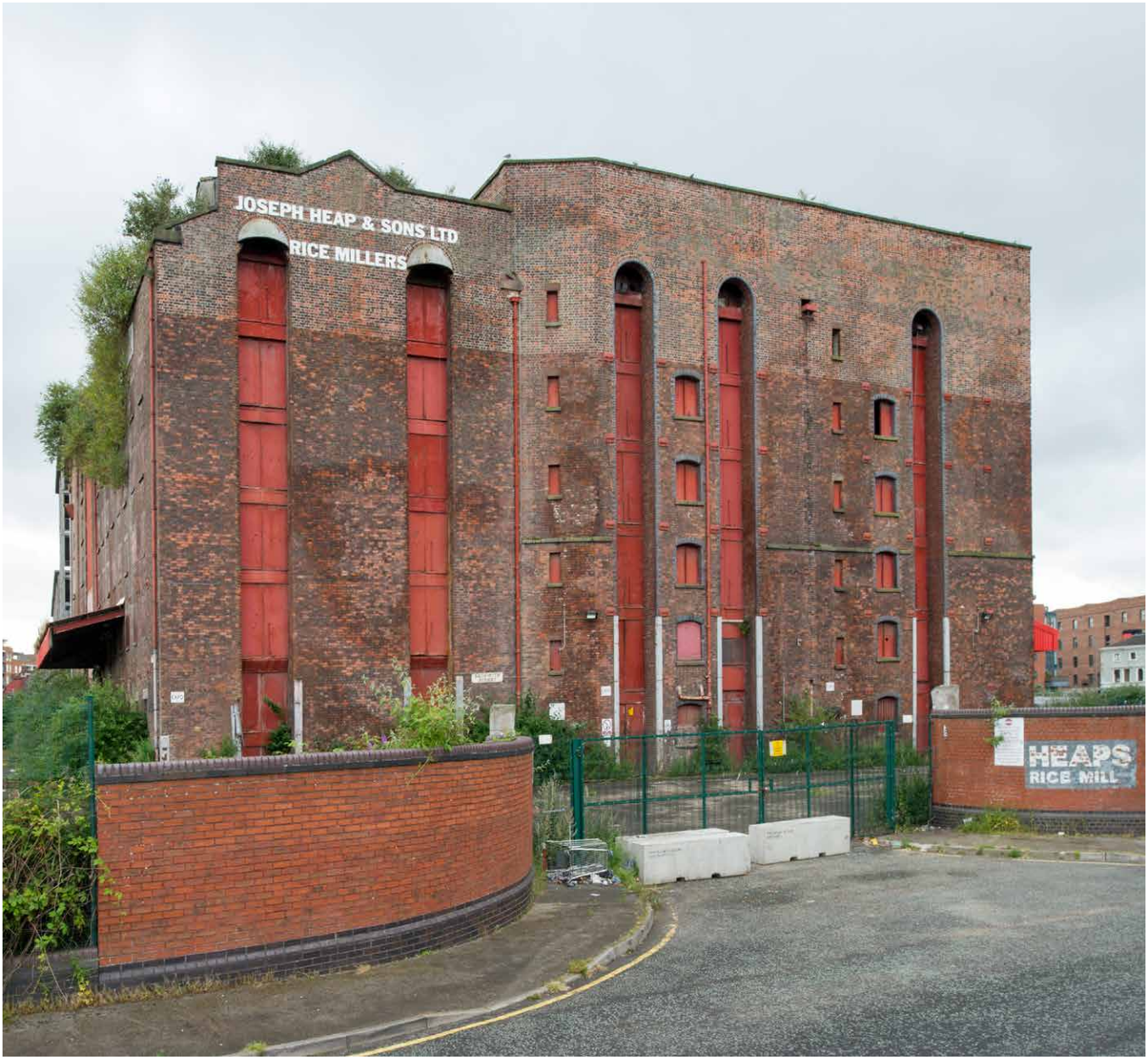
Historic England

Industrial Buildings

Listing Selection Guide



Summary

Historic England's twenty listing selection guides help to define which historic buildings are likely to meet the relevant tests for national designation and be included on the National Heritage List for England. Listing has been in place since 1947 and operates under the Planning (Listed Buildings and Conservation Areas) Act 1990. If a building is felt to meet the necessary standards, it is added to the List. This decision is taken by the Government's Department for Digital, Culture, Media and Sport (DCMS). These selection guides were originally produced by English Heritage in 2011: slightly revised versions are now being published by its successor body, Historic England.

The DCMS' *Principles of Selection for Listing Buildings* set out the over-arching criteria of special architectural or historic interest required for listing and the guides provide more detail of relevant considerations for determining such interest for particular building types. See https://www.gov.uk/government/publications/principles-of-selection-for-listing-buildings.

Each guide falls into two halves. The first defines the types of structures included in it, before going on to give a brisk overview of their characteristics and how these developed through time, with notice of the main architects and representative examples of buildings. The second half of the guide sets out the particular tests in terms of its architectural or historic interest a building has to meet if it is to be listed. A select bibliography gives suggestions for further reading.

This guide provides a brief overview of all historic industrial structures in England.

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HistoricEngland.org.uk/listing/

Front cover
Heap's Rice Mill, Beckwith Street, Liverpool. One of the earliest and last-surviving warehouse complexes in the city's Baltic Triangle. Listed Grade II.

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Introduction

Britain has outstanding international importance as the birthplace of the Industrial Revolution. This was as much a cultural, social and economic revolution as a revolution in the techniques of making things: it radically altered the way in which people thought and lived. The global significance of these events in Britain has been recognised by the inscription of six industrial landscapes as UNESCO World Heritage Sites. Industry has had a profound effect on the environment. Historic industrial sites are a vital element of our tourist industry. They also feature strongly in most urban regeneration and rural land use programmes: here they present opportunities for new use but also challenges for amenity and remediation. Because of the large numbers of surviving industrial buildings, the greatest care needs to be taken to establish the precise nature of a site's special interest prior to designation. The intention of this brief guide is to provide a general overview of industrial structures, highlighting factors that could be seen as being of special interest sufficient to warrant designation. Various buildings and structures associated with the Industrial Revolution are considered under other selection guides including Transport (toll houses, canals, railways), Maritime and Naval Buildings (docks, warehouses), and Domestic 1: Vernacular Houses (workers' housing). Consideration of industrial sites mainly surviving as ruins or archaeological remains is given in the Industrial Sites scheduling selection guide.

This guide has five main sections. A brisk contextual Historical Summary is followed by the Overarching Designation Considerations common to all types of buildings. Next come some General Principles used when considering industrial structures for listing, followed by some detailed Industry-Specific Considerations. Finally a Select Bibliography offers a guide to further reading.

1 Historical Summary

1.1 Up to 1700

The historic industrial environment is the cumulative product of mankind's industrial activities from the earliest days – not just the more prominent impact of the last three hundred years - and much of this survives as archaeology. At the end of the seventeenth century England was still predominantly rural with craftsmen comprising the most important industrial sector. Many crafts were organised in guilds and medieval guildhalls are often the most striking evidence for them. Early industrial buildings were often on a domestic scale, and the typical production unit – the workshop – has largely disappeared or survives heavily disguised by later conversion. While wind and water mills (for grinding corn, fulling cloth or crushing raw materials) were once common, very few pre-1700 examples survive in anything like their original form, machinery, if it survives at all, is typically the result of later refurbishment. There are a few very complete maltings dating from this period: the late-seventeenth century example at Alton, Staffordshire (listed Grade II*) is an interesting survival. Some areas of the economy such as mining, reached a substantial scale of operation but without the need for permanent buildings. Even with wool production surviving industrial buildings of this date are rare, if they survive at all. For physical evidence of the wealth generated, one must turn to the imposing churches of the West Country and East Anglia, clothiers' houses, and some early workers' terraces and model housing (for which see the selection guide for Domestic 2: Town Houses).

1.2 1700-1850

The eighteenth century witnessed the transformation of Britain's economy. Although the timing and origins of the Industrial Revolution are complex and the subject of debate, the effects are clear. England's population had increased from around 6 million in 1700 to nearly 16 million by 1841 with its distribution shifting north. The Industrial Revolution was stimulated by the expansion of trade in the eighteenth century and by a series of discoveries, inventions and developments that were to transform industry and the landscape over the next hundred years. Notable amongst these are the smelting of iron with coke, the puddling of iron, the invention and refinement of the steam engine, the invention of water-powered – and later steam-powered – textile machinery. This was accompanied by significant advances in ways of working, and the all-important emergence of the factory system: the emergence of a disciplined, systematised approach to production bringing together multiple powered processes on the same site. It is important to bear in mind that craft industries prospered alongside, and indeed were symbiotic with, the new power-driven industries of the Industrial Revolution. Factory-production, although becoming dominant towards the end of the period, did not command a monopoly of industrial production; for instance, the so-called 'little meisters' of Sheffield (South Yorkshire) – small-scale producers of knives and other edge tools – operated within striking distance of the large scale furnaces and industrial rolling mills of the Don Valley. Developments in transport, particularly canals, were also key in supporting industrialisation – see the two Transport selection guides https://HistoricEngland.org.uk/lsg-transport-infrastructure/and https://HistoricEngland.org.uk / sgg-transport-infrastructure/.

