3 Hydrology

by I Meadows

Introduction

The interrelationship between people and natural elements is something that is generally considered in all excavations. There is always, however, the difficulty of identifying the past situation as opposed to simply extrapolating the 'now' backwards. This is particularly true of water and watercourses in lowland England. The nature and form of the unimproved rivers would be at stark variance to the heavily managed waterways that exist now. These improvements will have altered the flow and behaviour of the river as well as the degree of flooding and the level of the floodplain wide watertable. The problem facing any study of the past within a valley is therefore identifying how the river behaved previously, through understanding periods of stability and change. This is possible because many of the changes have taken place in the historic period with the most extreme alterations occurring in very recent times.

Changes to the form of the river will have had an impact on the ground water in the immediate vicinity of the river, as the underlying geology of the floodplain is generally composed of highly permeable free draining gravels; the ground water would rise as a consequence of the rise of the river levels due to the construction of the Navigation and other improvements. This process is particularly apparent when features such as ancient wells, dug to abstract water, are found to have been excavated far deeper than would now be needed to ensure reliable clean water, suggesting the watertable has risen since their original excavation.

The Nene is typical of many midland rivers in so far as the course that now comprises the river is the product of a series of improvements and one of the specific aims of this project is to understand the impact each of the improvements had on the river and by inference the surrounding floodplain watertable. To facilitate this, the Nene will be examined in a series of reverse chronological stages starting with the most recent impacts and working back through to the archaeological data.

The River Nene, for the purpose of this study, will be examined from its source just west of Badby to the Town Bridge in Peterborough beyond which point the river changes character and becomes a major fenland waterway. The river initially flows east from a large catchment into a narrower defined valley with much reduced inflow (Fig 2.1.1). At Wellingborough the river swings slowly to run almost northwards as far as Wansford before again flowing east. The course of the river passes over predominantly impermeable rocks such as the Whitby Mudstone and Oxford Clay which are poor aquifers, so most of the water it receives is directly from permeable superficial deposits or tributary streams such as the River Ise and Harpers Brook. The river has a total catchment area of about 1630km^2 (based on figures supplied by the Environment Agency).

The course falls from the source at around 160m aOD to about 6m aOD at the Town Bridge in Peterborough and is tidal at the Dog in a Doublet Lock slightly further downstream. The majority of this fall is in the initial 9.5 kilometres, the channel lying at 80m aOD by Weedon.

The river has a very slack gradient after the initial section where it drops 1m in every 270m. This reduces, by the time it reaches Northampton, to a gradient of generally 1m fall every 1500-2000m to as far as Thrapston, where the gradient reduces to nearly 1m in every 3000m (see Appendix 1). This slack gradient coupled with the level of flow produces a river that is generally very sluggish.

Table 3.1: Gradient of the River Nene

Location	Height (maOD)	Distance from source	Gradient between contours	Gradient
Source at Staverton	160	0	N/A	-
Weedon	80	9.5	8.42m/km	1:119
Nether Heyford	70	11.9	4.16m/km	1:241
Northampton	60	16.5	2.17m/km	1:461
Cogenhoe	50	25.1	1.16m/km	1:862
Irchester	40	36.2	0.90m/km	1:1111
Denford	30	52.9	0.60m/km	1:1667
Oundle	20	70.3	0.57m/km	1:1753
Wansford	10	89.1	0.53m/km	1:1887
Peterborough Town Bridge	6	106.2	0.23m/km	1:4348

The river near the Town Bridge in Peterborough may in historic times have been affected by salt water if not fully tidal. The suggestion cannot, sadly, be supported by environmental data such as diatoms, but it is implied by the observation of a freshwater spring within the river described by Hugh Candidus writing in the twelfth century in the Peterborough Chronicle (Mellows and Mellows 1980). He says, 'In the middle of this river is a place as it were a sort of abyss, which is so deep and so cold in midsummer, when the heat of the sun seems hotter than a furnace, no-one swimming there can go to the bottom of it, and yet it is never frozen in the winter, for, as men say, there is a spring there, from which the water bubble up.'

The valley width varies hugely and the flat valley floor is in places a couple of kilometres across as at Wollaston but at other points only a few hundred metres. This natural division of the valley into a series of reaches may have given rise to discrete land use and ground conditions. This project will attempt to examine whether it is possible to identify previous watertable levels and evidence of flooding which might have impacted upon the nature of settlement and land use, either by providing physical impediments or creating conditions that were just too marginal for certain activities.

The identification of modern levels will provide a benchmark level for the watertable in the valley, but it must be recognised that the improvements to the river's course, beginning in the medieval period and culminating in the navigation improvements of the first half of the eighteenth century, mean that this level is unlikely to be 'natural'.

The hydrology of the river and its surrounding floodplain is a significant potential variable in the factors influencing land use and settlement. It should be possible to identify areas of archaeologically identifiable waterlogged areas/levels which can act as indicators of the general local water level at a given time. Features such as wells and palaeochannels are obviously going to indicate contemporary water levels, but the occurrence of waterlogged levels in pits and ditches may also further reflect the more general watertable. The wells and waterlogged features used will, however, be entirely drawn from the gravel floodplain. Features cut into the flanks of the valley whilst waterlogged will not reflect the river levels, instead they will show the level of water at that point in the strata. As a result the Roman wells at Ashton have been excluded from this study.

The nature of the Nene and its alluviation will also be considered as a marker of overbank flooding which represents a further constraint against permanent settlement and perhaps rendering the land marginal. While short floods will not develop easily identifiable alluvial levels, where they have been recognised such layers must denote an extended and probably repeated flood period extending over several years.

The third aspect to be considered will be the evidence for the navigation improvements to the Nene. The historical data from the last 250 years will be explored to try to understand the mechanics of the river even with 'modern' management schemes. Evidence for navigability and riparian activities such as milling and fishing will also be considered, as they can be indicators of channel flow and quality.

Origin of the Nene Valley

The valley of the Nene was formed as one of the tributary streams draining to a basin during the late Ice Age that was to become the North Sea. The size of the valley is a product of a larger, and more energetic, river than the present Nene and one with greater erosional capacity. The deposits associated with this watercourse comprise the gravel that has been commercially extracted from much of the valley floor and also forms small localised terraces. The Nene, unlike many of the larger river valleys, only preserves parts of two terraces and in most instances they are very fragmented by subsequent channel activity. Various papers discuss of the origin and form of the river (Langford and Bryant 2004) and it is not intended to repeat them all here. Very little archaeological work has examined the evidence for the late Pleistocene or early Holocene river course but it would appear that during the Holocene the river had been fairly consistent in terms of its form and flow, allowing for variations in climate and slight variations in precipitation, along with the variations in the type and level of ground surface cover of the catchments.

The Iron Age and Roman river

The extensive nature of the evidence for the Iron Age and Roman landscape of the valley floor and the number of excavated wells and other similar features mean that it is perhaps as near to a picture of the unimproved river as it is possible to get by archaeological means. Excavation along the valley has examined several large-scale Roman and Iron Age landscapes which have themselves generated numerous contexts indicating contemporary waterlogging. Unfortunately, many of the locations had been recorded in terms of depth from excavation surface rather than in terms of absolute heights, this precludes any detailed consideration of the difference, as often this level is relatively arbitrary. Additionally, in terms of the river's courses the sites for which such data is available are clustered where fieldwork has been carried out recently, elsewhere palaeochannel activity was all but ignored. Information mostly comes from the sections of valley between Grendon and Wellingborough, and at Stanwick. Excavations just off the floodplain, such as at Ashton, near Oundle, have produced a number of heights for wells and their waterlogged fills, but the levels will not reflect the watertable within the floodplain gravels and therefore the level of the contemporary river. Other data exist for single spots such as the well at Lynch Farm.

Unfortunately it is clear that the data set is too localised to make sense of the hydrology on a river wide basis, it can only be commented upon in the localities for which data exists however from those areas broader considerations can be extended.

