LOWER MARSH FARM
LANDULPH, CORNWALL

ASSESSMENT, REPAIR AND MANAGEMENT PLAN FOR THE WATERWHEEL

January 2011

Martin Watts

1 Trinity Cottages
Cullompton
Devon
EX15 1PE

Project LMF 190/2010

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Summary

The waterwheel at Lower Marsh Farm, Landulph, Cornwall, was installed between about 1844 and 1880, as a farm 'engine', to drive some form of agricultural machinery. It was located away from the principal farm buildings, in a small stone building alongside the drive to the farm. It is at present in a decayed state: the water supply has gone and the lower section of the wheel is standing in silt and water. Its iron structure appears intact, however, and, being of small size, it is considered to be within economic repair. This report sets out to assess and describe the waterwheel and to put forward proposals for its repair and long-term conservation.

Introduction

This report has been compiled to form an assessment of the waterwheel at Lower Marsh Farm, Landulph, and put forward proposals for its repair and future management, at the request of the property owners. It is based on the project design prepared for Natural England in June 2010.

Lower Marsh Farm is in the Higher Level Stewardship scheme and the following assessment of the waterwheel forms part of this management requirement, HLS reference AG00302210.

A preliminary visit was made by Martin and Sue Watts on 27 February 2010; a subsequent visit was made on 15 March and a detailed non-intrusive survey was carried out on 7 September 2010. Background and other relevant information have been compiled from a variety of sources, which are referenced and acknowledged.

A copy of the site record and photographs will be deposited with the Courtenay Library, Royal Institution of Cornwall.

A digital copy of the report will be uploaded onto the OASIS (Online AccesS to the Index of archaeological investigationS) database under the reference martinwa1-78111.

Location

Lower Marsh Farm is situated in the historic parish of Landulph, on the west bank of the river Tamar, at NGR SX 4296 6161. The farm is sited to the north-west of Landulph church, to the north of a large area of marsh on the north side of the tidal Kingsmill Lake. The site stands between 1 – 2m above Ordnance Datum. The waterwheel is located to the east of the farm complex, on the north side of the drive that leads to the house and farm buildings (NGR 4300 6160) (Figures 2 and 3). The geological survey map (Plymouth, sheet 348, 1977) shows that the farm buildings stand on alluvium, on the edge of the former marsh, the underlying geology being Upper Devonian slates, with occasional beds of hard brown weathered limestone (Cambridge 1992, 38).

Historical background

In 1538 Henry Courtenay, Marquis of Exeter was attainted and executed and his lands, including the manor of Landulph, were annexed to the Duchy of Cornwall in 1540 (Pounds 1982, xv; 69). There is no specific mention of Marsh in the section on the manor of Landulph in the Parliamentary Survey of the Duchy of Cornwall of *c.*1650, although it is likely to have been one of the 6 messuages held by copyholders in Landulph (*ibid* 70). One of these was a Katherine Elliott, and the Elliott family continued to hold land in Landulph into the 20th century. In an article about holy wells in Landulph (the building containing one of which is said to have been pulled down by 'one of the Elliotts') it is noted that 'Mr. Elliott lived at Marsh Farm. The family were there from 1819 to 1919.' (Adams 1937, 310). In the tithe survey of 1840/1, the owners of Marsh are given as the Duchy of Cornwall and William Elliott, and William also was the occupier. The holding at Marsh was just under 33 acres (13.3 hectares), of which about 88 per cent was pasture and a small area was orchard. William Elliott also jointly owned and occupied adjoining land, including *Landulph*, a larger holding of 151 acres (61 hectares) with a greater percentage of arable, *Collogett* (43acres / 17.5 ha) and *Penyoke* (40½ acres / 16.4 ha) (Landulph tithe apportionment 1840, CRO TA170). In 1855 the livestock at Marsh was advertised for sale, comprising a large number of sheep, cattle, including bulls and steers, horses and ponies and also pigs. The vendor was Mr Elliott, who 'has for a long series of years bestowed especial care in the selection of his stock, for which he has enjoyed a high reputation'. The reason for the sale was given as 'declining business' (*Exeter Flying Post* 20 September 1855, 1c). The low-lying position of Marsh, which is reflected in its name, also meant that the land attached to the farm was unsuitable for arable cultivation. The house and farm buildings, which are marked simply as *Marsh* on the first edition Ordnance Survey 1:2500 map of *c.*1880 (Figure 2), are described as being 'generally well preserved examples of C18 to C19 farm complex' (Cornwall and Scilly HER, 171961). They form an attractive group of buildings, although they are not listed. The farm remained the property of the Duchy of Cornwall until 1989.