Figure 1
A water-powered woollen mill in Saddleworth built in 1772, originally used for teasing. Before the move to large coal-powered mills in the expanding towns such small vernacular buildings kick-started the textile revolution. Listed Grade II.

For some industries, these developments have left a physical legacy comprising furnaces, forges and engine houses, fairly complete textile mill complexes and pioneer industrial settlements such as Ironbridge (Shropshire) and Cromford (Derbyshire). A unique survival as regards completeness is the Abbeydale Industrial Hamlet in Sheffield with its ranges of forges, crucible steel furnace and pot shop offices (scheduled and listed). For other industries, such as mining, surviving buildings are relatively scant. State investment in the naval dockyards (and arsenals) was underway before 1700 and by 1800 they had become the largest industrial concerns in the world and were at times in the vanguard of the mechanisation of industrial processes (see the Maritime and Naval Buildings selection guide).

Although the extractive industries have left major landscape features behind, including tramways and dressing floors, few buildings survive. Those that do include some of the world's earliest mine pumping engine houses – such as Elsecar Colliery (South Yorkshire) which remarkably still retains its Newcomen engine – and ore smelt mills such as those at Allendale (Northumberland) and Stone Edge (Derbyshire). Even vestigial remains can be of significance, but as archaeological sites they are often better considered for scheduling than listing. The same is generally true of the remains of the chemical industries such as gunpowder works like Chart Mill, Faversham, Kent (originally 1560, rebuilt 1815 and now scheduled), although some buildings, such as powder stores, may be suitable for listing. The development of industrial chemistry in the eighteenth and nineteenth centuries played a significant part in the success of the textile industry in the west and north of England through improvements in dyes, and also enabled advances in the production of items such as early plastics, soap, paints, and pharmaceutical products – many being by-products of the coal industry. However, surviving structures of these industries are rarely positively identified.

Figure 2
A substantial corn mill of the early nineteenth century in Staveley, North Yorkshire, still retains some of its original sliding sash windows which impart a surprising domestic character to it. Listed Grade II.

The textile industry has fared much better in terms of early surviving structures nationally, but with marked regional imbalances: thus in areas such as the Stroud Valley (Gloucestershire), where the industry contracted relatively early, there is a better survival of early buildings (a large proportion now being listed) compared to Lancashire and West Yorkshire where early mills were often replaced in the expansion of the industry in the later nineteenth century. The most widespread use of waterpower for textiles in the early eighteenth century was for wool fulling, which had been first mechanised in the medieval period. Although silk throwing saw the first development of the water-powered factory system (pioneered at Lombes Mill, at Derby, in 1721) it was developments in the cotton spinning industry in the 1770s that prompted the spectacular expansion of the textile industry in the late eighteenth to early nineteenth century, especially after Richard Arkwright's failure to protect his patents in the mid-1780s. Starting in the Derwent Valley in Derbyshire (now a World Heritage site), cotton spinning spread rapidly through the Midland and Pennine Valleys: by about 1800, the application of rotative action to the steam engine began to free mills from dependence on water power, although take up of this technology was slow in some areas. Cotton spinning mills were thus able to rapidly extend to the surrounding lowlands of Lancashire (and especially around Manchester prompting spectacular urban growth) where they were closer to coal, imported raw materials and markets. However it should be noted that early textile factories also frequently housed hand-powered processes as many were slow to be successfully mechanised. The development of the power loom in the 1820s, first used for cotton (slightly later for wool) sparked a further expansion of the industry and saw the rise of fully integrated mills. Cotton and flax mills were especially vulnerable to fire because of the dust generated. The first experiments in fireproofing date to the 1790s such as the world's

first iron-framed building, Ditherington Flax Mill, Shrewsbury, Shropshire (1797; listed Grade II*) inspiring William Stutt's North Mill, Belper for cotton (1804; listed Grade I). Although fireproofing techniques spread nationally, they were never universally applied and were seen as best practice, rather than common practice as late as the 1850s.

In this period the agricultural-based industries such as corn milling, tanning, malting and brewing, while undergoing considerable technical development, did not experience a comparable expansion in scale of individual sites because these industries were more widely distributed across the country. Only in London, with nearly 900,000 inhabitants, was there a sufficient market to achieve truly industrial scale in this period; the Whitbread brewery (listed Grade II) in Moorgate, in the City of London, was among the larger of the capital's industrial premises, with a massive room constructed 1776-84 for the maturing of beer that was surpassed in terms of span and size only by Westminster Hall. Although generally built on a smaller scale than textile mills, there was a flush of investment in new corn mills in the decade either side of 1800 prompted by raised grain prices caused by war on the Continent (Fig 2). In contrast to single-storey mills typical of the earlier eighteenth century, these new mills were multi-storied, designed to take better advantage of gravity in the processing.

1.3 1850-1914

This period saw Britain as the 'workshop of the world', spectacularly illustrated by the 1855 Great Exhibition, with a dramatic increase in production in all sectors but, by the end of the period, some industries, notably coal, had peaked and were set for permanent decline. This was also the age of the railways (see Transport selection guide) which revolutionised transport and largely freed industry from the need to be close to sources of raw materials and allowed a much wider distribution of basic industries. Thus most reasonably sized towns contained foundries, breweries, maltings and the like sufficient for their local market At the same time, improved transport supported the increase in centres of specialist industries such as hatting in Stockport, jewellery making in Birmingham and shoe manufacture in Northampton.

Most of this expansion of industry was powered by coal. Coal production rose threefold during the period peaking at about 170 million tons with over a million miners in 1914. This was also the classic period of the metal processing and metal working industries, and of the emergence of large-scale workshops. The pioneer blast furnaces, foundries and engine works of the earlier period were soon to be replicated and dwarfed in scale in hundreds of locations. Manufacturers of steam engines – which had powered the Industrial Revolution – turned to locomotive and marine engine construction from the 1830s onwards and some grew to enormous size: by 1913, locomotive engineering works such as those of the railway companies at Crewe (Staffordshire) and Swindon (Wiltshire) were among the largest works complexes in the world. Similarly, huge agricultural engineering works developed in the east of England (such as Ransome's of Ipswich, in Suffolk, and Clayton and Shuttleworth's of Lincoln) and supplied much of the agricultural machinery that opened up the American prairies and the European steppes.

Improved transport and rapidly expanding urban areas supported the increased industrial scale of food production such as large steam-powered roller flour mills and monumentally scaled breweries, often using architectural display as part of their firm's marketing. However, these landmark structures were always much fewer in number than the plethora of smaller concerns operating from a multitude of typically utilitarian premises spread throughout the country. This period also saw the great further expansion and flowering of the various branches of the textile industry with the application and refinement of steam power to weaving as well as further developments in spinning technology. Advances in building technology and a new breed of specialist mill architect emerged (for instance, George Woodhouse and the Stott family) who responded to the increasing scale of production – many mills contained more than 100,000 spindles – by developing new building

techniques and layouts, new sources of power and transmission arrangements and new building materials such as rolled steel beams and reinforced concrete. Such developments made England's industrial areas the objects of international fascination. This was particularly true of the first industrial estate created from 1896 at Trafford Park (Greater Manchester), which brought Taylorised production methods (which promoted efficiency and a scientific approach to management and manufacture) to the country and was where Henry Ford first established a UK presence in 1910. Against this background, and starting from a very small scale with the building of the Spirella corset factory (C H Hignett; listed Grade II*) in Letchworth (Hertfordshire) in 1912, such progressive concerns were a major objective of the Garden City Movement and introduced the idea of planned industrial zones. As industry expanded evermore into the outskirts of towns, the development of the planning profession, following the Planning Act of 1909, became a considerable influence on the siting and design of industrial facilities.

1.4 1914 to the present

The industrial heritage of the last 100 years is less easy to evaluate as regards designation. Many of the more traditional industries have steadily declined until there are relatively few sites left. The coal industry contracted dramatically in the 1980s and early 1990s with many historic sites cleared before a full evaluation could be made of their significance. The last deep coal mines in England closed in 2015. The iron and steel industry, which had contracted to only a handful of works focused on specialist steels by the end of the twentieth century may also be in terminal decline. Engineering has also refined its operations to the precision end of the market and the huge complexes employing thousands of workers virtually disappeared in the latter half of the twentieth century. Even the newer engineering industries – for instance, car manufacture and the aerospace industry – have undergone similar cycles of contraction and concentration and relatively few buildings worthy of designation survive.

