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THE WATERMEADOWS AT THE ITCHEN VALLEY COUNTRY PARK NEAR EASTLEIGH, HAMPSHIRE

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ABSTRACT

The Itchen Valley Country Park, near to Eastleigh in Hampshire, contains a complex system of redundant, floated watermeadows located on the lower floodplain and bounded by the River Itchen and the disused Itchen Navigation. Direct documentary references are few, but the Tithe Award Maps for the former parishes of North Stoneham and South Stoneham (1845/6) present a mature watermeadow system that is recognisable today. Much of the irrigation was via carrier systems from the river, although a smaller area was irrigated from the Navigation. The earliest construction material is brick with later concrete, and there are a number of archeologically significant water control structures such as aqueducts, main hatches (sluices) and smaller hatch housings. Sinuous channels and other floodplain features pre-date the construction of the watermeadows and these became incorporated in the irrigation and drainage arrangements. Despite considerable investment in aqueducts and control structures, it is likely this system of watermeadows was problematic due to poor drainage and abandonment of the Navigation in 1869. Surviving bedwork structures and dry carriers are locally evident and are associated with mineral alluvial soils, rather than peat.

INTRODUCTION

The watermeadows of the Itchen Valley Country Park (IVCP), near to Eastleigh in Hampshire, were once largely within the historic parish of North Stoneham with a small bordering area within the former South Stoneham parish. The meadows under investigation are situated immediately west of the River Itchen (Fig. 1) to the south of Eastleigh in Hampshire, and are bounded on their western side by the course of the Itchen Navigation. There are redundant watermeadows east of the River, and the valley was once famous for its extensive meadow irrigation systems. Archaeological interest in watermeadows (Hants County Council 2002) is growing through bids to conserve them via enrolment in agri-environment schemes and there is a long-standing interest in the Navigation (Wessex Archaeology 2005). The intrinsic interest in these watermeadows lies in the remaining structures (mostly of brick), the complex former watering arrangements and topographic relationships that accommodated original floodplain features of the lower river valley. Only some watercourses (mostly drains) remain operational today and these are important for the flagship conservation species, the Southern Damsel Fly (*Coenagrion mercuriale*). However, the present condition of watermeadow features makes detailed re-construction of system operation difficult. This means only a tentative reconstruction of the irrigation is possible.

Watermeadows were extensively constructed in Wessex from the early 1600s and this continued well into Georgian times (Bettey 1999 & 2009), although there are abundant examples from outside the region. Bedwork (ridged-up) watermeadows are commonplace on the floodplains of chalk and limestone fed rivers of southern England (OAU 2000), and comprise highly engineered features of the floodplain. Water is diverted from a river or canal (usually associated with a controlling

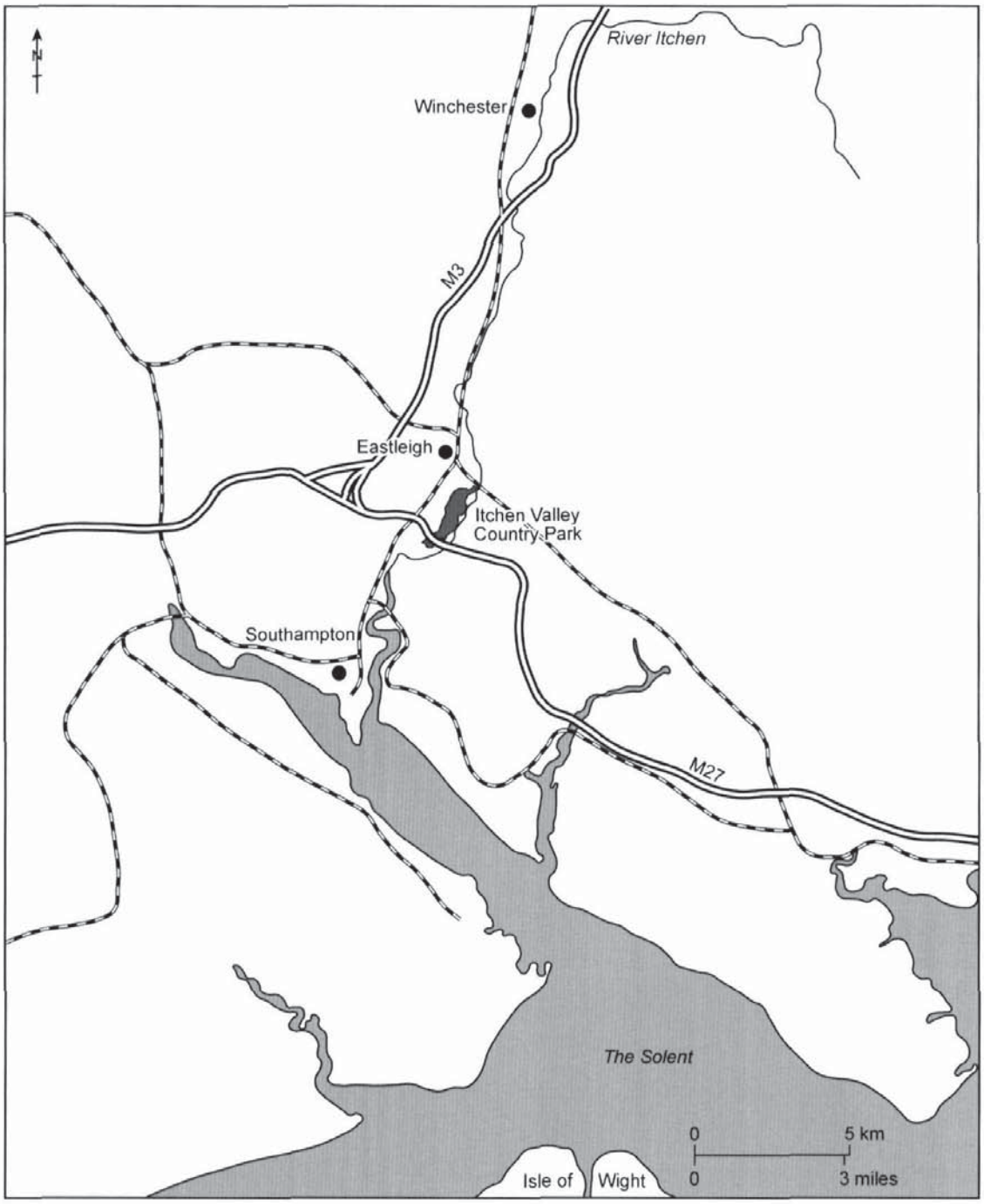

Fig. 1 Location map for the Itchen Valley Country Park in Hampshire

sluice called a 'main hatch'), via a main carrier or carriage (an irrigation canal), entering the meadows to feed small channels along the tops of 'bedworks'; these are ridges of alluvium with channels cut to allow water to move down 'panes' either side, through the grass sward to drains at the bottom of each ridge. In doing this, the grass is warmed, the mobile water remains oxygenated, and nutrients (especially nitrogen and phosphorus) are added to the saturated soil (Cutting *et al.* 2003; Cook *et al.* 2004). The economic importance of these irrigation systems was great (Bowie 1987b), such that by about 1790, almost all suitable sites had been 'floated' (watermeadows had been constructed), a process that involved 'draining and landscaping riverside meadow, marsh and waste'. During much of the period from the seventeenth century to the nineteenth century, the sheep flock that grazed the watermeadows was often folded at night on land being prepared for arable. The enrichment from their dung and urine added to the profit gained from meadow irrigation alone. This was the 'sheep-corn system'.

