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ST MARY'S MARSHES, HOO ST MARY, MEDWAY, KENT
AN ASSESSMENT OF THE LATE 19TH-CENTURY EXPLOSIVES MAGAZINES

Sarah Newsome and Rebecca Pullen

ASSESSMENT

ENGLISH HERITAGE

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St Mary's Marshes, Hoo St Mary, Medway, Kent
An Asssessment of the Late 19th Century Explosives Magazines

Sarah Newsome and Rebecca Pullen

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SUMMARY

In 2012 English Heritage carried out research into the little understood explosives magazines located at St Mary's Marshes on the Hoo Peninsula in Medway, Kent. The research was undertaken as part of the wider Hoo Peninsula Historic Landscape Project. Magazines were constructed on the marshes around 1892 by the Thames Storage (Explosives) Company for the packing, repacking and storage of explosives, as a commercial venture on land leased from the Dean and Chapter of Rochester Cathedral. Doubt remains over the original building materials: the surviving concrete buildings are possibly replacements for brick magazines. Documentary evidence suggests that the Thames Storage (Explosives) Company went into liquidation in 1907 but that the magazines possibly had a second life as a 'Government magazine', eventually going out of use in 1913, when the lease on the land also expired. Seven magazines survive in a ruinous state, some with protective earth bunds, and appear to be an unusual use of mass concrete in an explosives storage context.

CONTRIBUTORS

Sarah Newsome, Rebecca Pullen (English Heritage Archaeological Survey and Investigation – Cambridge) and Derwin Gregory (EPPIC Placement) undertook the rapid field survey. Sarah Newsome undertook the background research and wrote the report with contributions from Rebecca Pullen and Ed Carpenter (Aerial Survey and Investigation – Swindon). All photographs included in this report were taken by the authors unless otherwise stated.

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English Heritage is grateful to the Church Commissioners of England for their kind permission to visit the site and to the Medway Archives and Local Studies Centre and the Dean and Chapter of Rochester for their kind permission to reproduce a number of plans from their archives.

ARCHIVE LOCATION

The report archive will be deposited at the English Heritage Archives, English Heritage, The Engine House, Fire Fly Avenue, Swindon, SN2 2EH.

DATE OF RESEARCH

Site visited 13 January 2012, background research undertaken January to August 2012.

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INTRODUCTION

In 2012 English Heritage investigated a group of seven concrete explosives magazines centred on TQ 7991 7899 on St Mary's Marshes, Hoo St Mary parish, Medway (Kent HER TQ 77 NE 37; NMR TQ 77 NE 181). The investigation was undertaken as part of English Heritage's Hoo Peninsula Historic Landscape Project (5733) which aims to provide a greater understanding of the historical development of the Hoo Peninsula in order to underpin strategic decision-making in the face of anticipated major development (Carpenter *et al* 2013). The group of seven concrete magazines was identified during the wider project as being poorly understood and have not been subject to any previous research.

On 13 January 2012 English Heritage's Archaeological Survey and Investigation (Cambridge) team undertook a rapid survey of the site which was followed up by documentary research using both local and national archives. Rapid measured survey of a representative building was undertaken.

The site lies on the northern edge of the Hoo Peninsula adjacent to the River Thames. The magazines are located around 1.7m above Ordnance Datum on land reclaimed from salt-marsh consisting of London Clay covered by alluvium deposits.

The magazines are on private property and there is no public access.

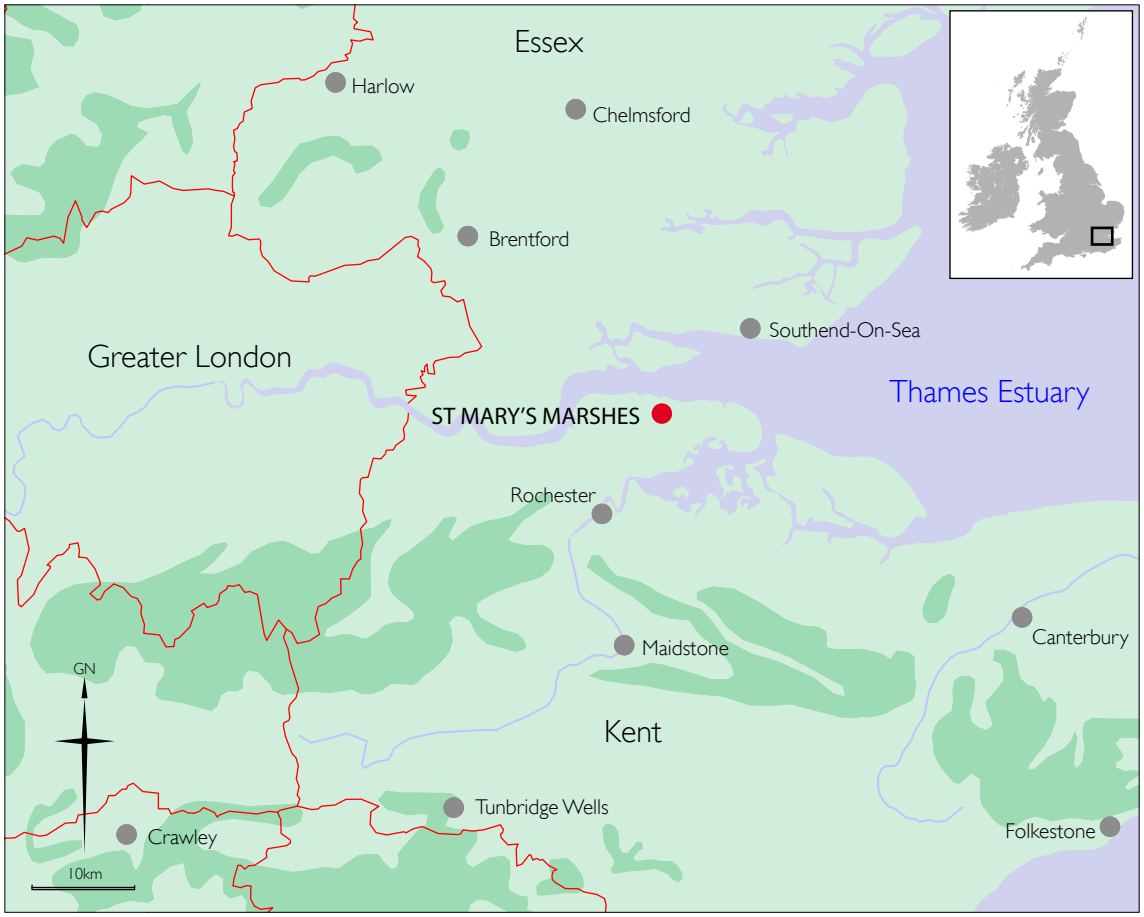

Figure 1: Location Map.

DOCUMENTARY EVIDENCE FOR THE HISTORY OF THE SITE

Origins of the magazines

Correspondence held in the archives of the Dean and Chapter of Rochester Cathedral demonstrates that a series of explosives stores, tramways and a caretakers cottage were being planned for land at St Mary's Marshes by late 1891 (MALSC DRc/Egz/151/1). Only an acre of land was thought to be needed for the actual site of the magazines, though a large exclusion zone of 324 acres, where no houses should be built, would be necessary and it seems that there was some initial local opposition to the locating of the magazines on the marshes (Figure 2).