However, significant changes were made to the image of industry through the spread of American and German industrial methods, allied to advances in planning. The attempts to improve the quality of industrial products in Germany before the First World War led to the creation of the *Deusche Werkbund* – a reforming association of industrialists and designers which became the model for its British counterpart, the Design and Industries Association (founded 1915). Works such as Berlin's classically-inspired turbine assembly hall of 1908, by Peter Behrens for the AEG, came to symbolize this new relationship between 'Art and Industry', and influenced some of the more progressively minded manufacturers. From the US the concept of the 'daylight factory' was introduced: its major impact was first felt in Trafford Park (Greater Manchester). These long, low, and sleek modern buildings with large areas of glazing, in pleasant grassed settings, account for many of the so-called 'by-pass modern' factories. Frequently sited along new arterial roads such as London's Great Western Road, the best known are those designed by Wallis, Gilbert and Partners, such as their Hoover Factory (1932-5, listed Grade II*; Fig 3). Recent developments in architecture have brought renewed attention to the challenges of factory design, and a number of significant High Tech structures from firms of international renown have been built such as the Renault Distribution Centre, Swindon (1983), by Foster and Partners (listed Grade II*). Another theme of the period has been the establishment of ever-more laboratories for scientific research: the British Gas Research Station, Killingworth, North Tyneside, designed by Ryder and Yates in 1965 and completed in 1967 (listed Grade II*; Fig 4), is a good example.

The textile industry witnessed a final expansive phase in the first quarter of the twentieth century but almost all manufactories and mills have now closed or been converted to other uses – many in the last three decades. The garment industry survived somewhat longer with a flourish in the 1930s producing notable modern buildings along many of the new bypass roads and boulevards: but even those have largely gone.

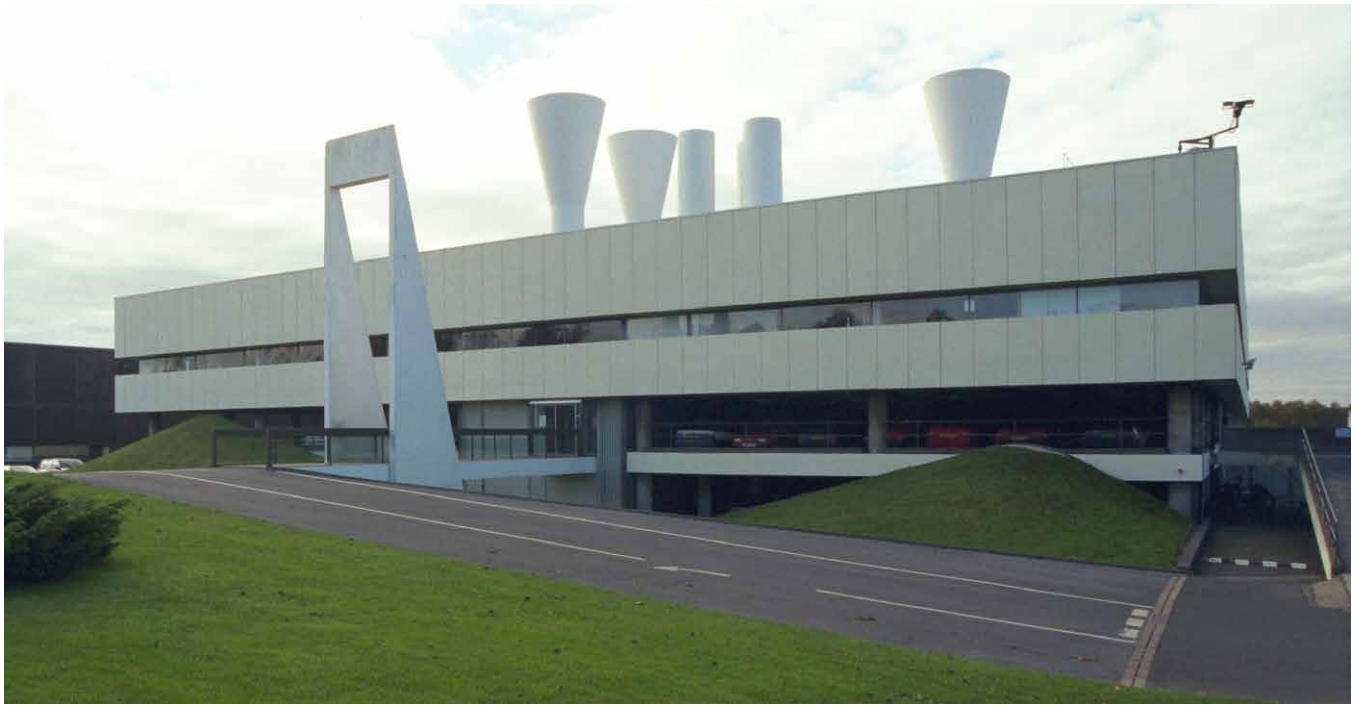

Figure 3 (top)
For long derided due to its overtly commercial character, daylight factories such as this one in the Art Deco style were prominently sited in the new by-passes and arterial roads of inter-war Britain to gain maximum impact. Industry was no longer something to be hidden from view in such buildings. Designed by Wallis, Gilbert and Partners, 1932-5, and listed Grade II*, the former Hoover Factory on London's Western Avenue was converted to a supermarket following closure of the factory.

Figure 4 (bottom)
British Gas Research Station, Killingworth, North Tyneside, designed by Ryder and Yates in 1965 and completed in 1967. A *tour de force* of post-war architecture with deliberate references to continental examples in the transformation of service elements into sculptural forms. Listed Grade II*.

2 Overarching Considerations

2.1 Scheduling and protection

Archaeological sites and monuments vary greatly in character, and can be protected in many ways: through positive management by owners, through policy, and through designation. In terms of our designation system, this consists of several separate approaches which operate alongside each other, and our aim is to recommend the most appropriate sort of protection for each asset. Our approach towards designation will vary, depending on the asset in question: our selection guides aim to indicate our broad approaches, but are subordinate to Department for Culture, Media and Sport (DCMS) policy.

Scheduling, through triggering careful control and the involvement of Historic England, ensures that the long-term interests of a site are placed first. It is warranted for sites with real claims to national importance which are the most significant remains in terms of their key place in telling our national story, their overarching cultural value and the need for close management of their potential. Scheduled monuments possess a high order of significance: they derive this from their archaeological and historic interest, which may include aspects of architectural, artistic and even traditional importance. Our selection guides aim to indicate some of the grounds of importance which may be relevant. Unlike listed buildings, scheduled sites are not generally suited to adaptive re-use.

Scheduling is discretionary: the Secretary of State has a choice as to whether to add a site to the schedule or not. Scheduling is deliberately selective: given the ever-increasing numbers of archaeological remains which continue to be identified and interpreted, this is unavoidable. The schedule aims to capture a representative sample of nationally important sites, rather than be an inclusive compendium of such assets.

Given that archaeological sensitivity is all around us, it is important that all means of protecting archaeological remains are recognised. Other designations such as listing can play an important part here. Other sites may be identified as being of national importance, but not scheduled: Government policy affords them protection through the planning system (see https://www.gov.uk/government/publications/national-planning-policy-framework--2), and local authorities play a key part in managing them through their archaeological services and Historic Environment Records. Policies for protecting non-scheduled heritage assets of equivalent significance to scheduled monuments are explicitly encouraged in recent Government guidance, which makes the identification of such sites all the more important. Archaeological remains are thus protected by various means alongside scheduling.

The schedule has evolved over 100 years, and some entries fall short of modern standards. We are striving to upgrade these older records as part of our programme of upgrading the National Heritage List for England. Where appropriate, we may recommend revisions to the designations, and improve their mapping as well.

2.2 Listing and scheduling

Considerable numbers of sites of industrial archaeological importance have been scheduled as monuments. Past practice has generally been to schedule sites and remains, where monumentalised, and to list buildings. There is considerable overlap, however, and some dual designation, that is where the same asset is both scheduled and listed. Our current approach is to consider what the appropriate designation response is, and consider how the site or structure is best managed. This is more fully discussed in the Industrial Sites scheduling selection guide.

