Blundell Mine, Edenderry
Co. Offaly

Report on Investigation of
Old Mine Workings

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1. Background

A previously unknown mine shaft collapsed in Edenderry Town on Wednesday 28th September 2011. The collapse appeared in the middle of a tarmac footpath in a public park (Blundell Park). The shaft is believed to have been part of the Blundell mines which were started in the mid-C18th and last investigated for mining in the mid-C19th.

The authors were contracted by Offaly County Council to investigate the shaft and to help identify any other areas at risk from collapse.

2. Geology

The Edenderry lead-silver deposit is hosted in Waulsortian Limestone of Courceyan age (Lower Carboniferous). During the Courceyan, Ireland was located close to the Equator and limestones were deposited on a stable shelf in shallow, warm tropical seas. Towards the end of the Courceyan (Lower Carboniferous), instability in the shelf lead to formation of local areas of subsidence and the rocks of this period can be divided into three distinct facies groups, based on ocean depth and depositional conditions (Sevastopulo and Wyse-Jackson, 2001). Pale grey shelf limestones dominated the shelf environment, while dark grey fine-grained, graded limestones and black shales dominated the basinal environment. In between these two facie are the Waulsortian "reef" Limestones, structures of fine-grained limestone, forming numerous mud mounds at the shelf margins. Waulsortian Limestone is typically light grey in colour and forms massive sequences locally over 500m thick, often with poor bedding. The sequence is comprised of poorly structured lime mud mounds with abundant skeletal remains and often with calcite filled cavities. Although they appear to be similar to modern day coral reefs they formed without the binding effect of fauna and the current theory is that bacteria acted as the binding agent. At Edenderry the Waulsortian mudbanks are set in a matrix of darker oolitic limestones known as the Edenderry Oolite formation and were deposited at the edge of a shelf with the unstable and slowly subsiding Dublin Basin lying to the North-East (Figure 1). Sediments in the Dublin Basin mainly comprised of a rhythmic sequence of very dark fine grained limestones and shales (locally known as the Lucan Formation).

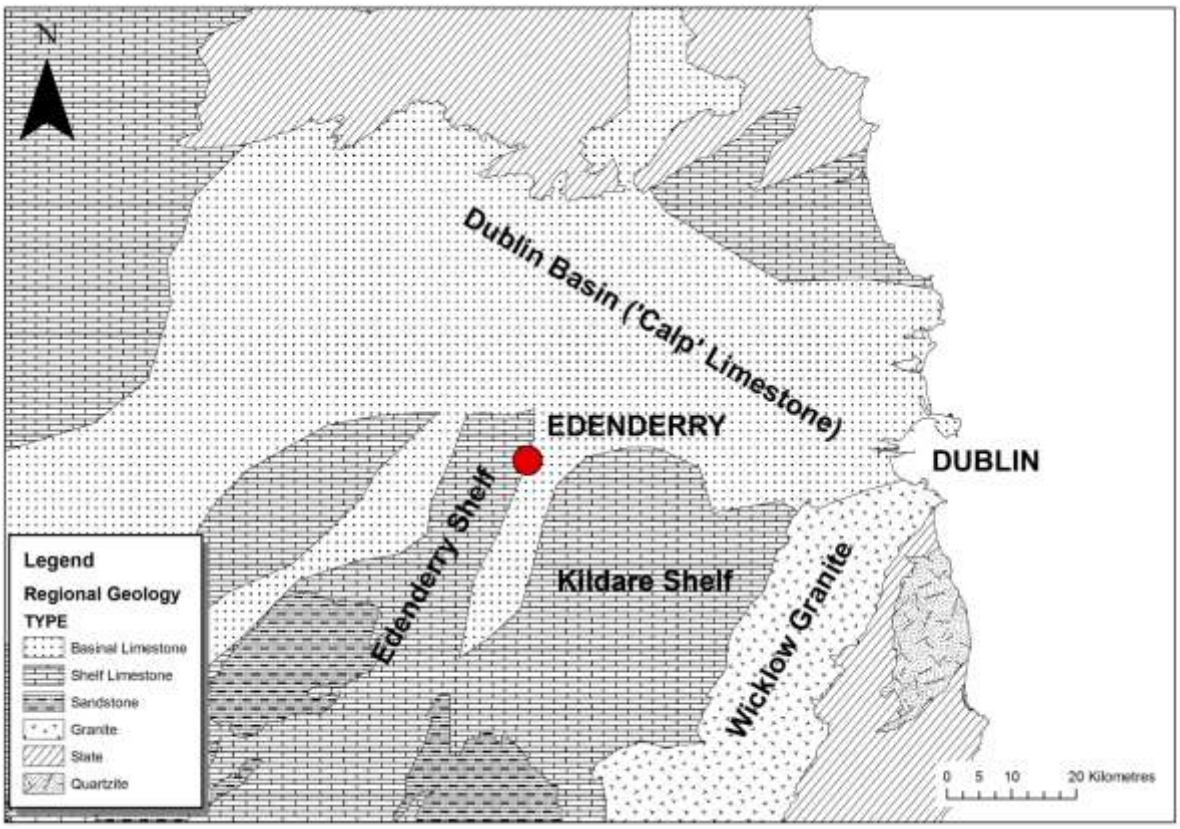

Figure 1. Regional Geology around Edenderry (After Geological Survey of Ireland)

The mine at Edenderry is located to the south of the town on a small hill upon which are the remains of the medieval Blundell Castle and an C18th Church (Castropetre Church). The hill is almost circular, about 500m across and rises some 20m above the surrounding landscape. The form and nature of the hill would suggest that is an eroded Waulsortian mudbank. The "One Inch" geological map from the mid-C19th (Fig. 2) shows the hill to be mostly comprised of dolomitised 'Lower' Limestone overlain by 'Middle' or 'Upper' Limestone to the east. The modern Geological Survey of Ireland map (Fig. 3) shows the Waulsortian Limestones of the hill to be unconformably overlain by the Lucan Formation to the east. However more detailed mapping by exploration companies over the last 20-30 years seems to confirm that most of the hill is underlain by 'reef' or Waulsortian Limestone (Fig. 4).

The only observed exposure of the bedrock in the present investigations has been in the underground workings where the limestone is heavily dolomitised and extensively brecciated. The bedding is poorly defined but appears to dip about 20° towards the south east. The First and Second Series six inch Ordnance Survey topographic maps show quarries on the western flank of the hill (which might have been the source of stone for Blundell Castle and the Church as well as perhaps the first discovery site of the lead-silver mineralisation). One of these was visited in the early 1980s and oolitic dolomitised limestone was observed (also shown in Fig. 4).