The waterwheel stands in a stone-built pit set at right angles to the north side of the drive leading to the farm. It was formerly housed in a small building, and was fed by a watercourse running to it across the field to the north (Figures 2 and 3). The cast-iron shrouds of the waterwheel carry the simple embossed inscription 'LANGDON', which indicates that it was made by William Langdon of Launceston. The precise date of the installation is at present unknown; it is not shown on the tithe map of 1840 (Figure 1) but the building and leat appear on the first edition Ordnance Survey 1:2500 map of *c.*1880 (Figure 2). The owner has looked at documents relevant to Marsh in the Duchy of Cornwall archives for the period between 1850 and 1914 but no mention of the waterwheel or its installation was found (pers comm). However, information on William Langdon (see Appendix) indicates that the wheel was almost certainly installed between 1844 and 1881, unless it was brought in second-hand. This is considered further below. From a search of local historic sources and relevant publications, there does not appear to be any other available documentary information concerning the waterwheel. Landulph parish was one of five investigated by Janet Cambridge in the 1980s and a photograph of the wheel (in a similar state of decay to that at present) accompanied an article by her on the local landscape in the *Tamar Journal* (Cambridge 1998, 25), although it receives only a brief mention in the text. It is not known for how long the waterwheel was in use, or when it stopped work.

Description of the site and features

The waterwheel is located in a stone-built pit, the lower end of which abuts the tarmac drive leading to the house and farm buildings. The waterwheel was positioned to make use of the natural slope of the ground, where it rises above the marsh, to give a working head of water. Water was supplied to the wheel by a small leat, an artificial watercourse which ran from the west-north-west, across the field above the wheel. This field is in separate ownership and the watercourse was not investigated. There was formerly a small building which appears to have enclosed the wheel and wheelpit. From the evidence of the standing masonry forming the wheelpit and lower part of the east gable, the walls were built of local random rubble stonework. The extent of the building is not clear and its footprint is at present largely obscured by infill and some over-growth, although its overall dimensions appear to have been about 7.16m east-west by 3.73m north-south, externally, including the wheelpit (Figure 3). It is possible that the building may also have extended to the east of the wheel, but further clearance would be required to establish its full extent.

The wheelpit is about 0.76m wide, and has silt and standing water in it to a depth of about 0.85m (Figure 4). The bottom of the wheel is obscured in the silt and water. The wheel was formerly fed from the north end of the pit and the tail water ran away from the wheelpit along a channel between the bank on the north side and the road surface of the drive. This channel, which although silted up still carries some water, runs for about 30m eastwards along the drive and is then piped or culverted under the drive, emerging in an open stone-lined channel across the end of the walled garden (Figure 3 and photographs). The tail water must then be piped or culverted under the public footpath running to the south of the garden, and water eventually runs out onto the marsh.

The waterwheel was overshot, although all evidence of the trough or launder that fed water onto the top of the wheel and any related water-control mechanisms have disappeared (Figure 5). The wheel is 10ft 6in (3.2m) in diameter by 2ft 3in (0.68m) overall width. Its construction is typical of many mid-late 19th century waterwheels in the south-west of England, being a mixture of iron and timber. There are six cast-iron sections forming the shrouds on each side, the sections being bolted end to end midway between the arms. The shrouds carried timber bucket and sole boards, most of which have gone. The buckets were formed of two boards, forming elbow-shaped buckets, with a wide outer or float board fitted to a short, shaped riser. The risers and float boards were located in flanges cast integrally with the inner faces of the shrouds and held in place by the cross-tie rods. Timber sole boards were bolted at each end to a return flange on the inner circumference of the shrouds. The surviving sole boards appear to be of pine. An unusual feature is a series of countersunk holes drilled through the shrouds, indicating that the outer bucket boards were at some time fixed with either screws or nails driven into the end grain. Whether this is an original feature, or the holes were drilled at a later date, to stop decaying timber boards working loose, is unknown.

There were formerly two sets of six timber arms (probably either oak or pine, approximately 100 x 75mm maximum section, tapering slightly to the outer ends) which radiated from circular cast-iron centres or naves, which are keyed to each face of a square forged iron shaft. The dimensions of the arms, which have all gone, and the thickness of the bucket and sole boards can be determined from the pockets cast integrally with the naves and shrouds and the remaining bolts. There are two cross-tie rods between each pair of shroud sections, giving a total of 12. The wheelshaft has turned journals at both ends which ran in two plummer block type bearings. That at the east end is fixed down to a slate cill within the thickness of the end wall, and that at the west end is positioned

between the west nave of the wheel and the drive pinion. This bearing appears to have been formerly bolted down to a timber pillow or sleeper block, which has rotted away (Figure 4). At the west end of the wheelshaft is a cast-iron spur pinion of about 0.74m overall diameter with six + section arms and about 90 closely pitched teeth. About one third of the gear ring and one arm have been broken off, although the broken segments are still on site.

