LANCASTER
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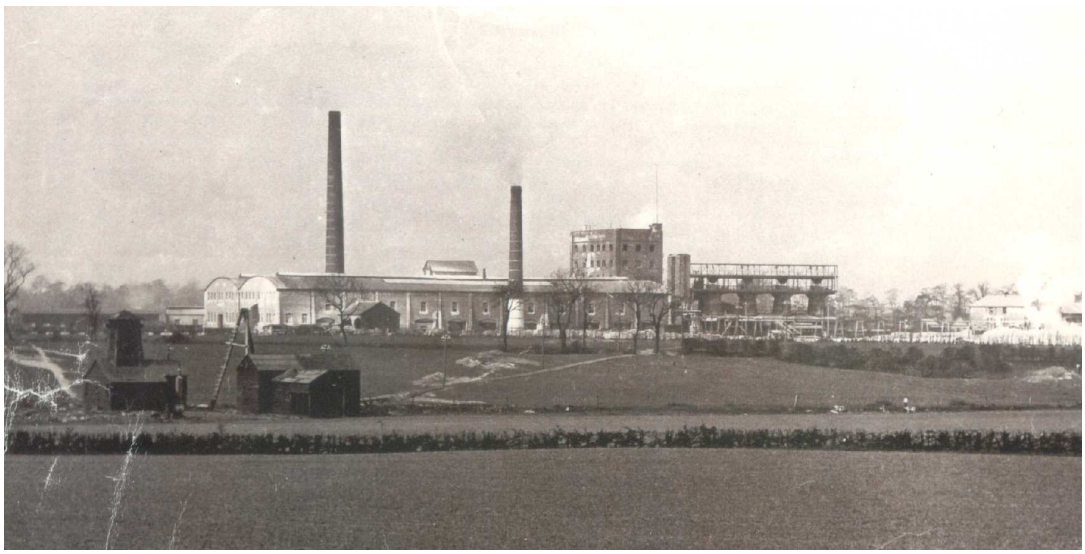
PLUMLEY LIMEBEDS
CHESHIRE



Interim Survey Report

Commissioned by: Cheshire County Council

Plumley Limebeds, Northwich
Cheshire

Interim Survey Report

Report no 2000-2001/044/AUA8059

Checked by Project Manager. ..... Date
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December 2000

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SUMMARY

Lancaster University Archaeological Unit (LUAU) were invited by Cheshire County Council Environmental Planning to create an identification map of the surviving remnants of the Plumley Limebeds, Northwich, Cheshire (SJ 708750), to undertake a fabric survey of a large warehouse, and, subject to the results of the identification survey, to undertake an archaeological evaluation of selective elements of the landscape. The programme was designed in accordance with a brief by Mark Leah, Archaeology Officer (Development Control) for Cheshire County Council. The land is presently a nature reserve but is on the site of a former ammonia soda works complex, which has been highlighted as being of particular importance in a recent step 1 report on the Chemical Industry for the Monuments Protection Programme (MPP) of English Heritage (D Cranstone pers comm). Early ammonia soda plants are rare; the Plumley site is one of only ten recorded by English Heritage's MPP programme for the Chemical Industry, and of these the remainder have either been destroyed entirely or have been severely altered by later use (UMAU 1999).

The results of the survey, undertaken in November 2000, have demonstrated the extensive survival of remains associated with all phases of the chemical plant, through both its civilian and war-time use. The fabric survey created a ground-plan of the warehouse, and the elevations of the building were recorded photographically. The potential for undertaking trial excavation was discussed with the client and the Archaeology Officer for Cheshire County Council, and it was agreed that localised trial excavation of the physical remains would not significantly add to our understanding of the complex, and therefore the evaluation phase was not implemented.

As a result of the walk-over survey the remains, which are at present at risk of becoming engulfed by the ensuing vegetation from the surrounding woodland, can be broadly equated with the buildings shown on the historical mapping (UMAU 1999). However, the interpretation of their function and purpose is still unclear as documentary evidence was limited in terms of the function of all the buildings. This lack of clear understanding regarding the function of the buildings is an issue which requires resolution; and it is recommended that further research be undertaken, particularly regarding the use of the plant during the years of the First World War (1914-18). It is recommended that a programme of detailed survey be carried out, which will enable a direct comparison with other First World War chemical plants in Britain. The fieldwork can then inform any further management decisions which need to be made as regards consolidation and interpretation of the remains.

Any attempts at forest clearance within the environs of the remains will have an impact on the remains themselves. The warehouse is at not at immediate risk, though structural weaknesses, observed during the fabric survey, suggest that further deterioration may occur should consolidation work not be undertaken within a short period.

ACKNOWLEDGEMENTS

LUAU would like to thank Paul D erryhouse of Cheshire County Council for commissioning the work, providing considerable assistance with the setting up of the project, and with providing copies of the 1910 and 1946 photographs. We would also like to thank Mark Leah, Archaeology Officer for Cheshire County Council, for his support in the course of the survey and to Alan Moores for his invaluable assistance both on and off site.

The walk-over survey was undertaken by Matthew Town, and the fabric survey was by Chris Wild and Matthew *Town:* The drawings were prepared by Neil Wearing and Jamie Quartermaine. The report was, written by Matthew Town and was edited by Jamie Quartermaine and Rachel Newman. The project was managed by Jamie Quartermaine.

1. INTRODUCTION

1.1 CONTRACT BACKGROUND

1.1.1 Lancaster University Archaeological Unit (LUAU) was invited by Cheshire County Council Environmental Planning to undertake a watching brief at Plumley Limebeds, Northwich, Cheshire (SJ 708 750). The work was undertaken in advance of a programme of reclamation and environmental improvement of the site for leisure and recreation. This followed on from, and was informed by, an archaeological assessment of the overall study area undertaken by the University of Manchester Archaeological Unit in August 1999 (UMAU 1999). The programme was designed (*Appendix 2*) in accordance with a brief (*Appendix 1*) by Mark Leah, Archaeology Officer (Development Control) for Cheshire County Council, to create an identification map of the surviving remnants of the site, to undertake a fabric survey of the large warehouse, and, subject to the results of the identification survey, to evaluate key elements of the landscape. The land is presently a nature reserve but is on the site of a former ammonia soda works complex, which has been highlighted as being of particular importance in a recent step 1 report on the Chemical Industry for the Monuments Protection Programme (MPP) of English Heritage (D Cranstone pers comm). The project design was adhered to in full, though following discussions with Cheshire County Council, it was decided to suspend the trial trenching programme, as it was considered that this would not usefully inform our understanding of the complex.

1.2 TOPOGRAPHICAL AND GEOLOGICAL BACKGROUND

1.2.1 ***Location and Current Land-use***: the study area, which lies *c*1km west of Plumley village and *c*0.5km south of the A556, at SJ 707 750, is a Site of Special Scientific Interest and a nature reserve managed by the Cheshire Wildlife Trust. Most of the site is covered with woodland, with a sizeable pond in the south east. Immediately to the north of the study area is the moated Holford Hall, the moat and moat platform of which are a Scheduled Ancient Monument. The hall is a Grade II* Listed Building, and the bridge across the moat is Grade II (UMAU 1999).

1.2.2 ***Geology:*** the solid geology of virtually all the study area comprises Lower Keuper Saliferous Beds, with Middle Keuper Marl in the extreme south-west corner. The overlying drift geology is predominantly Boulder Clay, but in the eastern half of the study area and running approximately north-north-east by south-south-west is a thin band of alluvium. To the south-east of the study area, beyond the railway line, are surviving peat deposits of the wetland of Holford Moss (Leah *et al* 1997, 102-3). The tithe award for Plumley names a field in the south-east corner of the study area as Moss Field, suggesting that this wetland once extended into the study area (UMAU 1999).

1.2.3 ***Topography:*** the topography of much of the study area is fairly flat, at a height of *c*30m AOD. However, in the north is an extensive mound of lime waste, with sides rising *c*7-8m high. The ground level in parts of the east of the study area is reported to have been raised by the tipping of material from

the construction of the M6 in the 1960s: to that period also belongs the construction of the present large pond (UMAU 1999).

1.3 HISTORICAL BACKGROUND

1.3.1 Most of the study area lay within the township of Plumley, the exception being the south-west corner which lay within Lostock Gralam. Immediately north of the study area lies the moated site of Holford Hall (CSMR 1235). The present house is a part of a larger timber-framed building of early seventeenth century date constructed for Mary Cholmondeley, heiress of Christopher Holford of Holford. The late nineteenth century Ordnance Survey (OS) first and second edition maps show the study area as being agricultural land (UMAU 1999).

1.3.2 John Henry Davies bought the Holford Hall estate in the early 1900s and exploratory borings were carried out on the estate revealing brine measures. In September 1906 Davies offered to sell the estate for £340 per acre to Ivan Levinstein, a Manchester dyemaker, who in turn sought the assistance of Arthur Chamberlain, chairman of the Birmingham ammunition firm of G Kyloch & Co, with the intention of developing the property as an ammonia soda works (UMAU 1999). The purchase was completed in 1907, and the Ammonia Soda Company Ltd (ASCOL) was founded as a private limited company in July of the following year (Plate 1); in 1912 the firm was launched as a public company. The prospectus for the Conversion recorded that '*The Company was established for manufacturing amongst other things Soda Ash by the Solvay Ammonia process. In addition to Soda Ash, Soda Crystals are now being manufactured and the company contemplates the manufacture of Caustic Soda and Bicarbonate of Soda*' (*ibid*). High optimism surrounded the conversion and the prospectus included geological reports indicating that the supply of brine on the company's land was almost inexhaustible, but subsequent profits were disappointing. In 1916 the company was acquired by Brunner, Mond & Co, but, prior to that date, this firm had attempted to limit the activities of the Ammonia Soda Company Ltd by buying up land around the Plumley works; they also took daily samples from a stream below the works in the hope of finding evidence of pollution. It may be added that the main written accounts of the works were by Brunner, Mond & Co, and reflect that company's views. A personal account from Herbert Levinstein (son of Ivan Levinstein) maintained that the failure of the Ammonia Soda Company Ltd's plant at Plumley was a lack of brine caused deliberately by Brunner, Mond & Co who owned the land across the railway and sank two brine shafts and built a pumping station as close to the ASCOL works as possible (*ibid*). Brine was pumped from here to reservoirs where the brine could flow by gravity to Brunner Mond's Lostock ammonia soda works. The corporate history attributes the failure to lack of water and stream contamination (George Twigg pers comm; UMAU 1999).