The usual purpose of 'drowning' (irrigating) the watermeadows in late winter and spring is to create an 'early bite' of grass for grazing animals once the meadow is drained. A few days later, the boost in sward growth is evident. Later in the summer, one or more hay crops were grown following subsequent irrigations and once the hay was harvested, watermeadows were available for aftermath grazing (Bettey 2007; Stearne 2007). The watermeadows provided a safe investment for landowners and farmers, such that legal agreements providing for legal agreements regarding the rotational use of water and, where these failed, litigants were prepared to undertake expensive legal action to preserve the viability of their meadows (Bowie 1987b).

Since the middle twentieth century, scholars and scientists have variously investigated the historical economic value, operation, archaeological interest, conservation, habitat creation and sediment and nutrient relations of bedwork watermeadows. Most recently, attention has been paid to their context in relation to the floodplain form and river systems, particularly whether the river system is single or multiple-channel (Cook 2008). Furthermore, the degree of human interference affecting a river can be investigated, and may be termed 'naturalness' (Sear *et al.* 2009). Study of the IVCP meadows enables insight into floodplain palaeohydraulics, the exploration of the relationship between the river and remaining structures and enables the relationship with a redundant canal (the Itchen Navigation) to be explored.

This article reports the findings from a ground survey of structures at IVCP, a reconnaissance survey of topsoil and vegetation cover and a search of the Hampshire Record Office at Winchester for supporting historical information. It incorporates evidence from Ordnance Survey, modern air photography and knowledge from the staff of IVCP. The 1:2,500 Ordnance Survey for 1895 (published in 1896) gives information that helps with the identification of main sluices, aqueducts, footbridges, drains and carriers (although the differentiation of the latter two require careful consideration); and there is an aerial photograph of the site from 2005 that is reproduced at a scale of 1:5,000. In this article, selected main features of the system are discussed and there is a tentative reconstruction of irrigation for the mid-nineteenth century.

HISTORY AND CONSTRUCTION

Enabling legislation for the Itchen Navigation was passed in 1664–5 (Hadfield 1969, 160), it was completed in 1710 (Course 1983, 8) and abandoned in 1869. Elsewhere in the region where watermeadows are irrigated from navigation canals are below Titchfield in Hampshire on the River Meon (dating from the early seventeenth century, Lambert undated, a) and at Britford, near Salisbury in the last quarter of the same century (Cutting *et al.* 2003; Hadfield 1969, 166). In their heyday, both canals and watermeadows were recognised as economically significant such that in the Act of 1665, that enabled the Itchen Navigation, it was noted

'great advantage to His Majesties subjects by preservation of meadows from summer floods' (Course 1983, 3). The manipulation of the hatches or sluices in the bank of the canal was a source of controversy between the proprietors of the Navigation and the riparian land owners and tenants.

No direct documentary evidence has come to light regarding the construction of the IVCP meadows, although historic meadow names (Fig. 2) are recovered from the Tithe Award Survey of 1845/6 for North Stoneham and South Stoneham parishes (21M65/F7/173/1–2 and 21M65/F7/217/1–2 respectively). On regional evidence, construction could be any time between about 1600 and 1800 (Bettey 2007a) with only circumstantial evidence providing a closer date at around 1700 (Bowie 1987b). Ground evidence relating to the arrangement of the main carrier, aqueduct system and watering off the Navigation suggests construction around the time of completion of the canal. The poorly drained, peaty condition of the western meadows most probably relates either to the canal leaking or overtopping (before 1870), or else to the canal bank acting as a hydrological barrier preventing efficient drainage. Peaty soils notably occur on the Common Meadow (Fig. 2).

The main carrier and aqueduct system feeding the southwest part of the system (today passing below the M27 in a culvert) is deflected south-westwards at a kink in the Navigation to the same deflection (SU 45381613 and Fig. 12a). This arrangement would give maximum watering access across the southern meadows, but it also had to accommodate the course of the Navigation. In the former Common Meadow east of the latter (Fig. 2) and towards the north end of the system bedworks were set at right angles to the canal, suggesting they were watered from it. There is little ground evidence for carriers running parallel with the Navigation in this vicinity; however the construction of a track at the base of the canal bank would obscure this evidence, at least to the south of Decoy Covert (or Decoy Wood).

Only brick, concrete and wood are used on the watermeadows, although stone was used in construction of the Navigation. Bricks were a widespread building material in England, from the late seventeenth century (Lynch 1993) and bricks were once manufactured in the woods of IVCP, east of the River Itchen. Many bricks in main structures are smaller than the more modern 'fletton' bricks (size typically 215×100×65mm) and, in the absence of detailed local information on brick manufacture, are regarded as from an early period of construction. Negative evidence provided by the absence of freestone on the meadows suggests, by analogy with elsewhere (Cook *et al.* 2008), that construction was unlikely before the end of the seventeenth century. Furthermore, the lower Itchen valley is underlain by Tertiary geology (IGS 1904) and singularly lacks freestone suitable for construction purposes, yet dressed stone is known from watermeadows in the Itchen Valley, at Highbridge Farm and at Twyford on the Navigation (Stearne 2010, pers. comm.). The use of bricks for construction is commonplace on the IVCP watermeadows, but the shuttered concrete, also commonly observed in construction elsewhere in the region, is likely mid- to late- nineteenth century in age (Cook *et al.* 2008). Wooden structures are most likely twentieth century in age.

A lease of 1727 between Richard Fleming (landowner) of North Stoneham and Richard Houghton of Eastleigh for a part of North Stoneham Farm, including grazing of the meadows called the North Mead, Tenn Acres (not subsequently identified) and Inholmes (Hampshire Record Office, 102M71/E28) refers to floodplain meadows ('meads'), but does not expressly state they are 'floated'. Copyhold tenants on the manor of North Stoneham had rights on the common meadows.

A legal arbitration (1748) relating to North Stoneham Farm (HRO 102M71/E5) concerns rights of watering and drainage and to infrastructural maintenance. Specifically mentioned are 'Little Oxlease', '?Honey Mead' and the 'Old River'. There were apparently areas 'which appear to us to be so watered for fifty years last past and upward'.