Wollaston

At Wollaston several Middle Iron Age wells and Roman wells were explored and their depth recorded against ordnance datum. Each well comprised a hole dug through the uppermost part of the permeable gravels. An assumption was made concerning the wells that as the height of the surviving waterlogged material was an artefact of the lowest prevailing watertable levels since the deposition. Because of this the level used for this discussion would be the base of the well as most wells will be dug to ensure a reliable all year water supply and are unlikely to greatly exceed the level needed to achieve that.

The scraped surface of sub-site 1, a pair of conjoined small Iron Age animal pens, lay at around 42maOD. Throughout its excavation, which occurred before the mineral company drained the gravel, the level of groundwater in excavated features was directly comparable to that of the river, indicating the parity between the present floodplain watertable and the river water level (Plate 3.1). Despite this widespread on-site presence of water no ancient waterlogged levels were recovered from any of the cut features, showing that in the past the prevailing water level had been lower than the base of any of the features. The current adjacent river water level is maintained at 41.15maOD downstream of Wollaston Lock and 43.13maOD upstream of Wollaston Lock. This difference in the water levels between the base of the past wells and the present river level, nearly 1km from the excavation, was recognised during excavation, showing that the present groundwater is at a higher level than in the past.

At one part of the site there were three Middle Iron Age wells, three Roman wells and a waterlogged Middle Iron Age ditch, all within a very short distance enabling some consideration of watertable through time.

The three Middle Iron Age wells no longer contained any waterlogged material, although decayed organics were noted in the lowest levels of each. The bases of the three wells were 41.0m, 41.2m and 42.0maOD (the last of these recorded levels may be incorrect), the waterlogged ditch base lay at 39.7maOD with waterlogged material up to 40.2maOD. Clearly, in the Middle Iron Age the watertable had been significantly higher than the single surviving level and it is likely to have been at least 41.5maOD.

The Roman wells were all of second or third-century date and had preserved bases at 40.56m, 40.56m and 41.45maOD, which is deeper than the preceding Iron Age wells by on average about 0.5m (Plate 3.2). This extra depth, whilst possibly a reflection that Roman wells were deeper due to the desire to ensure cleaner water, could equally suggest that the watertable had lowered during this period. This downwards fluctuation in the watertable is further demonstrated by the top of the surviving waterlogged levels in the wells at 41.0m and 41.3maOD, both of which levels are about the height of the base of the Iron Age wells. In the third well the organics had become desiccated and degraded.

This group of wells and the waterlogged ditch suggest that perhaps the local watertable dropped during the Iron Age into the Roman period. As the water is free moving through the gravels it is likely this level is also a reflection of the prevailing river levels.

Two further Roman wells of similar date were examined about 1300m to the south. They were found to have bases at 44.4m and 42.9maOD with organics surviving at 44.0m and 43.45maOD respectively. This rise may suggest a rise in the land, since three locks were installed to make the river navigable at this point with the upper section maintained at 44.5mOD and the lower end at 41.15mOD.

Downstream of Wollaston on the floodplain below Irchester Roman town a further well, not closely dated, but Roman extended to 38.7maOD (the current river level is 38.86maOD). Whilst four vertical stakes, driven into the underlying gravels, were preserved, no other organic levels remained in the well. Elsewhere on the floodplain palaeochannels, some of late glacial or early post-glacial date, lying at about 38maOD preserved organic materials (Meadows 1997).

At Turnells Mill Lane, directly south of Wellingborough, a palaeochannel was examined dated to the Neolithic and Bronze Age (Plate 3.3), it had an upper level of 39.7mOD (Brown 1997). Its infill was organic rich sediment that had remained sufficiently waterlogged to avoid decay to the above level. The site was overlain by alluvial clay up to 1.5m thick whose upper surface lay at about 39.0maOD indicating the level of medieval floods, the river is currently maintained at 41.15maOD.

The various wells and waterlogged ditch contexts at Wollaston and Irchester demonstrate how the ground surface, or sub surface gradient, is reflected in that of the watertable. The present river level gives a point of reference for current watertable levels. It is of note that in this section that level, and consequently that of the groundwater, is maintained at a level higher than that suggested either by the wells or the level of surviving organics. Clearly fluctuations in the watertable through time have caused the desiccation and deterioration of organic levels in wells and other formerly waterlogged contexts and some of these fluctuations cannot be dated, however, as the Iron Age wells were at least 0.5m shallower than their Roman equivalents at Wollaston, perhaps there was at that time a lowering of the prevailing water table.

Stanwick

From the excavations at Stanwick a group of eighteen Romano-British wells were recorded, they are presented below in tabular form. The wells in the table are all Romano-British and there are examples from most of the Roman period. The prevailing current river level at that part of the valley is maintained at about 32.74mOD.

Table 3.2: Basal level of Romano-British wells at Stanwick

Well overall	Well lining	Well cut	Recorded depth (m)	Height (maOD) of base	Date of construction	Site phase
3207	3219	89521	1.8	-	-	-
7697	-	-	-	-	-	-
7698	-	-	-	-	-	-
8297	8890	8889	2.8	32.38	340-410	12
9290	9752	9751	2.2	32.01	100-170	8
110058	9480	9377	2.0	32.21	170-230	9
31556	-	-	-	-	-	-
45632	45638	45635	1.38	32.51	170-230	9
46005	46080	46088	2.4	32.46	220-270	10
46073	46218	46215	2.25	32.10	220-270	10
46079	46154	46151	2.5	32.05	170-230	9
46675	46676	46677	3.25	31.67	220-270	10
65211	65909	65902	2.2	32.16	170-230	9
66330	66331	66358	2.1	32.17	270-340	11
66849	66901	66900	2.1	32.11	170-230	9
66851	66923	66934	2.1	32.61	220-270	10
66964	66965	89524	1.55	32.05	170-230	9
	81512	81510	1.77	33.07	170-230	9
	82901	82903	1.35	-	270-340	11
84947	84983/ 86372	84982	2.1	31.77	170-230	9
85245	-	-	-	-	-	-
86248	86252	86250	1.7	32.33	340-410	12
	86286	-	-	-	-	-
	87257	87255	1.58	-	-	-
88106	88107/ 88129	88130	2.96	31.83	220-270	10
88317	-	-	-	-	-	-
89172	89168/ 89169	89525	1.68	32.38	100-170	8
100268	-	-	-	-	-	-

The basal level of these wells was consistently below the level of the maintained river water level by amounts ranging from 1m to a few centimetres (one example had its base higher than the current river level, perhaps suggesting either a rogue level or the existence of a locally perched watertable. Within each chronological period there was a range of depths represented suggesting that within the period the depth of the contemporary watertable was fairly consistent. That the level is closer to the height of the adjacent river course might suggest that in this section of the reach the recently engineered waterlevel is close to the Roman water level.

The medieval river

The medieval river has been identified and examined archaeologically at a few places, enabling the localised identification of water levels or at least surviving waterlogged levels. However, there were far fewer levels than initially expected because of the lack of floodplain settlement and it will not therefore be possible to reconstruct a picture of the contemporary water level from them.

The height of the surface of the alluvial clay can provide only an indication of floodwater extents as the final extent of the spread will be the product of a continued and progressive encroachment across the floodplain rather than a simple final maxima flood. This limitation of the alluvium as an indicator is as a result of the progressive choking of lesser channels and the aggradation of the bank with resistant material, the stable bed aggrading bank model postulated by Brown (Brown 1997 24-5, Brown *et al* 1994), whereby fewer channels can carry the same volume of water.

The late Saxon/medieval period is generally regarded as the period of greatest build-up of alluvial clay in the Nene and other river valleys (Robinson 2006, 37) (Plate 3.4). These clays represent evidence for extensive and repeated flood episodes carrying soils derived from the land, perhaps as a result of the arable intensification and development of open field agriculture at this time (Foard nd 23). No micro-morphological analysis has been able to demonstrate individual episodes within the alluvial deposits of the Nene. This homogeneity is the product of, amongst other things, bioturbation where the floods silts first settle/accumulate on the vegetation cover of the flood plain before being mixed by either livestock grazing or by rain-washing the sediments down to the soil interface. That the product is so consistent both vertically and horizontally would suggest that as a surface it is only ever used as grazing or haymeadow. At West Cotton there was evidence of open field strips both sealed by the alluvial cover and also on top of the cover (Parry 2006, 36).