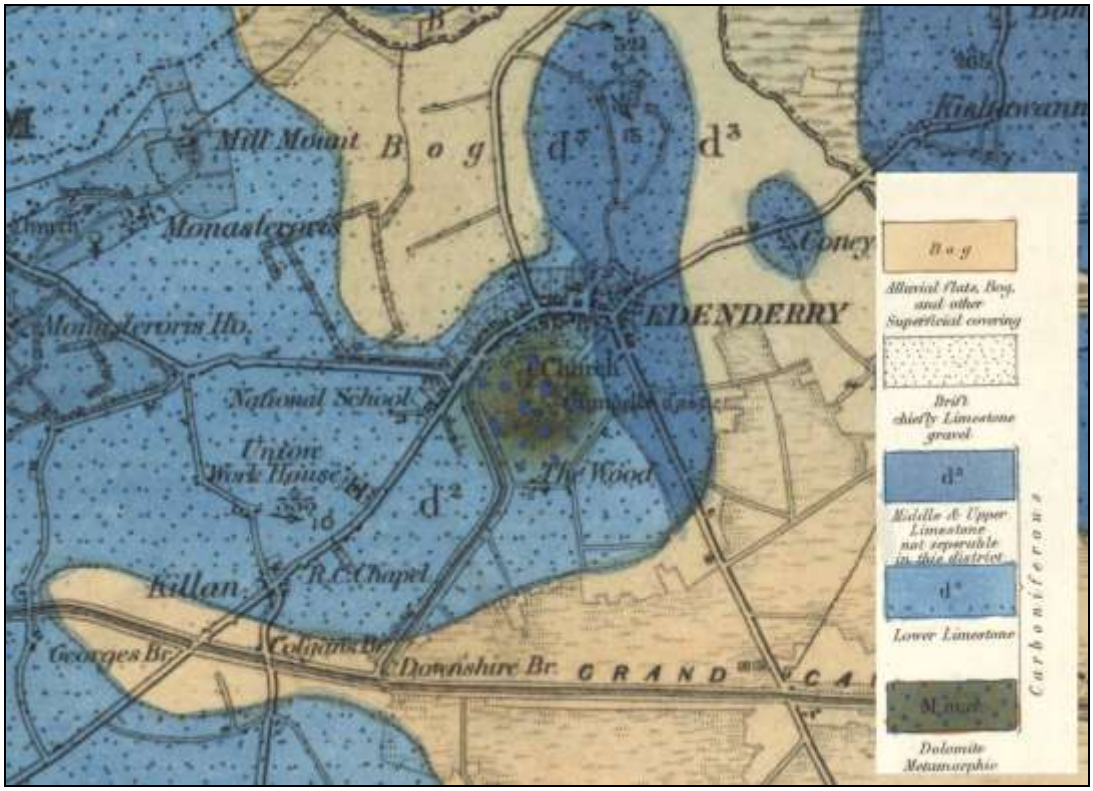

Figure 2. 'One Inch' Geological Map of Edenderry (Source Geological Survey of Ireland)

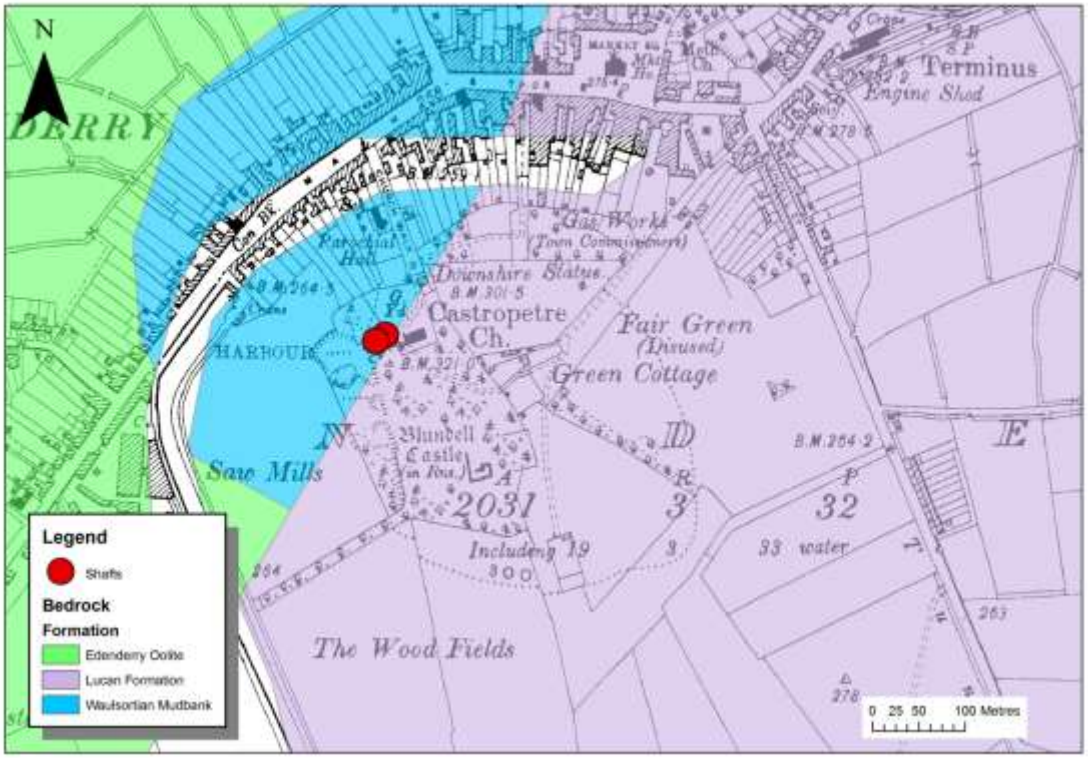

Figure 3. 1:100,000 Geological Map of Edenderry (Source Geological Survey of Ireland)