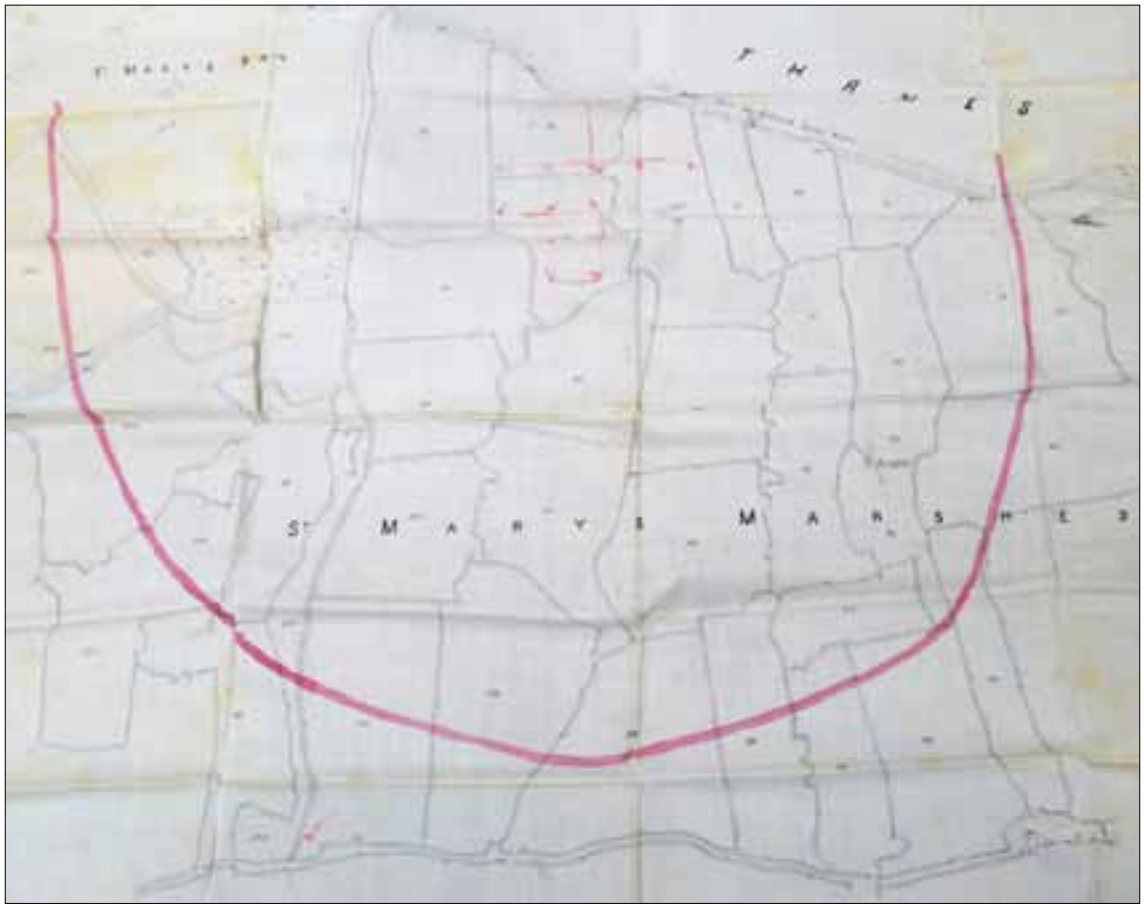

Figure 2: Plan showing the exclusion zone around the proposed site, where further building would not be permitted, and the location, to the south-west, of the proposed caretaker's cottage which was never built (MALSC DRc/Egz/151/2 – Permission of the Dean and Chapter of Rochester).

A new company, the Thames Storage (Explosives) Company, was set up for the purpose of constructing and administering the magazines with £10,000 capital, £3,000 working capital and Athol Thorne as it chairman (MALSC DRc/Egz/151/1). Athol Thorne was also chairman of the National Explosives Company in Hayle, Cornwall. Formed in 1887 the Hayle site was "to grow into by far the most extensive explosives factory in Cornwall" and a concern of "considerable significance for the defence of Britain" (Earl 2006, 190).

Athol Thorne was still chairman of the National Explosives Company on 16 December 1892 when notice of its voluntary liquidation was published in *The London Gazette* (1892, 7448), presumably to enable restructuring or refinancing of the company.

The Thames Storage (Explosives) Company Ltd was incorporated on 27 January 1892 in order to construct magazines for the 'storage of explosives' (TNA BT 31/5246/35679) under Explosives Licence 268 (Desborough 1905, 3). By the end of March 1892, the company had leased the land for the magazines on St Mary's Marshes from the Dean and Chapter of Rochester Cathedral (MALSC CCRc/T082; DRc/Egz/151/1). The site was known as Factory No 156 and was first licensed in 1892 for the 'packing and re-packing' of explosives of 'Classes 1 to 4' (Explosives Inspectorate 1893, 4) which comprised gunpowder and chemical explosives. Six months' rent for the site was £125 (MALSC DRc/Egz/151/1). The previous tenants were farmers and brothers Henry and James Pye and the lease of March 1892 ran for 21 years and was scheduled to expire on 6 January 1913. It provided for a right of way and a right to build tramways (MALSC DRc/Egz/151/2).

The plans that accompany the lease (MALSC DRc/Egz/151/2) depict a layout which does not appear to have been fully realised (Figure 3). The proposed layout consisted of 12 magazines occupying three separate parcels of land in an irregular, though geometric, arrangement. The magazines are linked to each other and to the river by a tramway and all have varying arrangements of earthwork bunds depending on their particular position in relation to the other magazines. A second plan marks the extent of the exclusion zone around the site where no new building would be permitted, restricted land adding up to over 440 acres, more than originally anticipated (Figure 2). This plan also shows a proposed caretaker's cottage to the south-west of the site (TQ 7966 7792) that was never built.

Five magazines were initially licensed with a storage capacity of 40,000 lbs, though soon after the establishment of the facility (September 1892) the Thames Storage (Explosives) Company sought to acquire an additional licence for a wooden packing shed and 'mixed explosives store'. An undated summary of correspondence from June and July 1892, relating to the additional licence, explains that the wooden building would be 12 feet square and used for the 'repacking of Sporting Powder etc into tins'. Athol Thorne hoped a new licence would not be necessary if quantities were minimised and no powder was stored overnight. The Home Office stated that the "operation of packing is one of manufacture and therefore needs a licence". This appears to have been accepted by the company but the idea of a 'factory' appears to have caused disquiet in the local populace and the Justices of the Peace did not grant a local licence for this change of use until 7 October 1892 (MALSC DRc/Egz/151/1), from which point the building was used for "packing or repacking into packages or cases for conveyance and weighing and marking the same in addition to the purposes the said premises were previously licensed". Though it is not clear whether the building was constructed as such, the proposed new shed was described as "a single building of one storey only constructed of wood and having a close-joined wooden floor and a roof of slate, tiles, felt or other suitable material and furnished with a door opening outwards and the whole interior (floor excepted) shall at all times be kept painted or varnished" (MALSC DRc/Egz/151/2).