1.3.3 ***Munitions:*** in the Great War, Brunner Mond became a leading player in the production of explosives, producing and purifying TNT (Tri-Nitro-Toluene), and in the production of Amatol. Britain was well-placed for the production of TNT; its main ingredient, Toluene, derived from coal tar and benzene, and the explosive was regarded as safer than its counterparts such as Lyddite (Picric Acid), as it could not be exploded by flame or strong percussion. Old

dyeworks, using good sources of coal tar, were rapidly converted to the production of TNT, mainly in the area around Manchester; Brunner Mond converted an idle caustic soda factory at Silvertown in East London to its production, and carried out hazardous purification of the substance at its Northwich plants (Cockroft 2000). Pure TNT was relatively expensive to produce, but by mixing it with ammonium nitrate it was possible to produce an effective but more economic explosive, known as Amatol, at a ratio of approximately 1:4 between the two substances. Ammonium nitrate was also used to create Nitric Acid, a prime raw material of most explosives, and consequently there was a considerable demand for ammonium nitrates at the outset of the war. Prior to the war nitrates had been derived from saltpetre (potassium nitrate) which derived from Chile, but submarine blockades meant it became difficult to rely on this supply and a more local alternative was sought. One option was to create ammonium nitrate from calcium nitrate, and Brunner, Mond and Co became experts in this process, through their extensive knowledge of the handling of ammonium nitrate manufacture (Watts 1923).

1.3.4 ***Plumley Munitions Plant:*** the ammonium nitrate production process became centered on a number of pre-existing plants in Cheshire (Cockroft 2000), particular that at Lostock Gralam, near Northwich. The raw material, calcium nitrate, was derived by treating sodium nitrate with calcium chloride, and was produced at an experimental plant that was established, on behalf of the Ministry of Munitions, alongside the Ammonia-Soda plant at Plumley. Between 1916 and 1918 the Plumley munitions plant produced 62,110 tons of calcium nitrate and 91,210 tons of calcium nitrate tetrahydrate (Watts 1923, 53).

1.3.5 ***Post-War Operations:*** after the end of World War I, the munitions plant was demolished (Plate 2). The original Ammonia Soda plant reverted to the production of Soda Ash but, in 1919, the Ammonia Soda Company Ltd went into voluntary liquidation on the grounds of poor market conditions (UMAU 1999). Brunner Mond then bought the site outright and production continued, but in 1926 the site was finally closed. From the 1940s to the 1980s the large warehouse was used to store sodium salts by Associated Octel (Moores forthcoming).

1.4 ARCHAEOLOGICAL BACKGROUND

1.4.1 The earliest known plan of the works is that on the 1908 OS 1:2,500 map**,** which shows the complex to have consisted of several buildings in the western half of the study area. These were served by their own railway network, linked with the adjacent main line, and were approached from the north-west by the routeway named Ascol Drive after the company. The only other known plan to show the works was drawn by AW Tangye (nd), of Brunner Mond & Co, which also includes a sketch of the buildings and is annotated with the names and function of the various parts shown; although the date is uncertain it was produced approximately between 1910 and 1914. Neither the 1908 plan nor that by Tangye includes the largest structure still standing on the site, the buttressed warehouse building which was built as part of the 1914 munitions works.

1.4.2 In the east of the study area the 1908 map indicates the location of a brine shaft sunk in 1907; however, there are a further four brine wells, three of which are known to have been sunk in the period 1906-8 (A Moores pers comm)

1.4.3 Maps produced in 1918 (1918 Site Plan and 1918 Site Drainage Plan) show that there were two main plants, the earlier soda ash plant in the eastern part of the site, and the larger munitions plant towards the southern end of the site. Large lime waste mounds occupied the eastern and northern part of the site. The next published OS map of the site, in 1938, shows the works' railway network intact, but no buildings are shown apart from the warehouse and two small structures. The use of the warehouse, and the remainder of the site, during the inter-war years is uncertain, but the Associated Octel plant constructed in the late 1930s just beyond the study area, on the south side of the main line, used the warehouse for storage until the 1980s when the last element of the Plumley works finally closed (UMAU 1999).

1.4.4 The railway within the study area had been removed by the mid-1950s as it does not appear on either the OS mapping or on aerial photographs of the period. The aerial photographic evidence from the mid-1950s shows that light woodland had already become established on at least the western side of the study area, with this tree cover becoming denser and spreading across most of the study area by the 1970s (*ibid*).

1.4.5 A full archive of the watching brief has been produced to a professional standard in accordance with current IFA and English Heritage guidelines (*Management of Archaeological Projects,* 2nd edition 1991).

2. METHODOLOGY

2.1 INSPECTION SURVEY

2.1.1 An inspection survey was undertaken to enhance an existing topographic survey of the site, extending over an area of 0.25sqkm. This served as the basis for planning and undertaking further archaeological work on the site; it represents the minimum standard of record and is appropriate for the discovery of previously unrecorded sites. Its aim was to record the existence, location and extent of smviving surface features, and involved the annotation of maps of the site provided by Cheshire County Council.

2.1.2 The survey was undertaken in the autumn when the density of vegetation within the area was diminished. The reconnaissance was undertaken in a systematic fashion, walking on approximately 1Om wide transects within the extent of the defined study area, but the interval was varied according to the density of the undergrowth and the sensitivity of the area; hence the more intensive investigation was undertaken in the area of the industrial plants and a less intensive survey was carried out in the area of the lime mounds. The reconnaissance was undertaken in conjunction with Alan Moores who has considerable knowledge of the site.

2.1.3 As required in the brief, the survey involved the enhancement of the existing topographic survey to give greater detail than was already shown and to depict features that were not previously depicted. There was no requirement for new survey work to be undertaken, and any identified features that were remote from detail depicted on the maps was not located to a high level of accuracy. There were considerable amounts of earthwork detail extending across the whole of the site which were not shown on the existing base survey and; because of the difficulty in recording detail that was remote from depicted detail, the more subtle of these earthworks features were not recorded.

2.1.4 The annotations were transferred from the site paper copy into the base drawing as a separate layer within a CAD system (AutoCAD 14). The features were cross referenced with those features shown on the 1918 map of the site (1918 Site Drainage Plan), which was incorporated as a Rasta backdrop within the CAD drawing to enhance the correlation between surviving and historic features.

2.2 FABRIC SURVEY OF THE WAREHOUSE

2.2.1 ***Instrument Survey:*** a survey to Royal Commission on the Historical Monuments (England) (RCHM(E)) Level 2 was undertaken of the building. An option was presented for an RCHM(E) Level 3 survey should the structure be earmarked for demolition, but as a decision has not yet been reached regarding the fate of the warehouse, this work was not undertaken.

2.2.2 A ground plan of the warehouse was created by means of a reflectorless total staiii.on, which is capable of measuring distances to architectural detail by reflection from the surface of that detail element (without need of a prism), and therefore allows for the recording of detail with limited access. The survey' was undertaken with respect to a series of accurately surveyed control stations established by

traverse around the outside of the building. The survey recorded all significant, extant structural elements, inclusive of blocked apertures, masonry joints and changes in internal levels; it was enhanced by manual survey techniques onto a film base. The graphic results of the survey were digitised into an industry standard Computer Aided Draughting (AutoCAD 14) system to enhance the manipulation and presentation of the results.

2.2.3 ***Photographic Survey:*** a general oblique photographic survey was undertaken of the warehouse in accordance with the RCHM(E) Level 2 recording. The record was fully indexed and photographic views were shown with respect to the existing architects' plans.

2.2.4 A conventional monochrome medium format record was undertaken of the warehouse including external elevations and appropriate architectural detail. A record was made in 35mm colour print and black and white formats of the room interiors and showed similar detail to the medium format record, as well as a broad range of generalised views.

2.2.5 The photographic record of the warehouse included:

i) general external coverage (colour print and medium format black and white);

ii) general internal coverage (black and white contact prints and colour print (35mm));

iii) general views showing the overall setting of the buildings;

iv) close-up views of significant internal and external architectural details (black and white contact prints and colour print (35mm));

v) general views of representative structural detail (black and white contact prints and colour print (35mm));

vi) detail views of the roof structure (black and white contact prints and colour print (35mm)).

2.2.6 ***Descriptive Record:*** a visual inspection of the site was carried out and a basic level of descriptive record was created in accordance with the RCHM(E) Level 2 standard. This involved the internal and external examination of the extant fabric, and generated a summary assessment of the period and significance of the buildings.

2.3 ARCHIVE

2.3.1 The results of the work programme formed the basis of a full archive to professional standards, in accordance with current English Heritage guidelines *(Management* c f *archaeological projects,* 2nd edition, 1991). This archive is provided in the English Heritage Centre for Archaeology format, as a printed document, and will be submitted to the Cheshire Record Office. A synthesis (the evaluation report and index of the archive) will be submitted to the Cheshire Sites and Monuments Record.

3. SURVEYRESULTS

3.1 INSPECTION SURVEY

3.1.1 Despite the dense vegetation, the survey provided an understanding of the factory and its associated buildings. The results are detailed in the gazetteer *(Appendix 3),* and highlighted on the accompanying ground-plan of the works (Fig 2). The warehouse was excluded from this part of the survey, as it was earmarked for a full fabric survey to RCHM(E) level 2 *(Section 3.2),* but the site is included in the gazetteer (Site 7).

3.1.2 ***Ammonium Soda Plant:*** the results show that extensive remains exist of the Ammonia Soda plant and the Crystal Soda plant buildings, in the form of concrete blocks and stanchions (Sites 1 and 2 respectively). Some of the structures' functions can be identified by correlation with contemporary plans and drawings of the site, and these are outlined in the gazetteer. The interpretation of their functions is part of a forthcoming study by Alan Moores (forthcoming). Several other ancillary structures, such as the offices and canteens, were also noted and the survey identified a number of railway lines which conform with their depictions on the early plans.

3.1.3 ***Munitions Plant:*** the main focus of new information gathered during the course of the works was centred on the Munitions plant buildings (Sites 3-5), which are outlined on a 1918 map (1918 Site Plan) as the 'Boilers Mixers and Pans', 'Crystalliser Shed' and 'Salt Pans' respectively. Brunner Mond Records (Watts 1923) indicate that this plant produced calcium nitrate by treating sodium nitrate, extracted from the brine, with calcium chloride. This product was then dehydrated using heat from the boilers and crystallised out in the crytalliser shed. The calcium nitrate was bagged, weighed and stored in the warehouse.

3.1.4 While the basic process could be established, primarily from documentary sources, the function of individual structures and the detailed industrial process could not be established from the identification survey undertaken. There were large numbers of structures for which no function could be established, and notably of these was a large concrete vessel (Structure 4.16), within the crystalliser building, which was clearly an important component within the chemical process, but its function is at present uncertain.