A 1792 reference (Hampshire Record Office, 102M71/E39) in a lease between the

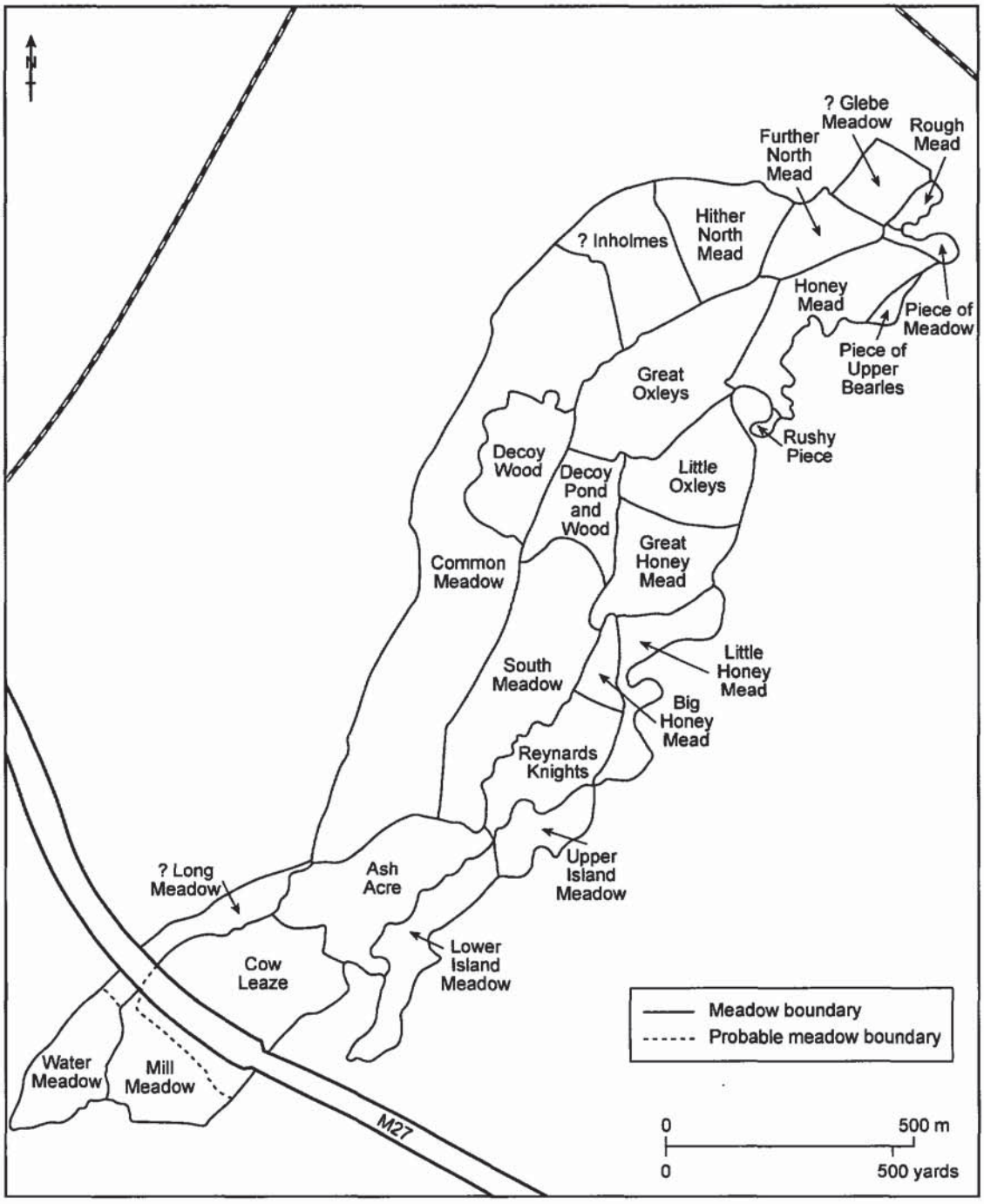

Fig. 2 Mead names in 1845/6 derived from the tithe apportionment surveys

Fig. 3 Deed of sale document for North Stoneham Farm from 1953. ©Hampshire Public Records Office

landowner John Fleming of Stoneham Park and Edward Bridges, of North Stoneham, talks of waters and watercourses, as well as residual common rights on several meads identified in the two Tithe Apportionment maps (Fig. 2).

Meadows were regarded as valuable assets. In the first decades of the nineteenth century there was concern regarding the poor condition of the canal and its infrastructure (Hampshire Record Office, TOP 355/3/1/11). The economic value of irrigated meadows was estimated at £4,450 per annum compared with £1,907 per annum if not watered (Course 1983, 7). Such a differential in the value of watermeadows compared with 'dry meadows' is consistent with the regional picture for rental values at the time (Bettey 1999). A survey of the canal – also undertaken at this time – shows there to be land: 'almost ruined by water overflowing and oozing through the banks'. There was a call for the Act of Parliament of 1665 to be complied with. The Act in 1811 gave a right to meadow owners to open sluices to lower the water, should a bank give way (Course 1983, 8).

Unfortunately, there is no known enclosure map for North Stoneham (Chapman & Selinger 1997) and the South Stoneham Enclosure Awards and map for Great and Little Allington Manors and the honour of Eweline (1825) (Hampshire Record Office, Q23/2/122/1–3) only gives information relating to watermeadows located north and east of the River Itchen. The Tithe Surveys for North and South Stoneham parishes (1845/6) show infrastructure typical of floated watermeadows, at a period when management would still have been much as it had been in Wessex for around two hundred years. There are several areas referred to as 'the Common Meadow', while Hither North Mead and Further North Mead appear to be positional names, with respect to access to North Stoneham Farm. Upper Island and Lower Island would suggest former islands in the river system (see below), while 'Inholmes', next to Hither North Meadow, would be more likely to refer simply to a river meadow, rather than have a Scandinavian derivation referring to an island. While most areas would be meadow, and most probably irrigated, the Tithe survey gives indications of other uses. An osier bed is mentioned on Lower Island Meadow with fringing reeds along the river with osiers also present on Rough Meadow. There is a pond and woods at Decoy Woods.

The classic sheep-corn system was ubiquitous in Wessex before about 1880 (Bettey 1999; Stearne 2007). There is no direct evidence for this practice at IVCP; however the major water control structures (grid ref. SU 46151724) are referred to enigmatically as 'the Sheep Wash' to the present. In 1845/6 there was arable land on the river terrace (Hampshire Record Office, 21M65/F7/173/1/2) by North Stoneham Farm (SU 457173), to which there was access across the Navigation (Ordnance Survey 1896). Bowie (1987a) describes the complexity and change of arable rotations in Hampshire, demonstrating the economic importance of arable that stood to gain from the overnight folding of sheep. However, watermeadow technology is highly adaptable, so that the grazing of dairy cattle and the winning of one or more hay crops became significant economic incentives, once the sheep-corn system was in decline (Stearne 2007). No detailed information for the economic function, or significance, of the IVCP watermeadows in the nineteenth century has come to light, but the proximity of the railway as well as large urban centres would point to this situation being likely.

The course of a railway is marked on the 1846 Tithe Award Map. The line links Portsmouth to Eastleigh where it joins the line from Southampton to Winchester, opened in 1838, and onward to London, creating good transport links both within and without the area (Lambert undated, b). The railway provided competition for canals and, while this was eventually to prove terminal for the Navigation (Hadfield 1969, 164–165), it improved access to agricultural markets including the growing port of Southampton. As an illustration, during the first half of the nineteenth century corn markets responded to national demand, but milk markets remained fragmented and responsive only to local urban centres (Perren 1989). However, by the 1870s, as English agriculture was heading for major recession that impacted on cereal production

(Cook 2010), liquid milk produced within four or five miles of a railway station enabled wholesale dairymen access to urban centres (Collins 2000). Wool prices also fluctuated, but these were in overall decline in Hampshire by the mid-nineteenth century (Bowie 1987a). Such would provide an incentive to change to cattle husbandry and hay production throughout much of the nineteenth century and after.

One elderly local resident recalls hay crops being taken off in the 1940s and 1950s, although there is no evidence for irrigation continuing into the twentieth century. A mid-twentieth century document (Fig. 3) is the 'Particulars and conditions of sale of the freehold agricultural estate known as the North Stoneham estate extending to about 1357 acres' from 1953 (Hampshire Record Office, 159M88/1128). This describes the Estate's 'Lot 19' as 'a valuable block of water meadows', while Lot 20 is 'Valuable Fishing rights in the River Itchen' The area involved is comparable to IVCP, less most of the river banks on the eastern side.

THE PHYSICAL ENVIRONMENT

The River Itchen is a chalk stream with a high base flow index – that is the proportion of a river's flow that is derived from groundwater (River Itchen Sustainability Study 2005). High base flow sustains a relatively even discharge from the chalk aquifer throughout the year when compared with surface water fed streams, making the Itchen highly suited to meadow irrigation. Furthermore, the water is sufficiently warm to trigger grass growth and aspects of the water's hydrochemistry are likewise beneficial to the production of grass (Cook 2007).