Figure 3: The planned layout of the site from the 1892 lease showing the proposed arrangement of 12 magazines with individual bund layouts and the suggested tramway network (MALSC DRcEgz 1511/2 – Permission of the Dean and Chapter of Rochester).

First phase of construction

In a letter dated 11 December 1891 to the solicitor acting for the Dean and Chapter of Rochester Cathedral, Athol Thorne stated that the company could not commence building until March (MALSC DRc/Egz/151/1), presumably until after the scheduled date for the signing of the lease. By 15 February 1892 a builder had been "engaged to erect five Dynamite Stores at St Mary's Bay for the sum of £900-0-0" and a letter from the solicitor acting for Rochester Cathedral to the Home Office dated 30 September 1892 stated that the Thames Storage (Explosives) Company "have already obtained licences for five magazines" with a licensed storage capacity of 40,000 lbs, suggesting that they had been constructed by that date (MALSC DRc/Egz/151/1).

The 2nd edition 25 inch Ordnance Survey map, revised in 1895 and published 1897, shows that five magazines had been built, three arranged along an existing east-west drainage ditch and two to the south (Figure 4). All five are surrounded by earthwork bunds and the three to the north are linked via an east-west track (possibly a tramway) which leads to a north-south track that heads directly to the river. The two magazines to the south and the mostly westerly of the three northern magazines have large ponds adjacent, presumed to be borrow pits for the earthwork bunds. A small building, approximately 12 feet square and located beyond the western end of the two magazines to the south, may represent the packing shed mentioned above.

The access track enters the site from the north and runs to a break in the east-west dyke which crosses the site. It is interesting to note that the access track does not cross the dyke at the pre-existing access point, depicted on the Ordnance Survey 1st edition 25 inch map published 1895 and the plan that accompanies the 1892 lease, and that the tramways which were proposed in the original lease do not appear to have been constructed, the tracks being depicted as broken lines rather than the solid line seen depicting tramways on the nearby Curtis and Harvey explosives works at Cliffe (Pullen *et al* forthcoming).

The river itself was probably accessed via the landing stage shown on the Ordnance Survey 2nd Edition 25 inch map. This landing stage is not shown on the Ordnance Survey 25 inch 3rd Edition map, revised in 1906 and published in 1908, though an indentation in the sloping masonry of the sea wall is depicted on this edition immediately to the north of the site, possibly indicating a landing area for boats.

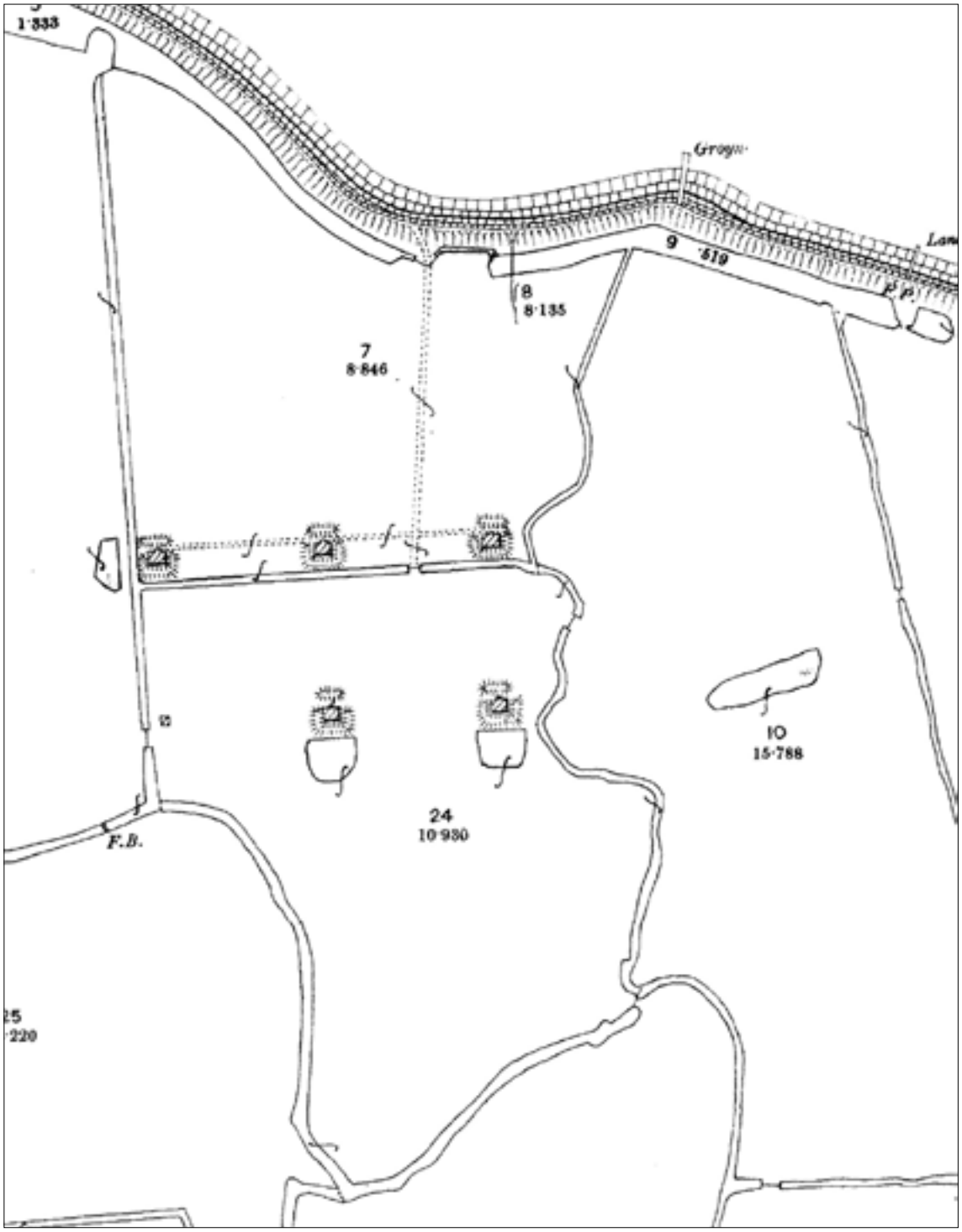

Figure 4: The Ordnance Survey 2nd edition 25 inch map (revised 1895 published 1897) showing the first phase of construction of the magazine complex. © and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2013) Licence numbers 000394 and TP0024

Second Phase

An accident report of 1905 stated that the original explosives licence was revoked in 1900 and the magazines incorporated with a 'neighbouring factory' under Amending Licence 873 (Desborough 1905, 3). This appears to have occurred when the seven existing magazine licences 467, 468, 469, 471, 472, 527, 528 were amalgamated under the single factory licence (Explosives Inspectorate 1901, 11), the existence of seven licences suggesting that two extra magazines were added between the revision of the Ordnance Survey 2nd edition map in 1895 and 1900 when the magazine licences were amalgamated. These new magazines may have been used for the Class 6 Division 3 Detonators and Electric Detonators which were stored on site from 1900 onwards (Explosives Inspectorate 1901, 57). A few years later, Class 6 Division 1 Safety Cartridges and Division 3 Quick-Firing Ammunition "for His Majesty's Land and Sea Forces only" were also being stored on the site (Explosives Inspectorate 1905, 76).