2.3 Heritage assets and national importance

Paragraph 139 of the National Planning Policy Framework (March 2012) (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf) states that in order to conserve and enhance the historic environment 'non-designated heritage assets of archaeological interest that are demonstrably of equivalent significance to scheduled monuments, should be considered subject to the policies for designated heritage assets'. These assets are defined as having National Importance (NI). This is merely the latest iteration of a principle first raised in PPG16 (1990-2010) and later in PPS5 (2010-12).

Historic England is currently (2016) undertaking a series of activities relating to NI in discussion with government and the sector which aims to produce a draft framework setting out agreed Principles of Selection, and agree a draft protocol clarifying how Local Authority Historic Environment Services would be involved in this.

2.4 Selection criteria

The particular considerations used by the Secretary of State when determining whether sites of all types are suitable for statutory designation through scheduling are set out in https://www.gov.uk/government/publications/scheduled-monuments-policy-statement. These considerations are under the following headings: period; rarity and representativity; documentation; group value; survival/condition; and potential.

3 General Principles

3.1 Integrated sites

With industrial sites it is important to consider how they functioned in terms process-flow: from receiving and storing raw materials, via the various manufacturing stages, through to warehousing and the selling of the end product. In addition, other structures may be present which served the needs of the workforce or facilitated maintenance. With sites of acknowledged historic interest, consideration should be given to listing all relevant structures, even where they are architecturally utilitarian. If elements have been lost from the complex, undermining the understanding of how the site functioned, this may make the surviving buildings unlistable unless they are of special interest for some other reason.

3.2 Architectural display

Some industrial buildings were deliberately architectural in their design. Architects, where

Figure 5
Isolated engine houses, such as this of the late nineteenth century at the former Wheal Jenkin copper mine, Linkinhorne, Cornwall, form some of the most evocative of our industrial remains. Listed Grade II.

they were employed, often focused their attention on public facing parts of the industrial complex, such as main offices or showrooms: such buildings can be of peripheral interest to the interest of the complex as an industrial site, but may be of special architectural interest in their own right (see the Commerce and Exchange Buildings selection guide).

3.3 Regional factors

Some industries are concentrated in particular regions, and designation is a way of capturing representative examples of buildings and complexes which give places their particular character. One example is the boot and shoe industry of Northamptonshire, another being listings in the Kent coalfield which preserve tangible evidence that not all coal came from the great northern coalfields. Some structures are so emblematic of a major national industry that they can be designated even when largely ruinous, as with Cornish tin mining engine houses (Fig 5), many of which also form part of a World Heritage Site

3.4 Machinery

Because redundant machinery is typically either replaced or sold for scrap, buildings retaining intact nineteenth-century or earlier machinery are exceptional; its presence can provide good justification for designation, sometimes at a high grade. Even where machinery has been removed, sufficient evidence of it may remain to allow a good understanding of manufacturing processes, and in some cases provide justification for designation either via listing or scheduling.

3.5 Historic interest, including innovation

Some buildings may be of special historical interest because they were where new technology was developed, such as Ladywood Works in Lutterworth, (listed Grade ll*) where Sir Frank Whittle developed the jet engine, one of the defining developments of the twentieth century. In such cases careful consideration needs to be given to how influential the development or variation proved to be; the greater interest will always lie with the 'breakthrough' innovation. Normally there should be some direct evidence of the innovation exhibited in the structure itself. Buildings may also be of special architectural interest for the use of technology in their physical construction (such as fireproofing). Associations with significant engineers, millwrights or entrepreneurs may also give, or enhance, special interest and grading.

Individual buildings must be assessed on their own merits. However, it is important to consider the wider context and where a building forms part of a functional group with one or more listed (or listable) structures this is likely to add to its own interest. Examples might include process buildings associated with industrial or military sites. Key considerations are the relative dates of the structures, and the degree to which they were functionally inter-dependent when in their original uses.

3.6 Extent of listing

Amendment to the Planning (Listed Buildings and Conservation Areas) Act 1990 provides two potential ways to be more precise about what is listed.

The empowerments, found in section 1 (5A) (a) and (b) of the 1990 Act, allow the List entry to say definitively whether attached or curtilage structures are protected; and/or to exclude from the listing specified objects fixed to the building, features or parts of the structure. These changes do not apply retrospectively, but New listings and substantial amendments from 2013 will provide this clarification when appropriate.

Clarification on the extent of listing for older lists may be obtained through the Local Planning Authority or through the Historic England's Enhanced Advisory Service, see www.HistoricEngland.org.uk/EAS.

4 Industry-Specific Considerations

The following sections examine the special interest of specific industrial building types, splitting the category into three functional sub-sections: extraction; processing and manufacturing; and storage and distribution. It is particularly important when reading this section to bear in mind the general principles outlined above.

4.1 Extraction

This can be divided into three groups. Firstly, coal, most iron ores and some other deposits such as fire clay, salt and some building stones all form relatively thick seams which are generally horizontally bedded and have been exploited by seam mining. Secondly, some iron ores and all other metal ores (such as lead, copper and tin) occur as veins that are typically narrow, intermittent and often cut across bedding planes vertically, resulting in a different range and distribution of buildings. Thirdly, surface quarrying and opencasting (of coal, iron ore, clay, aggregate and most building stones) which generally required little in the way of permanent buildings.

Seam mining

Early mines exploiting seams of coal or iron ore were shallow and consisted of multiple shafts spread across the landscape. Any surface structures are likely to have been temporary and will now only survive archaeologically. The earliest permanent buildings were vertical engine houses for pumping water from the mine workings, first introduced in the eighteenth century but not becoming widespread until the nineteenth. Ventilation chimneys, designed to

Figure 6
An unusually ornate castle-like chimney to a ventilation shaft (with imitation loopholes) in Bollington, Cheshire, of the mid-nineteenth century. The monumental funnel, complete with small furnace to aid the draught, serviced a coal mine beneath. Listed Grade II.

draw foul air out of the workings, generally date from the first half of the nineteenth century (Fig 6). It was not until around the mid-nineteenth century, when steam-powered winding started to replace horse power, that the archetypal pit head with buildings clustered around a pair of shafts really developed. Thus mining buildings pre-dating about 1850 may be listable even if they appear to be isolated from their mining context and, because of their rarity, may merit designation even if ruinous or converted to other uses. The highly capitalised pitheads that are now seen as emblematic of the coal industry (but were also a feature of iron mining in Cleveland and Furness) mainly date to the second half of the nineteenth and the early twentieth centuries. Because of a general policy of clearance after closure, few pithead complexes survive complete; accordingly, the completeness of a complex will be a bonus rather than a precondition for designation. Buildings representing fragmentary survivals of pithead complexes are likely to need some additional factor to be of special interest, such as some particular architectural elaboration (such as the 1911 winding houses at Ledston Luck, West Yorkshire modelled on Elizabethan prodigy houses, listed Grade II), or because they are a particularly rare survival (such as headstocks, as at Brittain Colliery, Derbyshire (see Fig 7) and fan houses, Snowdown Colliery, Kent both Grade II); isolated, utilitarian, non-specialist buildings such as workshops are unlikely to be listable.

Vein mining

Mineral mining has a much longer history than coal mining, stretching back into the Bronze Age, with earlier workings normally obscured by later reworking. The earliest permanent structures associated with mineral mines were smelt mills, the furnaces used for converting the mineral into usable metal. These, along with the associated remains of ore processing, generally survive

Figure 7
A lone colliery headstock with its winding wheel – one of the most instantly recognisable parts of our industrial heritage. This early example of 1848 survives at the former Brittain Colliery, Butterley, Derbyshire, and is listed Grade II.

as archaeological sites more appropriately designated via scheduling. Veins were typically worked via open cuts and shafts sunk down the line of the veins and via adits driven from adjacent valleys, the adits draining the mine workings. Such drainage adits were often expensive to construct and were sometimes given embellished portals that may merit listing, such as that to the Swinhope Horse Level, Allendale (Northumberland; listed Grade II). Exploitation below the lowest drainage level required pumping which was done by hand, horse-power or even waterwheel. Although Wheal Vor mine in Cornwall experimented with steam power for pumping as early as 1710, it was not until the later eighteenth century that improvements in the efficiency of steam engines made steam pumping viable for mines that were not close to a coalfield which could supply fuel. This economic factor saw Cornish mining engineers like Richard Trevithick (1771-1833) pioneer many improvements to the steam engine resulting in the spread of the classic Cornish engine house across the south-west and beyond in the nineteenth century. Again because of economics (and because less material is generally brought to the surface with mineral mines compared to collieries), steam winding was generally only employed at the best capitalised mines in the later nineteenth century. At some mines, the only permanent buildings were for a pumping engine and its associated boilers, so apparently isolated surviving buildings may still be listable. Some mines, in remote uplands, had mineshops, buildings providing dormitory accommodation for miners, often including a manager's office. These may merit designation even when ruinous and dating to the late nineteenth century. Assessments of vein mining sites should take regionality into especial consideration, as a Cornish tin mine has different characteristics to a Derbyshire lead mine which in turn is distinct from a lead mine in the North Pennines.