In the Oxford Archaeological Unit's desktop survey of watermeadows in Hampshire (OAU 2000), the IVCP comprises much of units 149 to 154, in the category 'large complex water-meadows'. Ordnance Survey 1:25,000 mapping shows floodplain elevations range from 4 to 7m AOD, with the 5m contour approximately bisecting the area. The overall floodplain gradient, descending from north to south, is around 0.001 along the stretch that incorporates IVCP, a gradient on the low side for watermeadow sites (Cook 2007), although spot-heights indicate greater gradients in the middle / upper system. Modest gradients suggest problems in maintaining a head of water for irrigation in the lower system, and this partly explains the need for aqueducts from the north-east that transferred water from the river. On the other side, the Navigation includes four locks along the length bounding the watermeadows, and this would improve the head of water.

West of the Navigation, the 1:63,360 Geological Survey (IGS 1904) maps the drift geology as valley gravel with brickearth over; the likely soil association being the fertile Hamble 2 association, thick, mainly aeolian, silty drift, overlying river terrace or raised beach sands and gravels (Jarvis *et al.* 1984). This area, now occupied by Southampton Airport, is the site of the former North Stoneham Farm. The watermeadows of the Wessex chalk streams of southern England were generally constructed on silty, mineral alluvial soils. In the case in IVCP, the soil association is 'Adventurer's 3', neutral and calcareous fen peat, including deep peats, as well as mineral alluvial silty and clayey soil (Jarvis *et al.* 1984). A field investigation of ten topsoil samples (both peat and mineral alluvium) from across the site were all found to be calcareous. Not only is peat common in lower river valleys elsewhere, but it represents areas of high infiltration capacity and high 'poaching' risk. It may be symptomatic that, within watermeadow systems that have lost their topographic definition or otherwise been abandoned (Cook *et al.* 2008), they were constructed using peat or 'humose' (high organic matter) soils. Abandonment linked with poor drainage may subsequently lead to the accumulation of further peat deposits in topographic lows. Observation at IVCP points to better survival of bedwork features, including carrier channels, in areas of mineral topsoil. Perversely, what may have been bad for past meadow irrigation today favours wetland habitat creation.

On the western boundary of IVCP, the Itchen Navigation follows closely the contour

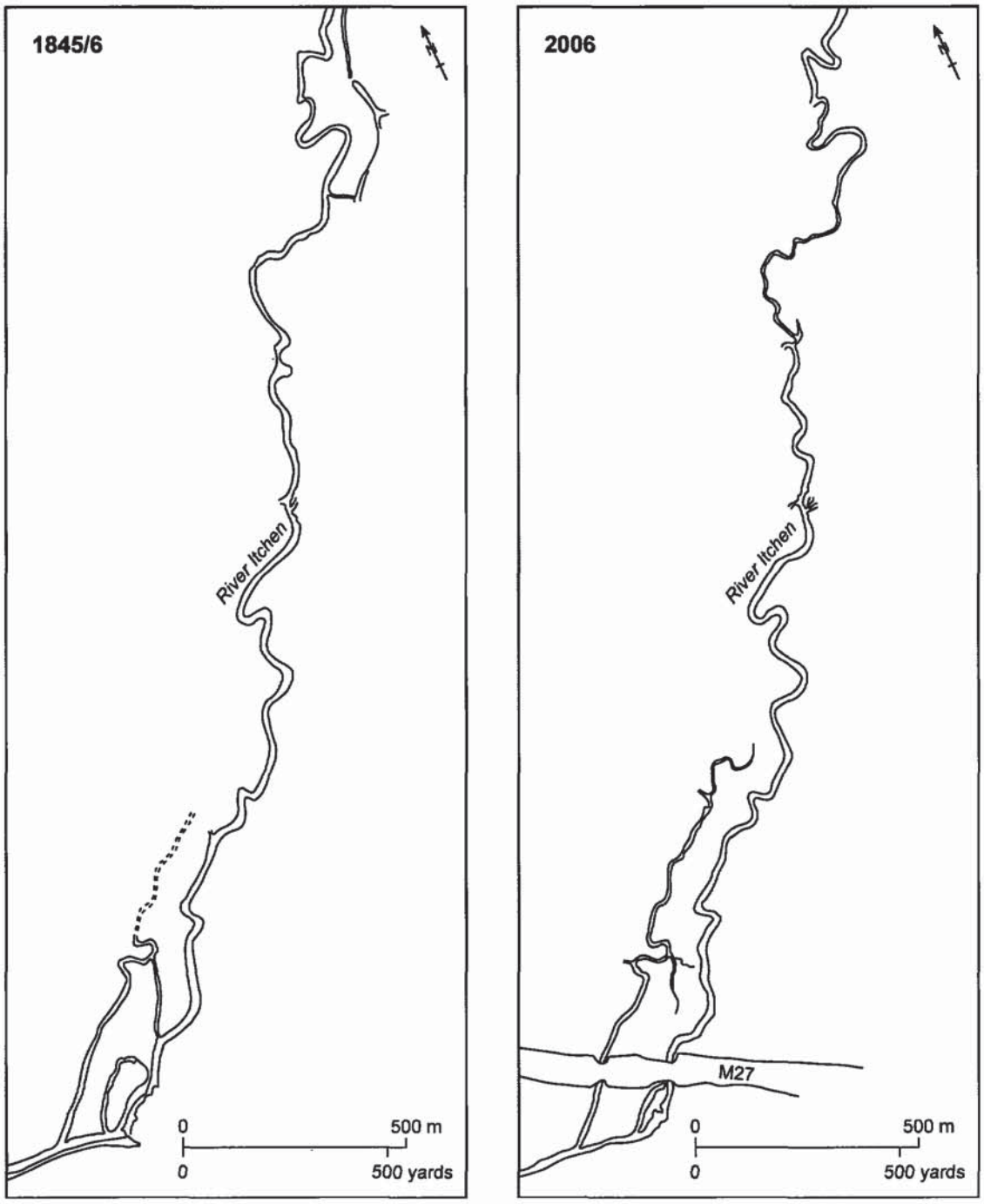

Fig. 4 Course of the river Itchen to the east of the modern Itchen Valley Country Park showing stable channel pattern between 1845/6 compared with 2006. Drawn from the tithe apportionment maps and from modern mapping.