3.2 FABRIC SURVEY - THE MUNITIONS WAREHOUSE

3.2.1 A full survey to RCHM(E) Level 2 standards was conducted on the warehouse according to the requirements of the methodology *(Section 2.2).* This involved a photographic survey of the upstanding structure, both to the interior and the exterior, and a detailed ground-plan produced with a reflectorless Total Station output into a CAD system.

3.2.2 Th! warehouse is a rectangular structure measuring 31m by 28m (Fig 3). It is buttressed on three sides (the north, west and south sides) and the east side faces towards the railway lines (Site 10), where there was an external loading bay (A Moores pers comm) (Plates 4 and 6). The buttresses measure 0.96m in width and

extend to the full height of the building. They are keyed into the walls for the first 3-4m and there upwards are built free-standing, such that many are now moving away from the walls. The brick construction of the building consists of three courses of stretcher bricks and one header course; a style known as English Garden Wall. The height of four courses is approximately 034111 and the bricks are machine made.

3.2.3 Internally there are two cells with a concrete floor and an internal loading platform at the eastern end, which is c0.8m high (Plate 4). Set into this eastern wall are two metal stanchions, on either side of the central east/west aligned wall, with an I-beam above. These were formerly large apertures for loading and unloading materials into the warehouse platform and onto the external loading platform; these apertures, however, have subsequently been filled. The central wall dividing the two cells has nine arched openings with a three-course-high brick arch (Plate 3). The openings are 3m high and 2.44m wide; the walls are 034111 thick, as are the walls of the warehouse. The piers of the arches measure approximately 1.08m square (Plate 3).

3.2.4 Two blocked doorways are visible in the south elevation, leading into the building from the south-east corner (Plate 5), and in the south-west corner is a recently blocked door. A blocked window is visible in the east elevation, north of the centre of the southern cell at mid-wall height. A blocked door is visible in the north-west corner, which had been narrowed, prior to blocking, by the insertion of 0.18m of brickwork. Drains are visible along the north and south internal walls, c0.05m deep. The main door is in the north-east corner, and is now protected with a roller shutter (Plate 6).

3.2.5 The roof has eight trusses to each cell, with an east/west aligned ridge with a raised louvre. The trusses are held with metal bolts and bars across the joints. There is corrugated plastic glazing in alternate bays.

3.2.6 Externally, there is evidence of an earlier sliding door on the north-east side of the building, which has now been replaced by the shuttered door (Plate 6). The buttresses stop short of this door suggesting that they post-date the sliding door. The blocked door in the north-west corner has a hanging bolt loop on the lower west side at floor level; a concrete floor is visible below the door and is c0.18m thick. A drain runs down the centre of the north side of the building.

3.2.7 A joist is visible on the east side which is socketed to hold a canopy above the railway loading bay, the sockets measuring 0.2m x 0.2m. A central drainpipe is afso visible and appears to have been originally recessed 0.18m into the lower two thirds of the wall. A very fragile iron down-pipe is now supported on timber pads across the recess. Two distinct loading bays are visible, one from each cell.

3.2.8 On the south-east corner, slight wall stubs are visible, belonging to a now demolished building. A concrete floor extends through the blocked doorways, visible on the south-east corner. Purlin sockets are visible in the wall and it is evident that this former building had north/south aligned pitched roofs, and a central north/south wall. The lowest purlin on the west side is within one of the buttresses, which indicates that it post-dates the buttresses. There are no buttresses along the south-east corner, as on the north-east corner, and they clearly respect the

earlier doors to the loading bay. The two door-ways and wall scar appear original. There is evidence of a below ground east/west aligned tunnel to the east of the ponds and under the two easternmost buttresses (Plate 5).

3.2.9 There are seven buttresses on the outh face. A blocked doorway is visible in the south-west corner of the south face with a now-collapsing timber and felt canopy over the top; this mirrors the doorway to the north. A central drainpipe is visible on the south face, mirroring that to the north and a further drainpipe is visible on the south-west corner.

3.2.10 On the west side are a further six buttresses, in two pairs of three. In the centre is a further drain, which feeds into a stone trough at its base; a roof access ladder overlies this drain. A large plastic drain is visible in the north-west corner of the wall. An area of render i visible along the north angle of the south buttress (0.36m wide, 4rhm in thickness and c3m high); its purpose is unknown.

3.2.11 ***Conclusion:*** the building was constructed specifically as a storage building, having a large internal volume, a high roof, buttress-supported side walls, and a large loading ramp supplied by rail tracks. The building is essentially single phase, although the buttresses would appear to post-date the main structure. A 1918 plan (1918 Site Drainage Plan) shows that the building to the south of the warehouse was a 'bag weighing plant' and evidently the product of the plant (calcium and ammonium nitrate) was bagged and weighed here for storage in the warehouse.

4. CONCLUSIONS

4.1 DISCUSSION

4.1. I ***Ammonia Soda Plant:*** early ammonia soda plants are rare; the Plumley site is one of only ten recorded by English Heritage's MPP programme for the Chemical Industry, the rest have either been destroyed entirely or have been severely altered by later use (UMAU 1999). The survey results have conclusively shown the extensive survival of remains associated with all phases of the chemical plant, through both its civilian and war-time use, for the production of ammonium nitrate.

4.1.2 ***Munitions Plant:*** it is likely that the main munitions buildings were functioning to produce calcium nitrate:· Cartographic sources, coupled with the survey results, have made it possible to assign the remains to their respective buildings; however, the interpretation of these remains is still uncertain, as the documentary evidence was limited in terms of the function of all the buildings. Any localised trial excavation of the remains would have served to reveal more of the structures but is unlikely to have significantly enhanced their interpretation.

4.2 IMPACT

4.2.1 The walkover survey served to clarify a number of issues regarding the positions and locations of the buildings, which are presently at risk of becoming engulfed by the expanding woodland vegetation. Any landscaping and reclamation of the site is likely to have an impact upon the remains of the plan. To quote the assessment: *'the remains* [...] *represent a rare and possibly unique survival* [...] *and are considered to he* q f *national importance. Any proposed reclamation of the site must take that sign?flcance into account'* (UMAU 1999). The warehouse is at present not at risk, though structural weaknesses, observed during the fabric survey (such as cracks in the walls, and the buttresses becoming disjointed from the walls), suggest the possibility that further deterioration is likely in the near future in the absence of consolidation work on them.

4.3 FURTHER WORK

4.3 .1 The lack of clear understanding regarding the function of the buildings is an issue which requires resolution; as has been previously discussed *(Section 4.1.2),* it is unlikely that this will be adequately resolved by excavation, and it was therefore agreed with the Archaeology Officer for Cheshire County Council that the contingency option for trial trenching at Plumley should not be implemented. The Soda Ash plant has been the subject of recent investigation (Moores forthcoming) and there is, consequently, a lesser priority for investigation; however, there is considerable uncertainty as to the function and operation of the buildings within the munitions plant. It is recommended, therefore, that further , investigation be undertaken of the munitions plant and the Great War phase of th Soda Ash plant; this will enable a direct comparison with other First World War chemical plants. The implementation of a detailed landscape survey would significantly enhance our understanding of the functions of the individual elements within the site. It would

also inform the proposed reclamation proposals for the site in terms of defining the significance and character of the relict landscape. The fieldwork can then inform any further decisions which need to be made as regards consolidation and interpretation of the remains.

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APPENDIX 1
PROJECT BRIEF

APPENDIX 2
PROJECT DESIGN

Lancaster University Archaeological Unit

July 2000

CHESHIRE STRATEGIC PROGRAMME OF RECLAMATION PLUMLEY LIMEBEDS, NORTHWICH

CHESHIRE

ARCHAEOLOGICAL EVALUATION AND FABRIC SURVEY

Proposals

The following project design is offered in response to a request from Cheshire County Council, Environmental Planning, for an archaeological evaluation of Plumley Limebeds, Northwich.

1. INTRODUCTION

1.1 CONTRACT BACKGROUND

1.1.1 Lancaster University Archaeological Unit (LUAU) has been invited by Cheshire County Council Environmental Planning to submit a project design and costs for a field inspection, an archaeological evaluation and fabric survey at Plumley Limebeds, Northwich, Cheshire. The work is being undertaken in advance of a programme of reclamation and environmental improvement of the site for leisure and recreation. This follows on from and is informed by an archaeological assessment of the overall study area undertaken by the University of Manchester Archaeological Unit in August 1999 (UMAU 1999). The project design is in accordance with a brief by the Archaeology Officer (Development Control) of Cheshire County Council. The land is presently a nature reserve but is on the site of a former ammonia soda works complex, which has been highlighted as being of particular importance in a recent step 1 report on the Chemical Industry for the Monuments Protection Programme of English Heritage (D Cranstone, pers comm).

1.2 ARCHAEOLOGICAL BACKGROUND

1.2.1 The ammonia soda works dates from 1912 with the establishment of the Ammonia Soda Company Ltd (ASCOL) which was established to manufacture Soda Ash. In 1916 the site was acquired by Brunner Mond and Co and the site started the manufacture of calcium nitrate, which was used in the manufacture of explosives. In 1919, following the end of the First World War the plant was closed, ostensibly because of the drop in demand for munitions (UMAU 1999).

1.2.2 Maps produced in 1918 show that there were two main plants, the earlier soda ash plant in the eastern part of the site, and the larger munition plant towards the southern end of the site. The eastern and northern part of the site was occupied by large lime waste mounds. The Ordnance Survey map of 1938 shows that although the railway network of the site was still in place, all but a large warehouse and a two smaller structures were then standing. The warehouse was originally constructed to store munitions, and, as a result, was supported by extensive buttresses to make it blast proof. Its survival through to the present in part reflects its over engineered structural integrity and also that it was subsequently used for storage by the nearby Associated Ethyl works which were constructed in 1939 to provide ethylene glycol for aircraft engines. By 1950 OS mapping shows that the railway network in the area had been removed (UMAU 1999).

1.3 LANCASTER UNIVERSITY ARCHAEOLOGICAL UNIT

1.3.1 LUAU has considerable experience of the evaluation and excavation of sites of all periods, having undertaken a great number of small and large scale projects during the past 18 years. Evaluations and assessments have taken place within the planning process, to fulfil the requirements of clients and planning authorities, to very rigorous timetables. LUAU undertook the initial assessment of the area as part of the Cheshire (Weaver Valley) Rolling programme (LUAU 1992) and has also undertaken a fabric survey of buildings within the nearby Brunner Mond plant at Lostock Gralam (LUAU 1998). LUAU has also undertaken numerous assessments, landscape surveys and evaluations on industrial sites throughout the North-West. LUAU has the professional expertise and resource to undertake the project detailed below to a high level of quality and efficiency. LUAU and all its members of staff operate subject to the Institute of Field Archaeologists (IFA) Code of Conduct and LUAU is a registered organisation with the IFA (no 27).