Whilst the medieval period generally has great potential for information derived from documentary sources relating to or produced by the major monastic houses and some secular estates (cf Courtney 2006, 6), the information was, however, very limited for the floodplain. Whilst there are references to some watermills along the river and a few references to fisheries (see section 2.6 Saxon and medieval valley), this is in marked contrast to other major rivers such as the Trent or Thames. It has been suggested (Mackreth pers comm) that the reason for this contrast is that as the Nene is a very steady river, with a course that is not dynamic and changeable, the conflicts, which are the source of many of the documents, are therefore rare.

The depth of alluvium, up to a maximum of about 2m, along the valley is not as deep as in some valleys for example the Trent or the Thames but it does denote substantial overbank flooding carrying an enormous load of soil and silt particles over an ill defined period. This process, whilst occurring in the prehistoric (Last 2005 349-50) and Roman periods seldom deposited extensive recognisable deposits of alluvial clays, other than in cut features. Traditionally this increase in run off is related to the two key factors, that is the climatic deterioration producing increased precipitation (Lamb 1977, 149-61) and secondly the extensive nature of the open field system of cultivation with long periods when the soils were bare (Brown 1997, 227). The nature of the ridge and furrow pattern of cultivation, with its ability to shed water into the furrows which generally ran downslope, created conditions that would produce high levels of load bearing runoff entering the watercourse. The precise date of the onset of alluviation in the valley is difficult to ascertain as its end but there is evidence from the Nene Valley to suggest it would be simplistic to regard the process as a single continuum.

The presence of an increasing number of mills, coupled with the increased run off would exacerbate the conditions for flooding and would also potentially slow even further the flow of the river by creating mill pools. Work at West Cotton (Chapman in press) has demonstrated the commencement of the sedimentary process from Late Saxon time onwards in at least one of its palaeochannels, that of the northern stream channel. This alluvium was deposited to a height of about 34.50maOD, which compares to the present river water level that is maintained at about 32.74maOD, elsewhere at West Cotton the flood alluvium reached a height of 35.55maOD. This would suggest flooding episodes that reached nearly 3m higher than the present river level.

The excavations at Peterborough Bridge Street (Meadows 2004) show how important river management was. This site produced evidence for probably monastic river management, including the straightening of the river course and the revetment of at least part of its side. The location of the first bridge across the Nene at Peterborough is believed to have been close to the present site but it was lost to the floodwaters and ice floes after one year. The replacement bridge once erected was handed by the Abbey to the town and that bridge stood until the nineteenth century. It would appear that lessons had been learnt as to the power of the river in spate and one response was to straighten the channel to reduce the erosive power of the river at the bridgehead. A timber revetment was used to protect the unconsolidated fills of the palaeochannel, which had once formed a meander loop at that point .

The sixteenth and seventeenth-century river

This period saw the river considered for improvement to form a navigation several times. As early as 1613 a petition had been submitted to make the Nene navigable to boat traffic with the intention of improving trade with Northampton. This petition, part of the Finch Hatton archive (NRO FH 3503), was submitted by people from Northampton to the second Lord Salisbury to make the Nene, 'navigable for the carrying of a vessel of some good burthen...' The slight gradient and slow flowing river would have been impossible to navigate as a result of lack of clear water, mill dams, vegetation and silts. The petition identifies several mills which would have needed locks constructing and fords that have obviously been built up to the point that they had shallowed the water. Additionally the petition identifies the possibility of straightening sections of the river by digging new channels or reinstating former channels. A sign of how poor the channel was is the way in which the river is described downstream of Alwalton as 'a little gutter that with a little scouring will be made straight and good.' In total about thirty-five pound locks were suggested for use in this improvement. Although the scheme was never taken up, the petition represents the start of the desire to make the river navigable from Northampton for commercial reasons and reflects the times which had seen the opening of the Exeter ship canal in 1566, the River Stour in Kent being made navigable and also the promotion by Act of parliament of the navigation of the River Welland, although work did not commence there until 1664.

In about 1653 an anonymous pamphlet entitled, 'Some considerations of the river Nine running from Northampton to Peterborow and so to the sea: shewing fesability and conveniency of making it navigable,' was produced. It saw the making of the Nene navigable as the means of supplying the recently drained fens 'sending downe many things they cannot but want'. The benefit of a navigable Nene was also seen as a way of transporting fuel to Northampton more cheaply than was then possible and also to alleviate some of the flooding. The document was quite detailed, even considering what draught the new vessels using the navigation should be, at 'not above two foot deepe', suggesting there was generally not even a clear channel of two-foot depth forming the river when the document was prepared.

The implication of both of these seventeenth-century documents is that passage by boat beyond Alwalton Mill was not generally practicable and the reasons were a combination of natural and human obstacles, the level of the river could also not bear additional flow as it was inclined to frequent flooding. It is probable at this time that the requirements of mill owners to generate a head of water and the lack of any maintenance would have produced a high ground water level.

The eighteenth-century river

The eighteenth century saw the initial improvement of the River Nene to make it navigable from Peterborough to Northampton. Prior to these improvements the river had only been passable to boat traffic as far as Alwalton, although it is possible that boat traffic used short stretches of water further upstream. Obstacles such as shoals or weirs that would impeded simple navigation could be by-passed by small vessels by means of portaging, unloading and passing on the bank and taking the boat out of the water, reloading once the obstacle was passed (Jenkins 1991 21); unfortunately there is little documentary evidence of this practice on the Nene.

In 1648 a vessel loaded with cheese is mentioned as passing up the river by means of portaging (Anon 1653); 'A boat of 3 tun laden with cheese …brought from Peterborow to Higham Ferrers at Michaelmas Faire (29th September), the wayes that wet season being unpassable: and though the owner was forced to hire two men to unlade his boat at every mill shore, and after lift the boat to the dam … which he did sixteen times: yet he brought his cheese at an easier rate than at the most seasonable time he could have done by land.' It is unclear whether the sixteen causes for the portaging were all mill dams or if some instances were fords but clearly this practise was acknowledged as cheaper even than using the roads when they were passable.

The impetus to improve the river network in England had been gaining pace long before the eighteenth century and the Nene was seen as a means of linking the midlands with the sea. The first act of parliament to make the Nene navigable was issued in 1714 (Anon 1714). It is clear that it was recognised that making the river navigable would require the waters to be made deeper, the consequence of which would be potential flooding and the submersion of fordable places. Anyone undertaking these works would be required to raise and strengthen the banks and erect bridges to replace the crossings. As the first act required the whole river to be made navigable along with the associated secondary works of bank raising and strengthening and crossings no one would undertake the work.

A second navigation act was passed in 1725 with less severe requirements that promoted the improvement of the river between Peterborough and Thrapston (Anon 1725). This act lead to the improvement firstly from Peterborough to Oundle and then subsequently on to Thrapston. The Commissioners appointed by this act agreed a scheme to make the river navigable between Peterborough and Oundle with Robert Wright and Thomas Squire at their own expense, but that they should be allowed to charge a toll of 1s 6d per ton on goods moved between the two places, this was completed by June 1730. Thomas Squire undertook the improvements to Thrapston on the same basis, completing that work by December 1737.

A further act was passed in 1756 to make the remainder of the river navigable to Northampton (Anon 1756). Boats were able to reach Wellingborough by March 1760 and Northampton by August the following year. A total of twenty locks were constructed in the section between Northampton and Thrapston in order to make that section passable to boats carrying amongst other cargo, coal, the result of which was to drastically reduce the cost of coal in Northampton. It is of note that in 1759 the navigation between Wansford and Waternewton had been neglected and Thomas Yeoman, a civil engineer who had surveyed the section of river upstream of Thrapston prior to its being made navigable, observed it. The situation had been exacerbated by the use of the tolls not being linked to any amount of conservancy. This situation was eased in 1794 by a further act that saw the appointment of a clerk and overseers by the Commissioners but, as has been described above, in 1833 the Clerk of Works for the Eastern Division had to take the commissioners to the local assizes for non payment of salary and costs.