Quarrying and opencasting

Surface extraction of coal, stone, clay or aggregate was sometimes extensive but required few built structures. Remains of tramways, working areas and spoil tips are more appropriately considered for scheduling, albeit with any standing structures assessed for listing.

4.2 Processing and manufacturing

Furnaces and kilns

Nationally, the most common form of furnace (a structure in which the application of heat is used to convert a material's chemical composition) is the lime kiln (for a convenient summary see Pre-Industrial Lime Kilns IHA. These were used to burn chalk or limestone to produce lime for building (mortar, cement, plaster) or for agricultural use (as a soil-improver; Fig 8). Most are flare kilns, which were loaded with stone stacked within the kiln and fired from beneath for a few days before being allowed to cool before emptying. The late eighteenth century saw the invention and development of the draw kiln (which externally could look identical to a flare kiln) where a mix of fuel and stone was loaded into the top, and continuously burnt with the lime drawn out from draw holes or eyes at the base. Lime kilns can vary considerably in scale

Figure 8
Small limekilns for agriculture can be found throughout the countryside but larger industrial-scale kilns such as this one in Boldon, South Tyneside, are rarer. Carefully sited to exploit the topography like many large kilns it was built close to a local quarry. Listed Grade II.

from small single or paired agricultural kilns through to banks of more industrial-scale kilns often sited beside canals or harbours. The rarer, industrial-scaled kilns (along with other kiln types developed from the mid-nineteenth century such as the Hoffman kiln) were in the past typically assessed for scheduling although in more recent times listing has again been favoured. Smaller field kilns typically exhibit regional variation; listing may be appropriate where they are relatively intact externally for their special interest as local vernacular structures.

Other forms of furnace, such as coke works, calcining kilns, iron blast furnaces, lead smelt mills, brick kilns, glass cones and pottery kilns are rarer and are also more typically considered for scheduling. Some, such as the very distinctively bottle-shaped pottery kilns of Stoke-on-Trent (Staffordshire) may merit consideration for listing even if they have lost archaeological interest through their conversion to other uses.

Corn mills (and similar)

Before the second half of the nineteenth century mills supplied local markets, were generally small-scale and typically wind- or water-driven (for an overview see the IHA on Mills). Up until the eighteenth century, watermills were typically single-storey and were often attached to the miller's house. Such examples are often listable even if now converted to domestic use with the loss of all machinery. The decades either side of 1800 saw the construction of many new multi-storey watermills. These had attic storage, feeding to the milling floor below, that in turn was set above the ground floor where the flour was bagged and dispatched, all making good use of gravity in the processing. Such mills pre-dating to about 1850 may also be listable even where machinery has been removed. In all cases the retention machinery may justify listing at a high grade.

In comparison to watermills, windmills have a lower rate of survival, possibly because their form was historically less adaptable to new uses. Consequently even ruined examples pre-dating 1840 may be eligible for designation.

In the later nineteenth century, flour milling became more industrial in scale, steam or electrically driven, with new mills normally constructed by major companies, usually associated with large granaries at ports. Often designed with a measure of architectural pretension, the most imposing will be candidates for designation even if no longer retaining machinery.

Textile workshops

Before the introduction of the factory system (see below), woollen, linen, silk and cotton manufacture was carried out in houses, which increasingly from the early eighteenth century (earlier in some places) were specially adapted for the task. Cotton and flax was best woven in damp conditions, in basements; survivals in Lancashire and Yorkshire are quite rare and may be identified by blocked cellar windows. The most characteristic loomshops for the other fabrics occupied the top floor of houses and are marked by long rows of mullioned windows; many survive in Yorkshire and the south-west (for wool). Similar garret workshops are associated with silk (they form a distinctive feature in some Cheshire towns such as Macclesfield), cotton (Derbyshire), hosiery (Leicestershire) and lace (Nottinghamshire). Differences in plan and construction differ according to the availability of building materials and the nature of the product. The development of larger machines necessitated separate buildings (for instance, framework knitters' workshops or frameshops which proliferated in the east midlands after the 1830s), as did certain changes in business structures, where quasi-independent operatives would be brought together in specially built loomshops. Positively identified examples retaining evidence of their original use, even dating to the late nineteenth century, will merit listing consideration.

Textile mills

The earliest mechanised textile sites were water-powered mills for teasing wool (Fig 1) or for fulling (finishing) woollen cloth. These are often indistinguishable from corn mills and often worked in tandem with them; many fulling mills were converted solely to corn milling in the late eighteenth century. The earliest multi-storeyed

throwing mills – that is for the manufacture of twisted silk yarn - appeared in the silk districts of Derby and east Cheshire in the early eighteenth century. By 1765 there were 67 mills, confined to London and the north midlands. From the1770s Richard Arkwright and others adapted the technology to cotton spinning, initially in the Derwent Valley, and later elsewhere. Combining a variety of water-driven processes in tall, narrow buildings constructed with load-bearing walls, their width being restricted to the span of the wooden beams supporting their wooden floors, this type of mill endured for a century. The 1770s also saw water power applied to wool scribbling and carding (both to lay the wool fibres roughly parallel) and then to spinning which saw the development of early integrated woollen mills including dye shops and hand loom weaving workshops in the late eighteenth century. Many good examples of these structures are listed in the south-west, for instance around Stroud (Gloucestershire). The late eighteenth century saw the rapid spread of the multi-storeyed spinning mill up Pennine river valleys and elsewhere, and by 1800 mechanised spinning was being employed for all of the major fibres: cotton, flax, silk and wool. By this time also, a way had been developed to convert the vertical action of a beam steam engine into rotary action, allowing mills to be sited without the need for a head of water to power a waterwheel. This saw the rapid development and phenomenal urban growth of Manchester as the centre of the cotton industry.

Since traditional mills (especially for cotton and flax) were prone to disastrous fires, fireproof mills were developed from the late 1790s: Ditherington, on the edge of Shrewsbury, in Shropshire (1796-7; listed Grade I) is reckoned the first. By the first decade of the nineteenth century the classic fireproof mill with cast iron columns supporting cast iron beams with brick jack arches tied by wrought iron tension rods and with metal-framed roofs had evolved. The construction of fireproof mills was constantly refined throughout the century. Exploiting new materials as they became available, mills increased substantially in width and reached their apogee in the twentieth century with steel-framed and concrete-floored mills of enormous dimensions. Most early multi-storeyed fireproof mills are already designated, some at high grades; many of the later mills displaying high quality architectural design or technological interest may also be eligible. Fireproof mills were never universal; they were more expensive to construct than traditional mills and the two persisted alongside each other for much of the nineteenth century. Indeed, traditional mills remained the norm in some areas, such as the west of England, and even in the textile heartlands of the north they probably constituted a majority until the end of the century.

Although there were many early experiments with applying power to weaving, it was not until the 1820s that it was successfully applied to cotton weaving and subsequently to other fibres. Although initially powered looms were installed into traditional multi-storeyed mills, the increasing size and weight of power looms led to the development of the single storey weaving shed with its distinctive saw-tooth roof with north-lights. This resulted in a further expansion of the industry with the development of integrated mills (for cotton from the 1820s and for wool from the 1830s) with single storey weaving sheds extending from multi-storey preparation and spinning blocks, often all sharing a single power source. In the cotton sector, numbers of integrated mills peaked around 1850, to be gradually replaced by firms concentrating on either spinning (centred on Manchester) or weaving (centred on Burnley, Lancashire). By the end of the century over 80 per cent of all spindles were in the spinning district while over 65 per cent of all looms were in the weaving area: industries were becoming more concentrated and specialised. Building activity peaked in different towns at different periods – Bolton in the 1850s, Oldham in the 1870s and 1895-1907 (and see Fig 9 for Stockport), Wigan and Leigh in the early twentieth century (all now in Greater Manchester). Parallel trends are evident in the woollen sector centred on West Yorkshire. In the 1820s, the automatic mule was introduced to woollen production and this, with the introduction of the power loom a few years later, revolutionised the industry and led in the second quarter of the

Figure 9
The appropriately named Pear Mill, Stockport, of 1908-1912 was designed by leading northern mill architects the Stott family. Making a strong statement in the landscape we need to remember that its sylvan setting today is in stark contrast to the pollution which would originally have surrounded it. Listed Grade II*.

century to the spread of integrated mills. These reached their zenith in mid-century with huge steam-powered complexes such as Saltaire (West Yorkshire), a World Heritage Site. As with cotton to the west of the Pennines, the buildings of the wool and worsted industries were to dominate the landscape of West Yorkshire, especially around Halifax, Huddersfield and Bradford. The flax industry peaked in the mid-century, the magnificent Egyptian-style Temple (or Marshall) Mills, Leeds (1838-48, by Ignatius Bonomi; listed Grade I; Fig 10) marks the high point in combining advanced technology and architectural panache. Lace factories were similarly transformed with the introduction of the bobbin-net lace machine perfected and patented by John Heathcoat. Lace production was concentrated in the east midlands (with huge complexes at Beeston in Nottinghamshire, and at Draycott, Long Eaton and Sandiacre in Derbyshire) and the focus of the trade was the Nottingham Lace Market precinct with its magnificent commercial warehouses such as the Grade II listed Barker Gate Warehouse of 1897 designed by Watson Fothergill. There were important outliers in Somerset and Devon too. The silk sector developed gradually in its Cheshire heartland until it exploded in scale in the later nineteenth century with the huge mills built in Yorkshire such as the spectacular Manningham Mills, Bradford, by Andrews and Pepper of 1873 (listed Grade II*).