2. OBJECTIVES

2.1 The following programme has been designed in accordance with a brief by Mark Leah, Archaeology Officer (Development Control) for Cheshire County Council to create an identification map of the surviving remnants of the site, to provide an archaeological evaluation of the area, and to undertake a fabric survey of the large warehouse. The required stages to achieve these ends are as follows:

2.2 INSPECTION SURVEY

2.2.1 An inspection survey will be undertaken to enhance an existing topographic survey of the site. It will involve the annotation of the earlier survey record and should correlate the surface evidence with the historic maps. The field survey would be undertaken in conjunction with Mr Alan Moores, who has considerable knowledge of the site and its operation.

2.3 TRIAL TRENCHING

2.3.1 A programme of trenching will be informed by the inspection survey, but will not exceed 50m of machine cut trench.

2.4 FABRIC SURVEY OF THE BLAST-PROOF WAREHOUSE

2.4.1 A survey to RCHM(E) Level 2 will be undertaken of the building, and an option for the implementation of an RCHM(E) Level 3 survey is also costed.

2.5 EVALUATION REPORT

2.5.1 A written evaluation report will assess the significance of the data generated by this programme within a local and regional context. It will examine the archaeological implications of the reclamation and landscaping proposals.

3. METHODS STATEMENT

3.1 The following work programme is submitted in line with the stages and objectives of the archaeological work summarised above.

3.2 FIELD INSPECTION

3.2.1 It is proposed that a basic identification survey of the study area be undertaken extending over an area of 0.25sqkm. This will serve as the basis for planning and undertaking further archaeological work on the site and represents the minimum standard of record, it being appropriate to exploratory survey aimed at the discovery of previously unrecorded sites. Its aim is to record the existence, location and extent of surviving surface features, and will involve the annotation of maps of the site provided by Cheshire County Council.

3.2.2 At present the area is considerably overgrown with both undergrowth (nettles) and leaf overgrowth to the extent that considerable areas are inaccessible, and will severely inhibit any surface recording programme. It is therefore recommended that the survey be undertaken in the Autumn when the density of vegetation will be diminished. The reconnaissance will be undertaken in a systematic fashion, walking on approximately 10m wide transects within the extent of the defined study area, but the interval will be varied according to the density of the undergrowth and the sensitivity of the area; hence more intensive investigation will be undertaken in the area of the industrial plants and less intensively in the area of the lime mounds. The reconnaissance will be undertaken in conjunction with Alan Moores who has considerable knowledge of the site.

3.2.3 As required in the brief, the survey will involve the enhancement of the existing topographic survey to show greater detail than is already shown and to depict elements of features that are not presently depicted. There is no requirement for new survey work to be undertaken, and therefore any identified features that are remote from detail depicted on the maps will not be located to as high a level of accuracy. There are considerable amounts of earthwork detail extending across the whole of the site which are not shown on the topographic survey and, because of the difficulty in recording detail that is remote from depicted detail, the more subtle earthworks features will not be recorded.

3.2.4 The base survey can be provided within a CAD format, and consequently the annotations will be transferred from the site paper copy into the base drawing as a separate layer within a CAD system (AutoCAD14). The features will be cross referenced with those features shown on the 1918 map of the site, which will be presented as a rasta backdrop within the CAD drawing to enhance the correlation between the surviving and the historic features. The maps will be depicted with site numbers corresponding to the gazetteer of the documentary study in order further to enhance the correlation between the observed and the documentary records.

3.3 EVALUATION TRENCHING

3.3.1 ***Targeted Trenching:*** the programme of trenching will be informed by the inspection survey, and is intended to answer specific queries arising out of that survey. Whilst the timing of the trenching is dependent upon the inspection survey, there is also a preference for undertaking the evaluation in autumn as the there will be less damage to the ecology by the movement of plant through the reserve if the evaluation is undertaken during the autumn months when much of the undergrowth and overgrowth has died back. Because of the reliance on the inspection survey the size and number of the trenches is uncertain, however, in order to enable a comparative tendering process it is deemed that the costing be determined on the basis of 50m of trenching at a 1.5m width. Should there be a requirement for a larger amount of trenching the cost will need to be subject to variation.

3.3.2 This programme of trenching will establish the presence or absence of suspected archaeological deposits and, if established, will then briefly test their date, nature, and quality of preservation. Excavation will assess the character of all archaeological deposits, although it will be designed to disturb the integrity of the significant archaeological deposits as little as possible, but will be continued to the depth of natural subsoils. This element of the trial trenching is invaluable in order to assess those parts, within the proposed study area, where there is a potential for archaeological deposits to survive, and will concentrate on features identified from the inspection survey.

3.3.3 The costing is based on five 10m x 1.5m trenches, the locations of which will be directly informed by the inspection survey and will be subject to discussions between LUAU, the client, and the Archaeology officer, Cheshire County Council.

3.3.4 ***Methodology:*** to maximise the speed and efficiency of the operation, the removal of overburden will be undertaken by machine (with a 1.5m toothless ditching bucket). The sections and trench floors will be manually cleaned prior to undertaking any further excavation.

3.3.5 All sensitive deposits will be examined by entirely manual excavation, which will enable an assessment of the nature, date and survival of deposits to be made. The deposits will be investigated sufficiently to establish their character but the full depth of the deposits to natural subsoil will not necessarily be established across the whole trench. All trenches will be excavated in a stratigraphical manner, whether by machine or by hand. All features exposed will be sample excavated, which typically would involve the excavation of 50% of discrete features and 25% of linear features. No feature or structure will be wholly excavated as the intention is simply to evaluate only the archaeological resource at this stage. Trenches will be accurately located with regard to surrounding features, by use of a total station survey instrument, and will be tied into the CAD mapping of the inspection survey.

3.3.6 ***Recording:*** all information identified in the course of the site works will be recorded stratigraphically, with sufficient pictorial record (plans, sections and both black and white and colour photographs) to identify and illustrate individual features. Primary records will be available for inspection at all times.

3.3.7 Results of the field investigation will be recorded using a system, adapted from that used by Centre for Archaeology of English Heritage. The archive will include both a photographic record and accurate large scale plans and sections at an appropriate scale (1:50, 1:20, and 1:10). All artefacts and ecofacts will be recorded using the same system, and will be handled and stored according to standard practice (following current Institute of Field Archaeologists guidelines) in order to minimise deterioration. Samples will be collected for technological, pedological, palaeoenvironmental and chronological analysis as appropriate, but it is not intended to process such material for assessment at this stage. If necessary, access to conservation advice and facilities can be made available. LUAU maintains close relationships with Ancient Monuments Laboratory staff at the Universities of Durham and York and, in addition, employs artefact and palaeoecology specialists with considerable expertise in the investigation, excavation and finds management of sites of all periods and types, who are readily available for consultation.

3.4 FABRIC SURVEY OF THE WAREHOUSE

3.4.1 ***Plans:*** a ground plan of the warehouse will be created by means of a reflectorless total station. The reflectorless total station is capable of measuring distances to architectural detail by reflection from the surface of that detail element; consequently it does not require the placement of a prism

on the detail. It is therefore an ideal tool for the recording of detail where there is limited access. The survey will be undertaken with respect to a series of accurately surveyed control stations established by traverse around the outside of the building. Where possible the survey of the plan will be enhanced by manual survey techniques onto a film base. The survey will record all significant, extant structural elements, inclusive of blocked apertures, masonry joints and changes in internal levels. The graphic results of the survey will be digitised into an industry standard Computer Aided Draughting (AutoCAD 14) system to enhance the manipulation and presentation of the results.

3.4.2 ***Photographic Survey:*** a general oblique photographic survey will be undertaken of the warehouse in accordance with the RCHM(E) Level 2 recording. The record would be fully indexed and photographic views would be shown with respect to the existing architects' plans.

3.4.3 A conventional monochrome medium format record would be undertaken of the warehouse including external elevations and appropriate architectural detail. A record would be made in 35mm colour print and black and white formats of the room interiors and would, show similar detail to the medium format record as well as a broad range of generalised views.

3.4.4 The photographic record of the warehouse will include:

i) General external coverage (colour print and medium format black and white).

ii) General internal coverage (black and white contact prints and colour print (35mm)). This will include internal elevations of the rooms.

iii) General views showing the buildings relationship to other associated buildings and showing the overall setting.

iv) Close-up views of significant internal and external architectural details (black and white contact prints and colour print (35mm)).

v) General views of representative structural detail (black and white contact prints and colour print (35mm)).

vi) Detail views of the roof structure (black and white contact prints and colour print (35mm)).

3.4.5 ***Description and Analysis:*** a visual inspection of the site will be carried out and a basic level of descriptive record will be created in accordance with the Royal Commission on Historic Buildings in England (RCHME) Level 2 standard. It will involve the internal and external examination of the extant fabric, and will generate a summary assessment of the period and significance of the buildings.

3.4.6 ***RCHM(E) Level 3 Survey (Optional):*** subject to decisions about the eventual fate of the warehouse, a survey may be undertaken of the structure at RCHM(E) Level 3. In addition to that undertaken for Level 2, this would normally require additional survey drawings, and in particular the drawing of cross-sections through the building, and detail drawings of structural detail such as trusses. The photographic requirements would be for any internal and external detail relevant to the building's design which is not adequately covered by the general photography, and photography which relates the building to its setting. The written account would involve the account of the buildings form and development, an account of the building's past and present use, evidence for the former existence of demolished structures associated with the building, copies of documentary records of the building, and secondary information relating to the building.

3.4.7 The methodology applied to the Level 3 survey will be the same as that applied to the Level 2 survey, although there will be additional recourse to undertaking an investigation of the site within libraries and the Cheshire Record Office, and would follow on from that undertaken to date by the documentary assessment (UMAU 1999). A visual inspection and analysis of the building would be carried out by experienced in-house staff if the Level 3 option were followed. The visual inspection will allow for the interpretation and analysis of the building. It will involve the internal and external examination of the extant fabric, where health and safety allows, and will generate a description and assessment of the period and significance of the building. Where possible it will define the form and character of the building within a regional context.

3.5 EVALUATION REPORT

3.5.1 ***Archive:*** the results of Stages 3.1-3.3 above will form the basis of a full archive to professional standards, in accordance with current English Heritage guidelines (*Management of archaeological projects*, 2nd edition, 1991). The project archive represents the collation and indexing of all the data and material gathered during the course of the project. The deposition of a properly quantified, ordered, and indexed project archive in an appropriate repository is considered an essential and integral element of all archaeological projects by the Institute of Field Archaeologists in that organisation's Code of Conduct. This archive will be provided in the English Heritage Centre for Archaeology format, as a printed document, and a synthesis (the evaluation report and index of the archive) will be submitted to the relevant Sites and Monuments Record. The archive will be deposited with the County SMR within six months of the end of the fieldwork.