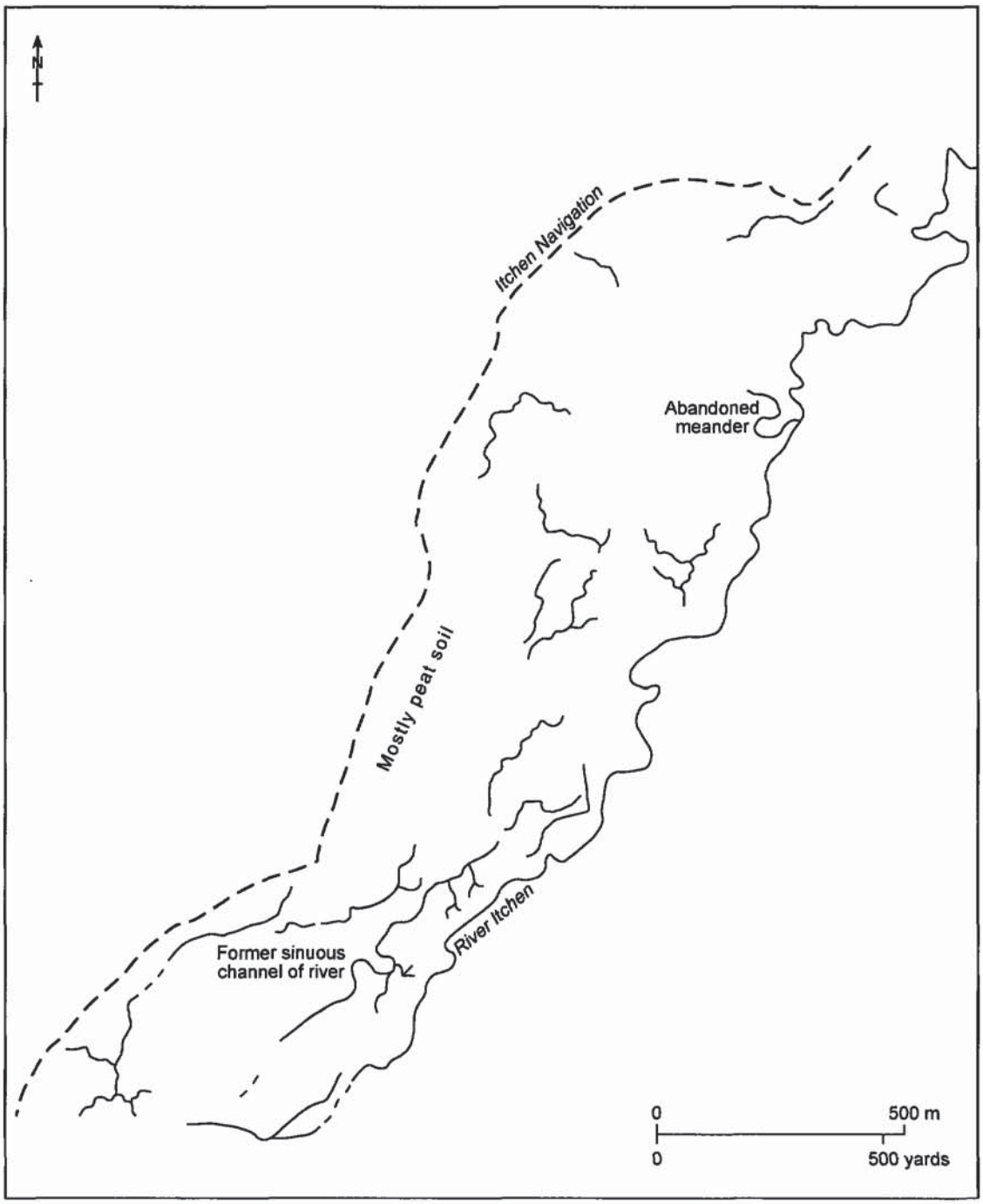

Fig. 5 Sinuous channel elements in the landscape at the Itchen Valley Country Park, identifiable from ground survey, modern mapping and air photography.

of the river terrace – the flat area west of here is raised above the modern floodplain, including the site of North Stoneham Farm. With sources of calcareous water on two sides, the floodplain had good potential for watermeadow development. Figure 4 shows the similarity in shape for the main River Itchen channel in 1846 and in 2006. Stability of river systems in Wessex is no doubt partly a result of engineering to protect investment in canals, leats, mills, meadows and irrigation systems. There is also inherent stability associated with channel patterns that tend towards being multiple in instances of relatively low gradients, finer alluvial loads and fringing vegetation (Harwood & Brown 1993; Rosgen 1996).

Sinuous or (locally) meandering, natural channels contrast with straighter, man-made watercourses, including watermeadow carriers and drains. Otherwise, there are no absolute criteria that differentiate 'natural' from man-made channels. Figure 5 shows non-linear (sinuous) channel elements of the landscape, traced from mapping and aerial photographs on the floodplain of the Itchen at IVCP. Most non-linear landscape elements are within 300 m of the present main channel of the Itchen and represent former channels, or re-activated palaeochannels used in watermeadow construction. Sinuous elements that are evident today and incorporated in the watermeadows as drains (and also carriers) may be presumed to have achieved their shape from past hydrodynamic conditions where channels have remained active, the possibility of adjustment of a former straight artificial cut to sinuous form cannot be ruled out, especially if a watermeadow became neglected and bank erosion lead to impairment of the channel.

The main stretch of the River Itchen conveys the flow to the east of the IVCP meadows in a single channel of overall sinuosity >1.4. This displays characteristics of both meandering (single thread) and multiple channel patterns. To the north of IVCP, around Bishopstoke the river has an appearance of multiple channel, but there has been considerable human intervention. On the south side of the Park, the original flow was likely discharged through two approximately parallel channels. Today, these flow beneath the M27 on the south side (crossing points SU 45421571 and SU 45281567); both have low sinuosities (around 1.2). Such a pattern is consistent with stretches of multiple channels, often termed 'anastomosed' (branching and re-joining). The name 'Lower Island Meadow', with the adjacent 'Upper Island Meadow' probably refers to an island resulting from the original multiple channel. Furthermore, 'Y'-shaped drains leading away from the River on Lower River Island (SU 45651605, Figs 5 & 12d) suggest the site of former avulsion events where a river (at least partially) leaves its bed during a flood). Avulsions are regarded as the main channel-forming processes in anastomosing rivers and there is relative channel stability between times of overtopping the banks. These multiple channel patterns on silt-dominated alluvial floodplains of low gradient (<0.005) contrast with the more regular channel pattern and coarse alluvium of true braided river floodplains (Rosgen 1996).

To the north of this stretch, around SU 46251700, is a clear abandoned meander feature that is incorporated in a main carrier inlet to the system (Fig. 5). The River Itchen at IVCP may thus be in a transitional state between anastomosed and multiple-channel. This complex floodplain geometry is the basis for the layout of the watermeadows. Cook (2008) has reviewed the possible causes of switches between a single meandering channel to multiple forms for Wessex alluvial valleys and suggests multiple channels may arise from increased soil erosion and channel sediment loading since pre-historic times, although a tendency to multiple channel may also be inherited from the late Pleistocene. Then true braided rivers associated with valley-fill gravels, are likely to have dominated the valleys (Gibbard & Lewin, undated). However, the modern interplay between meandering and multiple channel geometries reflects adaptations in channel form relating to Holocene climatic, hydrological, soil vegetation and human factors. A lower valley environment is vulnerable to up-catchment changes in