The two additional magazines are depicted to the south of the initial group on the 3rd edition 25 inch Ordnance Survey map (revised 1906 and published 1908; Figure 5). These extra magazines are also depicted with earthwork bunds and associated borrow pits. In addition, these two magazines are depicted within their own fenced enclosure and, by 1906, a fence has also appeared around the three northern magazines. Two further borrow pits have also appeared, one adjacent to the middle of the three northern magazines and a square one at the southern end of the site. The track can be seen continuing across the southern half of the field and heading for a causeway across the drainage ditch in the south-eastern corner of the field. The small square structure (which may represent the packing shed) is also still shown on the western side of the site, close to the drainage ditch. An additional pond or possible borrow pit is also visible to the south of the southern row of magazines. This pond and an associated earthwork have been identified from aerial photographs as the possible site of a never-completed eighth magazine (Ed Carpenter, EHA (NMR) TQ77NE181).

The accident report focuses on a magazine which was destroyed by fire on 29 July 1905. It states that the magazine was constructed of brick with a slate roof and with an inner and outer door, the latter faced with iron sheet and having two locks. The magazine had ventilators with outlets with iron grates and the both the floors and walls were lined with wood (Desborough 1905, 3). The accident report also suggests that some buildings on the site were of 'light wooden construction' (Desborough 1905, 7), suggesting that there were structures other than the magazines on the site (possibly referring to the aforementioned packing shed).

Though the magazine in question was licensed to hold 40,000 lbs of explosives of Class 1 to 4 (Desborough 1905, 4), when the fire occurred the magazine only held 9,730lb of explosives, including rifle, flameless, cannon and sporting powder, imported from abroad by the Normal Powder and Ammunition Company, and Walsrode KO and KL powder, imported by Messrs G Beutner and Company. Confusion is added by a reference in the report (Desborough 1905, 6) to importation in 1896 of rifle powder "effected by the predecessors of the firm now in occupation of the factory at St Mary's Marshes". It is not clear whether another firm occupied the site before the Thames Storage (Explosives)

Company, though given the present evidence this seems unlikely.

Evidence from the historic Ordnance Survey maps may suggest that it was the central magazine of the northernmost row which was destroyed by the fire. The Ordnance Survey 3rd edition map (revised 1906, published 1908) depicts this magazine with a much thinner line than the others (Figure 5) and on the Inland Revenue map of 1910 (which used the same 1906/1908 Ordnance Survey base map) the same magazine is not hatched suggesting that, unlike the others, it is no longer roofed (TNA IR124/6/9).

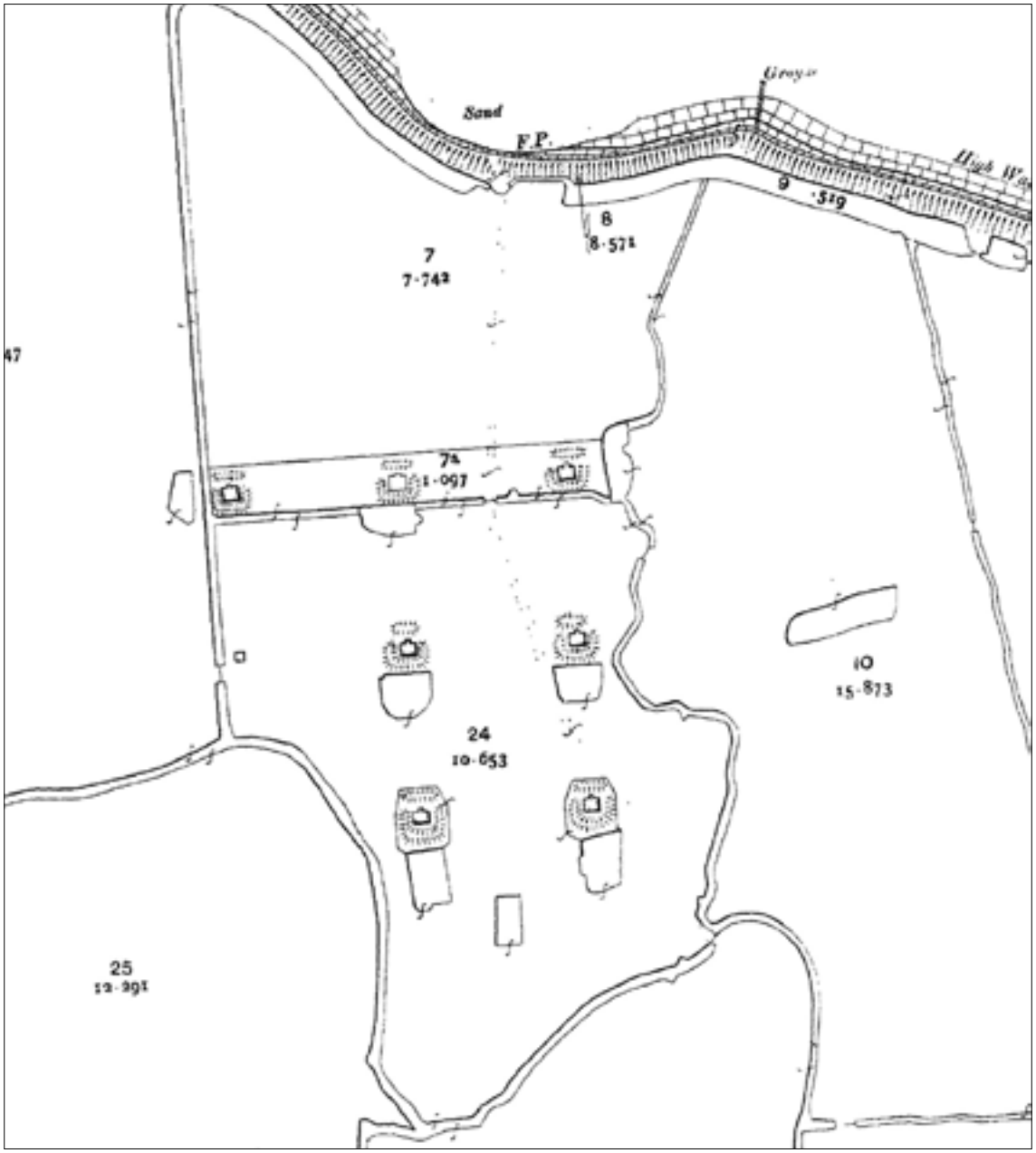

Figure 5: The Ordnance Survey 3rd edition map (revised 1906, published 1908) which shows the additional two magazines that were constructed to the south of the first five buildings. © and database right Crown Copyright and Landmark Information Group Ltd (All rights reserved 2013) Licence numbers 000394 and TP0024

Third Phase?

A report from His Majesty's Inspectorate of Explosives states that the factory became 'extinct' in 1907 (Explosives Inspectorate 1908, 27) and it appears that the Thames Storage (Explosives) Company was placed into liquidation, shortly before the publication of the 1908 map, on 8 July 1907 (TNA BT 34/826/35679). However, Kelly's Directory of Kent for 1909 describes the site as a 'Government magazine' constructed in 1907, suggesting that the site had another lease of life after the Thames Storage (Explosives) Company went into liquidation. The directory also states that the site was in the process of being extended.