3.5.2 All drawings will be produced within a CAD system and can be output at any size or medium that is required. Each sheet will be fully titled. Particular attention will be paid to achieving drawings of the highest quality and accuracy.

3.5.3 The archive will be formed of all the primary documentation, including the following:

- Survey Information
- Building Record Sheets
- Context Records
- Finds Records
- Sample Records
- Field / Inked Drawings and digital copies of CAD data
- Photographic negatives, prints and colour transparencies
- Written report
- Administrative records

3.5.4 ***Report:*** three copies of a written synthetic report will be submitted to the client and two copies to the SMR. The report will present, summarise, and interpret the results of the programme detailed in Stages 3.1-3.4 above, and will include an index of archaeological features identified in the course of the project, with an assessment of the sites development. It will include the following:

- Summary of the results
- Acknowledgements statement
- Methodology statement
- Copies of the brief and project design
- Summary of past and present land-use
- Summary of the historical background
- Location Plan
- Plans and sections
- Monochrome and colour photographs as appropriate
- Description of archaeological features
- An interpretation of the results
- Statement of the archaeological implications of the proposed development.

3.6 OTHER MATTERS

3.6.1 ***Access:*** it is understood that access to the site will be arranged by the client, who will also negotiate with English Nature for the work to be undertaken within the reserve. The excavation of the trenches will require the use of mechanical plant (JCB Wheeled excavator) which will need to gain access via the principal paths.

3.6.2 ***Health and Safety:*** LUAU conforms to all health and safety guidelines as contained in the Lancaster University Manual of Health and Safety and the safety manual compiled by the Standing Conference of Archaeological Unit Managers. The work will be in accordance with Health and Safety at Work Act (1974), the Council for British Archaeology Handbook No. 6, *Safety in Archaeological Fieldwork* (1989). All site procedures are in accordance with the guidance set out in the Health and Safety Manual compiled by the Standing Conference of Archaeological Unit Managers (1991) and risk assessments are implemented for all projects.

3.6.3 Full regard will, of course, be given to all constraints (services etc) during the excavation of the trenches, as well as to all Health and Safety considerations. LUAU provides a Health and Safety Statement for all projects and maintains a Unit Safety policy. As a matter of course the Unit uses a U-Scan device prior to any excavation to test for services. It is assumed that the client will provide any available information regarding services within the study area, if available. excavation will not be undertaken to a greater depth than 1.25m from surface without shoring. If there is a need to excavate to a greater depth then there will be a recourse to variation funding.

3.6.4 ***Reinstatement and Security:*** land disturbed as a result of this work will be reinstated to the client's satisfaction, and it is understood that the requirement in this instance is that the topsoil be stored separately from sub-surface material and the materials be backfilled in the reverse order from that removed, following which the surface will be relaid. It is presumed that the client will have responsibility for site security. LUAU would take responsibility for temporary fencing arrangements to exclude livestock and members of the public. In addition, any deep sections of open trench would be fenced off to prevent any accidents occurring to LUAU/client staff.

3.6.5 ***Confidentiality:*** the report is designed as a document for the specific use of the client, for the particular purpose as defined in the project design, and should be treated as such; it is not suitable for publication as an academic report, or otherwise, without amendment or revision. Any requirement to revise or reorder the material for submission or presentation to third parties beyond the project brief and project design, or for any other explicit purpose can be fulfilled, but will require separate discussion and funding.

3.7 PROJECT MONITORING

3.7.1 ***Cheshire County Council:*** Any proposed changes to the project brief or the project design will be agreed with the Archaeology Officer, Cheshire County Council and the client.

4. WORK PROGRAMME

4.1 The following programme is proposed:

4.2 ***Inspection Survey***

A three day period is required to undertake the site survey.

4.3 ***Evaluation Trenching***

A five day period is required to undertake the trenching.

4.4 ***Fabric Survey (Level 2)***

A two day period is required to undertake the fabric survey.

4.5 ***Post survey and evaluation processing and preparation of report***

A 15 day period will be required to complete this element.

4.5 LUAU can execute projects at short notice once an agreement has been signed with the client.

4.6 The project will be under the management of **Jamie Quartermaine, BA, Surv Dip, MIFA** (Unit Project Manager) to whom all correspondence should be addressed. The work will be directed by a project officer, who will be appointed once a start date has been agreed with the client. All Unit staff are experienced, qualified archaeologists, each with several years professional expertise. Project Officers in Unit terminology are senior field archaeologists, capable of organising and running complex projects and undertaking less complex work quickly and efficiently to a high standard.

The sites are marked on the base plan as site numbers, but can include within them structure numbers which mark out particular elements observed on the ground. Some information in gazetteer taken from UMAU Assessment report (1999); pre-industrial sites excluded due to lack of presence in the area.

Site number 1
Site Name Ammonia Soda Works Main Building Complex

NGR SJ 7062 7503

Site Type Factory

Period World War I

CSMR No

Source UMAU (1999) site P10

Description The assessment describes the site as: 'large structure, indicated on the 1908 map (1:2500) and named there as Ammonia Soda Works, this being the largest building complex belonging to those works. Main part of this complex formed a rectangle, c 75m x 52m, aligned roughly north to south divided by a wall along its long axis. The Tangye sketch and an early photograph show this building to have been of 2 storeys. The eastern half of this building is annotated as 'Finishing Machines', the western half as 'Saturators'. Adjoining the northern end of the western half of this building, the OS map shows a smaller range, annotated on the Tangye plan as '5 boilers'. This plan shows that this building had been extended on the south side, this extension being annotated as '2 new boilers'. The accompanying sketch shows these boiler houses as of 1 or 1 ½ storeys. To the south of the boiler houses, and west of the main building, the plans shows a detached Boiler Chimney; on the east side of the main building was also a detached chimney, annotated 'F.M chimney', presumably an abbreviation for 'finishing machines'. Both the sketch and the early photographic evidence show these chimneys to have been the tallest features on the site. Aligned across the northern end of this main building, the 1908 map shows a narrow range, divided along the same axis as the cross-wall in the main building itself. The Tangye plan shows a different arrangement, of a range mainly aligned alongside the eastern half of the main building; that range is annotated as 'Distiller Tower Shed'. On the accompanying sketch and early photograph, this is the tallest building within this complex, at 4 or 5 storeys high, with windows on every side. Adjoining this, in turn, on the north was a wider range, shown on the sketch as a 1 or 1½ storey building and annotated as 'Blowing & [?] Vacuum Engine House'. To the east of that building and running northwards, the 1908 and Tangye plans show a line of four circular structures, annotated on the Tangye plan and sketch as 'Kilns'. That sketch shows these as tall cone-shaped structures, set within a shared superstructure. The site of this building complex is vacant on the I938 map and later maps. However, extensive remains still survive within the woodland. The density of the trees means that their full extent of the remains and the exact position of individual features is difficult to ascertain. However, among the features noted by the present survey are the following. Running immediately south of the central east-west path through the study area, but obscured from that path by the vegetation is a line of four circular concrete bases, each 5m wide and at least c 0.7m high, which can be identified with the bases of the four 'kilns' or Solvay towers indicated on the 1908 plan and by Tangye. To the west of the two southernmost of those tower bases are a group of concrete beds, with holding down bolts, which correspond with the position of the Blowing and Vacuum Engine House on the Tangye plan and sketch; set within these beds are also two concrete shafts, clm square, one c 15m deep, the other much shallower but probably infilled. Immediately to the south of this engine house site are the remains of two parallel lines of vertically placed cast-iron or steel I beams, surviving to a height of c 0.5m. These correspond with the site of the 4 or *5* storey Distiller Tower Shed, and are

presumed to have formed part of that building's supporting frame. To the south of this area are two circular concrete bases, one 6m wide and c lm high with a flue hole, the other c 2m wide, and a square concrete base with 2 holding down bolts. It is unclear how those features relate to the map evidence, unless the larger of the circular bases belonged to the boiler chimney on the west side of the main building. On the east side of the site, to the east of the southernmost of the four 'kiln' bases are the remains of a circular iron tub, c 1.7m in diameter, and c 0.5m deep. To the south of the southernmost of the four 'kiln' bases are two other circular bases, c 4m in diameter. These roughly correspond with the position of what appears to be two chimneys shown on an early photograph. Further south again, are two parallel rows of concrete structures. The more westerly of these comprises three substantial possible bases, c 3m wide, c 3m high, ranging between c 4m and 7m in length, each with an arched passage, c 1.7m high and c 0.7m wide running along its length, with other such passages running across these. The easterly row comprises a line of five or six concrete bases c 2m wide, c 2m high, and c 3m long, with holding down bolts on their upper surfaces; at the northern end of this row there is also a smaller concrete base on the same alignment. These two rows of concrete structures, which are visible on a 1954 I 5000 AP lie within the eastern half of the main building annotated 'Finishing Machines' on the Tangye plan, and are aligned along the long axis of that structure. To the east of these bases, and roughly on the same axis, are three brick-arched culverts. The northernmost of these leads via a short inlet and sluice gate (comprising a cast-iron frame with an infill of bricks) into a brick-lined tank, partly silted up but still holding water. This culvert is also linked by a silted up channel to one of the two other culverts, to the south, which also has the remains of a sluice. This lies adjacent to the third culvert, which leads directly into a small pool.'