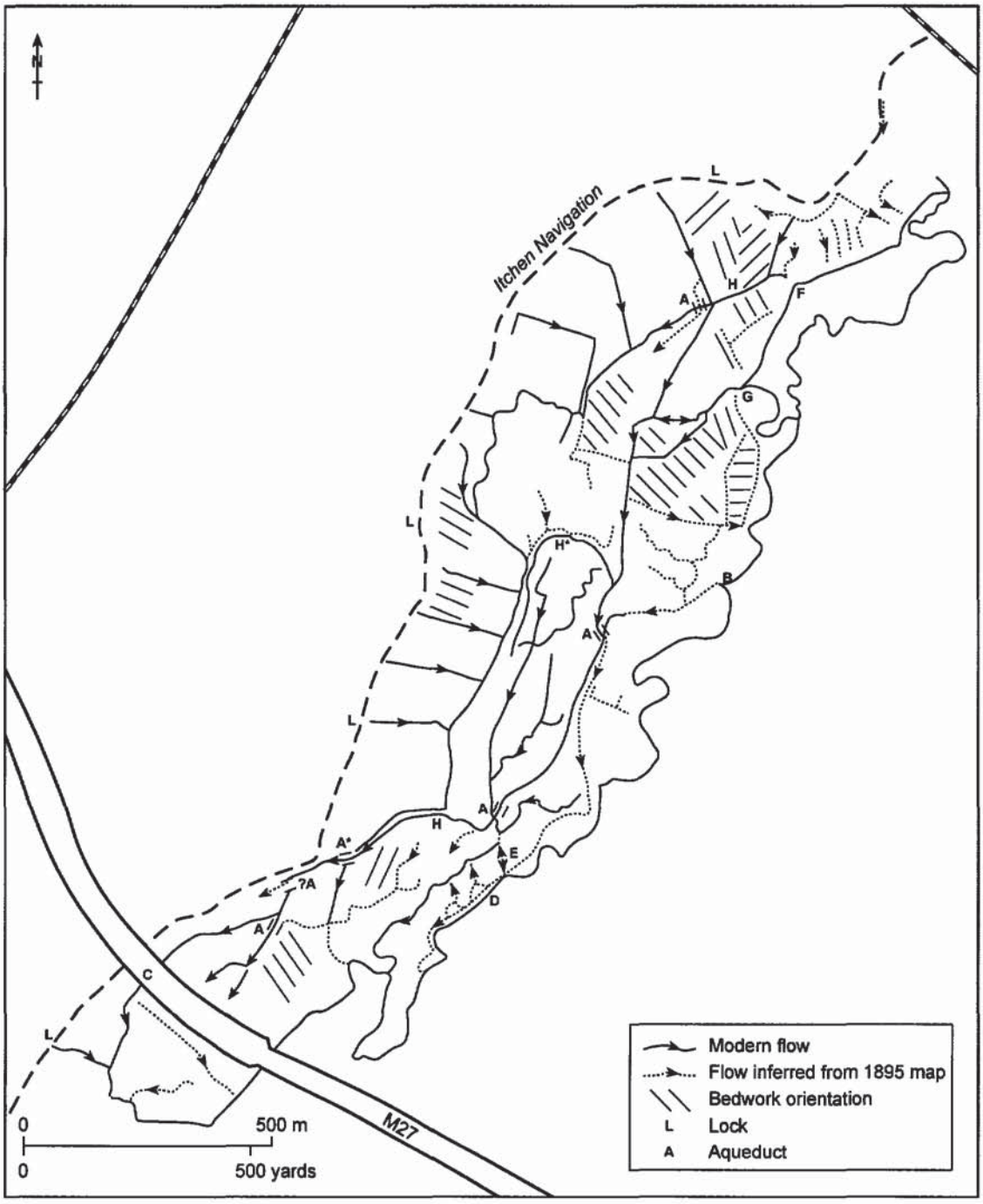

Fig. 6 Speculative reconstruction of watering arrangements at Itchen Valley Country Park watermeadows. See text and the figure key for explanations.

Fig. 7 Aqueduct structure and hatch housing (photo H. Cook)

sediment load as well as to hydrology and changes in base-level, particularly the sea-level rise since the early Holocene. The area today is close to the tidal limit of the Itchen.

Adjacent to the Navigation peat soils are common and it is probable that organic matter accumulation in floodplain depressions prior to meadow construction within an alluvial floodplain, would be relatively common under anastomosed systems that contrasts with strongly meandering channels that would have a greater tendency to erode and re-work floodplain material. A combination of peat soils and a tendency towards more regimented setting-out of the watermeadows in the north and west of the IVCP, became possible due to the proximity of the Navigation, contrasting with the incorporated sinuous elements closer to the river.

SYSTEM OPERATION

The fashion to construct watermeadows in Wessex, post-1600, was driven by the potential for economic gain. In some places water-meadow systems may have failed to operate efficiently, while in other floodplain locations, it is possible they were never constructed in the first place. Moon and Green (1940) note that, where a lack of gradient made watering difficult, meadow abandonment followed; larger extant systems have been shown to approximate floodplain areas of long-profile

Fig. 8 Hatch pool complex (photo H. Cook)

that is relatively steep (Cook 2007). At the IVCP, notably in the southern part of the Common Meadow where there is no evidence apparent, it remains possible that floated watermeadows were not constructed where peat dominates. Archaeological investigation would clarify this position.

Figure 6 shows a tentative reconstruction of the system. The modern channels showing direction of flow are differentiated from those re-constructed or interpreted from late nineteenth century mapping (at a scale of 1:2,500). Only the orientation of clear bedworks is shown from ground evidence and from that of the 1:5,000 aerial photograph. While most of the eastern and southern meadows are directly supplied from the River, the meadows on the western side are situated to be watered from the Itchen Navigation. In the mid-eighteenth century there were hatches leading (presumably at the north end) from the Navigation (HRO 102M71/E5). Draining and irrigation of adjacent watermeadows (as well as transport) were recognised as functions of the Itchen Navigation since its inception, but until the Act of Parliament of 1811, this function had been in the hands of the proprietors (SCS 1977). With four pound locks (marked 'L') along the IVCP section of the Navigation (from the lower end: Mansbridge Lock, Sandy Lock, Decoy Pond Lock and Chickenhill or Chickenhall Lock) there was ample control of water level within the canal as well as for the meadows.

There are three main carriers from the river.

Fig. 9 Hatch in bridge (photo H. Cook)

These arise near the Fish House (indicated on the 1:2,500 map) entering the meadows via a sluice at point F on Figure 6 (SU 46301730). The meandering stretch of the river south of point F appears narrower on the 1896 map, suggesting adjustment to water taken off for the meadows. There was a second main carriage leading off the river at point G (SU 46211708), this remains the major, and sometimes problematic, supply. A third carrier supplies the meadows from point B (SU 46191669). These carriers fed approximately 70% of the system; originally involving aqueducts (marked 'A') that conveyed water as far as the SW corner of the Park beyond the modern M27 (point C). A* is illustrated in Figure 7; although in other instances it is less than clear whether a collapsed structure was merely a bridge. Ground evidence for carriers is often unclear. However, in general, the presence of aqueducts is consistent with a need to maintain levels to feed carriers throughout much of the system to its southerly limit. In a few cases, there appears to have been carriers that lead off lower down the Itchen (point D, Lower Island Meadow), but it is doubtful if these were successful unless the river was close to bankfull discharge. The dry channel and concrete hatch structure (point E, see also Fig. 11) suggest a spillway returning excess water to the river from the main carrier system.

Main hatches, such as those marked H (see also Figs 8, 9 & 10) would have provided main controls for secondary carriers (now

Fig. 10 Hatch structures in woodland (photo H. Cook)

often dry and, once more, seldom clear on the ground). The presence of the decoy and woods confuses interpretation on the former Common Meadow (Fig. 2). In the north (Further North Mead, Hither North Mead and possibly NW side of Glebe Mead), the disposition of drains suggests a water source from the Navigation. It is likely that abandonment of watering commenced at around 1869, the abandonment date for of the canal. This is supported in the 1896 Ordnance Survey that indicates much of the remaining system was probably only functional where irrigated from the river. The survival of watercourses parallel to the Navigation is intermittent, such may be seen in the vicinity of Inholmes, but are absent further south. The watering of this meadow, Hither North Mead, Further North Mead and Glebe Meadow was likely from the Navigation via a carrier to the east of the northernmost of the locks (these are marked 'L'); much of the southern part of Common Meadow may never have been irrigated, or it was abandoned. Further south still there are the remains of a bridge structure that could also have been an aqueduct for watering Long Mead, but both map and ground evidence are unclear.