A new licence for Factory 221 (Kent), whose location is unclear, was issued in 1906 for 'Henrite and Safety Cartridges' and may relate to this next phase of the St Mary's Marshes factory's life (Explosives Inspectorate 1907, 6). Factory 221 (Kent) became extinct in 1913 (Explosives Inspectorate 1914, 5), further indicating a possible relationship with the final phase of the St Mary's Marshes magazines as the original lease for the land on the marshes was for 21 years and due to run out in 1913 (MALSC DRcEgz 151/2). This ties in with further references to the Government magazine in Kelly's Directory which suggest it went out of use some time before 1915, in which Directory the site is no longer mentioned (Kelly's Directory 1915). Although it seems strange that the magazine went out of use just before the First World War, this may relate to the consolidation of state interests at the Curtis and Harvey works at Cliffe which saw rapid expansion in 1913/1914 (Pullen et al forthcoming).

However, the reference to the 'Government magazine' in the Kelly's volumes should be treated with caution. Despite their clear existence as a commercial venture since 1892, the magazines are not mentioned in earlier directories (Kelly's Directory 1899; 1903; 1905) suggesting some confusion may have occurred in the entries, possibly involving the much larger HM Cordite Factory just a few kilometres to the west on Cliffe Marshes. No other references to a 'Government magazine' on the St Mary's Marshes site have been identified but it is possible that the site's function was incorporated in the large expansion of Cliffe's HM Cordite factory. If a different factory had taken over the site using a new licence and a new factory number it would be very difficult to track through the reports of HM Inspector of Explosives.

DESCRIPTION AND INTERPRETATION OF THE REMAINS

Magazine Buildings

The site consists of seven almost identical concrete buildings (see Figures 6 and 7). The magazines are arranged in a grid pattern with a distance of approximately 70m between each magazine. The magazines are all approximately 7.1m by 6.2m in plan and 4m in height to the apex of the gable (see Figures 21, 22 and 23). There are no discernable differences in size between the two phases of construction suggested in the previous section. Each building is formed of coarse mass concrete around 0.45 m in thickness which was covered externally with a concrete render 1cm thick and incised with an 'ashlar block' design (Figure 8). The two most southerly magazines and the eastern magazine of the central row all show a pink staining of the concrete render on the eastern elevation, perhaps caused by differential weathering.

Figure 6: The magazine complex as seen from the north-west. NMR 26598/0190 6-APR-2010 English Heritage

Each of the buildings has a centrally placed entrance porch in its northern elevation which originally had a wooden door covered with metal sheet and held by pintel hinges on to a wooden frame (Figure 9A), the slot for which is clearly visible. When open the magazine doors may have been secured with a hook located on the eastern porch elevation at a low level, which was possibly linked by a cord or chain to the small iron loop visible on the outer metal panel of the door that survives (Figure 9B). Each porch had a pitched roof with a concrete gable. A slot which carried the porches' wooden roof ridge is visible at the apex of the porch gable. No evidence of an inner door, described in the Explosives Inspector's report as having been visible on the brick magazine (Desborough 1905, 3), was noted.

Figure 7: An example of a typical magazine building (eastern magazine in central row).

Figure 8: Gable end of a magazine showing the 'ashlar pattern' incised into the concrete render and the three slots which carried the roof purlins.

Figure 9A: Surviving metal-clad wooden magazine door.

Figure 9B: Hook on east elevation of porch for securing door when open.

Gable ends to the main east and west elevations indicate that the buildings had pitched roofs with wooden frames. Square holes on either side of both gables indicate the position of two wooden pole plates, to support the rafters, which ran the length of the north and south elevations just above eaves height and protruded beyond the gable end (Figure 10). Three slots on each gable, one at the apex and two mid-pitch, indicate the position of the ridge plate and purlins which carried the roof. Similar slots are visible at eaves level in the north and south elevations where the wooden roof rafters protruded to form the eaves. Remains of the collapsed timber roof within a number of the structures show that the roof rafters had an element of detailing on the end that would have been visible. Small holes which run internally across the base of the gables may indicate the position of a ceiling (Figure 11). Evidence for a slate roof covering survives on the ground in and around the magazines, though drips of bitumen on the exterior of the magazine to the extreme south-east of the site suggest that patch repairs may have been made to its roof at some point.

Figure 10: Surviving roof timbers in the magazine to the extreme south-east of the site indicate the position of the pole plate which protruded through both gables and carried the rafters. Evidence for some form of cover over the ventilation pipe in the east elevation is also visible.

Good ventilation was vital in the storage of explosives. Pairs of air bricks (or holes where they were located) are visible at ground level to the east and west of the door on the northern elevation of the magazines. At least two types of air brick were used: red unglazed bricks and brown glazed bricks (Figure 13). Curving ceramic pipes are visible on each building, at eaves level in the eastern gable at its southern end and in the western half of the southern elevation at a low level (Figure 14). The lower portion of each pipe is blackened internally. The pipes are probably related to the magazines' ventilation systems. Witness marks appear to indicate that the pipes in the eastern elevation had some sort of square external fitting, possibly a grill (Figure 10). Evidence for a different form of ventilation is also visible on the most northerly row of magazines. These magazines all have evidence for two (only one is visible on the most westerly magazine) rectangular-section concrete pipes buried vertically into the protective bund against the eastern and western ends of the southern elevation (Figures 12A and 12B). These vents originally had a concrete cap and metal grill in their southern face. This type of vent is not visible on the magazines further to the south and may relate to variations in the configuration of the bunds (see below). These vents could relate to the ventilation of the wooden floor.

Figure 11: Small holes on the interior surface at the base of the gables that may indicate the position of a ceiling.

Apart from the various types of ventilation there is little other external detail on the magazines. Evidence for lightning conductors in the form of a column of three copper alloy fittings is visible to the west of each magazine entrance porch (Figure 14) and other witness marks of unclear function are visible to the east.

Internally, three slots 5.5 cm wide run horizontally around the entire internal wall surface of the magazines (Figure 15), one 0.27m above floor level and two equally spaced 0.65m (2 feet) apart above that. The slots carried the batons for some sort of 'anti-spark' wooden cladding (match-lining). Some of the batons can be seen surviving *in situ.* A dwarf concrete wall running east-west across the centre of the buildings carried a floor, probably supported on the slightly protruding plinth at the base of the building (Figure 16A). Similar supporting concrete walls can be seen within the porch area of the building (Figure 16B). Slots in the plinth in each of the internal corners may have carried floor joists, as seen surviving in the magazine to the far south-east of the site. There are occasional pieces of slate attached to the walls which appear to be vertically aligned with a pipe in the southern wall of the magazines (Figure 15).

There are some variations in the condition of the seven magazines. Only the eastern of the two central magazines retains its triangular pediment above the door and the central magazine of the northern row has lost its east and west gables and some render.

Figure 12A: An example of the concrete ventilation shafts visible buried in the bunds on the south elevation of the most northerly row of magazines.

Figure 12B: A concrete ventilation shaft with the cap removed.

Figure 13: An example of the air bricks visible in the northern elevations of the magazines to the west and east of the porch.

Figure 14: An example of the copper alloy fixings for the lightning conductors which were attached to each magazine. The ceramic vent pipe to the east of the entrance porch can also be seen.