Dating and discussion

As noted above, the dating of the waterwheel, from map evidence and information on William Langdon, indicates that it was installed between about 1844 and 1880. No reference to the wheel was found in a search of documents in the Duchy of Cornwall archives for the period after 1850, so it is possible that it may have been put in between 1844 and 1850. From the writer's experience, however, the detailing and construction of the wheel are more consistent with a date in the third quarter of the 19th century. A further consideration is that the spur pinion, by which the drive was taken from the wheelshaft, is more likely to date from the 1870s or 80s than the 1840s. This may, however, be a later replacement. A final consideration is that the wheel may have been acquired second-hand and installed at a later date, although the presence of the watercourse and building on the 1880s Ordnance Survey map indicate the wheel was in place by then.

The exact function of wheel is at present unclear. It would have been capable of producing a maximum of about 3.3 horsepower (2.5kW), given a constant supply of water. However, the pinion on the end of the wheelshaft is of relatively small diameter and the teeth are relatively fine pitch (closely spaced), so it is not likely to have been capable of transmitting a large load. No evidence of the drive that was taken from this gear appears to survive, although it is possible that excavation of the plan of the building may reveal more information, possibly even fixings or the location for a machine base. According to local memory, the small building is said to have contained a mill (N. Toynton, pers comm), but this would more likely have been some form of semi-portable barn machine, rather than conventional millstones. As Marsh Farm appears to have been almost exclusively pastoral, it seems probable that the wheel drove a machine for processing animal feed. It is possible that there may be some local recollection of the wheel being used.

Statement of significance

The waterwheel installation is somewhat unusual in that it is set apart from the main complex of farm buildings. The wheel itself is an important survival, as its size and accessible position would have made it vulnerable to removal, either for re-use elsewhere, or for scrap. Its setting, adjacent to a private drive, and ownership have undoubtedly contributed towards its survival *in situ*. On the positive side, its size and accessibility make it a prime candidate for repair and, provided that a suitable water supply can be re-instated, for economic restoration to turning/working order. It is well made, and all of the iron structure appears to be in fair condition.

Summary of condition survey

The waterwheel is considered to be within economic repair, with all the castings and other ironwork apparently intact. There may be some deterioration of the shroud castings at or just below the standing water level in the wheelpit, and possibly other damage below this level which is not visible at present. However, the small size of the wheel would suggest that any damage would be small scale and within economic repair or replacement.

The timber arms have all rotted away, as have most of the buckets and sole boards. These elements are relatively straightforward to replace; repairs and minor replacements would have been carried out during the working life of the wheel. The cross-tie rods have deteriorated, but again these can be easily renewed.

The masonry structure of the wheelpit is also repairable. A minimum should aim to repair, consolidate and re-point the wheelpit and surrounding walls, to provide a safe housing and solid support for the wheelshaft bearings.

A longer term proposal would be to reinstate the small building which housed the wheel and whatever machinery it drove. This could be in the form of an open-fronted roofed structure, which would give the wheel some protection in the longer term.

In order to run the wheel it will be necessary to re-instate a water supply, along with some form of structure to support a launder to deliver water to wheel and some control mechanism. The area immediately to the north of the wheelpit needs to be cleared and any evidence of supports for a launder and water controls determined.

The wheelpit and tail water channel need to be cleaned out, so that water can run away as freely as possible from the wheel. There are some implications with clearing the tail water channel as it runs alongside the driveway to property. It may be considered appropriate to build a low kerb between it and road surface, to preclude the possibility of vehicles driving into it and also to protect pedestrians. The final part of the tail water channel, which runs across the end of the garden and under the footpath, may also require cleaning and possibly some repair.

Summary of guiding principles

When considering repairs to waterwheels and historic machinery, the following general principles are considered to be appropriate:[1]

- All repair work should be carried out with the primary aim of conserving the visual appearance and the functional and historical integrity of the machinery.

- Historic machinery is the product of functional evolution and contains features of particular historic interest and importance. Great care should be taken, therefore, to avoid unnecessary disruption and to retain as much as possible of the historic fabric. New work should be fitted to the old, rather than the old being altered to accommodate the new.

- Damage to historic fabric is different to damage to new work; it cannot simply be rectified by replacement, because original features are no longer so if they are renewed.

[1] A general *The Philosophy of Repair* for watermills and windmills has been issued by the Mills Section of the Society for the Protection of Ancient Buildings. The Mills Section publication *Some Principles and Practice in Watermill Repair* (1994 and subsequent editions) may also be consulted.