Manningham Mills are an excellent example of Victorian industrial architecture conceived as public architecture, in which the place of work was as deserving of display as the place of sale. However, it should be remembered that such ambitious, monumentally-conceived complexes designed to impress were the pinnacle of the industry and are often thus listed at high grade. Most textile mills were far more utilitarian in design and may be of special interest for other reasons despite lack of architectural elaboration. Largely intact integrated mill sites are becoming

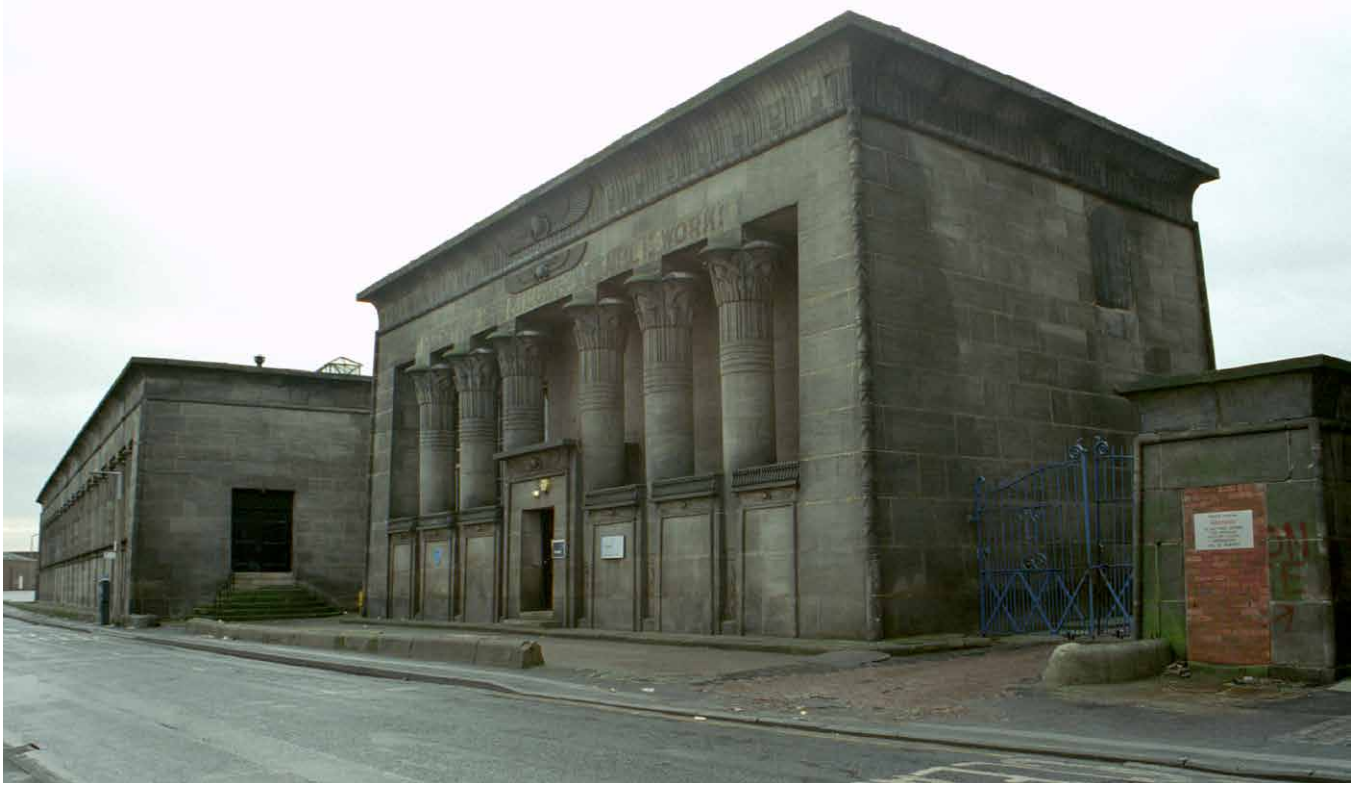

Figure 10
Marshall's Mills, Leeds (1838-40), also known as Temple Works, raised the standard for mill design above the merely utilitarian in this copy of the Temple at Edfu in Egypt. Designed by Ignatius Bonomi and listed Grade I.

increasingly rare and may merit listing even if they are Victorian in date and utilitarian in appearance. Late nineteenth-century specialised mills will require careful assessment, especially weaving mills with their extensive weaving sheds which are becoming increasingly rare. Surveys of textile sites in Greater Manchester in 2005 and 2014 suggest that at least half have been lost since the 1980s.

The textile industry also drove innovation in power systems both in terms of production and transmission. Waterwheels continued to be developed after the introduction of steam power with innovations such as the suspension wheel, rim drives (both early nineteenth century) and wheels built entirely of iron (mid-nineteenth century). The survival of *in situ* waterwheels is nationally rare and will normally justify designation, even with wheels in a collapsed state or where extensive modern restoration has taken place. Associated water systems, dams and sluices will also merit assessment. The early application of steam engines to textile production was for pumping water to the mill pond or onto the water wheel. Surviving structural evidence for early systems will merit consideration for listing at a high grade. Haarlem Mill in Wirksworth (Derbyshire) is the earliest standing textile mill known to have incorporated a steam engine and boiler house into its original design, for use alongside its water wheel, and is listed at Grade ll*. Early steam-powered mills, using single-cylinder beam engines, normally had their engines placed within the main mill building, their position identified by a tall window. From the 1830s wider, double-beamed engines were often employed. By the 1850s, external engine houses had become common and may sometimes be listable in isolation. After the 1870s, with the adoption of the compound engine with horizontal cylinders, engine houses were sometimes large and architecturally embellished. Those retaining their engine are likely to be listed at a high grade, even after the loss of the rest of the mill.