Very little can be added to this extensive description except for the following details. A series of I-beams were noted west of the engine house associated with a drain which runs to the north-west out of a brick culvert. To the south-west of the drain are two concrete ground anchors which may have held a cable to support the boiler chimney described above, as they appear to be aligned with it. To the south-west of the arched structures were a series of low walls, which may be the remains of the west wall of the factory; a line of I-beams runs north from these walls turning westwards towards another concrete base. To the east of the bases were a series of tanks and concrete structures, whose function is uncertain. The series of circular bases described to the south of the main four Solvay tower bases are in fact three in a row; these have holes in their tops, are made of brick and concrete, and have low passages running north-south through the middle. A collection of concrete blocks and a manhole to the south-west of the factory may be the footings of an outbuilding.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 2

Site Name Crystal Soda Plant and associated tanks

NGR SJ 7065 7514 (plant) and SJ7067 75ll (tanks)

Site Type Factory

Period World War I

CSMR No

Source UMAU (1999) sites P14 and P17

Description The assessment describes the site as: 'structure c 35m x 22.5m shown on 1908 (1:2500), on a site shown as vacant on the 1897 map and again as vacant on the 1938. Named on the Tangye plan as Crystal Plant, and shown on the accompanying sketch as of roughly 2 storeys with a gabled bay running across its south end. Site of this building includes stone and concrete footings. North of these are 3 large concrete bases, c 1 .5-2m long, c 1.5m wide, 2.5m high, with an arched passage, c 1.6m and 0.2m wide, running along their length; the arrangement is similar to the larger bases at site P10 (site 1), but without the transverse passages. To the northwest of these is a brick-lined pit, c 1m square.'
The site is as described in the assessment, though a great number of concrete and I-beam stanchions were noted, forming a lattice between the south end of the site and the concrete structure (structure 10). To the north, the I-beams continue along the east and west side but are notable by their absence in the centre. The north edge is marked by a low mound. To the east of the factory at approximately the mid-point is a low line of concrete blocks which may form the south edge of the eastern extension shown on the site plans.
To the immediate south of the factory are two tanks, which are described in the assessment as: 'two adjoining iron tanks, each 2.5m wide by c 4m long. This site is not shown on any maps examined.' This description is accurate. Further detail noted was a large concrete block to the east of the tanks and another small iron tank to the south; a short drain may lead from these tanks westwards.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 3

Site Name Boilers, Mixers and Pans

NGR SJ7095 7492

Site Type Factory

Period World War I

CSMR No

Source 1918-9 site plans

Description The building is shown on the site plans as a long rectangular building orientated north-south, and its function is named as such on the 1918 site plan. The building is located to the east of the main railway lines (site 10), and west of the crystallizer shed (site 4) which runs parallel to it. Not much is now visible on the ground; a line of concrete blocks marks the east side of the building and at the mid-point is a large overgrown square structure with large associated blocks of concrete. North of this are a series of overgrown linear earthworks, which may correspon with the area shown as 'pans' on the site plan.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 4

Site Name Crystallizer Shed

NGR	SJ7105 7492
Site Type	Factory
Period	World War I
CSMR No	
Source	1918-9 site plans
Description	The building appears on the site plans as a long rectangular building with an additional thinner building attached at the south-east corner; the thinner building houses shops and a lab while the main building forms the crystallizer shed. Of the former, the only visible remains consist of two short concrete walls on the eastern side of the building, and two central concrete stanchions. The latter begins just to the north, and consisits of a number of concrete structures. The first appears to be a concrete 'dispenser' or possibly a kiln, approximately 2m square and with a concrete block to the east (structure 16); this has a hollow centre and a drawing shaft through the front, suggesting it may be some form of coal dispenser. North of the structure are a series of five irregular concrete blocks in a line. West and parallel to the to these blocks is a long rectangular structure, mostly overgrown to the south and visible as a sub-rectangular concrete base to the north. A series of four iron I-beams are visible protruding from the western side, and a further two girders are shown to the north of the concrete on the same alignment. To the north of the girders is a further concrete structure (structure 15), which consist of a concrete base measuring 15m in length, on which stands ten concrete blocks with tapering tops, and arches in every other block (i.e not continuous all the way through). North of the structure is a further irregular base stretching to the north-west. East of the arched structure is a linear north-south depression, aligning with structure 16, and a concrete block to the north. To the west is a further linear depression parallel and adjacent to the arched structure, and west of this is a buttressed wall (possibly the west wall of the shed).
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	5
Site Name	Salt Pans
NGR	SJ7115 7492
Site Type	Building
Period	World War I
CSMR No	
Source	1918-9 site plans
Description	The buildings appear as three rectangular linear structures running parallel to and east of the crystallizer shed (site 4), orientated north-south. No structural evidence is visible for the eastern two buildins other than a series of low mounds and depressions which run north south and appear to correspond with the positions of the structures. The main central building has its east and west sides marked by similar depressions, and very little structural evidence is visible on the ground though some does survive. Four concrete blocks are visible in the south-west corner on the survey maps, but these were not located due to high vegetation. Two low buttressed walls are visible in

	the southern end of the building, made of concrete and measuring 7m in length and approximately 1m in height. To the north of these are further earthworks suggesting walls. North of the buildings is structure 9 (site 15).
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	6
Site Name	Unnamed building, munitions plant
NGR	SJ 7075 7488
Site Type	Brick tank
Period	World War I
CSMR No	
Source	UMAU (1999) site P20
Description	The assessment describes the site as: 'tank, partly silted-up but still water-filled, with a brick lining visible on the north side. At its south-east corner is a square concrete base with holding down bolts. Neither feature is shown on any of the maps examined.' This site was seen and recorded as structure 18; this was as described except the survey in fact located two concrete blocks at its southern edge. The tank appears to correspond with a small rectangular building shown on the 1919 drainage survey, shown adjacent to a couple of round tanks; its possible this building covered the reservoir, though this is not conclusive.
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	7
Site Name	Blast-proof warehouse
NGR	SJ7065 7492
Site Type	Warehouse
Period	World War I
CSMR No	
Source	UMAU (1999) site P13
Description	The assessment describes the structure as: 'tall warehouse, built of machine-made brick, with twin gables aligned east-west, massive buttresses on the south, west and north, and a mansard roof. In the eastern elevation, each of the two bays contains a horizontal I-beam, centrally supported by two iron pilasters. Beneath these beams and between these pilasters, the brickwork of the wall is inset from a height of c 1m above the ground; this inset brickwork seems to be infillling, and the whole arrangement is suggestive of blocked loading bays, presumably associated with the railway which ran along this side of the building. In the southern bay in this elevation, there is a blocked camber-headed window above the I-beam. No other windows were observed in the building. There are small doorways, blocked with brick, at the west ends of both the north and south

elevations, and a wider shuttered door at the east end of the north elevation. At the eastern end of the south elevation are two tall brick-arched doorways, that on the left narrower than that on the right. Both have been blocked with brick. The thresholds of these two doors are c1m above ground level, and the two were evidently once set within a projecting gable, the evidence of which is the ghost of a gabled roofline in the south elevation, complete with holes for the ridge-beam and a purlin on either side. The ground surface on this side of the building shows evidence of concrete footings. extending to the two adjoining tanks (P12). The warehouse is not shown on the 1908 map. nor on the Tangye plan and sketch, but first appears on the 1938 OS map which depicts it as L-shaped, comprising both the surviving building and the area on the south now represented by concrete footings. On the 1954 map only the main warehouse building is shown. The warehouse building is believed to have been built during World War I to house explosive materials produced on site. the aim of the buttresses being to strengthen the walls in case of accidental explosion. They were subsequently used for storage by the nearby Associated Ethyl works, established 1939, later Octel (A Moores, personal communication).'
This site is to be subject to full building recording and was not examined in this survey.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 8

Site Name Repair Sheds

NGR SJ 7056 7498

Site Type Building

Period World War I

CSMR No

Source UMAU (1999) site P8

Description Described in the assessment as: 'rectangular structure shown on the 1908 map (1:2500) on a site vacant in 1897. Aligned approximately north-south, c 75m x 15m, and shown divided into four bays, the three southernmost each c 20m long. The plan and sketch by A W Tangye names this building as Repair Sheds, and shows it as a single-storey structure with a chimney to the rear. On the 1908 map (but not on the Tangye plan) a smaller structure, c 10m x 7.5m, is shown c 7.5 metres to the south. Neither structure is shown on the 1938 map. However, a 1954 1:5000 AP shows what may have been agricultural material stored on the site of the Repair Sheds; a standing building is also shown on the site of the smaller structure on the south. Both sites are shown as vacant on later maps and APs examined and now lie within the woodland. A line of low moss-covered dumps of ceramic and other waste material roughly coincides with the site of the larger building; this same area also includes an overgrown brick/concrete-lined pit, c l.5m long, lm wide and at least 0.75m deep.'
The survey examined the area of the building, but no dumps of ceramic waste, nor the brick-lined pit were located, probably due to the high vegetation. The southerly building was visible, however, as a low concrete turfed over wall fitting the dimensions described, and this building is marked on the 1918 site plan as an 'oil store'; this was recorded as structure 4.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	9
Site Name	Cable stanchion
NGR	SJ 7069 7482
Site Type	Structure
Period	World War I
CSMR No	
Source	UMAU (1999) site 18
Description	The assessment describes the site as: 'two large concrete blocks, c 2.5m wide and c 4m high, are set facing each other, c 3.5-4m apart, with vertical inner faces, and slightly sloping outer faces. On the south are two smaller concrete blocks. This structure is not shown on any map, but possibly carried piping over one of the railway lines indicated in this area on the 1908-1938 maps.' The site was seen during the survey and recorded as structure 5; the structure is as described in the assessment. This appears to align with a further brick pylon to the north-east (structure 19, marked as 9b on the map) which lies adjacent to the railway lines (site 10). The brick pylon is approximately 1.5m in height and 2m square, and sits on a concrete base.
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	10
Site Name	Railway lines and sidings
NGR	SJ 7066 7524 - SJ 7075 7482; SJ 7080 7483 (centre)
Site Type	Railway
Period	World War I
CSMR No	
Source	UMAU (1999) sites P16 and P22
Description	Described in the assessment as: 'P22 site of sidings serving the Ammonia Soda Works, visible as linear embankment, c 1m high, covered with trees and adjacent to main line track still in use. Sidings are shown on the 1908 and 1938 maps. On the 1954 map the track is no longer shown, and the site of the eastern half of these sidings is shown as an earthwork.' This description fits with the surveyed evidence which show the sidings as a low wall running east-west and facing north; these sidings adjoin the main railway track which runs north as a trunk line, ostensibly for the movement of explosive out of the factory. The railway lines are recorded in the assessment as: 'P16 railway line running north-south across the study area, linking with the main line to the south via sidings (P22). The main plant building complex (P10, equivalent to site 1) and the Crystal Plant (P14, equivalent to site 2) were each located on either side of this line, which also served the warehouse building (P13, equivalent to site 7). This line is now heavily overgrown but can still be traced for most of its course as an earth work. To the north of building complex P10 (site 1) to the northern boundary of the study area. This comprises a bank with a ditch on the west side. To the east of building P10 (site 1) and the warehouse the line divides into two. The course ol the eastern branch is

visible as an open but water-logged track c 3-4 wide, while the course of the Western branch survives as a boggy ditch of similar width. To the south ot the warehouse the course of the line can be partly traced as a dry ditch. This line is shown on the 1908 map and the Tangye plan and is still shown on the 1938 map, but not on the 1954 map, by which date the track had presumably been removed. The 1908-1938 maps also show a branch line running parallel to this on the west, running between the main works complex (Pl0; site 1) and the Repair Sheds (P8; site 8) and similarly crossing the study area from north to south. No evidence for that second line was identified on the ground during the site visit for the present survey.