- Particular attention should be paid to detail and the use of good, traditional and compatible materials and methods. Observation of existing methods of construction, fixings and finishes (where original examples survive) is important in determining how to conserve historic machinery, to ensure the retention and survival of specific local or regional millwrighting and engineering details and traditions.

- Any renewal of timberwork should be carried out using good quality timber of the same dimensions, section and, if possible, species as that being replaced.

- Any strengthening and/or renewal of parts that is necessary for machinery to be maintained in a safe condition, whether static or working, should seek to use traditional solutions that properly reflect the history and development of the machinery.

- Fixings and fastenings should be of traditional form and of the correct diameter and proportions for millwrighting work. The use of threaded bar, or studding, for bolts and tie rods in waterwheels and other moving parts is not recommended, as it has poor lasting qualities and, if used to join timber and iron components that are likely to flex or move whilst turning, a fully threaded fastening will cause rapid enlargement of bolt holes, with resultant instability of the wheel or machinery. Bolts of the correct diameter, with plain shanks, should therefore be used.

- Treatment of rusted ironwork should be restricted to cleaning off loose and scaling surfaces and coating with an appropriate paint system. New paintwork should match the original colour and finish as closely as possible.

- Bearings should be retained or replaced in their traditional form. The provision of lubricators or remote grease points for bearings in locations that may be difficult to access or service once the waterwheel or machinery is in turning order is considered to be acceptable practice.

- A particular feature of millwrighting work is the need to allow for adjustments to be made, both when setting up and working machinery. It is important therefore that all wedges and fittings are in good condition and capable of being altered or tightened as/when such a need arises.

- It is considered that the waterwheel should be removed from the wheelpit, to allow consolidation and repairs to the stonework to be carried out. If any further dismantling of the wheel components is found to be necessary, it is important to mark all parts for correct re-assembly.

- It is recommended that work to waterwheels and historic machinery should be carried out or supervised by a specialist or specialists with relevant experience and competence

- Stonework repairs and re-pointing should be carried out using lime-based mortar of an appropriate mix and colour. Hard cement-based mortar must be avoided.

Outline schedule of work

Note that the following items are not necessarily listed in the order in which they may be carried out.

- Carry out clearance as necessary to provide clear access to the wheel and wheelpit area
- Carefully remove silt and debris from bottom of wheelpit
- Carefully lift out the ironwork of the waterwheel, with the shroud sections either as complete rings or with partial dismantling to make handling easier
- Carry out clearance and any repairs necessary to ensure a clear flow of tail water away from the wheelpit, to include the channel alongside the drive and across the end of the garden, and any piped or culverted sections
- Clear and excavate the plan of the building to the west of the wheelpit – the extent of this work to be determined
- Consolidate, repair and rebuild the stone walls of the wheelpit and supporting wall for the inner (west) shaft bearing
- Overhaul both wheelshaft bearings, allowing for renewal of bearing shells and fastenings
- Fix a new timber sleeper or pillow block in place on the stone wall on the west side of the wheelpit
- Fix down the west wheelshaft bearing to a new timber pillow block
- Allow for repairs to the ironwork structure of the waterwheel, if required
- Clean and paint the iron structure of waterwheel
- Supply and fit 12 new timber arms and new fixings
- Lift waterwheel components back into position, set wheelshaft up in bearings and assemble wheel with new timber arms
- Supply and fit 36 new timber buckets, complete with new fastenings and tie rods
- Design and construct a new timber launder, to feed water to top of wheel, with appropriate water control mechanism
- Carry out works as required to reinstate a working water supply to feed the waterwheel

Impact assessment

The most significant area of impact resulting from the proposed works is likely to be the reinstatement of a water supply, including the excavation of a small holding pond in the field immediately to the north of the waterwheel installation and the clearance of the end of the leat channel. Some provision will be required for a spillway or by-pass channel or pipe, in order to regulate the flow from the pond and control the flow onto the waterwheel, and access will be required to service the pond and any water controls.

It is understood from the property owners that there are no archaeological issues with regard to the proposed siting of a small pond in the field above the waterwheel and digging out the end of the leat.

It is considered that the reinstatement of a working water supply, so that the wheel can be run periodically, will both enhance the setting and serve to prolong the life of the timber components of the waterwheel. If the buckets can be kept wet and the wheel is able to be

run periodically, it will stay in better balance and uneven weathering of the structure of the wheel will be reduced.

The rebuilding of the masonry structure around the wheel and wheelpit area, and the clearance of the tail water channel will result in some visual impact, although this will be short term.

The reconstruction of a timber launder, the cleaning and painting of the wheel structure and the fitting of new timber arms and buckets to the wheel will also have a visual impact, but such new work will soon weather down.