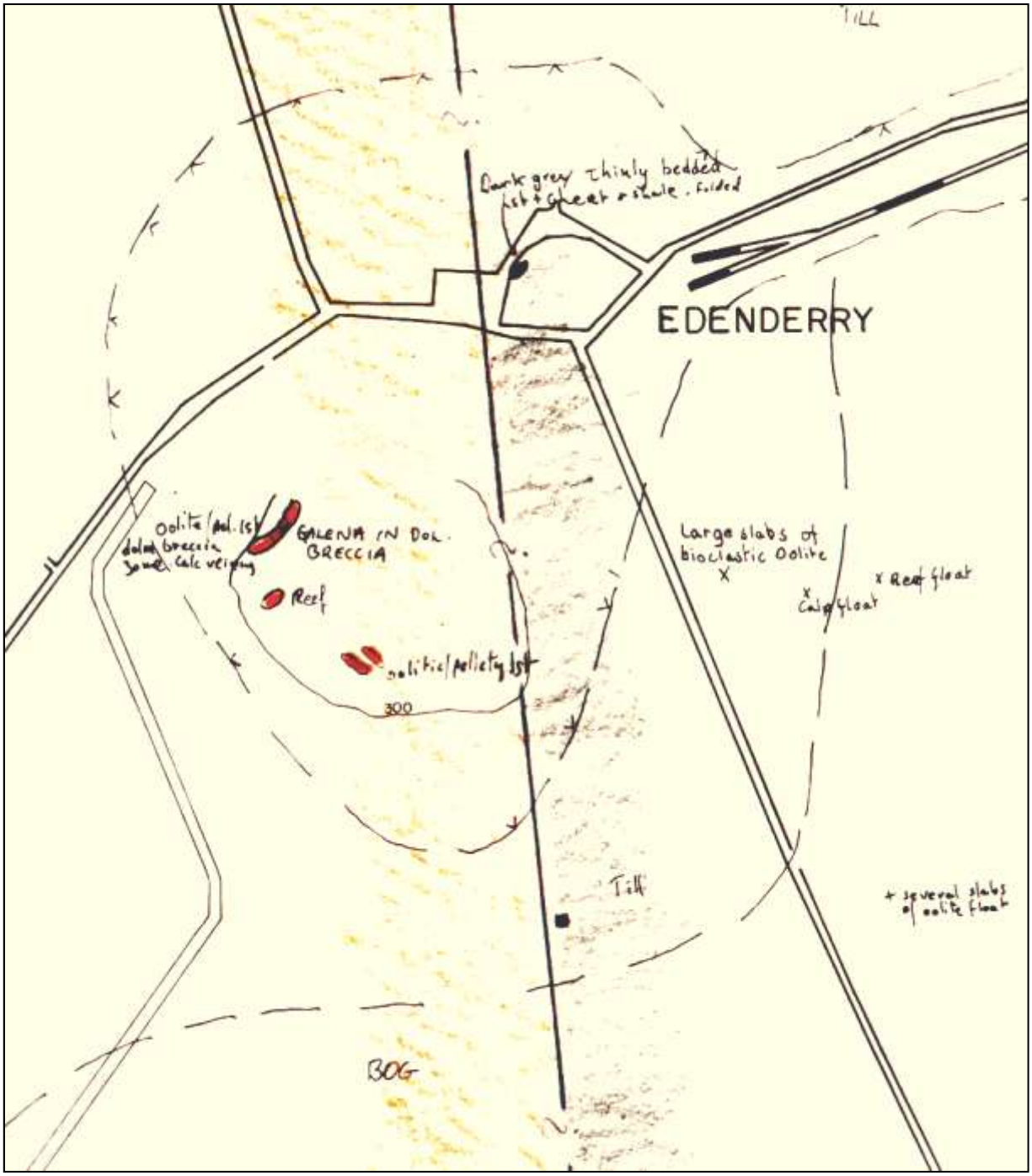

Figure 4: Field Geological Map of Edenderry (Source Baryton, 1982. Open File Report Exploration and Mining Division, Department of Communications, Energy and Natural Resources)

3. Mineralisation

Coote (1801) records "On the Hill of Edenderry, now the church yard, there was formerly a silver mine, twice attempted to be worked, but not within these forty years". Coote did not give any description of the mineralisation. Weaver in 1825 inspected the Edenderry mine workings and presented a report to the Hibernian Mining Company in which he noted the presence of galena particles in calcareous spar (Critchley and Schwartz, 2011). Subsequently the Geological Survey of Ireland (1860) published a memoir for the one inch geological map covering Edenderry in which was noted the presence of carbonate veins and previous working for lead, but no there were no details of the form of mineralisation. The six inch geological field slips from the same period (Fig. 5) do record the approximate location of old mine workings. A search of known mining records has not revealed any details of production figures from the Edenderry mine.

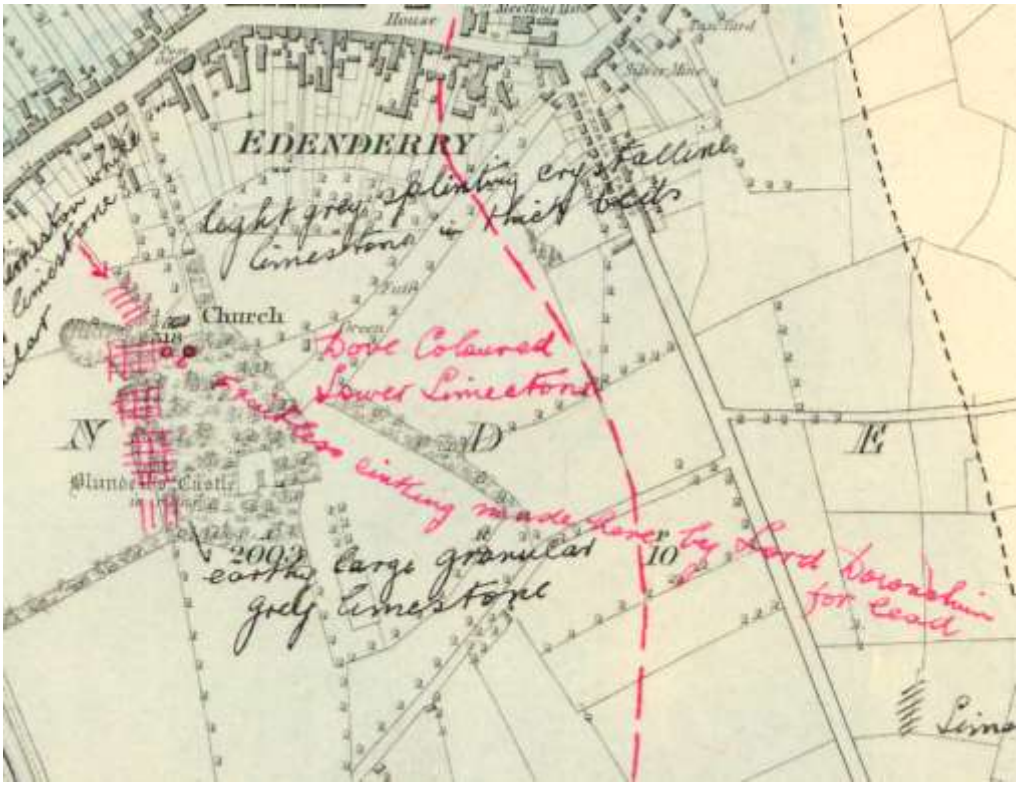

Figure 5. Fair copy geological field map (circa 1850's) showing three shafts and note "Fruitless working made here by Lord Downshire for lead"

A modern phase of mineral exploration on Co. Offaly started in the early 1970s and over the years several different companies have undertaken exploration; primarily for zinc and lead. The results of one aspect of the work shows a large anomaly of lead in the soils surrounding Edenderry (Fig. 6). This anomaly not only covers the hill to the south of the town but also the area to north, but there is no evidence of historical mining in the area to the north.