Little can be added to this extensive description of the track apart from to say that the southern section described as a dry ditch was not seen during the survey, due to the vegetation cover. A further short and undetermined section of track was also located to the east between site 3, the boiling and mixing sheds, and site 4, the crystallizer sheds. This was visible as a single rail and depression running south from the intersection between the two buildings for approximately 15m and curving towards the main lines, before becoming lost in the vegetation. Its function was probably the movement of explosive from the factory out to the warehouse.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 11

Site Name Reservoir

NGR SJ 7056 7495

Site Type Reservoir

Period World War I

CSMR No

Source 1918-9 site plans

Description This is a shallow reservoir visible to the south of the repair sheds (site 8), which probably originally served the cooling tower shown on the 1918 site plan, west of the warehouse. The pond measures approximately 40m in length and 5m in width, and is still full of water.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 12

Site Name Wincham Brook Tributary

NGR SJ 7099 7476

Site Type Brick culvert

Period World War I

CSMR No

Source 1918 drainage maps

Description A brick and concrete culvert is shown on the 1918 drainage maps running north south along the east side of the site, replacing a pipe which originally ran over the lack on brick pylons (site 14). This culvert is still running, carrying the brook around the effluent beds. An open Y-shaped drain is visible to the south.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 13
Site Name Brine Shaft

NGR SJ 7098 7496

Site Type Building (demolished)

Period World War I

CSMR No

Source UMAU (1999) site P30
Description Described in the assessment as : 'Shaft (Brine) shown on the 1908 (1:2500) map, on site vacant in 1897. Shaft is shown as set within an L-shaped structure, with maximum dimensions of c 1 lm x 7m; an elongated earthwork, c 30m x l0m, is shown immediately to the south. The same arrangement is shown, and the brine shaft is again named, on the 1938 and 1954 map. This shaft was sunk in 1907 (Wharmby 1987, 141 no 2-3-532). This site is still evident, comprising brick and concrete footings, belonging to three adjacent structures. The remains of the northern two of these are partly obscured by demolition infill. The remains of the southern of the three include the top of the bore pipe. A horizontal pipe also leads north-westward from this site. It is reported that an early 20h~century photograph shows this shaft crowned by a derrick; that the visible footings belonged to two singlestorey buildings, with an open brick-lined structure on the north; that the shaft was in use until the l960s and that the buildings themselves were demolished in the early 1980s (A. Moores, personal communicahion).
Seen during survey and described as structure 8, the remains still visible as partially covered by rubble and and water (due to flooding of area). Close inspection not possible due to this, but description in assessment confirms own description.

Assessment The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number 14

Site Name Brick Pylon

NGR SJ 7093 7517

Site Type Structure

Period World War I

CSMR No

Source UMAU (1999) site P26

Description	The assessment report describes the structure as : ‘machine-made brick surround (blue Staffordshire brick), situated within the centre of an extensive pond, and rising c 2m above the water. The original function of this structure is uncertain, but it is said to have stood adjacent to brick-built cooling tanks c 2m high, which were demolished c 1960 (A Moores, personal communication). This site was seen during the survey and described as structure 7. The brick structure is likely to be a pipe support or pylon for a pipe which ran across the lake; the support is shown on the 1918 drainage plan as holding ‘the old 18” pipe for the stream’ later diverted into the culvert (site 12).
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	15
Site Name	Anti-blast shelter
NGR	SJ 7073 7507
Site Type	Shelter
Period	World War I
CSMR No	
Source	UMAU (1999) site P19
Description	The site is described in the assessment as: ‘structure c 5m wide comprising two parallel concrete walls c lm wide, lm apart and standing c lm high above ground level. The interior is sunken. The northern wall is broken by a gap c 0.5m wide, the base of which is partly filled by brick. The form of this structure suggests that it is anti-blast trench. Its southern, unbroken wall faces towards the warehouse building (P13) c 125m to the south-east.’ The site was seen during the survey and described as structure 9. The description in the assessment is accurate, though it is unlikely the shelter was built for the warehouse which is at some distance from the structure. Its location immediately adjacent to the munitions factory is a more likely explanantion.
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	16
Site Name	Brick Pylons
NGR	SJ 7065 7520
Site Type	Structure
Period	World War I
CSMR No	
Source	1918-19 site plans
Description	Two brick pylons are visible along the north-west side off the lime beds (structures 12 and 13), with the latter standing approximately four metres in height and the former two

	to three metres. These are square structures and appear on the 1918 drainage plan to carry overhead pipes or cables. To the west north west of 13 is a square water tank.
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	17
Site Name	Dressing rooms/canteen
NGR	SJ 7045 7525
Site Type	Building
Period	World War I
CSMR No	
Source	1918-19 site plans
Description	The sole remnants of this building appear as a sub rectangular low brick (overgrown) wall with a man hole at the third north west end. This building appears to correspond roughly with an outbuilding to the rear of the dressing rooms. The structure measures 10 metres by 5 metres approximately and stands 0.5 metres high. No other remains are visible.
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	18
Site Name	Lime Beds
NGR	SJ 7085 7520
Site Type	Lime Waste Mound
Period	World War I
CSMR No	
Source	UMAU (1999) site P23
Description	Described in the assessment as : ‘extensive lime waste mound, with sides up to c 8~9m high. These sides have a bank to their upper edge, retaining the inner, dry, lime waste. On the north the bank is capped with material which includes boiler clinker The upper part of the mound is covered within thin woodland and the form of the feature is perhaps best understood with the map and AP evidence. The feature is first discernahle on the 1954 map when it is shown as comprising a large kidney-shaped earthwork with an irregular shaped enclosure on the east. An AP of 1955 shows the kidney shaped mound subdivided by banks running roughly north-east to south-west, and on later APs these banks can still be discerned as lines of trees. The 1955 AP shows the adjoining irregular enclosure, like the main mound itself, as defined by an external bank. On later APs that enclosure is distinguishable by its comparative lack of vegetation. The concrete remains of a World War II anti-aircraft position are reported to be situated on the mound (A Moores, personal communication), but this site was not located during the present survey.’ The site was seen during the survey, but little further can be added to this description. The site to the east, shown on the map as 18b and described on the 1918 drainage plan as ‘the

	new lime beds' has now been taken in as a field and ploughed extensively, though banking is still visible to the east alongside the culvert (site12)
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

Site number	19
Site Name	The main offices
NGR	SJ 7045 7514
Site Type	Building
Period	World War I
CSMR No	
Source	Site plans 1918-19
Description	West of the Crystal Soda plant, and the north-south railway depression, and immediately adjacent to the track is a low square brick structure (shown on the 1919 map as a free standing square building south-east of the offices). This may be another oil store, similar to site 8. A brick man hole is a visible to the south west. The offices themselves are no longer visible (apart from a series of dumps of crockery and other waste visible to the north and east of the structure).
Assessment	The site lies within the boundary of the 24ha assessment area and will be affected by the development.

ILLUSTRATIONS

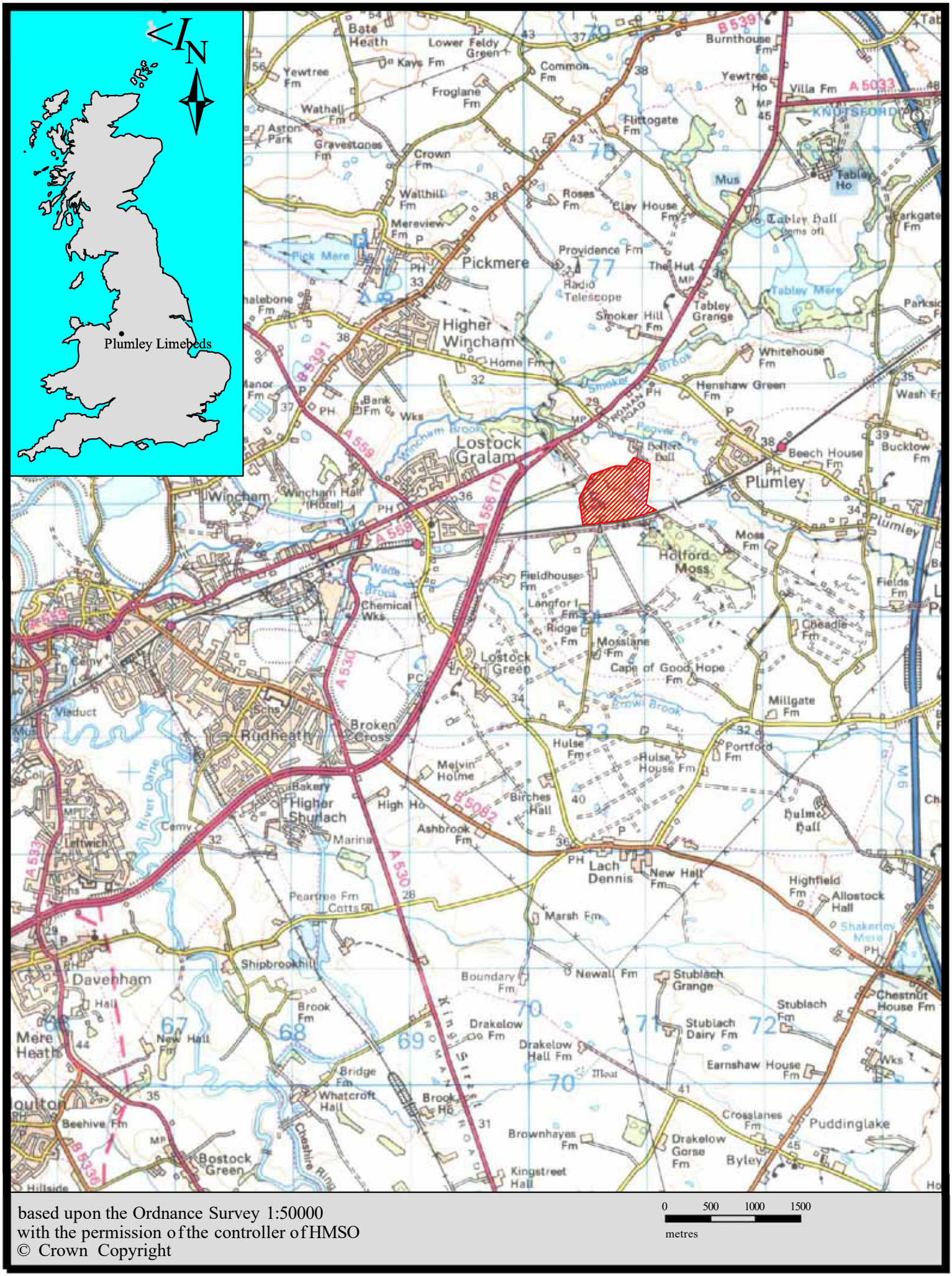

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Fig 1: Plumley Limebeds Study Area: Location Map