Masonry repairs and the re-pointing of the wheelpit and surrounding masonry walls will, if carried out using an appropriate mortar and masonry techniques, have a limited visual impact and will ensure the stability of these structures for the future.

Some barriers may be required to prevent unauthorised access to the waterwheel and also a kerb or some covering may be necessary beside the tail water channel where it runs alongside the drive.

The clearance of the floor area of the building that formerly housed the waterwheel will also have some impact and may necessitate a requirement for further masonry repairs and re-pointing (of the rear wall and of any masonry features currently buried). Consolidation of the floor surface within this building may also be required.

Some landscaping of the area around the wheelpit area and former building may also be appropriate.

Future management and maintenance

With regard to those aspects which are within the scope of this report, the following management and maintenance issues need to be considered:

1. Maintenance of a water supply, including periodic removal of silt and debris
2. Maintenance of launder and water controls
3. Regular clearance of overgrowth from the leat and around the wheel/wheelpit
4. Maintenance and clearance of tailwater channel
5. Regular lubrication of waterwheel shaft bearings
6. Checking waterwheel buckets and re-fixing or replacing loose, broken or damaged bucket boards
7. Maintenance of any fences, gates, barriers etc. required to protect the waterwheel and areas adjacent to it from unauthorised access
8. Maintenance of the area around the waterwheel and former building, including hedge trimming and grass cutting
9. Maintenance of any new structure or building associated with the waterwheel

Requirement for further work

There is the possibility that further information may be found which can confirm a more precise date for the installation of the waterwheel, and also its intended function. Any such additional information should be recorded as appropriate and added to the site archive.

The clearance and possible excavation of the plan of the building to the west of the wheelpit may serve to provide more information about its installation and use. If the wheel is to be used to perform any new function in the future, then a new adjoining building is likely to be required, to house any plant or machinery.

Martin Watts
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Final: 27 January 2011

Acknowledgements
I am grateful to the property owners for providing access and information and for searching the Duchy of Cornwall archive for information on the waterwheel; to Janet Cambridge, who first informed me of the existence of the wheel; to Martin Bodman, for information concerning Langdon of Launceston; and to Sue Watts for her help with the site survey and in the preparation of this report.

Sources and bibliography

Adams, J.H. 1937: Some Notes on the Holy Wells of Landulph. *Devon & Cornwall Notes & Queries* 19, 308-11

Cambridge, Janet. 1992: Five Cornish Parishes. *Tamar Journal* 14, 32-9

Cambridge, Janet. 1998: The Hidden Landscape of East Cornwall. *Tamar Journal* 20, 20-30

Pounds, Norman J.G. 1982: *The Parliamentary Survey of the Duchy of Cornwall* 1, 69-72 (Devon & Cornwall Record Society)

Figure 1: Marsh, Landulph. Landulph tithe map, 1840 (Cornwall Record Office, TM107)
The arrow indicates the approximate position of the waterwheel