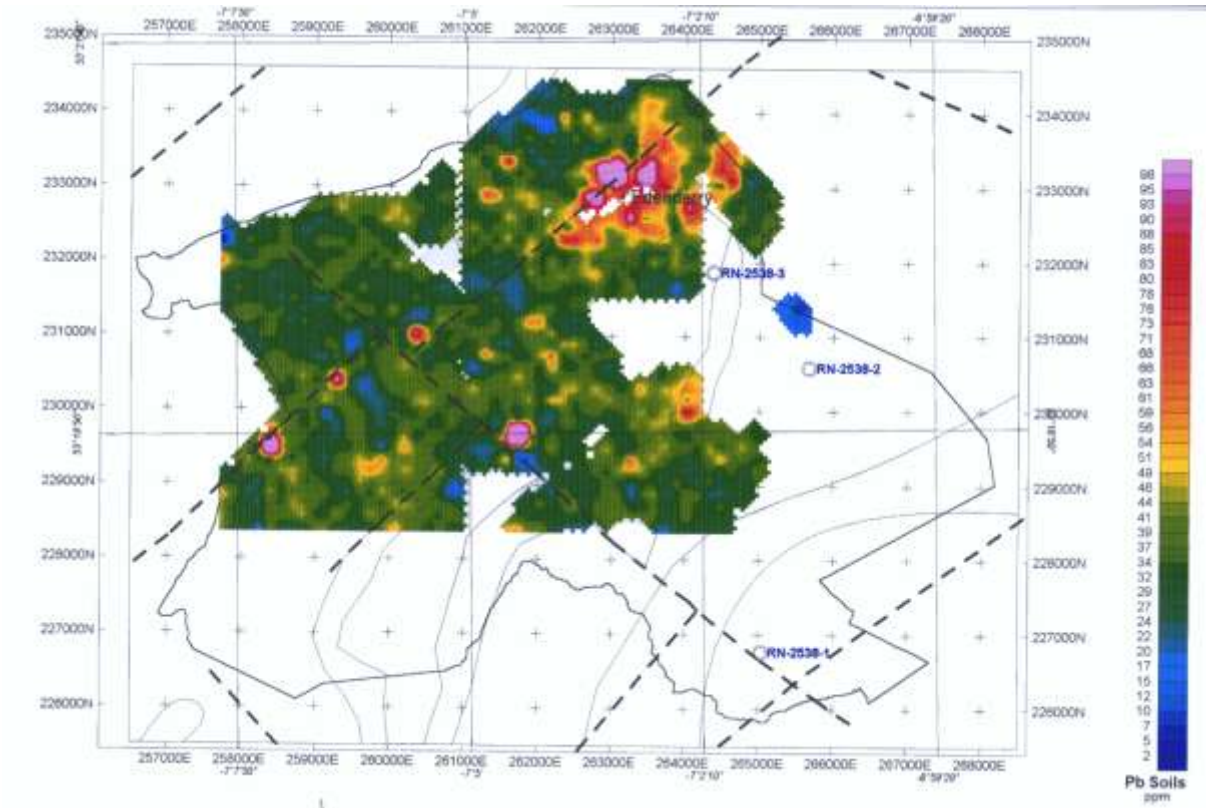

Figure 6: Pb (lead) in soil geochemistry map of Edenderry (Source Noranda, 1999. Open File Report Exploration and Mining Division, Department of Communications, Energy and Natural Resources)

Geological mapping at Edenderry in the mid-1975 (Fig. 7) delimited a zone of brecciated mineralisation (calcite and galena) in dolomitised limestone to the west Castropetre Church . At this time four shafts were recorded on the site and possibly one or two features which suggested collapsed workings. Parts of the quarries were also still accessible on the western flank of the hill in the 1970s.