The nineteenth-century river

At the start of the nineteenth century, despite only a relatively short period after the river had originally been made navigable, the upper reaches of the River Nene were already in a state of poor repair; the number of stoppage notices to allow repairs published in the local newspapers reflects this. The repairs were generally for maintenance such as re-hanging of lock gates but in at least one short period several stoppages were required, which would have effectively interrupted trade along the river. Between May and June in 1818 the river was closed between Wansford and Elton to repair Yarwell sluice; throughout June 1821 the navigation was closed for repairs to Cotterstock Sluice; in August 1824 the navigation was closed between Peterborough and Oundle for hanging new doors at Warmington sluice (the others having been damaged by misuse); in July and August 1825 the navigation between Peterborough and Oundle was closed for the hanging of new doors to Water Newton Sluice and also in 1825 the navigation was closed in November for repairs to the Cotterstock and Elton sluices. These repairs were carried out in an environment in which one paper, *Drackard's Stamford News* (7th May 1830, p3 col 3), when reporting the meeting of the Commissioners in May 1830 comments that; …'it does seem that there has been great neglect for a series of years on the part of the commissioners of the Nene Navigation…..' (Parker 1998, 145).

This situation was partly the result of funds from tolls along the navigation not being used for maintenance and in 1833 the Clerk of Works for the navigation took the Commissioners to the local sessions court for non-payment of his salary and costs. It was stated that the funds derived from the tolls were being siphoned away from river conservancy and that there was insufficient even to meet the salary of the clerk (Tibbets v Yorke November 12th 1833)

There also appeared to be a serious conflict between the requirements of the mill owners along the river and the needs of the navigation. The mill owners inserted overfall boards to raise the head of water serving the mill, this practise had the effect of flooding adjacent farmland and will have also raised the ground watertable, albeit temporarily. In the contemporary newspapers there are several instances of mill owners being taken to the sessions because of this flooding, which in some instances it was severe enough to '...render the land not tenantable..' (Parker 1998, 145)

These local actions had a significant effect upon the general height of water in the main channel by raising each section by the amount of the overfall board. The response of the commissioners was to recognise the use of these boards '…subject to their removal when required by certain of the proprietors and occupiers of meadow-land adjoining….' The height of the boards agreed for each mill was as follows:

Wadenhoe Mill	11 inches (280mm)
Cotterstock Mill	18 inches (455mm)
Elton Mill	16½ inches (415mm)
Yarwell Mill	9 inches (230mm)
Wansford Mill	18 inches (455mm)
Waternewton Mill	11 inches (280mm)
Alwalton Mill	18 inches (455mm)

The desire for waterborne communication along canals and rivers that had driven the navigation acts was slowly succeeded firstly by the improvements to the road network as a result of the turnpike trusts and subsequently by the construction of the railways, one of the earliest of which, ironically, used the Nene Valley to allow a relatively flat gradient from the midlands to the North Sea ports of initially Peterborough and then Wisbech and Kings Lynn. It is suggested by one author that this railway was perceived by railway companies as a cheap one to construct, as it needed little significant engineering work (Dane 1978). The first railway to arrive in Peterborough came from Blisworth, via Northampton, Thrapston, Oundle and Wansford with the very first train on Monday 2 June 1845 and the first goods service from December that year (ibid 9).

The impact of the railways on the river traffic was to reduce the volume of goods being transported and consequently to reduce the value of maintaining the river as a navigation. This situation was reflected in a report of a survey by George Hurwood of the Nene, published by the Admiralty (Hurwood 1852), which makes it clear that the river had '… been for a long series of years virtually without any conservancy.' He expressed doubts that the river above Peterborough was even passable to barges and he also notes it as very prone to flooding.

The twentieth-century river

The River Nene today is maintained by the Environment Agency and is a relatively slow flowing river utilised by pleasure craft along its navigable course. This was largely created in the twentieth century by extensive dredging and recutting of the watercourse. The River Nene Catchment Board came into being as a result of the Land Drainage Act 1930 (this act was a result of the 1927 Royal Commission on Land Drainage which put the Nene on a list of rivers in urgent need of attention). They were responsible for the management and supervision of the river from its source to the sea, as previously no single body or individual had overall control. In the case of the Nene there were previously about 40 private drainage acts and other national and public acts.

The Royal Commission found the river in a poor state as a result of many years of under investment (Plates 3.5-3.8). In the history of the work of the Catchment Board (Dallas 1951) its condition was described;

The upper reaches of the river were in a really deplorable condition. Neglect of maintenance over a long number of years had resulted in unparalleled decay and dilapidation.' … 'it (Nene) became choked with weeds and reeds, mud and silt. The locks and sluices were so seriously decayed that they were beyond repair.'… 'Locks are necessary to maintain a level of water in the river. Without locks there would be little water in the river over very long periods.

The Nene Valley Drainage and Navigation Commissioners, who preceded the River Nene Catchment Board, had been reliant upon income derived from tolls on traffic using the river, but with the increase in rail use in the nineteenth century this traffic had lessened to such a degree there were insufficient funds to maintain let alone improve the river. The situation in the early 1930s was recorded photographically with selected images, before and after, reproduced in a number of annual reports produced by the River Nene Catchment Board. It was sadly not possible to locate the complete set of photographs but even allowing for the selection of the most dramatic for publication it is clear the river was in a deplorable state by 1930.

The First World War provided impetus to restore to navigability many of Britain's inland waterways and improve the agricultural potential of the country as a whole. A survey of the river was carried out by the engineer Mr Clark, but sadly no written version of this survey was identified and enquiries made to the Environment Agency archives led to the suggestion it was never committed to plan or text. Whilst this seems unlikely, it is possible the original survey may have been lost as the Catchment Board records were passed through the various bodies, culminating in the present Environment Agency.

Overall the Catchment Board restored the navigation by the rebuilding and replacement of locks, constructing the Dog in a Doublet lock in 1937 that created a limit to the tidal flow, and by an extensive programme of dredging. The scale of works undertaken in addition to cleaning the existing channel included dredging many of the tributaries and the excavation of new cuts for the main river to improve flow; the flood relief scheme around the Bedford Road in Northampton is a good example of this type of work (Plates 3.9 and 3.10). Here, a wide flood relief channel was excavated where there had previously only existed a narrow weed-choked brook. At various stages there were both floating and bank-based dredgers clearing a channel along the river. In 1938, on the river upstream of Peterborough Town Bridge there were two floating dredgers, one at Lilford Lock and one at Wansford staunch, additionally there were eight draglines operating at Lilford, Elton, Alwalton, Irthlingborough, Brampton, in 1939 there was one floating dredger and six draglines at new locations and in 1943 there were nearly thirty operating, largely improving agricultural drainage.

This recent phase of work on the river course altered both the location and form of the main river and influenced its flow and the level of retained water to allow navigation. The navigation is maintained to a depth of at least 1.2m (based on figures for maximum draught provided by the Inland Waterways Association and the Environment Agency). A River Nene Waterway Plan (Environment Agency no date) has been circulated by the Environment Agency, who now has responsibility for the river; this plan is aimed at improving the quality of the river and recognising all the various users.

The river is now again an arterial route for pleasure craft after the concerted dredging and active management. The river that exists now is clearly unlike its earlier forms and it is important to recognise this in any examination of the past, because whilst the river is a major natural feature which can act in both a positive and negative way on land use, it is no longer in its natural form so that interaction may be different. The nature of a river in the landscape means that that it acts on all land use decisions made, this must be borne in mind both in terms of the visible river but also in terms of the accompanying watertable that exists in the free draining gravels that dominate the flood plain.