Figure 15: The internal slots which carried batons on to which wooden anti-spark 'match-lining' would have been fixed. Pieces of slate can be seen embedded in the interior face of the southern wall above a ceramic pipe. This may be related to the external concrete ventilation shaft seen on the southern elevation of some of the magazines.

Figure 16A: East-west concrete dwarf wall which supported a floor.

Figure16B: Concrete floor supports within the entrance porch.

Building Platforms and Bunds

On the 3rd edition 1908 Ordnance Survey map (Figure 5) all of the seven magazines are shown with a protective U-shaped earthwork bund around their western, eastern and southern sides with a separate linear bund to the north allowing access to the magazine entrance from the east and west. These earthworks were intended to minimise the impact of accidental explosions. Today the earthworks of the three most northerly magazines survive; to the south the westernmost of the next two magazines has lost its northern bund and possibly had the northern ends of its southern bund truncated; and to the south again, the bund of the westernmost magazine has been levelled on all sides and the northern bund of the eastern magazine has been removed whilst the southern bund has been truncated at its northern ends on both sides (Figure 17). The bund arrangements do not reflect the complex layouts proposed on the 1892 plan that accompanied the lease (MALSC DRcEgz 151/2; Figure 3).

Figure 17: A surviving example of the earthwork bund which originally protected all the magazines (eastern of central two magazines).

There are some notable variations in the form of the bunds between the different rows of magazines. On the most northerly row of magazines the protective bunds are thrown up against the rear (southern) magazine elevation, to a height of around 1.2m in the case of the magazine to the extreme north-west of the site. The height of the bund allows the concrete cap of the vent on the rear of the magazine to remain visible (Figure 12A), suggesting that the vent has determined the height of the bund (NB this concrete cap is missing on the adjacent magazine to the east).

The bunds of the two magazines in the central row and that which survives around the magazine to the extreme south-east were constructed differently to those in northern row. A clear gap has been left between the magazines themselves and their protective

bunds. As no vents are visible on the rear (southern) elevation of these magazines (or on the westernmost of the two southern magazines where the bund has been levelled) the gap may have been intended to allow for a less elaborate form of ventilation (Figure 18).

Figure 18: The western magazine of the central row has a clear gap between its southern elevation and the protective bund, in contrast to the row of magazines to the north.

In addition to the bunds, a number of the magazines were constructed on sub-rectangular earthwork platforms. This is particularly clear with the northern row of magazines, where the central and eastern magazines and their bunds clearly sit on platforms. A slight platform is also visible beneath the western magazine of the southern row.

Other Structures

A low square platform, 4.3m by 4.8m, is visible in the south-western corner of the site, close to the causeway which gives access to the field immediately to the west. It is cut into spoil from historic ditch clearances and is defined by slight scarps on its northern, eastern and southern sides. A small stretch of brick wall foundation is visible through the grass immediately to the south of the platform, running parallel to its south side, and a section of square concrete drain is set vertically into the ground. These may be the remains of the structure shown in the south-western corner of the site on the Ordnance Survey 2nd edition map (revised 1895 published 1897) which may have been the packing shed described previously. The adjacent causeway contains a substantial amount of brick rubble and black tile, possibly suggesting that there were earlier brick magazines as stated in the Explosives Inspector's report (Desborough 1905, 3).

Evidence of another small structure survives to the north of the most easterly magazine of the northern row. At the western end of the northern earthwork bund which protects the door is a neat square scoop, 4m north-south by 3.6m east-west (Figure 19). Any structure which was located in this position must post-date the use of the magazine for explosives storage as a building would not have been permitted in such close proximity. Another possible platform was noted to the north of the eastern of the two magazines in the central row.

Figure 19: Location of possible building which post-dates the closure of the magazine complex, immediately to the north of the most easterly of the three northern magazines.

Drains and Borrow Pits

The magazines were laid out within a pre-existing pattern of drainage ditches. A drain was later cut across the southern part of the site from north-west to south-east some time after 1961(Ordnance Survey 1:2500 published 1961; Figure 6). The cutting of this drain may have resulted in the partial removal of the bund around the magazine in the south-west corner of the site as well as the infilling of its associated borrow pit and one to the south. It also appears to have truncated the borrow pit of the magazine to the east. The position of the pit relating to the western magazine is visible as a slight scarp in the field immediately to the south of the drainage ditch. The location of the former borrow pit which was positioned to the west of the most westerly magazine in the northern row is visible as a vegetation mark in the adjacent field. The origin or function of the hollow immediately to the south of the central magazine in the northern row is not clear. The remaining borrow pits are now water-filled.

Trackways

The north-south track which acts as the main access to the site has probably been modified since the magazines went out of use, but is embanked apart from where it crosses the east-west track described below. To the south of the east-west drainage ditch which bisects the site, it continues on an angle towards the magazine located in the far south-east corner as a very slight, spread bank. Just before this magazine it appears to fork with the other branch heading south-east for a few metres before disappearing.

An embanked trackway runs through the gaps in the bunds of the three most northerly magazines to link them together (Figure 20). Between the most north-westerly magazine and the one to the east, this track is roughly 3.5m wide at the base and 1.8m at the top. It does not directly align with the gap in the north-west bund, perhaps suggesting that it was constructed before the bund. As the track heads east towards the most easterly magazine it widens to 4.2m at its base and 2m at the top before being cut by the main north-south track into the site. There is no evidence of embanked tracks linking the other rows of magazines or the suggested site of the packing shed.

Figure 20: Embanked trackway which runs east-west between the northernmost row of magazines. It is truncated by the main north-south access track before it reaches the easternmost magazine.