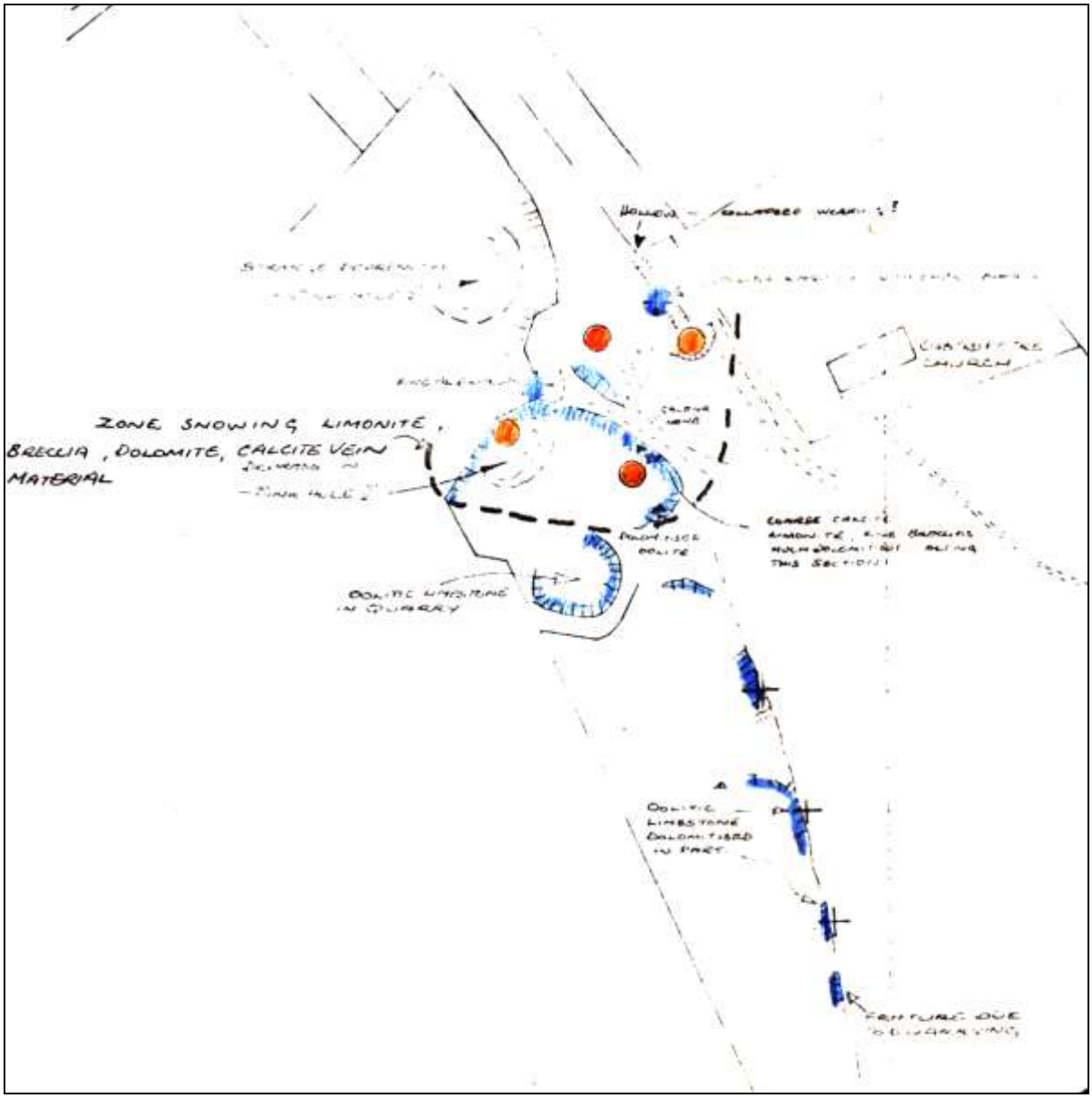

Figure 7. Geological sketch map of Edenderry showing observed mineralisation and surface workings (Source Cominco, 1975. Open File Report Exploration and Mining Division, Department of Communications, Energy and Natural Resources)

Observations underground during the present site investigation has also confirmed the style of the mineralisation to be in the form a breccia hosted orebody. In addition there is sub-horizontal calcite veining which appears to be contemporaneous with the brecciation and follows the bedding. This differs from the type of mineralisation which the C18th and C19th miners might have expected. Such miners were usually only familiar with vein (lode) style mineralisation in which the ore is found in vertical or sub-vertical fractures or faults in the rocks. Vein style mineralisation is usually extracted using shafts and galleries which follow the depth and strike (horizontal extent) of the fracture. The breccia style of mineralisation as found at Edenderry consist of clasts of the host rock (limestone) with a cement of calcite and occasional coatings of galena (lead ore) or sphalerite (zinc ore) with pyrite (iron sulphide). In breccia style mineralisation there may be local rich 'pockets' of ore but as a whole the ore grade may be low but distributed over a larger massive orebody. The

best way to mine such a breccia orebody would be to use underground pillar and stall mining or opencast surface mining, neither of these methods appear to have been used at Edenderry. In fact the overall grade of the ore was probably not good enough for economic mining and it is likely that much of the working was via a series of shallow pits and shafts across the area of mineralisation and/or access via adits driven horizontally from the quarries to the west.

Figure 8. Breccia style mineralisation in the underground workings at Edenderry showing clasts of dolomitised and iron stained limestone in a matrix of coarse calcite crystals

Edenderry is only one site in the Irish Midlands in which breccia style mineralisation has been found. Nearby at Harberton Bridge in County Kildare a large breccia style deposit was discovered in the mid-1970s (Emo, 1986). It consists of 3.6Mt of ore at a combined lead-zinc grade of 9.6% and at present it is not economic to work the deposit. The Harberton Bridge deposit extends over a vertical range of about 500m (Fig. 9).

The genesis of the breccia style mineralisation has been studied by a number of researchers. Emo (1986) postulated that the source of the metals at Harberton Bridge were either derived from basement leaching or from basin dewatering of the contemporaneous Carboniferous sediments. Wilkinson at al (2005) have determined the chemical composition of 350-my-old solutions extracted from fluid inclusions, and strontium isotopic compositions of hydrothermal minerals from the Irish zinc-lead orefield. These data show that ore-forming fluids were derived from evaporated seawater and acquired metals by deep circulation within fractures in continental crust. Massive lead-zinc sulphide mineralisation (such as at Navan and Silvermines) occurred in the near-seafloor environment when these solutions returned to the surface and mixed with brines rich in H_2S produced by bacterial reduction of seawater sulphate. The breccia ores at Edenderry (and Harberton Bridge) could conceivably be located above basement faults on feeder zones to massive

sulphide sea-bed mineralisation in the now eroded limestone sequences above. The brecciation would probably be the result of hydraulic fracturing of the host rocks by the mineralising fluids.

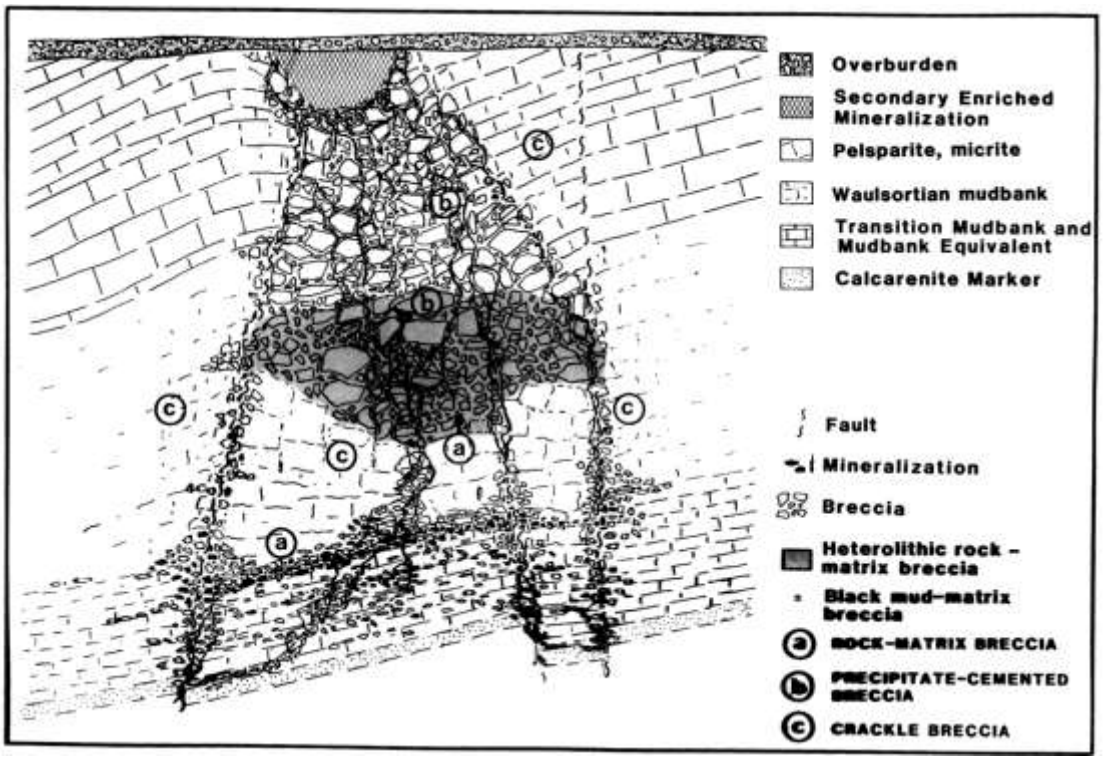

Figure 9. Breccia style mineralisation at Harberton Bridge, vertical range is approximately 500m(from Emo, 1986)

4. Site Investigation

The shaft which opened up in October 2011 is situated in Blundell Park on a small hill in the southern part of Edenderry Town (Fig 10). The shaft collapse was in the centre of a tarmac footpath which crosses managed grass parkland about 30-40m west of Castropetre Church (Figs. 11-13). The area has witnessed previous subsidence, and during the course of our site investigation several locals related to us how a suspected shaft had opened in about 1985 close to the present collapse and very close to the church wall. One recalled seeing a brick or stone lined structure around a metre square and another remembers someone entering a tunnel with a stone lined archway and walking underground for some 40-50 feet. Although these accounts cannot be verified, they serve to illustrate the possible presence of other workings in the immediate area.