Shallow channels

One feature of the valley between Grendon and Irchester was the number of channels, some very shallow, running across the gravel (Fig 3.1). When seen with the current drainage pattern the alignment/possible course of some of these channels would appear to have survived to form the basis of the current streams that run across the area. This was clearly the case in a number of instances, for example the channels defined at Wollaston where the more westerly extended into the limit of extraction, this course was defined by the present brook which originates in the high ground to the east of Wollaston.

In many instances it was not possible to date the channels and many were regarded during excavation only as potential ‘winterbournes’ because of their shallowness. It perhaps significant, however, that at both Wollaston and Irchester the channel courses were mirrored by flanking ditches and, in at least one instance, banks, which followed the curving course of the channels suggesting contemporaneity and ongoing risk of flooding. The work at Grendon has demonstrated that channels can be active for a period before becoming isolated then being reactivated centuries later (Last 2005). Here a shallow but wide channel (20m wide) was active in the Holocene/pre-boreal phase, a hiatus during the Neolithic, and then sedimentation recommenced in the Bronze Age and continued to the Early Iron Age.

In this part of the valley as a whole it is of note how shallow most of the channels that have been explored have been and whilst this might be an artefact of the extractive process avoiding deep organic deposits, it could equally be representative of the character of much of the unimproved Nene, a series of shallow channels of anastamosed form across the flat gravel flood plain. The low gradient of the valley would assist in the evolution of such a system of shallow, sometimes seasonally active, channels. If this was the case then it is quite possible that much of the Nene in its unimproved state could have resembled the photographs taken by the River Nene Catchment Board in the 1930s. The valley floor could have been a series of shallow channels fluctuating in and out of use over time. Their very shallowness, certainly in the parts of the valley with a wide floodplain, would preclude their use for any commercial purpose either for transportation or motive power, but as can be adduced from the efforts made by the Roman farmers their presence created an overbank flood risk that needed controlling by the construction of banks and ditches. Although shallow the watercourses could be very wide as was shown at Grendon (20m) and also further downstream where the course spanned by a bridge at Aldwincle was of similar width (Jackson and Ambrose 1976).

At Orton Longueville, just upstream of Peterborough, and in a section of valley where the floodplain was not as wide as at Aldwincle or Wollaston, deeper channels were observed (Mackreth forthcoming). A number of meander channels were observed and intermittently recorded south of the present river during gravel extraction. It is likely that the sequence recorded represented an early river course whose infill comprised very organic silty clay, which overlay a peat deposit. At the top of these silty clays Iron Age metalwork was recovered (see Iron Age section above), this was sealed under a 0.5m deposit of organic peat below alluvial clays. This upper peat has suggested as a deposit that formed in an isolated backwater.

A similar deep palaeochannel was recorded at the Town Bridge in Peterborough (Meadows 2008). Here the channel appeared to have an uninterrupted organic sedimentary sequence extending several metres down with early medieval pottery in its upper levels. This channel, forming a meander, was evidently active until probably the construction of the timber revetment and probable channel straightening isolated it (Plate 3.11). That a deep channel was observed at this point is perhaps not a surprise as the floodplain at this point is very narrow constricting the flow.

Discussion

Work on the River Nene by a number of specialists has produced a model for its form and character. This model sees the river having a stable bed with the process of alluviation, leading to deposition of alluvial deposits that raise the bank, this process can then initiate the concentration of the water in fewer but deeper channels (Brown 1997, 24).

The excavations in the stretch of valley between Grendon and Irchester has produced many shallow channels indicating the ancient river had an anastamosed form, few of the observed channels were even 1m deep. It is a shame that few have been absolutely dated but the work at Grendon shows how even single channels can be active and then cease to flow before becoming active again at a later stage (Last 2005) perhaps during a flood episode.

The channels examined at Grendon, Wollaston, Turnells Mill Lane and Irchester were all shallow and whilst there may be a temptation to suggest they are minor tributaries or backwaters they could be characteristic of much of the water flow that now forms the River Nene. Such channels could have formed a network, some always wet but many others only seasonally active, effectively winterbournes, threading across the floodplain.

If such shallow channels were characteristic of the river, and if the water was not continuously present (even in the post-medieval period it was recognised that locks and weirs were needed to keep a body of water along the whole length of the Nene), then the river is highly unlikely to have been a route for transport or communication other than on the most local and ad hoc basis. It may equally be the reason that so many Roman towns were located at confluences with other channels as the extra volume of water may have ensured water supply and perhaps even waste disposal.

This survey has recognised the need for more absolutely dated channels to better reconstruct the character of the river and also it has found that many of the archaeologically recorded contexts, which had been anticipated to provide markers of water level, had sadly not been recorded against Ordnance Datum. This lack of absolute data has been a severe limitation upon this section.

It has,, however, been possible to identify that the current levels of water, which are maintained in the river for navigation purposes, have a broader consequence as they artificially raise the watertable in the surrounding floodplain gravels. The level of that raising is consistent with the free movement of water through the gravels, but it is clear that it is not a height consistently above any single earlier level. The wells and other surviving organics at Wollaston suggest the present level is 1-2m higher than at any time in the past whilst at Stanwick that difference was far less. Clearly any strategy to maintain and manage the effects on the watertable to mitigate against the loss of archaeological and environmental levels needs more detailed information than currently exists.

The River Nene as it now is evidently an artefact of large amounts of management and it will continue to require that management to remain an open watercourse. The consequence of the any alterations in the channel on the broader hidden landscape within the gravel must always be considered as clearly we still do not fully understand what the full character of the River Nene was for much of the archaeological past and as archaeologists it is very difficult to recognise its effect on the landuse on the valley floor. The need to maximise the understanding of available archaeoenvironmental data and for more absolutely dated archaeoenvironmental studies of the valley is apparent.

Bibliography

Anon 1653 *Some considerations of the river Nine running from Northampton to Peterborow and so to the sea: shewing fesability and conveniency of making it navigable*

Anon 1714 *An Act for making the River Nyne, or Nen, running from Northampton to Peterborough, navigable*

Anon 1725 *An Act for making more effectual an act passed in parliament holden in the Twelfth Yeare of the reign of her late Majesty Queen Anne, entitled, An act for making the River Nyne, or Nen, running from Northampton to Peterborough, navigable*

Anon 1756 *An act for explaining and amending and rendering more effectual, Two several Acts of Parliament,….one of them passed in the twelfth year of her late Majesty Queen Anne, for making the River Nyne, or Nen, running from Northampton to Peterborough, navigable: and the other made in the eleventh year of his late Majesty King George the first, for making more effectual the said former act*

Brown, A G, 1997 *Alluvial geoarchaeology: floodplain archaeology and environment change,* Cambridge University Press

Brown, A G, Keogh, M K, and Rice, R J, 1994 Floodplain evolution in the east midlands, United Kingdom: the late glacial and Flandrian alluvial record from the Soar and Nene valleys, *Phil Trans R Soc Lond A*, **348,** 261-293

Brown, A G, and Meadows, I D, 1997 Environmental analysis of a Neolithic/early Bronze Age palaeochannel fo the river Nene at Turnells Mill lane, Wellingborough, Northamptonshire, *Northamptonshire Archaeology*, **27,** 185-91

Chapman, A, in press West Cotton, Raunds: a study of medieval settlement dynamics, AD 450-1450, Oxbow Books

Courtney, P, 2006 The documentary project, in S Parry 2006, 6-7

Dallas, G, 1951 River Nene Catchment Board: A brief record of some of the work

Dane, R, 1978 *Railways of Peterborough*, Peterborough Paper, **2**

Environment Agency nd River Nene Waterway plan

Foard, G, nd An archaeological resource assessment of Anglo-Saxon Northamptonshire (400-1066), The East Midlands Archaeological Research Frameworks Project,
www.le.ac.uk/ar/research/projects/eastmidlandsfw/pdfs