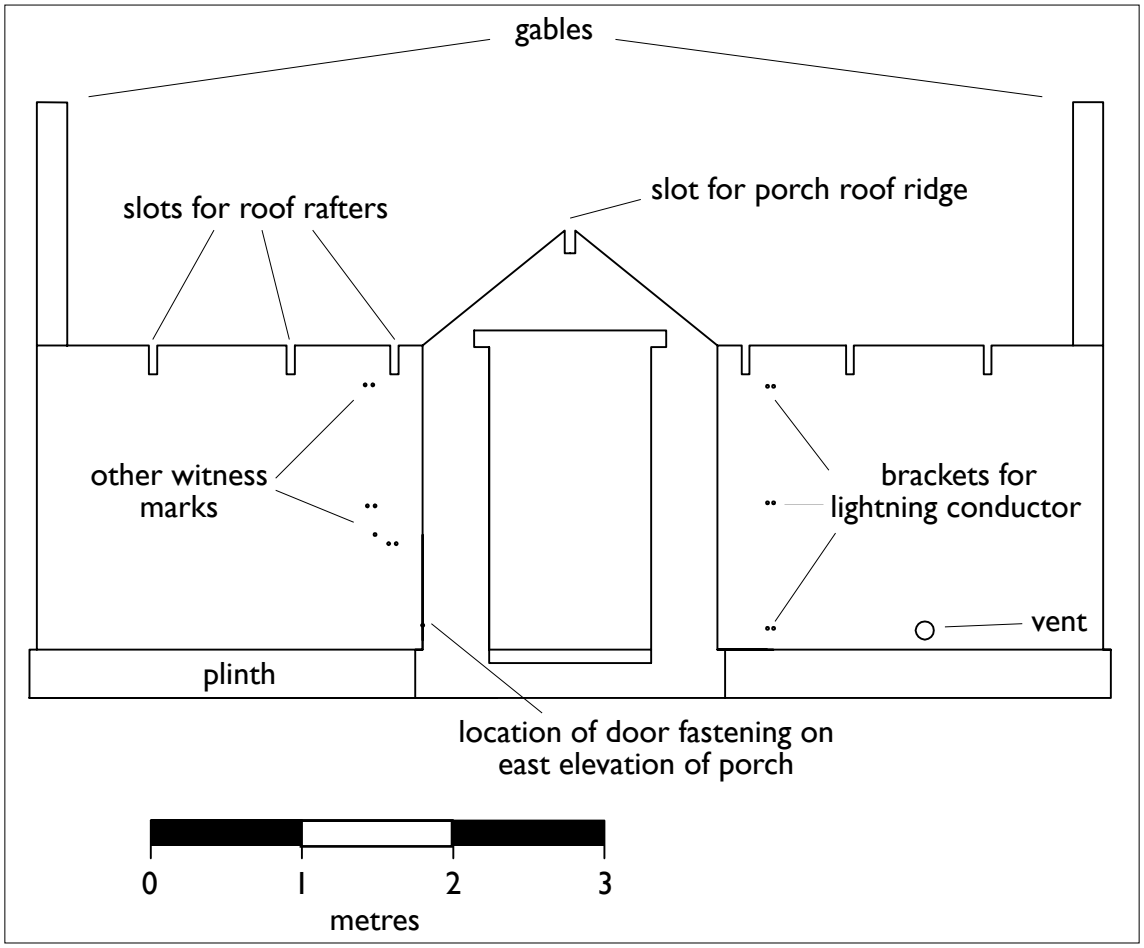

Figure 21: North elevation of explosives magazine (eastern magazine of central row measured).

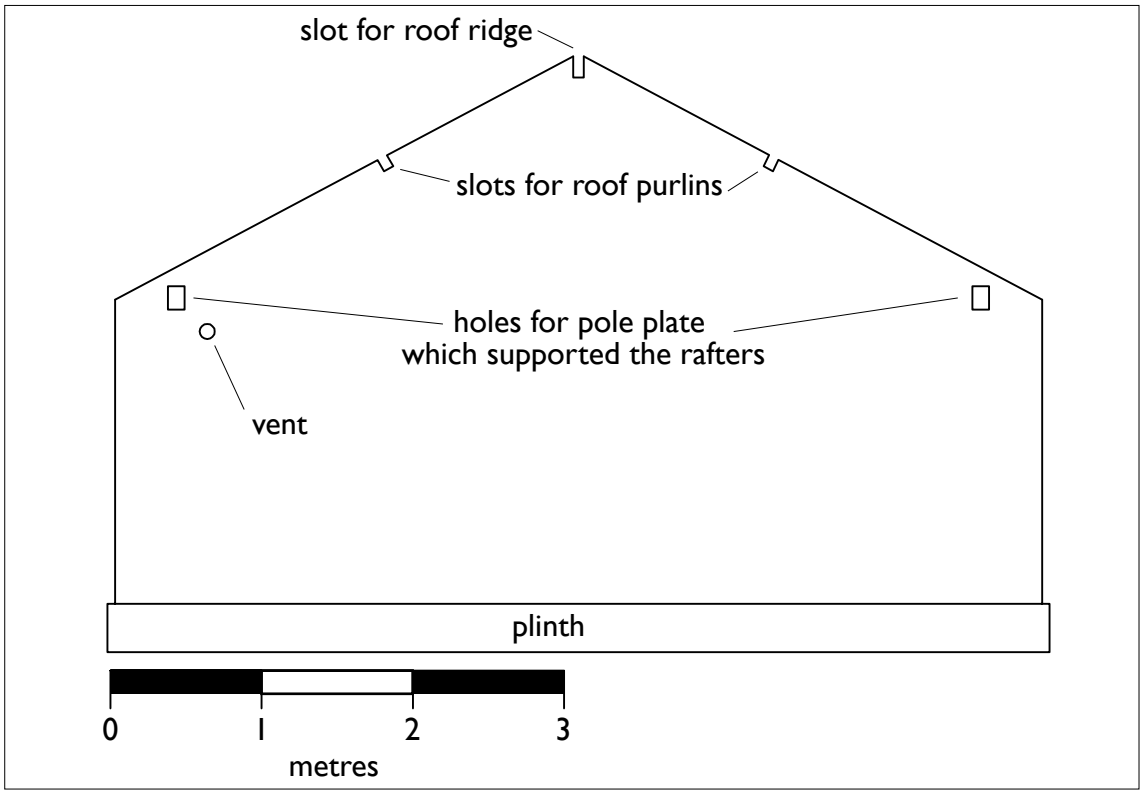

Figure 22: East elevation of explosives magazine (eastern magazine of central row measured).

