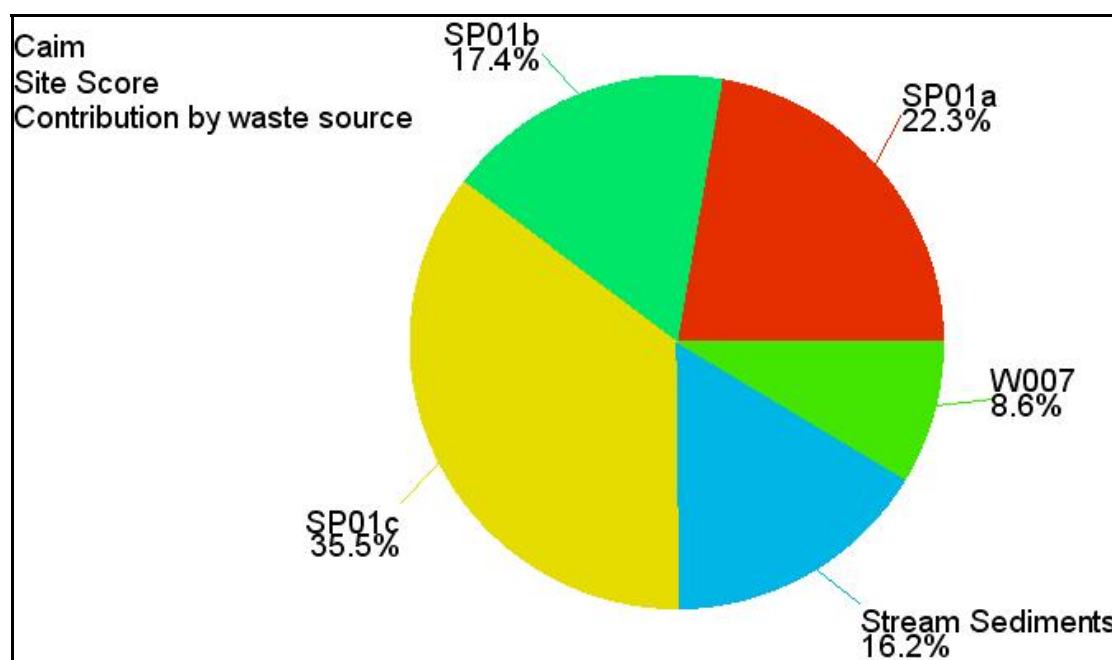
ppm	Pb	Zn	Cu	Sb	S	Mn
n	20	20	20	20	20	20
Minimum	5674	170	224	0.000	0.000	1044
Maximum	85213	12836	8353	1271	27529	51170
Median	56028	2021	3089	387	11371	20112
Mean	51102	2282	2511	369	11251	16140