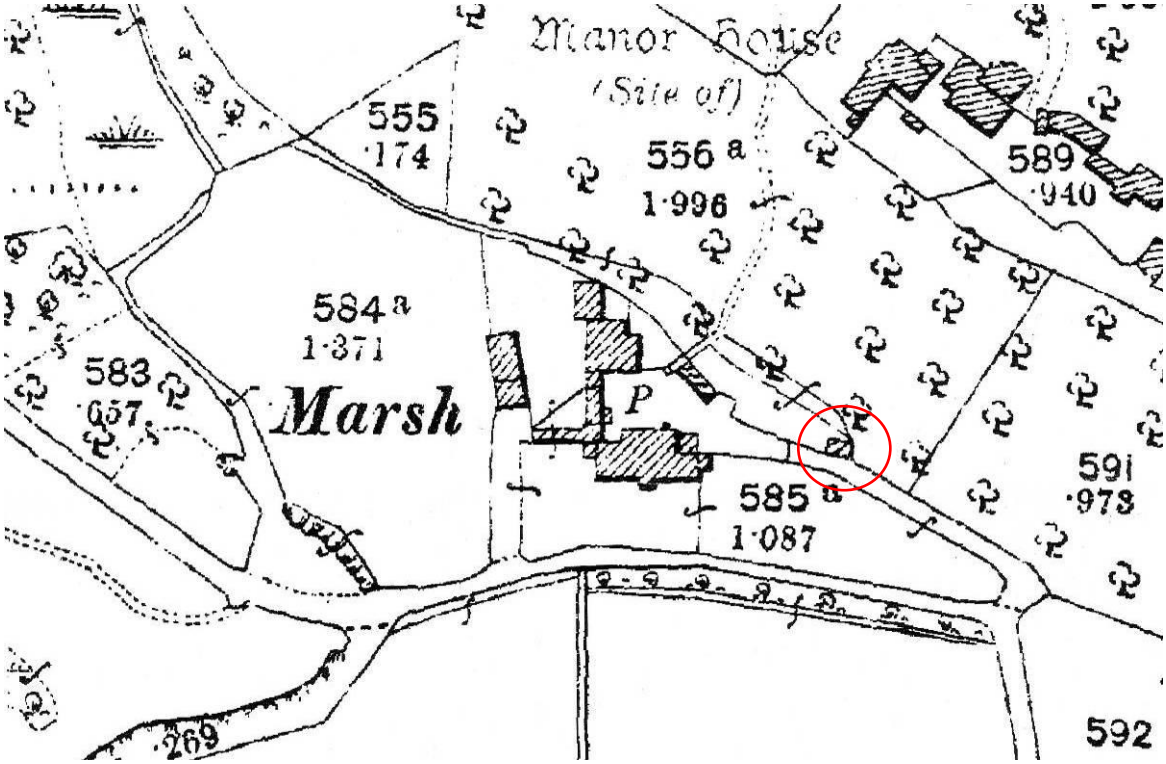


Figure 2: Marsh, Landulph. Ordnance Survey 1:2500 first edition, *c*.1880
The location of the waterwheel is outlined in red