Figures 7 to 11 show respectively: Intact aqueduct and hatch housing (A* in Fig. 6) at SU 45431613, the hatch pool complex (northernmost 'H' in Fig. 6) at SU 46151724, a bridge and hatch housing at SU 45771656, a hatch structure (H* in Fig. 6) at SU 45821674 and concrete hatch housing (probably for a

Fig. 11 Concrete (double) hatch structure

double hatch) ('E' in Fig. 6) at SU 45741612. Figure 12 shows extracts from the 1:2,500 Ordnance Survey, some of which relate to the photographs.

CONCLUSIONS

The IVCP watermeadows display a topographic and hydraulic relationship with a floodplain of complicated geometry, as well as with an artificially constructed canal. This would likely mean the northern-most meadows ceased irrigation first of all, due to abandonment of the Navigation in 1869. However, the presence of the Navigation bank would also create drainage problems – particularly for the Common Meadow along the SW edge of the Park and much of the area below the 5m contour line. In the south it is probable that low gradient partly necessitated the addition of complex aqueduct structures. The aqueduct system from the river, that most likely does not post-date abandonment of the canal would be required to transverse drains and maintain a head of water for bedwork irrigation in a lower river valley environment where gradients are low. The prevalence of peat, be it a feature of the original floodplain or a result of waterlogging and abandonment of watermeadows, would not form suitable soil for irrigation.

The extensive use of brickwork, with later concrete in construction, points to a late seventeenth or early eighteenth century origin,

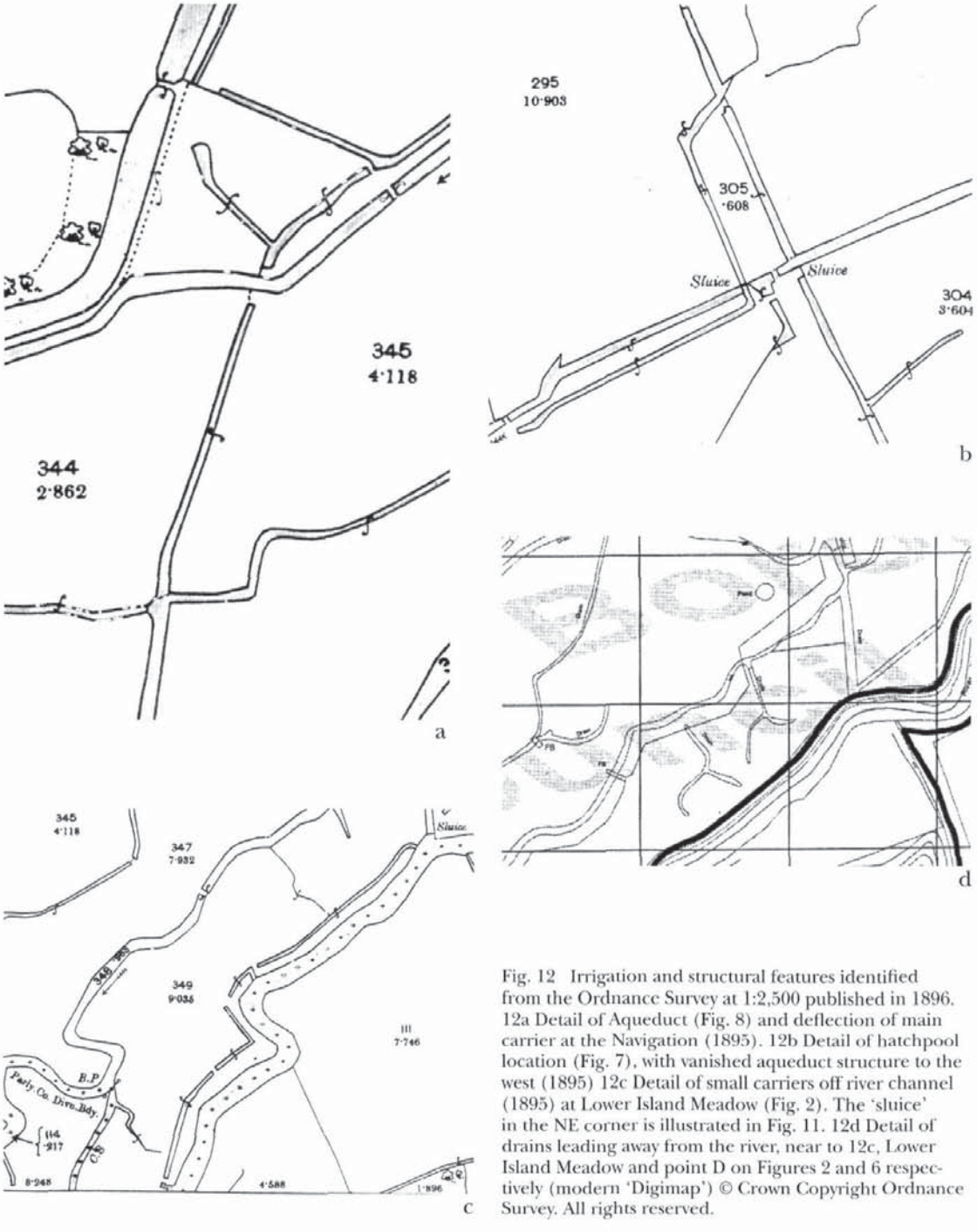

Fig. 12 Irrigation and structural features identified from the Ordnance Survey at 1:2,500 published in 1896. 12a Detail of Aqueduct (Fig. 8) and deflection of main carrier at the Navigation (1895). 12b Detail of hatchpool location (Fig. 7), with vanished aqueduct structure to the west (1895) 12c Detail of small carriers off river channel (1895) at Lower Island Meadow (Fig. 2). The 'sluice' in the NE corner is illustrated in Fig. 11. 12d Detail of drains leading away from the river, near to 12c, Lower Island Meadow and point D on Figures 2 and 6 respectively (modern 'Digimap')

towards the end of the 'zenith' period of watermeadow construction in the area. A construction date after 1700 is favoured because this was the time when the canal was completed. Irrigation was probably progressively abandoned after the Navigation was de-commissioned, although a date for the cessation of irrigation of the majority of meadows has not been forthcoming. From comparisons elsewhere, it is surmised this process would have been both progressive and haphazard depending on factors such as labour, demand for products from the meadows and a need for recurrent investment in structures (Cook *et al.* 2008). Late culverts, and 'fletton' brickwork, may only point to maintenance of drainage on these once 'floated' watermeadows. There is no evidence for the presence of long carriers off the River to the north and east earlier than about 1700.

It was likely a problematic and perhaps not very successful watermeadow system, given the potential for watering problems, for peat accumulation and the abandonment of supply from the Navigation. The historical and archaeological significance lies in its possibly relatively late construction and in certain surviving structures that are worthy of preservation. From a design point of view, this is a fine example of a 'complex system', significant because of its accommodation of fluvial geomorphological features that are typical of a lower river valley floodplain. The original channel geometry provides some main carriers, but mostly it is drains that are incorporated in the watering arrangements, including both an abandoned meander and a stretch of multiple-channelled river.

Details of the agricultural system locally practised remain uncertain. The mixed agriculture of North Stoneham Farm in the nineteenth century is not unusual and would it preclude the operation of the 'sheep-corn' system in the region, prior to that time. Referring the regional pattern, it is possible that cattle came to dominate grazing in the nineteenth century because of the proximity of the railway to transport milk to market. This derelict system of watermeadows is accessible to the public and worthy of further scientific, historic and archaeological investigations.