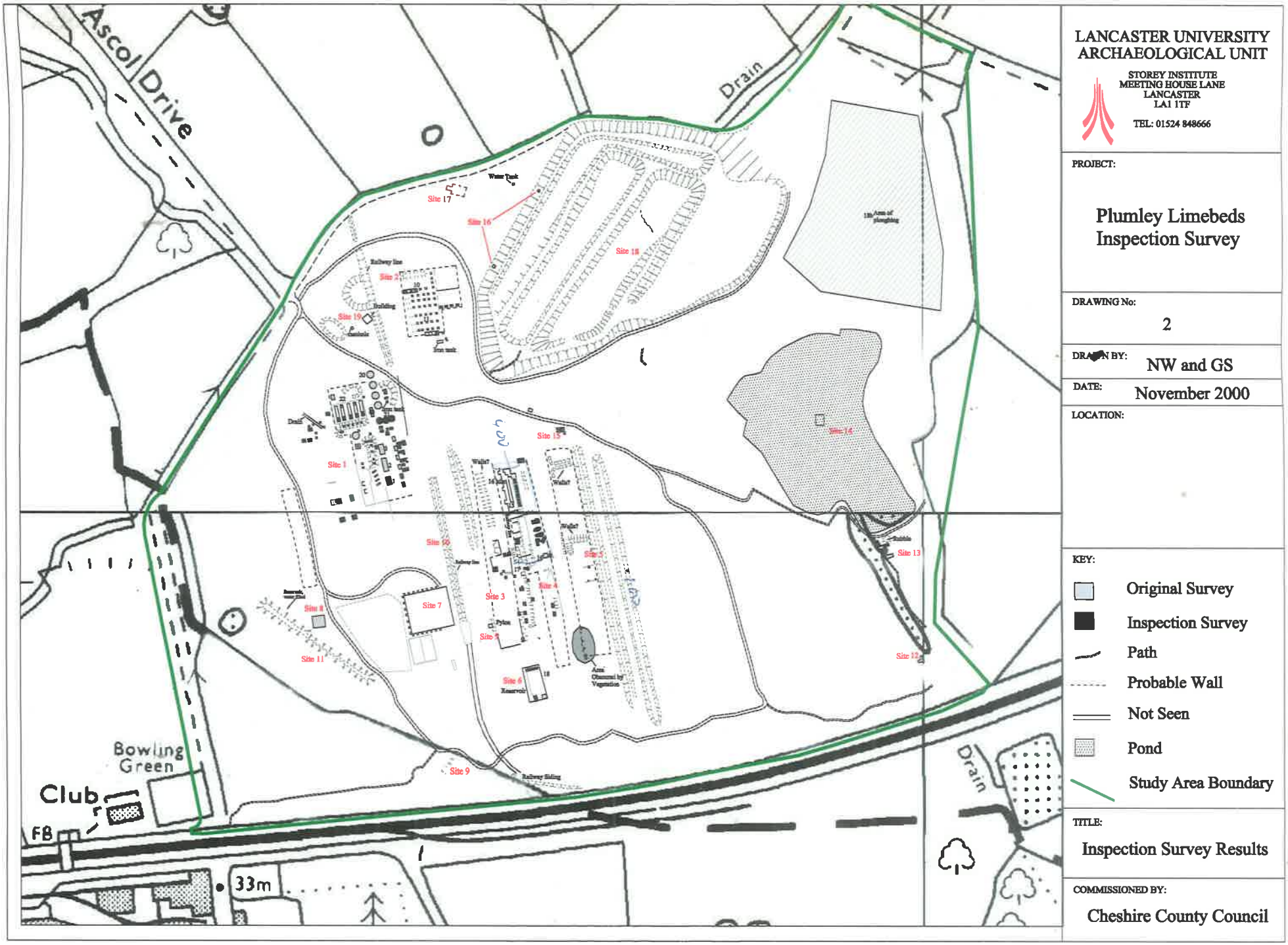

Fig 2: Results of the Inspection Survey

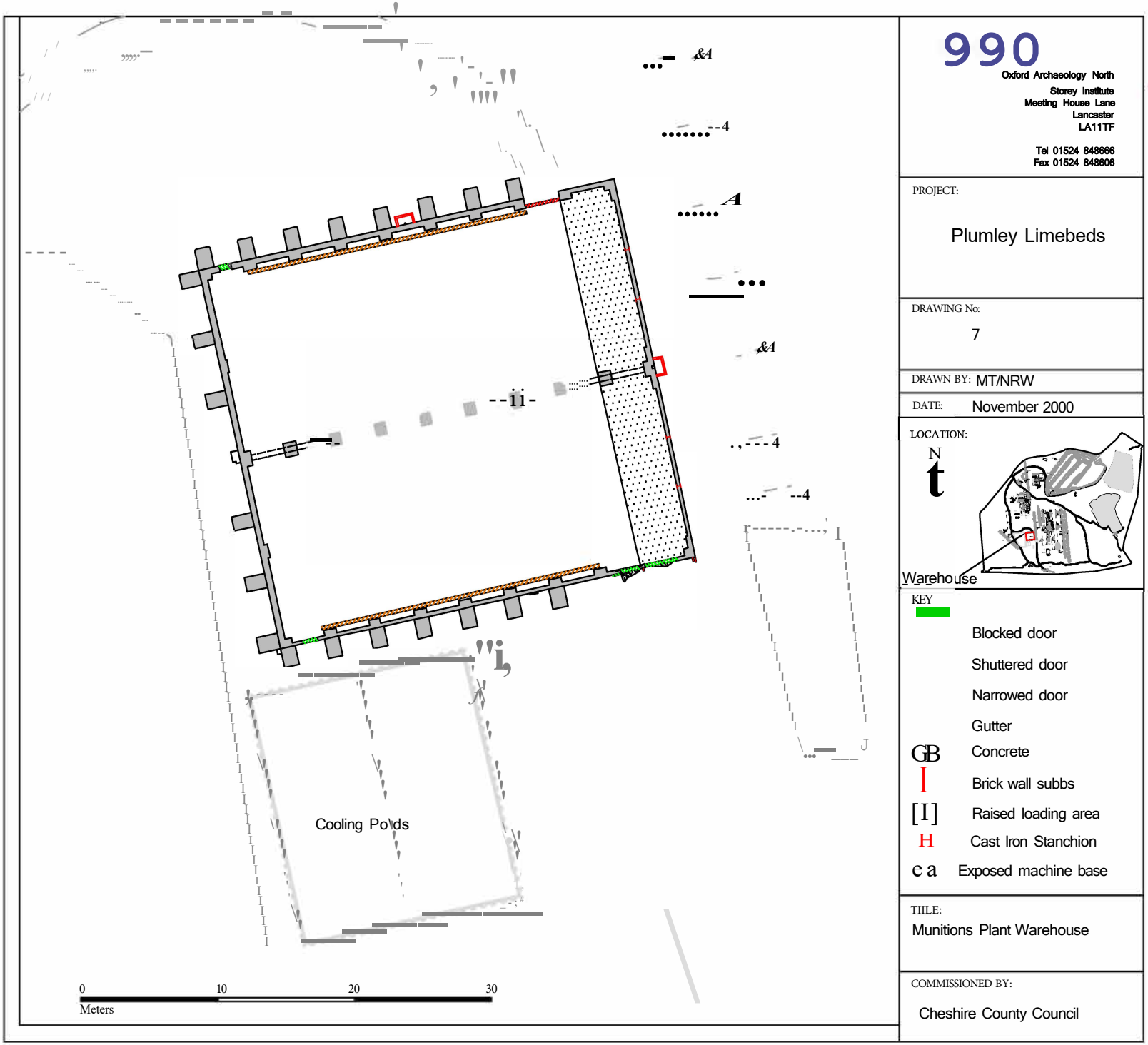

Fig 3: Warehouse Plan

PLATES

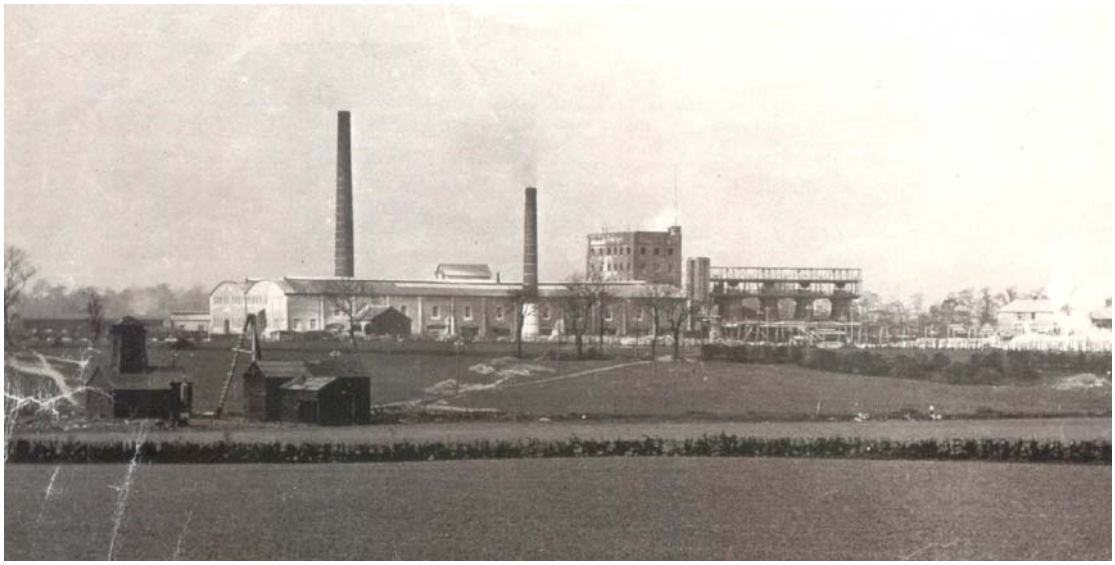

Plate 1: Photograph of the Soda Ash Plant dated *c*1910 looking north-west

Plate 2: Vertical air photograph of the Plumley site, taken in 1946

Plate 3: Central arched wall in the interior of the warehouse, looking south-east

Plate 4: North-cell of the warehouse, showing bricked-up loading bays, looking east

Plate 5: South external elevation of warehouse, showing blocked doorways and roof scars in the south-east corner

Plate 6: North and east elevations of the warehouse, showing shuttered door and bricked-up loading bays