The opening in the tarmac was about 1m circular in diameter but was undercut all around for about 50cm to the sides of the shaft below (Figs. 14). The shaft itself was square cut to a depth of 4-5m deep with the remains of stone collaring on the southern side and with fragments of stone-lining to a depth of just under a metre, holding back the soil cover. Although the shaft was about 2m in diameter when investigated it would appear that the sides have partly collapsed and the original diameter would have been smaller. A modern water mains pipe was encountered cutting across the shaft about 1m below the surface and it is surprising that the shaft was not found when this pipe was laid back in about 1969, suggesting that the shaft was covered over just beneath the pipe (Fig. 15). Typical methods of covering old shafts in the past would be with rocks placed upon timbers or a circular 'beehive' of rocks over the shaft collar. At the bottom of the shaft a two metre long level lead off to the north-east (034 degrees). Some digging (and removal of traffic cones which had been thrown into the shaft) was necessary to gain access to the level. Our digging did not reveal the bottom of the shaft and there were at least three traffic cones still embedded in clayey soil with boulders. The shaft may be only as deep as the level which leads off to the north but a deeper continuation to lower workings cannot be ruled out.

Entry to the level at the bottom of the shaft was hampered by low oxygen levels, detected using a gas meter, and concern about a possible internal shaft within the workings. The council brought in a 4-wheel remote controlled camera to inspect the extent of the workings before we judged it safe to enter. With the workings beginning to vent we judged that the oxygen levels (18.5%) were acceptable for a short stay and we conducted a survey using a tape and compass The level was 2m long and sloped down steeply being partly infilled with gravel and with only a roof opening of about 30cm at the start. It led into a small chamber in brecciated limestone 1.3 m in height and 1.7 m across . There was abundant brown coarse calcite crystals in the breccia matrix with some indication of sphalerite but no immediate signs of lead minerals. The workings may date from the C18th as we only saw evidence (Fig. 16) of the use of hand tools (pick marks) and no obvious drill holes. Vegetation and snail shell debris on the roof of the chamber would suggest that at some time the workings have been completely flooded with water to the roof.

A 5.5m long horizontal branch level from the chamber to the east (090 degrees) terminated at a shaft going upwards which was filled with unstable boulders (Fig. 17). The location of this shaft corresponds to another shaft on the surface that apparently collapsed on the surface about 25 years

ago and was in-filled. Fragments of plastic debris in the rubble at the foot of this shaft would seem to confirm this as being of modern derivation. A second branch level from the chamber to the north (010 degrees) slopes downwards by about 30 degrees and terminates where the debris from the shaft collapse and gravel in-wash fills the passage to the roof. Due to time constraints we were unable to determine if the passage continued past this point as digging would be needed to remove the gravel.

The possibility of a level heading south-west from the entrance shaft towards the site of the old quarries cannot be dismissed but soil and debris infill obscured this side of the shaft. The continuation of the entrance shaft below the level accessed is also a possibility but again this could not be confirmed due to debris in the shaft. The lack of standing water in the workings accessed would suggest either drainage by deeper workings or a porous nature to the limestone rocks (but as noted above we did find evidence of flooding which might suggest that the water table fluctuates).

Following our site investigation it is understood that the mine shaft was sealed by tipping of hardcore into shaft.