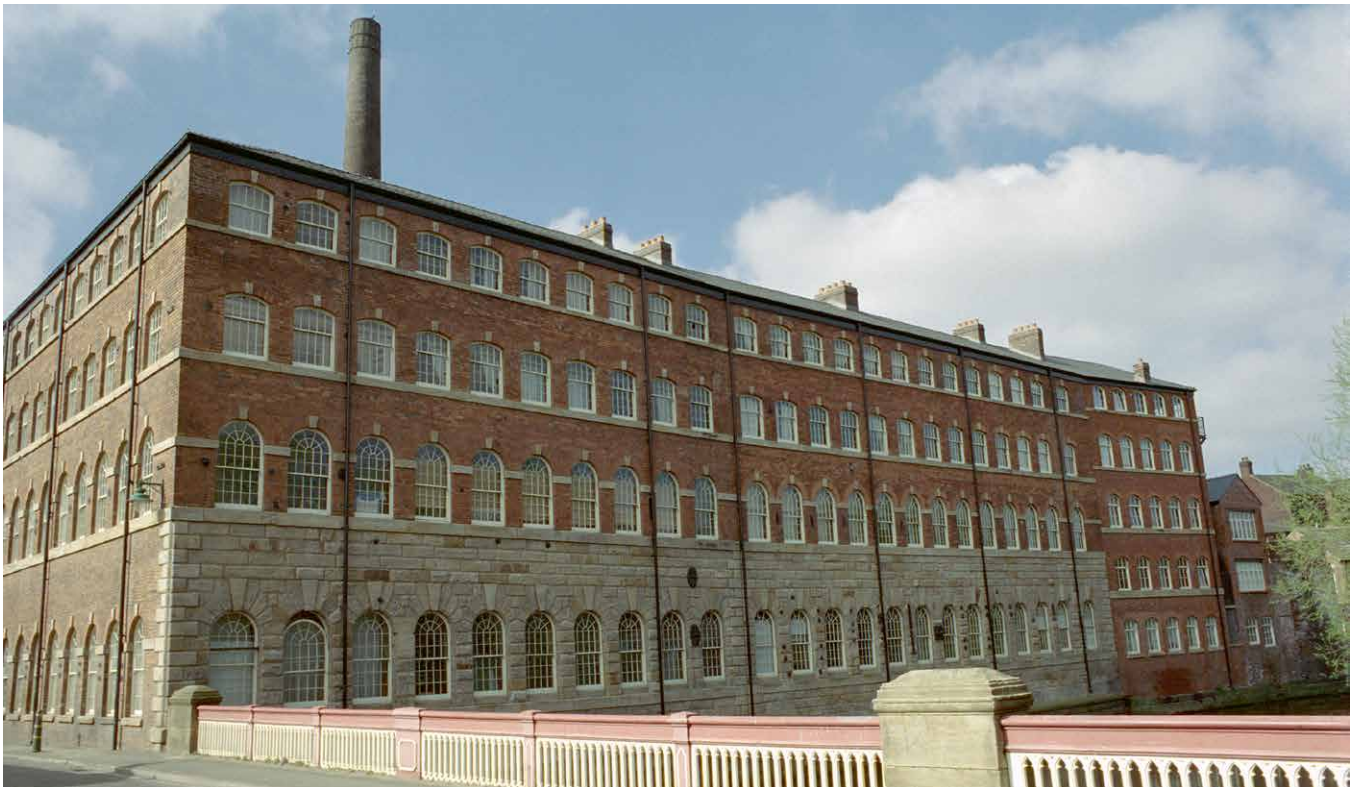

Figure 11
Sheffield's Cornish Place Works – the impressive river frontage to a large conglomeration of integrated specialist cutlery and sheet metal workshops which range in date from the late eighteenth to the early nineteenth century. Listed Grade II*.

Horizontal engine houses lacking their engines, unlike beam engine houses, are unlikely to be listable in isolation unless they have particularly architectural interest. Survival of intact chimneys and boiler houses of any date is increasingly rare; they will usually be included in listings of mill buildings even though they are typically utilitarian. Chimneys with architectural design quality may be eligible for listing in isolation. The power transmission systems of mills can also be of interest, even where evidence for it is fragmentary. Intact survival is very rare and may justify listing at high grade.

Bleacheries and printing shops

These are seldom found on integrated sites since they were operated by specialist independent firms. They could be very large; some of the 170 printing works in Britain in the 1860s employed over 1,000 workers. Few have been listed, but they can sometimes be of considerable interest, on architectural or technological grounds.

Metal and other workshops

Factory-scale production came late or not at all to some metal-making processes. As with textiles, these activities were carried out in, behind or close to the operative's house. The reasons for the survival of small-scale production are various. In the jewellery trade (notably in Birmingham's Jewellery Quarter) this was because the production of a single item might involve numerous processes carried out in the workshops of different firms, and where neighbourliness was essential when moving valuable materials about. In contrast, nail making was a low-skill, low-value activity that never justified investment in factories although some nineteenth-century nail masters accumulated sufficient capital to build terraced houses with adjacent smitheries that they hired out to tenant workers. These examples indicate the extremes of metal workshop organisation: the clock and watchmakers, furniture makers, locksmiths, cutlery and edge-tool workers and so forth were workshop-based for much

of the nineteenth century (and in some cases well beyond) but subject to varied economic pressures that resulted in different chronologies for each sector. Where industries became increasingly mechanised and factory based, such as lock production in the late nineteenth century, evidence of workshops may be scarce. Where they survive in large numbers, as, for instance, with the workshops of the boot and shoe industry in Northamptonshire or the leather workshops of Walsall, they make a distinctive contribution to the townscape (Fig 11). Evaluations for listing need to be made in the context of the specific industry and its region, especially where trades came to concentrate in particular areas. Here the transition from workshop through to factory can be observed in a small geographical compass.

Drink and food processing

A rapidly increasing population from the late eighteenth century on, together with revolutions in transport, led to major changes in the organisation of the food and drink trades, to mechanisation in processing, and transformations in the scale of buildings. Consequently, many early buildings – the predecessors of the giants of the later nineteenth and twentieth centuries – have disappeared or been substantially altered or camouflaged. Such buildings (for instance, eighteenth-century maltings) are rare and will be serious candidates for listing, even if substantially changed.

Oast houses

These are effectively drying kilns (see also the Agricultural Buildings selection guide: most are found on farm sites). The earliest date from the mid-eighteenth century but most are nineteenth. Oast houses are distinctive buildings in hop-growing areas, notably the south-east and Herefordshire. Plans vary: most have round towers with a conical cowl, but some are square. Very few survive in use and the majority have been converted to dwellings with consequent loss of internal features. However, if they remain recognisable, they may still be listable, especially pre-1850 examples.

Maltings

Maltings are recognizable by their cowls and rows of small windows that ventilate rather than light the shallow germinating floors. In competition with mechanised pneumatic malting from the late nineteenth century, floor maltings are highly vulnerable, especially since the floor heights make conversion difficult. Like oast houses, but built on a much more industrial scale, maltings can make a major contribution to the landscape. Some in Lincolnshire are vast, such as that at Sleaford (1892-1905; listed Grade II*), and show industrial architecture at its most monumental.

Breweries

Breweries grew rapidly in size from the eighteenth century to meet increased demand and accommodate changes in science and technology, notably the introduction of steam engines and the widespread use of metal equipment. While oast houses continued to dry hops on the farm in Kent, Herefordshire and elsewhere (Fig 12), the nineteenth century saw the introduction of mechanised mashing (1855), improvements

Figure 12
A group of unaltered oasthouses in Sandhurst, Kent, of the early nineteenth century. Now a quintessential image of English rural life, oasthouses were once an essential industrial component of the brewing industry. Listed Grade II.

in controlled heating (and particularly cooling techniques) and witnessed the emergence of the professional Brewery Engineer. As with so many industries, the tendency was towards integrating processes vertically in a single building – the 'tower', which contained liquor tanks, grist mills, grist hopper, mash tun, and wort receiver, and a wider range of functions – from malting to bottling – on a single site. The major breweries are often monumental in scale and architectural ambition (especially during the construction boom of 1880-1900), but many towns contained one or more that were equally up-to-date, replete with tower, albeit built on a smaller scale. Oxfordshire's Hook Norton brewery (1872; listed Grade II) exemplifies the ornamental functionalism of such Victorian plants. Recent changes in the brewing industry have resulted in a major loss of breweries of all sizes: towers, that were often embellished, are always serious candidates for designation; their importance is enhanced if they form part of a well-preserved integrated site, but may still be listable even with the loss of associated buildings. Conversely breweries that have lost their towers are often rendered unlistable.

Food processing buildings

These survive in enormous numbers and the nineteenth century in particular saw immense changes in technology and scale, especially following the spread of railways. This selection guide cannot touch on them all and some sectors have not been fully researched on the building side. As with industrial buildings generally, candidates for designation need to be assessed within the context of their specific industry as well as with regard to the completeness of individual sites. So, with milk production, for instance, this would range from the collecting depots at railheads in dairy country to wholesale collecting points and bottling plants in cities such as London; with meat production, the key date is the Act of 1890 requiring local authorities to inspect the slaughter of animals that led to the widespread use of municipal abattoirs rather than back-street slaughter houses. The manufacture of luxury foods such as chocolate resulted in large-scale and often innovative factories, such as Cadbury's at Bournville (Birmingham). New food types, such as breakfast cereals, required large factories, for instance, the Shredded Wheat works at Welwyn Garden City, Hertfordshire (Louis de Soissons,1926; listed Grade II). Even the production of craft-food, such as marmalade, assumed an industrial scale (for instance, Frank Cooper's factory at Oxford, 1903). Underpinning changes in these industries was the development of refrigeration, used commercially from the 1850s but on a massive scale after the invention of the ammonia compression machine in 1876: the Grimsby Ice Factory of 1901, which still retains machinery, is Grade II* listed. This in turn led to the frozen food industry established by Clarence Birdseye in the early 1920s. Cold stores emerged as a distinct building type around 1900; sometimes their cavernous interiors were given imposing outward architectural treatment which can sometimes warrant designation, as with that on Charterhouse Street (London Borough of Islington) of 1899, designed by C Stanley Peach and listed Grade II (and see too Fig 13).