Hurwood, G, 1852 Admiralty Reports under preliminary Inquiries Act-Nene Valley Drainage and navigation Improvement

Jackson, D, and Ambrose, T, 1976 A Roman Timber Bridge at Aldwincle Northants*, Britannia,* **7**, 39-72

Jenkins, H J K, 1991 Along the Nene: Peterborough's waterway traffic through the centuries, Cambridge

Lamb, H H, 1977 Climate, present, past and future, Methuen

Langford, H E, and Briant, R M, (eds) 2004 *Nene Valley Field Guide*, Cambridge: Quaternary Research Association

Last, J, 2005 Life by the river: a Prehistoric landscape at Grendon, Northamptonshire, *Proceedings of the Prehistoric Society,* **71**, 333-60

Meadows, I D, 1997 An archaeological watching brief and pre-emptive works at Irchester Quarry June 1995-May 1996, Northamptonshire Archaeology report

Meadows, I, 2008 A Riverside timber revetment at 130 Bridge Street, Peterborough, *Northamptonshire Archaeology*, **35**, 163-172

Mellows, C, and Mellows, W, 1980 *The Peterborough Chronicle of Hugh Candidus*, Peterborough Museum Society

Parker, D, 1998 Oundle in the news. Local newspapers as a source of historical information about Oundle, Stamford

Parry, S, 2006 Raunds Area Survey: An archaeological study of the landscape of Raunds, Northamptonshire 1985-94, Oxbow Books/English Heritage

Robinson, M, 2006 Environmental archaeology of the Raunds Area excavations, in S Parry, 31-37

APPENDIX 1 Gradient of the River Nene from Northampton Lock to Stanground Lock (Dog in a Doublet)

Location/name	Distance to next lock (km) (a)	Upstream level (b) (maOD)	Downstream level (b) (maOD)	Height difference (m)	Gradient to next lock
Source of river	25			92.79	1:270
Northampton Lock	2.41	57.21	55.96	1.25	1:1928
Rush Mills lock	0.67	55.96	54.35	1.61	1:416
Abington lock	1.91	54.35	53.37	0.98	1:1949
Weston Favell lock	1.28	53.37	52.12	1.25	1:1024
Clifford Hill lock	0.97	52.12	51.08	1.04	1:933
Billing Lock	2.09	51.08	49.80	1.28	1:1633
Cogenhoe lock	1.93	49.80	48.40	1.40	1:1379
Whiston Lock	1.45	48.40	47.24	1.16	1:1250
White Mills lock	1.45	47.24	45.72	1.52	1:954
Earls Barton Lock	2.09	45.72	44.5	1.22	1:1713
Doddington Lock	1.13	44.5	43.13	1.37	1:825
Wollaston lock	2.09	43.13	41.15	1.98	1:1055
Upper Wellingborough Lock	1.61	41.15	39.44	1.71	1:942
Lower Wellingborough Lock	3.06	39.44	38.86	.58	1:5275
Ditchford Lock	3.37	38.86	36.70	2.16	1:1713
Higham Ferrers Lock	3.7	36.70	35.08	1.62	1:1713
Irthlingborough Lock	3.86	35.08	32.74	2.34	1:1649
Upper Ringstead Lock	0.97	32.74	31.88	0.9	1:1077
Lower Ringstead Lock	3.7	31.88	30.48	1.4	1:2643
Woodford Lock	1.45	30.48	29.60	.88	1:1647
Denford Lock	2.41	29.60	28.19	1.41	1:1709
Islip Lock	3.54	28.19	26.49	1.70	1:2982
Titchmarsh Lock	4.19	26.49	24.57	1.92	1:2182
Wadenhoe Lock	1.77	24.57	23.23	1.34	1:1321
Lilford Lock	3.86	23.23	21.85	1.38	1:2797
Upper Barnwell Lock	0.48	21.85	21.03	0.82	1:585
Lower Barnwell Lock	3.22	21.03	19.93	1.10	1:2927
Ashton lock	3.38	19.93	18.68	1.25	1:2704
Cotterstock Lock	2.73	18.68	16.98	1.70	1:1606
Perio Lock	3.87	16.98	15.61	1.37	1:2825
Warmington Lock	2.57	15.61	14.17	1.44	1:1785
Elton lock	4.83	14.17	11.89	2.28	1:2118
Yarwell Lock	2.09	11.89	9.94	1.95	1:1072
Wansford	6.12	9.94	8.08	1.86	1:3290
Water Newton lock	3.22	8.08	6.31	1.77	1:1819
Alwalton Lock	6.11	6.31	4.21	2.1	1:2909
Orton Lock	8.21	4.21	2.9	1.31	1:6267
Dog in a Doublet	N/A	2.9	tidal	2.9	

To the east lies Stanground Lock and the Dog in a Doublet

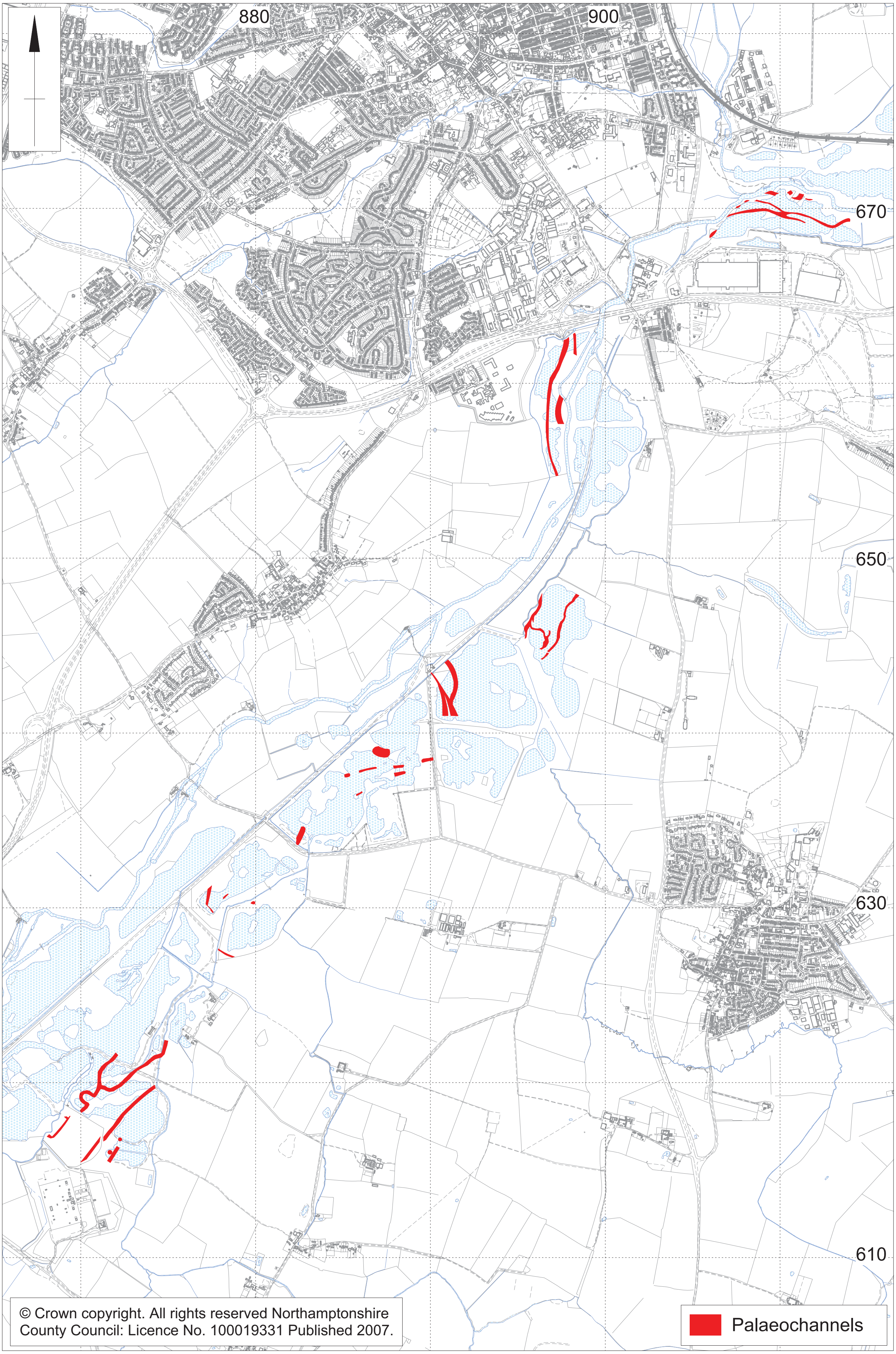
(a) Based upon the figures in the undated Environment Agency Leaflet, *River Nene Navigation: the Nene your river for life*.