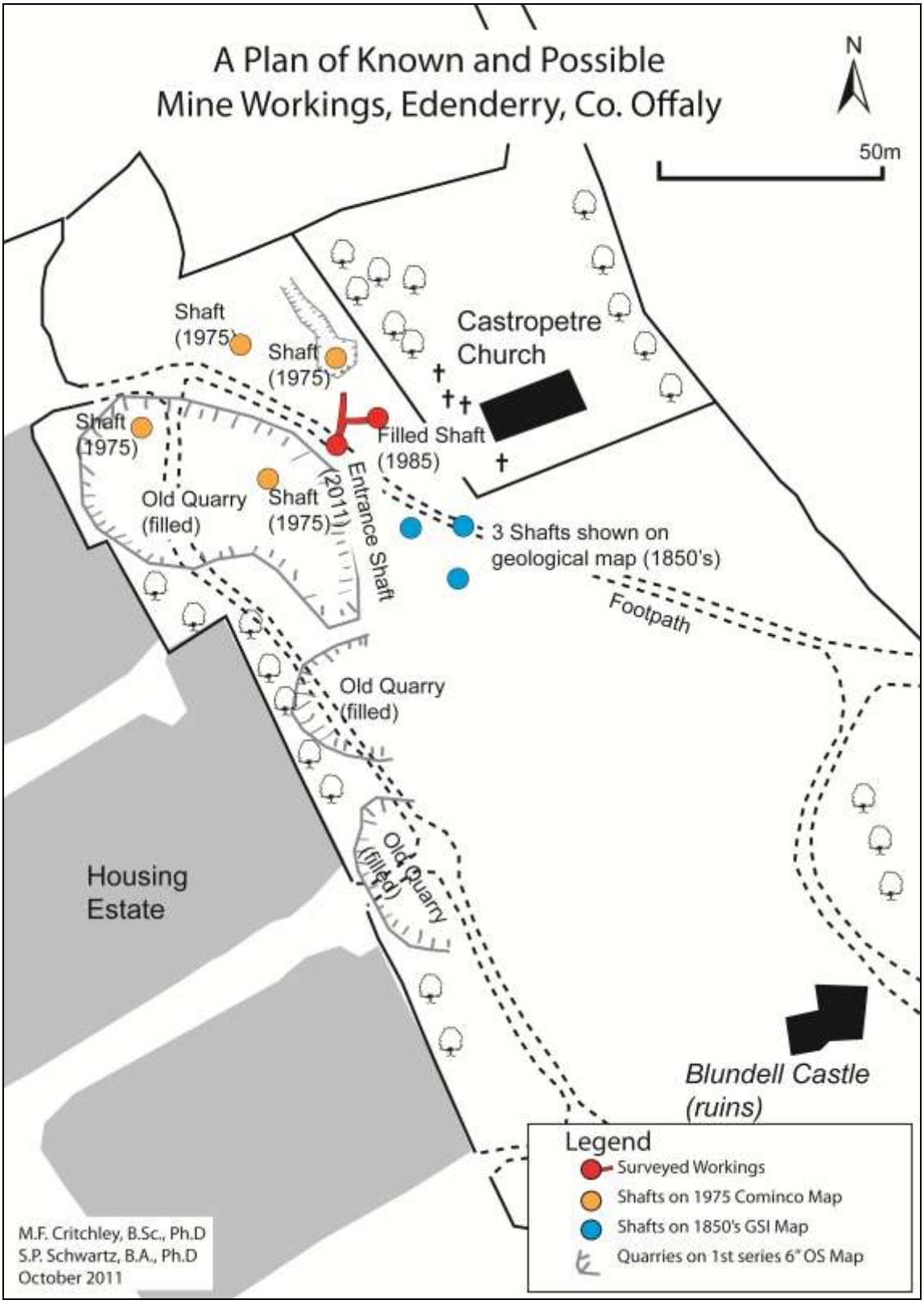

Figure 10. Location of surface features from 2011 investigations, 1st Series 6 inch map, 1975 Cominco map and geological map field sheets (circa 1850's)