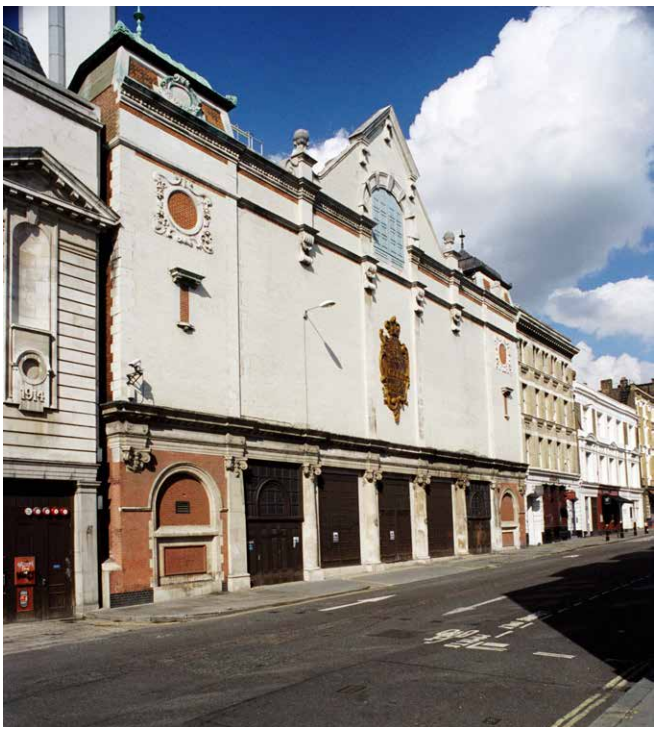

Figure 13
An unusually ornate cold store built to supply the Smithfield market area in London, designed by C Stanley Peach and dating from 1899. Listed Grade II.

Engineering works and factories

The difference between the terms 'works' and 'factories' is not a technical one but is adopted here to make a useful distinction between manufacturing and assembly plants that revolved around the erecting shop and those that did not. Although there is considerable overlap and a danger of over-simplification, railway locomotive and carriage works and agricultural engineering works fall into the first category, motorcar and aircraft factories into the second. The development of the 'day-light factory', exemplified by the Bryant ans May Match Factory, Garston, Liverpool, of 1919-21 by Mewes and Davis (listed Grade II), can apply across categories but generally applies to the latter.

Railway and agricultural engineering works

Both types of works have their own 'pre-history'. The first works for the manufacture and maintenance of locomotives was built in South Street, Newcastle (1823, for Robert Stephenson and Co) but for much of the early nineteenth century locomotives were ordered from established engineering firms and carriages from stagecoach manufacturers. From the mid 1840s the railway companies started to build their own locomotives and rolling stock with the consequent emergence of railway towns such as Swindon (Wiltshire) and Crewe (Cheshire). In the agricultural sector, specialist foundries had emerged by the 1790s for the production of engines, wheels and castings, and workshops might be arranged around a round house containing the forge. By the 1840s, integrated sites were constructing the components, assembling them on site and erecting them in the erecting shop – an aisled building with a central area lit by a clerestorey that contained an overhead travelling crane. This revolutionised flow line provided comprehensive coverage for the entire floor for lifting and moving the heaviest components. The agricultural engineering workshops – making traction and stationary engines and all sorts of implements for the domestic and world market - were concentrated in the towns of the east of England: the Garrett works in Leiston (Suffolk) with its 1853 'Long Shop' (listed Grade II*), remains a good example.

The erecting shop remained the dominant engineering building, gaining in effectiveness with more sophisticated crane technology. Survivals prior to the general adoption of the erecting workshop (pre-1850) and the earliest erecting workshops themselves will be strong candidates for listing if they survive reasonably intact; after about 1850, rigorous selection should be made on the basis of completeness of site, scale and architectural interest. Early machinery will strengthen the case for listing and may justify a high grade. Many sites will contain forges and pattern shops and other ancillary buildings such as fettling shops and annealing ovens: these are rare and strong candidates for protection.

Motorcar and aircraft factories

Both tended to occupy adapted premises, and often switched production according to market demand, for instance from cars to bicycles or cars to aircraft in time of war. The earliest surviving purpose-built car factory (and showroom) dates from 1900 (for Dennis, at Guildford, Surrey; listed Grade II); the earliest aircraft factories are dated 1909 (at Leysdown, Kent, for Short Bros., and 1913 in Kingston-upon-Thames, Surrey, for Sopwith Aviation: listed Grade II). The building type of both assumed the standard form of large, north-lit, unobstructed sheds, which for aircraft are often huge. The most distinguishing features are usually the offices and showrooms where Art Deco, stripped Classical or Moderne styles were favoured: these are sometimes listed, as is the de Havilland works of 1934 in Hatfield (Hertfordshire) by Geoffrey Munro of J M Munro and Son (listed Grade II). The large assembly plants seldom are unless they have intrinsic architectural or technical interest, as is the case with some inter-war and post-war plants such as the American-designed Cummins Engine Factory of 1964-5 in Darlington (County Durham) by Roche and Dinkeloo (listed Grade II*). Some factories can claim historical importance, such as the former Hawker factory in Kingston-upon-Thames of 1933 (Grade II) wherein a number of important aircraft, above all the Hurricane, were designed and produced. Often, however, remarkable vehicles were produced in unremarkable premises whose listing is unlikely to be warranted.

4.3 Storage and distribution

Warehouses

Merchants' warehouses have served the wool, cloth and other trades since the medieval period, and were typically attached to merchants' own houses, with goods stored on one or more floors, or within the basement or attic. By the eighteenth century these might form distinct wings attached to houses (as in Whitehaven, Cumbria). By the mid-nineteenth century, purpose-built premises were appearing in growing numbers. From 1839, the palazzo-style, pioneered in Manchester, formed a model for warehouses throughout the country until the 1870s after which designers drew on a rich diversity of styles. The introduction of new facing materials such as faience and terracotta in the late nineteenth century brought about further change to warehouse appearance, and the introduction of steel framing in the Edwardian period increased the glazing area and the size of buildings, enabling merchants to gain maximum return from the plots. Warehouse plans varied according to function. Bonded warehouses are characterised by small windows and a forbidding presence not unlike prisons. Other types needed light as well as security. Heavier goods tended to be stored on the lower floors whilst the upper floors were used for inspection. Packing took place in the basement, which, because of the raised ground floor, could be lit by pavement-level windows usually protected by iron grilles. Some warehouses contained specialised equipment according to the goods being handled: for instance, in Manchester, where hydraulic presses compressed cloth into airless

Figure 14
The enormous goods warehouse for the Great Northern Railway Company on Manchester's Deansgate (1885-96) was designed to allow goods to be moved on hydraulic lifts between canal, railway or road levels. Listed Grade II*.

bales for safer shipping, long-term storage and security. Most would have hoists and lifts, some hydraulically powered. Packing warehouses (for making-up, packing and dispatching goods) were sometimes occupied by several firms: the chief indicators of this are the numerous wagon entrances, loading bays and cranes.

Transit warehouses and depots

These, which provided short-term warehousing – moving goods from long-haul to local transport – are to be found lining canals and railways and in every port. At their most ambitious they vie with naval dockyards in scale: the London and North-Western Railway depot at Camden (London) opened in the early 1840s and by the 1880s covered 14 acres; surviving elements from 1855-70, including stabling yards, are listed Grade II. The most sophisticated structures facilitated interchange between road, canal and rail transport: Camden is again a well-preserved example; others exist in cities like Manchester where the enormous Great Northern Railway Company warehouse on Deansgate of 1885-96 is listed Grade II* (Fig 14). Smaller, more modest examples pre-dating 1914 may also be of special interest, illustrating the former importance of canals and railways for transporting general goods now carried predominantly by road.

Warehouses of the later nineteenth century often employed the latest building technology, mainly developed for fireproofed textile mills, such as iron and later steel and concrete construction. Often they were also designed to impress, and many are grand and architecturally distinguished. Technical and architectural interest will often combine in a single building. In addition, groups of warehouses together can create urban environments of enormous character and importance: in cities such as Manchester, Liverpool, Leicester, Nottingham, Lancaster and London they comprise some of the most memorable reminders of the Industrial Revolution (Fig 15).

Figure 15
Towns, such as Nottingham, Leeds, and pre-eminently Manchester, were at the cutting edge of construction techniques to create ever more specialised warehouses for their goods. Manchester's Canada House of 1909 was designed by W G Higginbottom employing a cast-iron frame with steel trussed roof to take great weight whilst allowing maximum daylight. Now successfully converted to offices. Listed Grade II.

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The Association for Industrial Archaeology has produced regional and county gazetteers in connection with its annual conference each year for over 20 years.

5.5 Websites and Societies

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https://www.spab.org.uk/spab-mills-section/ The mills section of the Society for the Protection of Ancient Buildings for traditional water and wind mills.

5 Where to Get Advice

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