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REFERENCES

Primary Sources

Hampshire Record Office, 21M65/F7/173/1–2. Tithe Apportionment Award and Map for North Stoneham (1846).

Hampshire Record Office, 21M65/F7/217/1–2. Tithe Apportionment Award and Map (1845) for South Stoneham (1845).

Hampshire Record Office, 102M71/E5. Arbitration award of Wm. Sloane and Thomas Yale Caverley concerning the water rights respectively attached to North Stoneham farm (Sir Francis Seymour Pile) and Swathyling farm (John Dummer) with orders as to weirs and rents 10 December 1748.

Hampshire Record Office, 102M71/E28. A lease of part of North Stoneham Farm (i) Richard Fleming of Stoneham Park (ii) Robert Houghton of Eastleigh farm and (ii) Edward Bridge of North Stoneham 1727.

Hampshire Record Office, 102M71/E39. A lease for 8 years (i) John Fleming of Stoneham Park (ii) Edward Bridge of North Stoneham. 5 Nov 1792.

Hampshire Record Office, TOP 355/3/1/11. Report of Benjamin Bevan and Richard Eyles meeting at Winchester 13th October 1808.

Hampshire Record Office, 159M88/1128. Particulars and conditions of sale of the freehold agricultural estate known as the North Stoneham estate extending to about 1357 acres. James Harris & son, Southampton, 15 May 1953.

Maps

Institute of Geological Sciences, 1904 *Southampton sheet 315 (drift)* scale 1:63360, reprint of 1948.

Secondary Sources

Bettey, J 1999 The Development of Water meadows in the Southern Counties, in Cook, H & Williamson, T (eds), *Water Management in the English Landscape*, Edinburgh, 179–195.

Bettey, J 2007 The Floated Water Meadows of Wessex: A Triumph of English Agriculture, in Cook, H & Williamson, T (eds), *Water Meadows*, Windgather, 8–21.

Bettey, J 2009 George Boswell of Puddletown (1735–1815): progressive farmer and author, *Agricultural History Review* **57** (1) 58–69.

Bowie, G G S 1987a New sheep for old – changes in sheep farming in Hampshire, 1792-1879, *Agricultural History Review* **35**(1), 15–24.

Bowie, G G S 1987b Watermeadows in Wessex – a Re-evaluation for the period 1640–1850, *Agricultural History Review* **35**(2), 151–158.

Chapman, J & Selinger, S 1997 *A Guide to Enclosure in Hampshire 1700–1900*, Hants Record Series, **XV**.

Collins, E J T 2000 Rural and Agricultural Change, in Thirsk, J (ed.), *The Agrarian History of England and Wales* **VII** (pt.1), 1850–1914, Cambridge, 72–233.

Cook, H F 2007 The Hydrology, Soils and Geology of the Wessex Water Meadows, in Cook, H & Williamson, T (eds), *Water Meadows*, Windgather, 94–106.

Cook, H F 2008 Evolution of a floodplain landscape: a case study of the Harnham Water Meadows at Salisbury England, *Landscapes* (9) 1, 50–73.

Cook, H F 2010 Boom, slump and intervention: changing agricultural landscapes on Romney Marsh 1790 to1990, in Waller, M P, Edwards, E & Barber, L (eds), *Romney Marsh: Persistence and Change in a Coastal Lowland*, Romney Marsh Research Trust Monogr. No 5, Romney Marsh Research Trust, Sevenoaks, 155–183.

Cook, H F, Cowan, M & Tatton-Brown, T 2008 *Harnham Water Meadows: History and Description*, Hobnob Press, Salisbury.

Cook, H F, Cutting, R L, Buhler, W & Cummings, I P F 2004 Productivity and soil nutrient relations of bedwork watermeadows in southern England, *Agriculture, Ecosystems and Environment* **102**(1) 61–79.

Course, E 1983 *The Itchen Navigation*, University of Southampton Industrial Archaeology Group, Southampton.

Cutting, R, Cook, H F & Cummings, I 2003 Hydraulic conditions, oxygenation, temperature and sediment relationships of bedwork watermeadows, *Hydrological Processes* **17**, 1823–1843.

Gibbard, P L & Lewin, J undated *Climate and Related Controls on Interglacial River Sedimentation in Lowland Britain*. (http://www.qpg.geog.cam.ac.uk/research/projects/interglacialrivers/). Accessed March 2011.

Hadfield, C 1969 *The Canals of South and South East England*, Davis & Charles, Newton Abbott.

Hampshire County Council 2002 *Water Meadow Policies*, Report of the County Plannning Officer. Winchester.

Harwood, K & Brown, A G 1993 Fluvial processes in a forested anastomosing river: flood partitioning and changing flow patterns, *Earth Surface Processes and Landforms* **18** 741–748

Institute of Geological Sciences 1904 *Southampton sheet 315 (drift)* scale 1:63360, Reprint of 1948

Jarvis, M G, Allen, R H, Fordham, S J, Hazleden, J, Moffat, A J & Sturdy, R G 1984 *Soils and their use in South East England*, Bull

Soil Surv of England and Wales no **15**, Harpenden.

Lambert, T undated a *A brief history of Titchfield, Hampshire* http://www.localhistories.org/titchfield.html. Accessed March 2011.

Lambert, T undated b *A Brief History of Eastleigh.* http://www.agentsmart.co.uk/blog/a-history-of-hampshire/cities-towns-and-villages/a-brief-history-of-eastleigh-by-tim-lambert/. Accessed March 2011.

Lynch, G 1993 Brickwork: the historic development, The Building Conservation Directory. http://www.buildingconservation.com/articles/brick/brickwork.html. Accessed March 2011.

Moon, H P & Green, F H W 1940 Water meadows in Southern England, in Dudley Stamp, L (ed.), *The Land of Britain*, The Report of the Land Utilisation Survey of Britain, pt. 89, app. 2, Geographical Publications Ltd, London, 373–90.

Oxford Archaeology Unit, 2000 *Hampshire Water Meadows Survey, Archaeological Desk- Based Study*, Vol. 1, Oxford: Oxford Archaeological Unit.

Perren, R 1989 Markets and marketing, in Mingay, G E (ed.), *The Agrarian History off England and Wales* **VI**, 1750–1850, Cambridge University Press, 190–274.

The River Itchen Sustainability Study, http://www.riveritchensustainability.org.uk/. Accessed Jan 2010.

Rosgen, D 1996 *Applied River Morphology*, Wildland Hydrology, Pagosa Springs, Colorado.

Sear, D, Newson, M, Hill, C, Old, J & Branson, J, 2009 A method for applying fluvial geomorphology in support of catchment-scale river restoration planning, *Aquatic Conservation: Marine and Freshwater Ecosystems* (19) 506–519 DOI: 10.1002/aqc.1022.

Stearne, K 2007 The management of water meadows: four hundred years of intensive integrated agriculture, in Cook, H & Williamson, T (eds), *Water Meadows*, Windgather, 107–121.

The Southampton Canal Society, 1977 *The Itchen Navigation A survey by Southampton Canal Society*, The Society, Southampton.

Wessex Archaeology, 2005 *Itchen Navigation Heritage Trail: Heritage Report for a Conservation Management Plan*, Wessex Archaeology, *unpublished report* (reference 58850.02). http://www.hwt.org.uk/data/files/Itchen_Nav/itchen_navigation_heritage_report.pdf accessed March 2011.

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