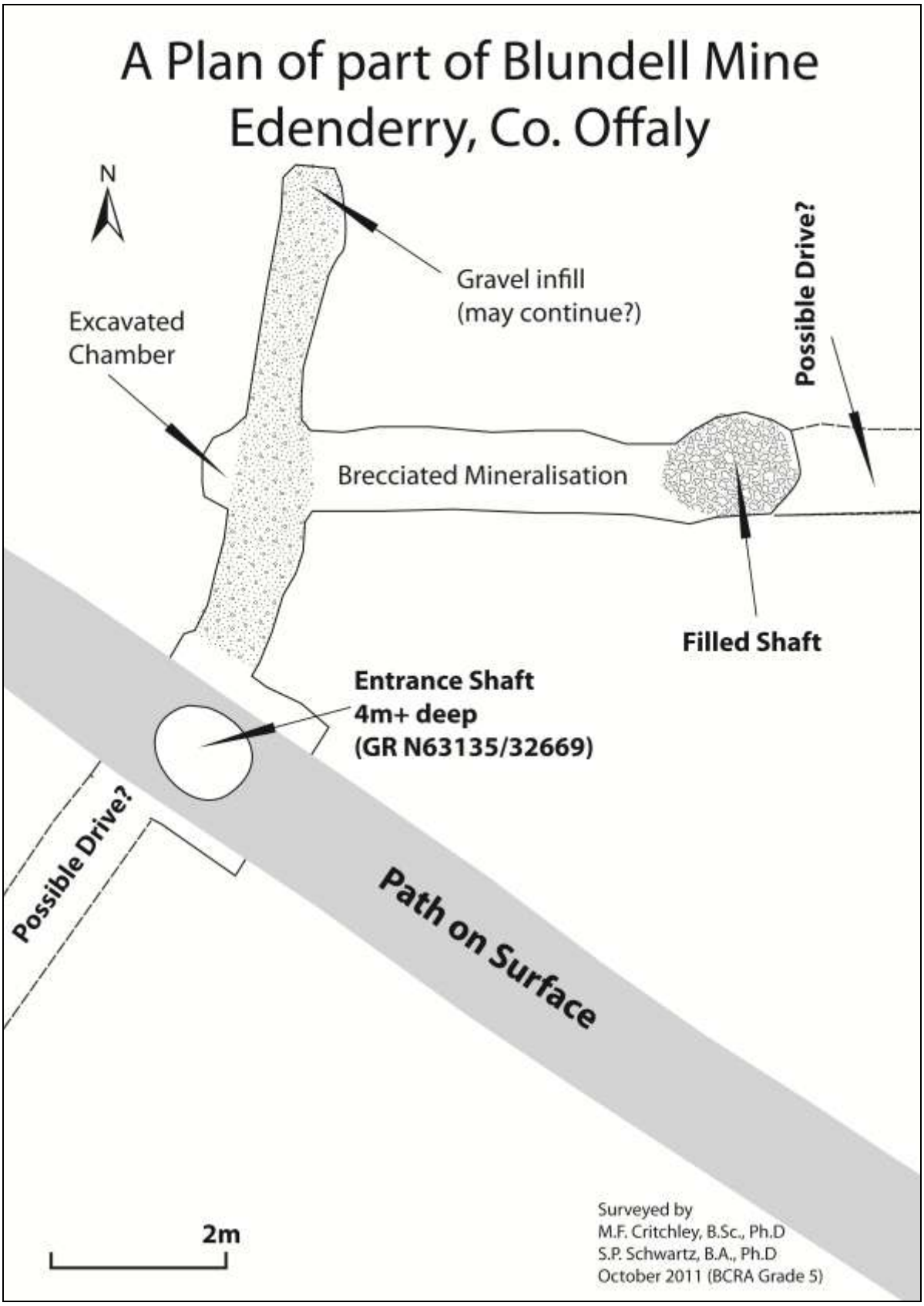

Figure 11. Plan of workings

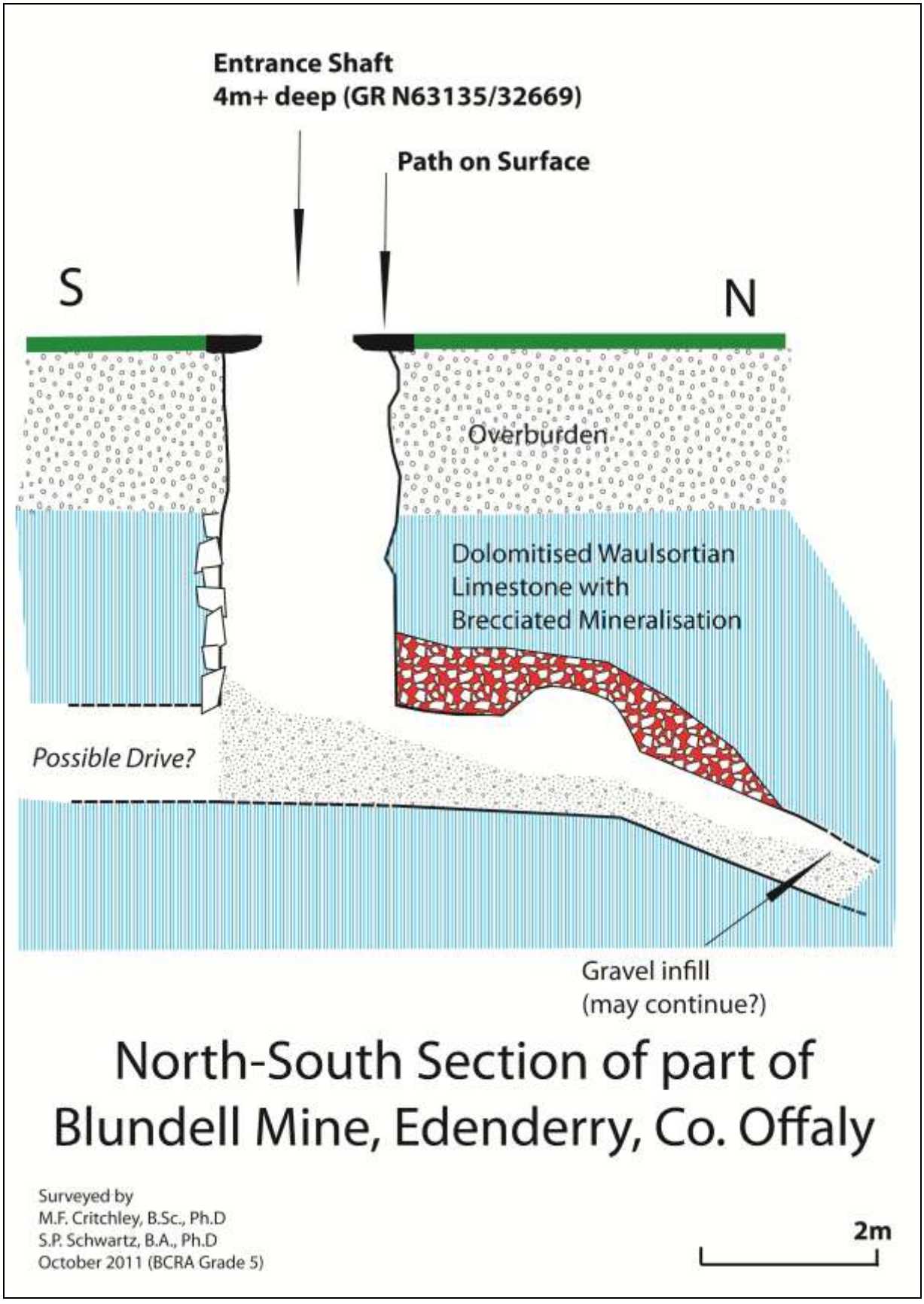

Figure 12. North-South Section of workings

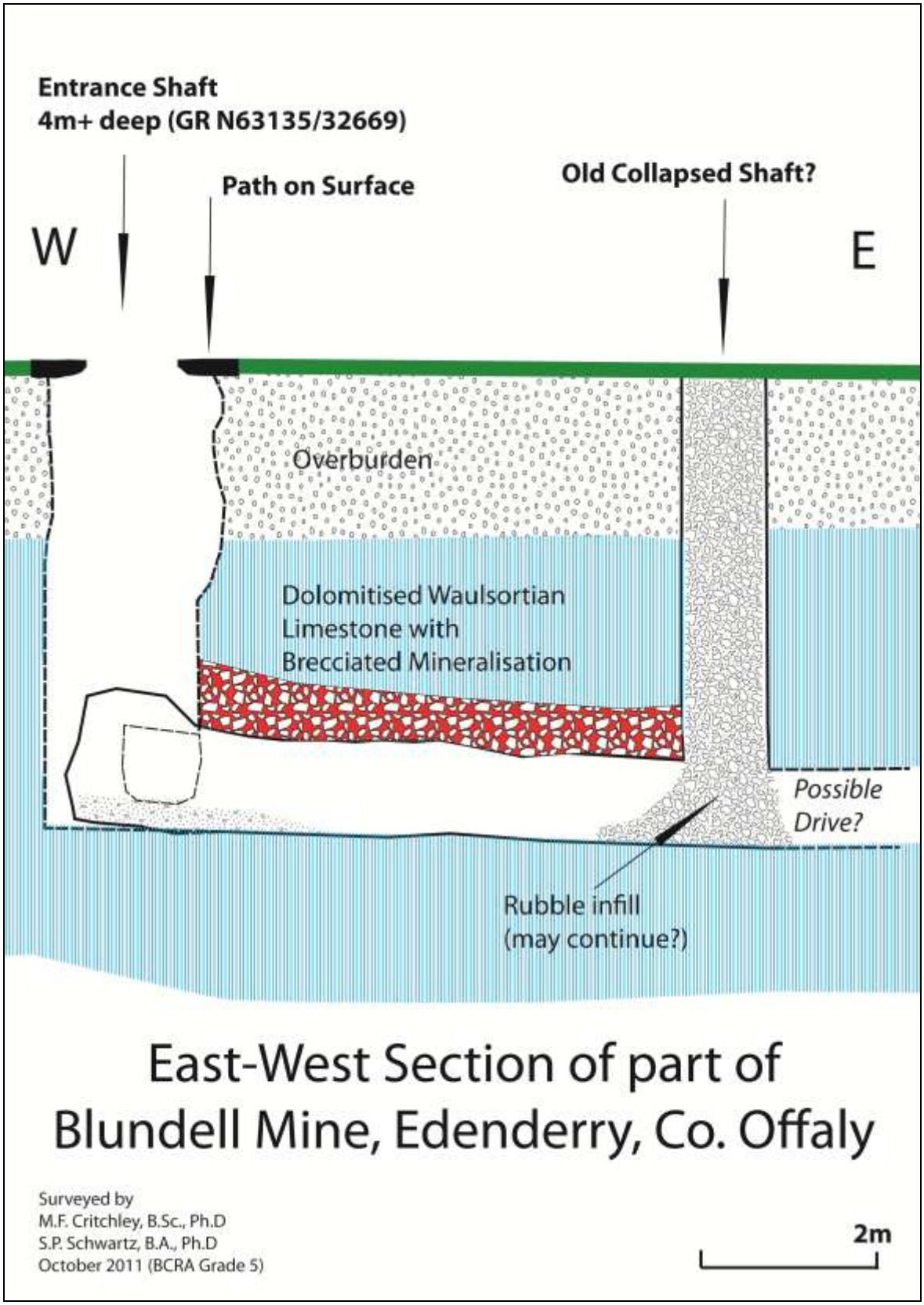

Figure 13 East-West section of workings

Figure 14. Entrance Shaft which appeared in the footpath in October 2011

Figure 15. Looking down the entrance shaft showing water main in the top right

Figure 16. Pick marks

Figure 17. Foot of filled shaft at the end of the workings (this was the shaft which opened up in 1985)

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