(b) Figures provided by Environment Agency. The figures used are for the Drought Retention Water Level, although clearly levels can vary upwards by as much as 1.5m dependant upon the section of the river.

The height of the source is treated as 160maOD.

This gives a total length from the source to the Dog in a Doublet of 128.79km, a 150m fall so an average gradient of 1:805.

From Northampton the distance to the Dog in a Doublet is 103.79km and the fall is 57.21m with an average gradient of 1:1814.



Scale 1:30,000

Palaeochannels around Wollaston Fig 3.1

Plate 3.1: High ground water level in Iron Age enclosure ditch at Sub site 1, Wollaston.
(Northamptonshire Archaeology)

Plate 3.2: Roman well at Wollaston
(Northamptonshire Archaeology)

Plate 3.3: Section showing depth of alluvial clays at Wollaston.
(Northamptonshire Archaeology)

Plate 3.4: Section across palaeochannel at Turnells Mill Lane
(Northamptonshire Archaeology)

Plate 3.5: River Nene at Irthlingborough before dredging.
(River Nene Catchment Board)

Plate 3.6: River Nene at Irthlingborough after dredging.
(River Nene Catchment Board)

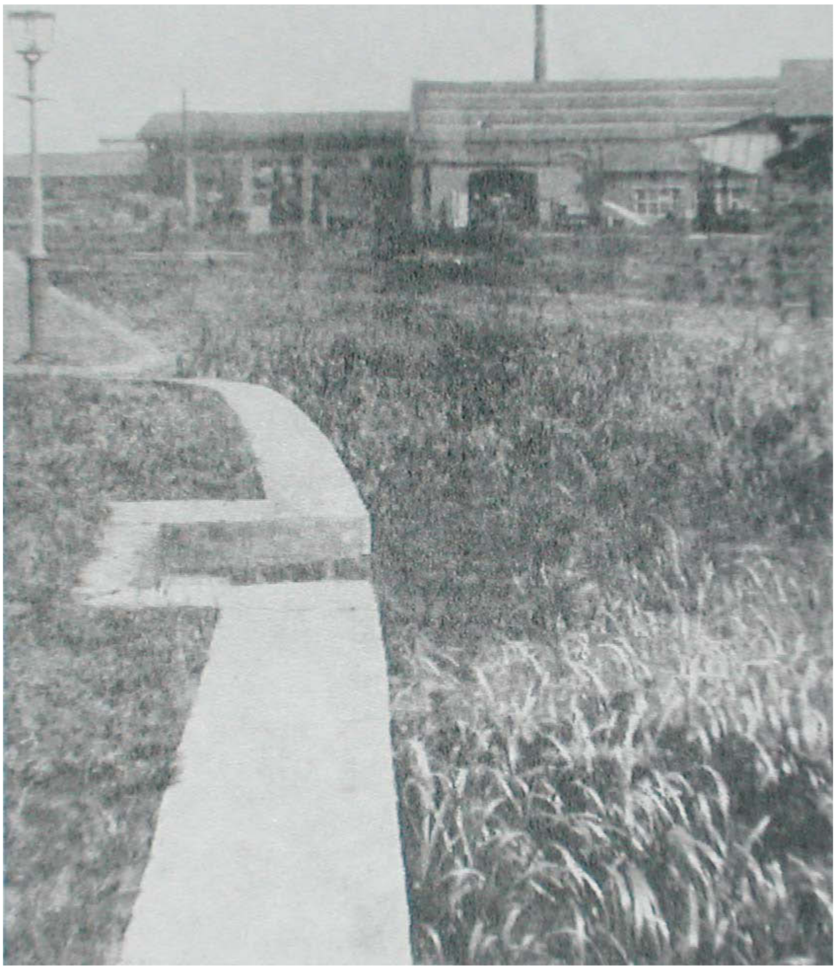


Plate 3.7: River Nene from South Bridge, Northampton before dredging.
(River Nene Catchment Board)

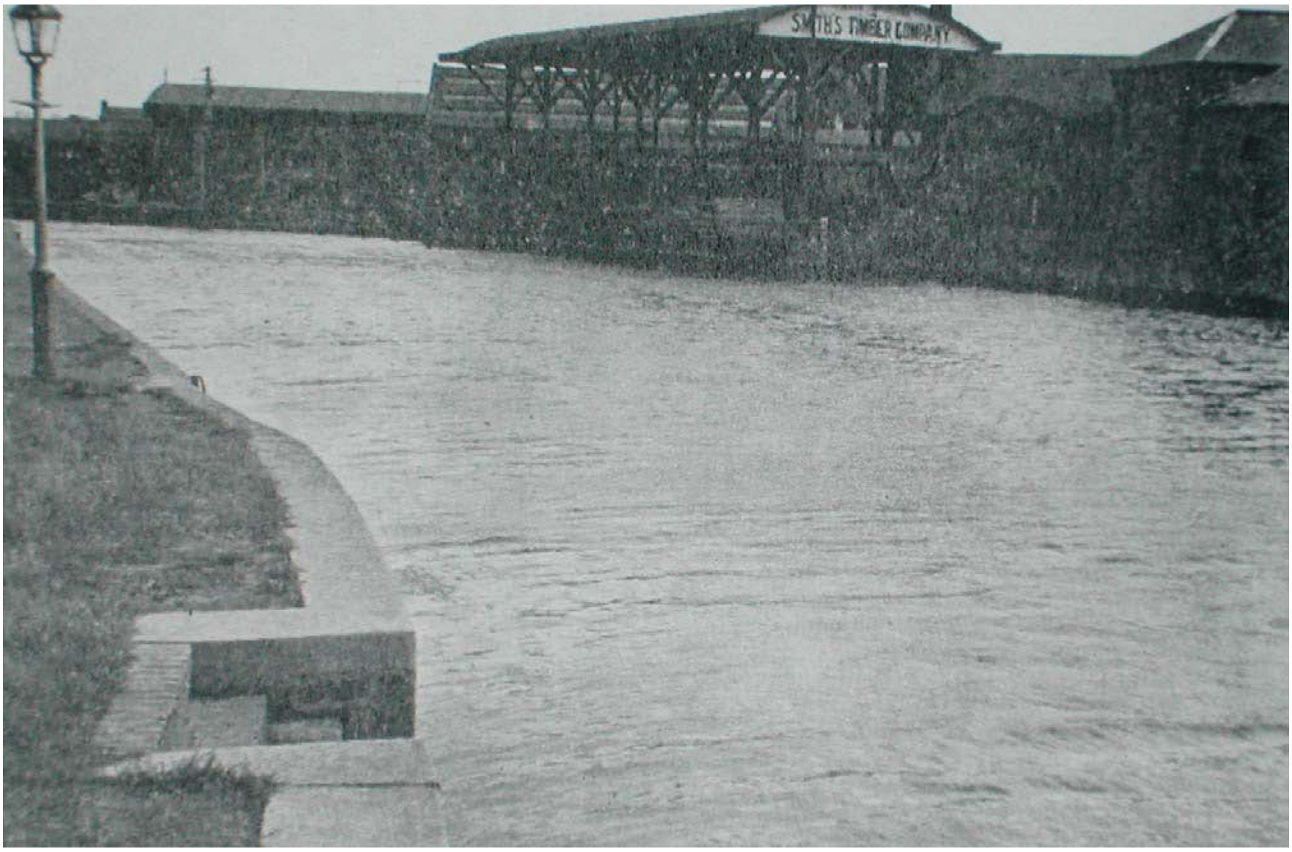


Plate 3.8: River Nene from South Bridge, Northampton after dredging.
(River Nene Catchment Board)