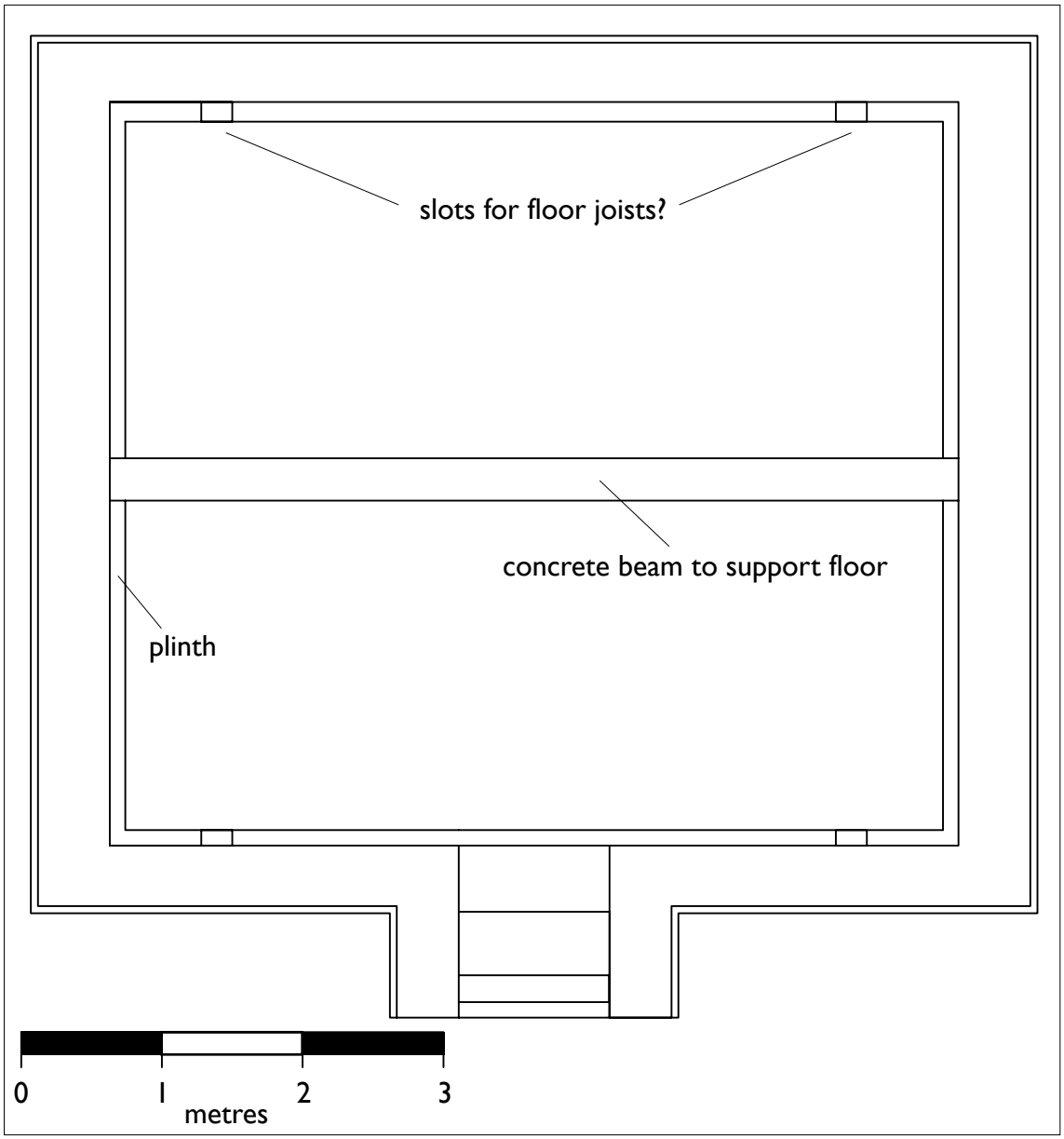

Figure 23: Floor plan of explosives magazine (eastern magazine of central row measured)

DISCUSSION AND CONCLUSIONS

It is clear from the research that the magazines at St Mary's Marshes were constructed, at least in the first instance, as a commercial venture in order to aid distribution of explosives, particularly given the restrictions on shipping large quantities of explosives further up the Thames towards London. The initial five magazines were constructed in 1892 by the Thames Storage (Explosives) Company with two further magazines added between 1895 and 1900. The Thames Storage (Explosives) Company went into liquidation in 1907 but references in the Kelly's Directory volumes suggest the site was reincarnated as a 'Government magazine' which closed around 1913. It is not clear what Kelly's Directory meant by the term 'Government magazine'. Evidence for post-1907 use of the St Mary's Marshes site, taken from Kelly's Directory, is supported by the existence of an unidentified Factory 221 in Kent which was storing explosives in the same period, 1907-1913.

A question mark remains over the exact dating of the surviving concrete magazines, raised by a single reference to a brick-built magazine in Desborough's 1905 report on the fire. There are three ways of explaining this apparent discrepancy between the building materials described in the Explosives Inspector's report and the surviving structures:

1) The original magazines, as shown on the historic maps, were all constructed in brick and subsequently reconstructed on the same footprint in concrete. This seems unlikely given the low quantity of brick rubble on the site, the short number of years the site was in use and the fact that the Thames Storage (Explosives) Company chairman, Athol Thorne, was linked to the Hayle factory in Cornwall which saw extensive use of concrete in the same period the St Mary's Marshes magazines were initially constructed. However the reincarnation of the site suggested by the Kelly's Directory references and the existence of the unidentified Factory 221 could provide a context for the wholesale reconstruction of the magazines in concrete and it is possible that they were responding to the recommendation of the HM Inspector of Explosives that any new magazines should be enlarged to allow for a reasonable amount of access space even when the magazines were full to their licensed capacity (Desborough 1905, 7).

2) Some of the magazines were originally built in brick, whilst others were built in concrete. It is possible that the first five magazines were brick, whilst the two additional magazines were concrete, with the original five then subsequently reconstructed in concrete, or that they were all built in brick and replaced in concrete in a piecemeal fashion. The accompanying notes for a modern self-guided walk in the area describe a notice surviving inside one of the concrete magazines, dated 1900, warning visitors to extinguish all lights (The Cliffe Community and Conservation Partnership, n.d.). This notice no longer survives but, if it was in its original position and if its date relates to when it was installed, it could suggests that at least one concrete magazine had been constructed on the site by 1900 and stood alongside at least one brick magazine that caught fire in 1905.

3) The Explosives Inspector made a mistake in his report and concrete was the original construction material of all the magazines on the site. This seems extremely unlikely

but the magazine that appears to be depicted as unroofed on the 1908 Ordnance Survey maps (TNA IR124/6/9) and, therefore possibly represents the location of the fire, coincides with the only building out of the surviving seven where both the western and eastern elevations have lost their gables, possibly supporting the idea that it, a concrete magazine, was the one destroyed by fire.

Regardless of the exact date of the magazines that survive today, concrete was infrequently used in explosives contexts, such as in the Royal Ordnance Yards, in this period at the very end of the 19th century and the start of the 20th century (Evans 2006). Cocroft (2000, 81; 101) notes the construction of an experimental mass concrete traverse at the Royal Ordnance Factory at Waltham Abbey in 1884 and suggests that the factory at Hayle, Cornwall possesses the "earliest known group of surviving concrete magazines" possibly built in response to the 1890 proposal from the Explosives Inspectorate which suggested a "clause in all new licenses that magazines were to be built of good quality Portland cement concrete". This would clearly have influenced the choice of original material at St Mary's Marshes. Mass concrete was also used at an explosives factory at Port Cornaa on the Isle of Man around this time (Garrad 1980, 315). The Hayle magazines appear to have been constructed around 1890 (Earl 2006, 212) and were designed by Oscar Guttmann, one of leading consulting chemical engineers of his day (Cocroft 2000, 144). Like the St Mary's Marshes magazines, they are of mass concrete and have some similarities in design. Given that Athol Thorne had interests in both the Hayle and St Mary's Marshes sites it seems possible that Guttmann may also have been involved in the design of the magazines on St Mary's Marshes.

Though Cocroft (2000, 101) notes that the favoured construction technique for traverses had returned to earthworks by the end of the 19th century (due to the dangers of the solid debris created in the event of an explosion) when Oscar Guttmann's thoughts on concrete magazines are reported in 1910 (Guttmann 1910, 930) he seems to be suggesting that ordinary concrete (not reinforced) is actually most suitable for explosives buildings and that this is a relatively new or innovative technique. Despite this anomaly it appears that concrete was little used in the 20th century in explosives manufacture and storage (Cocroft 2000, 185); the surviving press house, acetone recovery stove and cordite drying stove structures at Cliffe, north Kent, being unusual in that they are reinforced concrete and date to around the start of the First World War (Pullen *et al* forthcoming).

Whether constructed in 1892 or after the fire in 1905, the St Mary's Marshes concrete magazines are a rare survival of mass concrete buildings, or indeed any concrete buildings, connected with explosives, particularly as they survive as an isolated group beyond a production context. It also appears that surviving mass concrete buildings are rare in other contexts as the fashion was moving towards reinforced concrete by the late 1890s (Newby 1996, 267). Few *in situ* or mass concrete buildings appear to have survived in great quantity (Hurst 1996, 291).

METHODOLOGY

A rapid survey of the site was undertaken including extensive photography. A rapid measured survey of a typical magazine building (the eastern magazine in the central row) was undertaken using basic graphical techniques and the plans drawn up using AutoCAD. Background research was undertaken using a variety of paper and online archives (see below).

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