## 5. HMS-IRC Site Score

**Table 5 HMS-IRC Site Score, Caim**

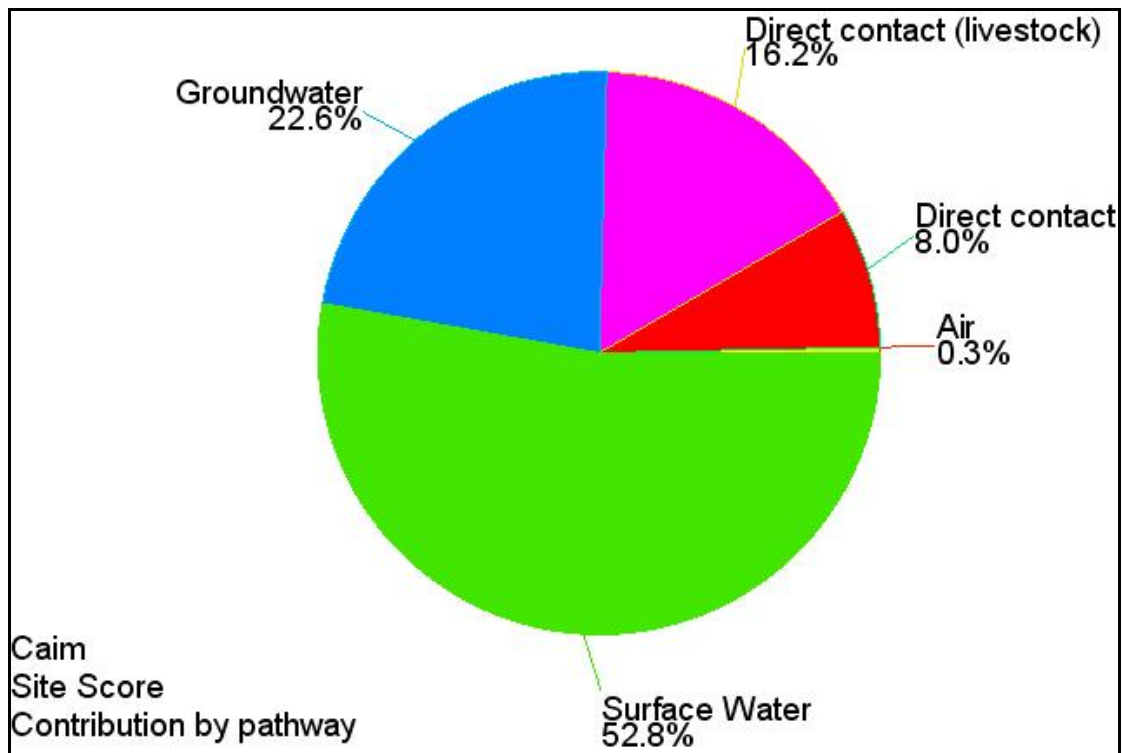
Waste	SP01a	SP01b	SP01c	W007 Discharge	Stream Sediments	Totals
<b>1. Hazard Score</b>	<b>211</b>	<b>176</b>	<b>346</b>	<b>157</b>	<b>314</b>	<b>1204</b>
<b>2. Pathway Score</b>						
<i>Groundwater</i>	25.98	28.86	51.83	19.66		126.34
<i>Surface Water</i>	75.07	65.58	126.22	28.45		295.32
<i>Air</i>	0.85	0.10	0.86			1.81
<i>Direct Contact</i>	22.76	2.88	19.31			44.96
<i>Direct Contact livestock</i>					90.67	90.67
<b>3. Site Score</b>	<b>125</b>	<b>97</b>	<b>198</b>	<b>48</b>	<b>91</b>	<b>559</b>

The total site score for Caim is 559 (Table 5). The bulk of the score (58%) is accounted for by the two spoil heaps, SP01a and SP01c (Fig. 4). The very large volume of the latter (Table 1) gives it a higher score than SP01a despite the exceptionally high Pb concentrations of the latter. Very high measured Pb concentrations over an extended length (> 1km) of stream give an unusually high proportional score (16%) to stream sediments. The relatively low volume of the mine water discharging to the stream minimizes its contribution to the score.



**Fig. 4 Contribution of individual waste sources to Caim Site Score**

Fig. 5 shows the contribution of the different pathways to the total site score at Caim. Pathways are the routes by which receptors are exposed to the hazard. The surface water pathway dominates the scoring, accounting for over half the total score. The low proportional contribution by the groundwater pathway is a consequence of the perceived relatively low vulnerability of the aquifer, i.e. the presence of more than 1m of overburden. Both the direct contact pathways contribute substantially to the score, with the livestock score the greater since there is direct cattle access to streams containing sediments with high Pb concentrations.



**Fig. 5 Contribution of individual waste sources to Caim Site Score**

## 6. Geochemical overview and conclusions

Solid mine waste at Caim has very high concentrations of Pb (5674 – 85213 mg/kg; median 56028 mg/kg) as well as high concentrations of Zn, Cu, S and Mn. The fine processing waste that forms the waste heap on the southern part of the site is uncovered and potentially a source of airborne contamination and direct-contact contamination. Evidence on site suggests quad biking has taken place, increasing the potential for dust releases. Similarly, empty drinks containers suggest the site has been used for other leisure purposes.

The high Pb concentrations measured in run-off and seepage from the solid waste heaps do not appear to persist for any significant length downstream of the site once the surface water has been diluted by stream water. However, stream sediments are contaminated for at least 1km downstream of the site where the measured Pb concentration was 2582 mg/kg. The Expert Group for Silvermines recommended that livestock should not be allowed direct access to watercourses where Pb concentrations are greater than 1000 mg/kg (Inter-Agency Group 2000; EPA 2004).

## References

Inter-Agency Group (2000) Report into the presence and influence of lead in the Silvermines area of Co. Tipperary. Department of Agriculture, Food and Rural Development, Dublin.

EPA (2004) Final report of the Expert Group for Silvermines, County Tipperary – lead and other relevant metals. EPA, Wexford.

Geraghty, M.F. (1991) The geological setting and nature of polymetallic mineralization at Caim, Co. Wexford. Unpublished MS, Mine Records, Geological Survey of Ireland.