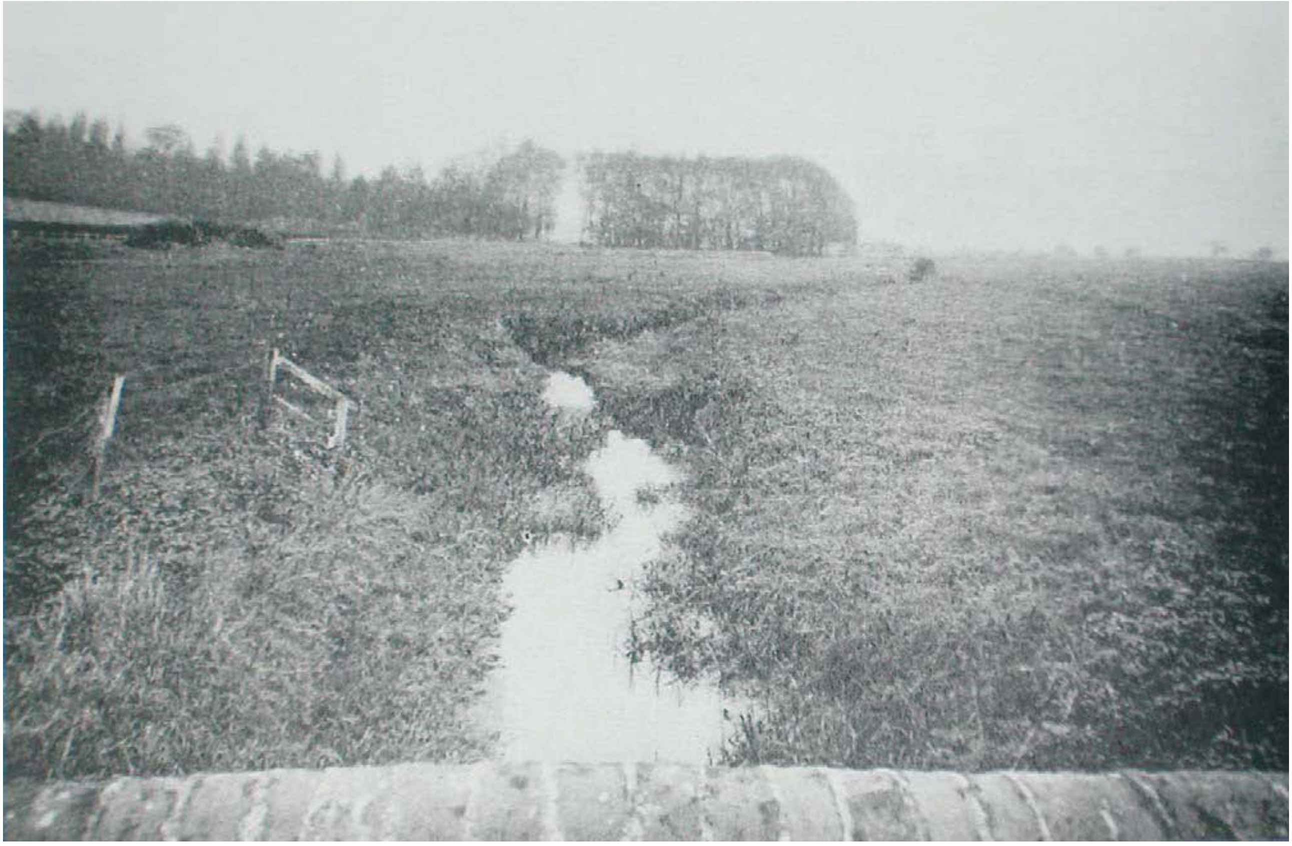


Plate 3.9: River Nene from Bedford Road, Northampton before dredging.
(River Nene Catchment Board)

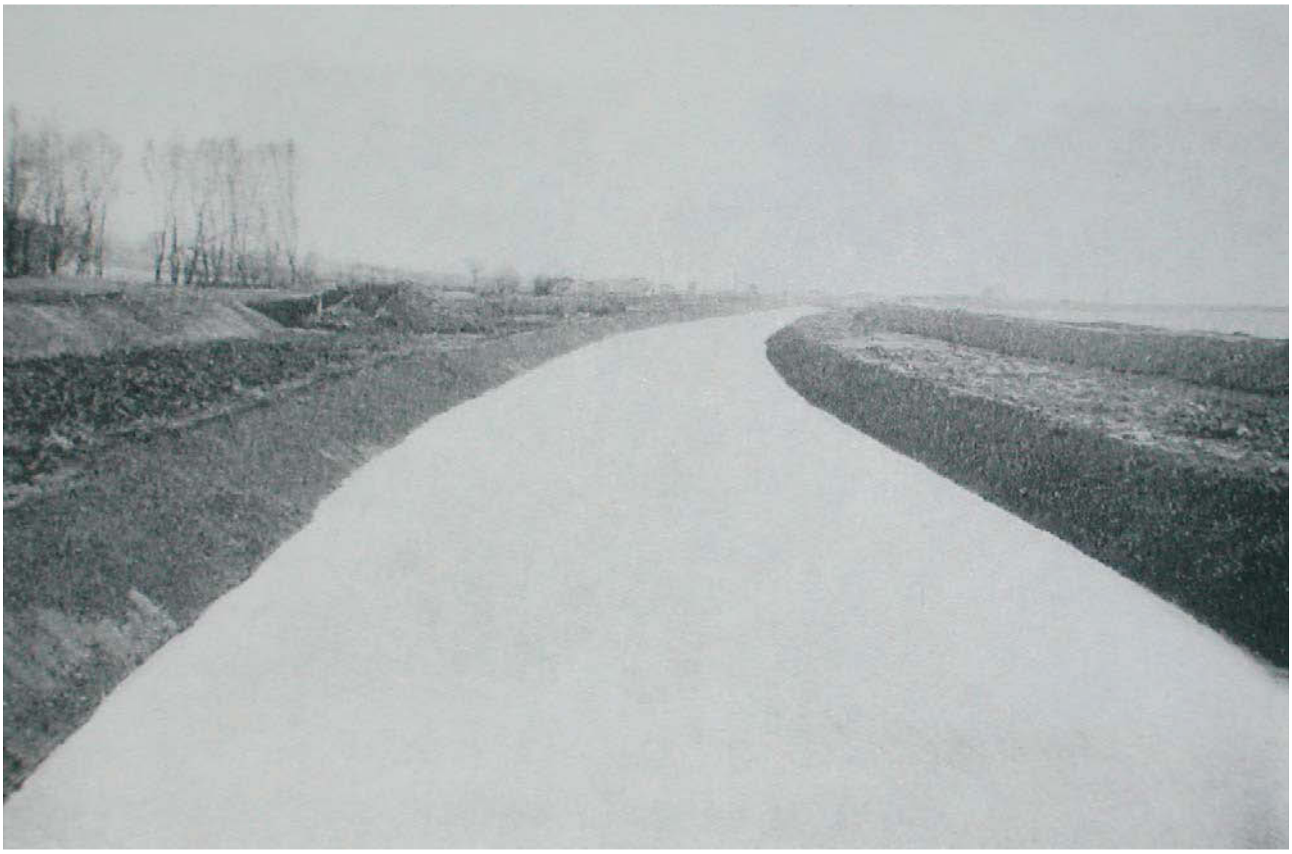


Plate 3.10: River Nene from Bedford Road, Northampton after dredging.
(River Nene Catchment Board)

Plate 3.11: Timber revetment at Bridge Street, Peterborough
(Northamptonshire Archaeology)