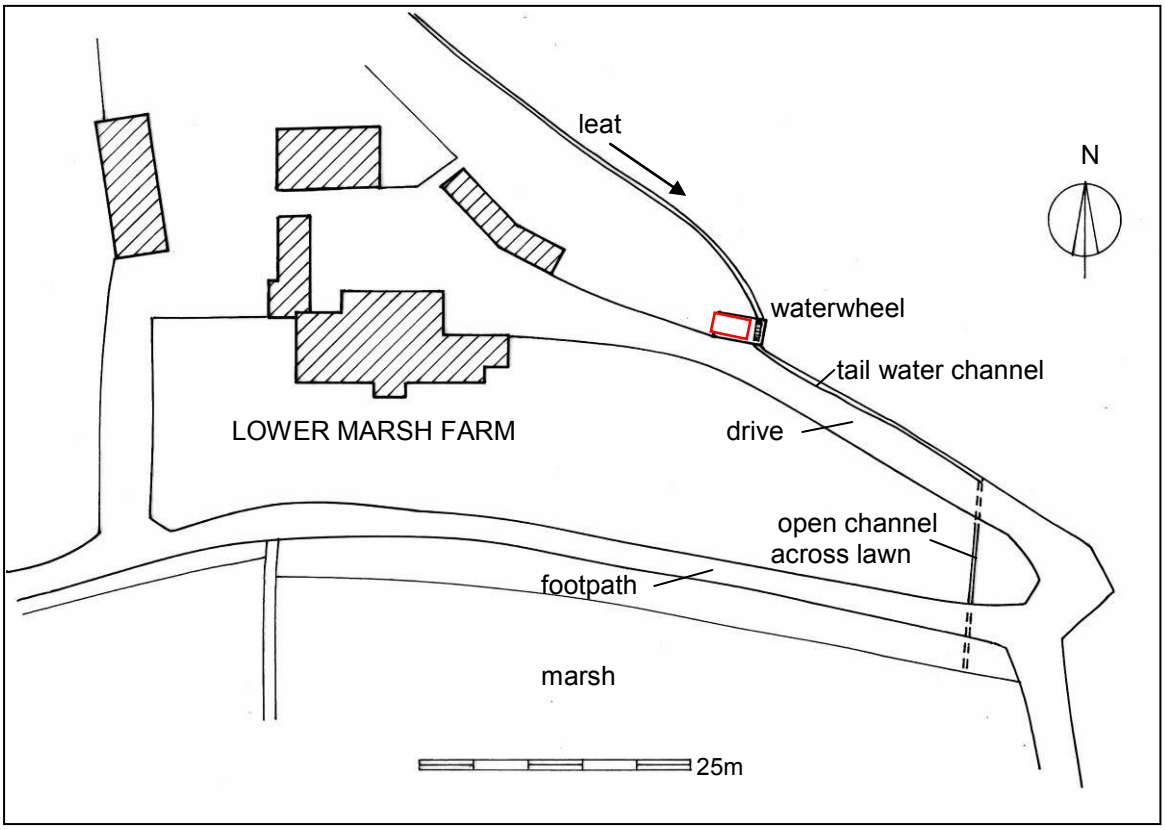


Figure 3: Lower Marsh Farm, site plan

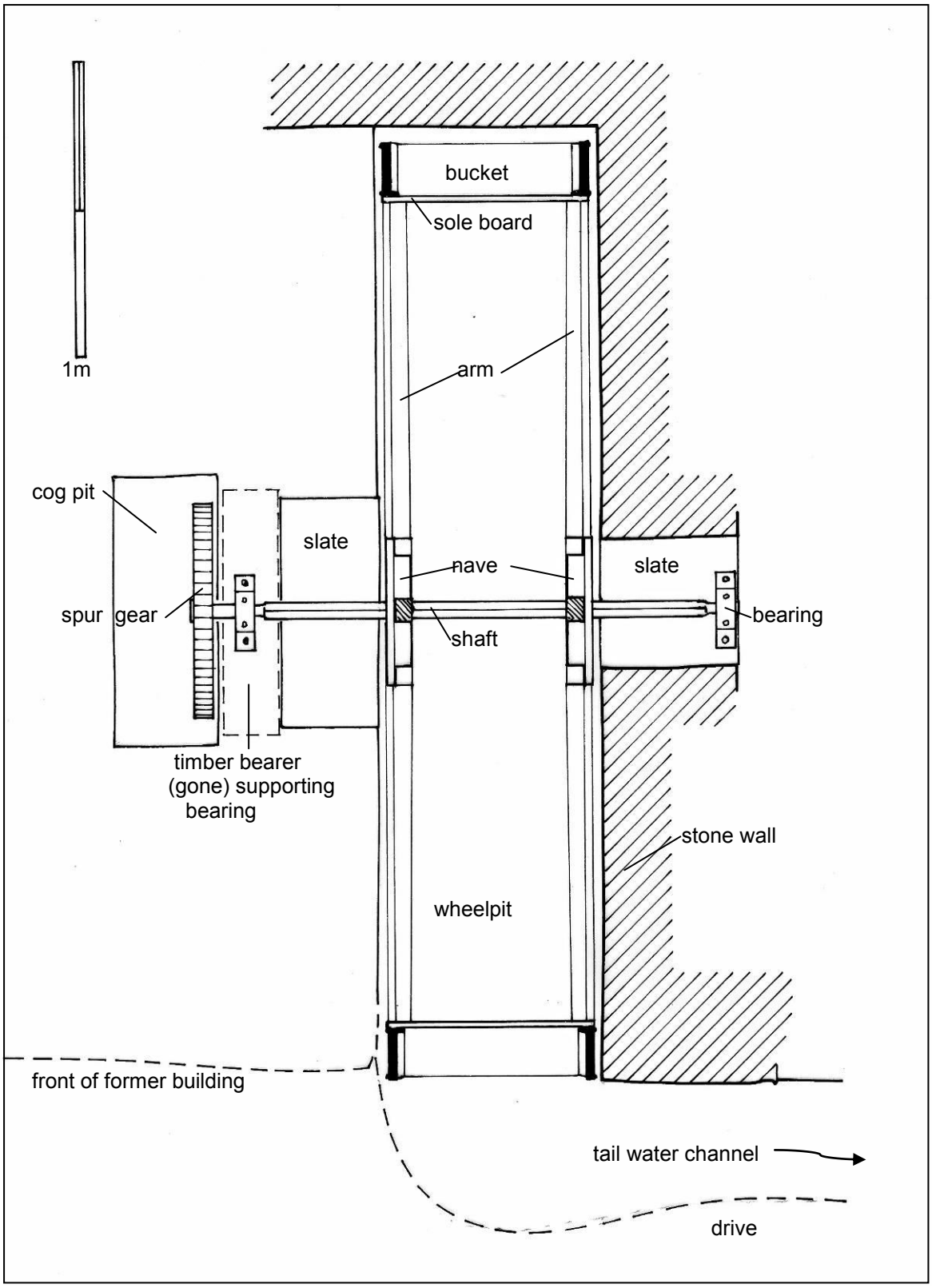


Figure 4: Lower Marsh Farm. Plan of wheelpit and waterwheel

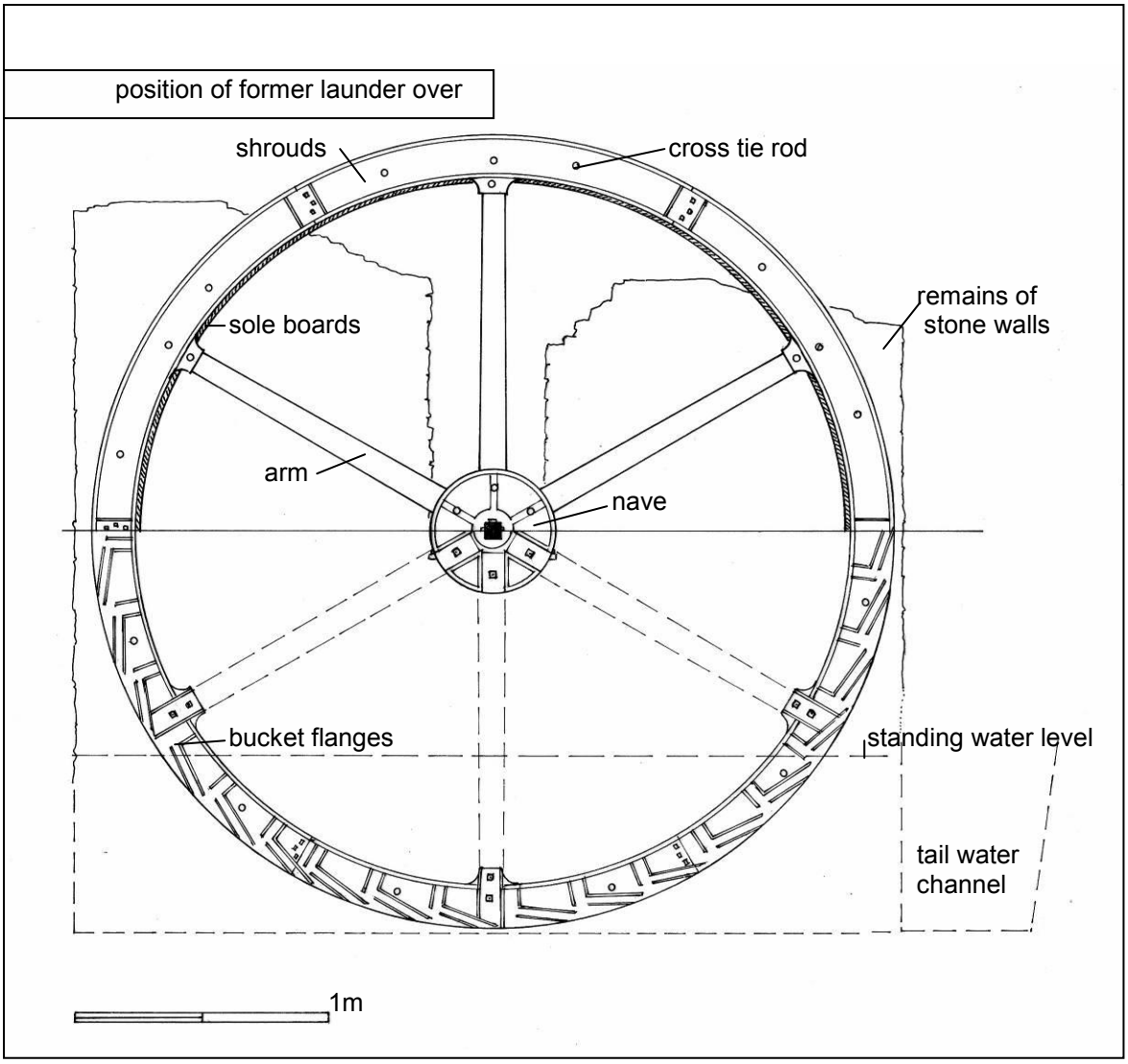


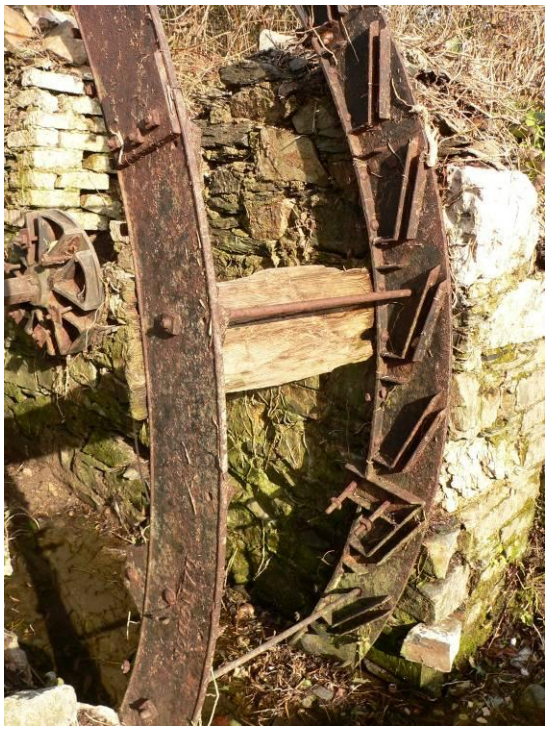
Figure 5: Lower Marsh Farm. Elevation and section of waterwheel, with arms reconstructed. Depth and shape of wheelpit and tail water channel are conjectural

Lower Marsh Farm, Landulph: waterwheel from west, showing its position and the course of tailwater channel running along the edge of the drive

The waterwheel with remains of building and wheelpit walls

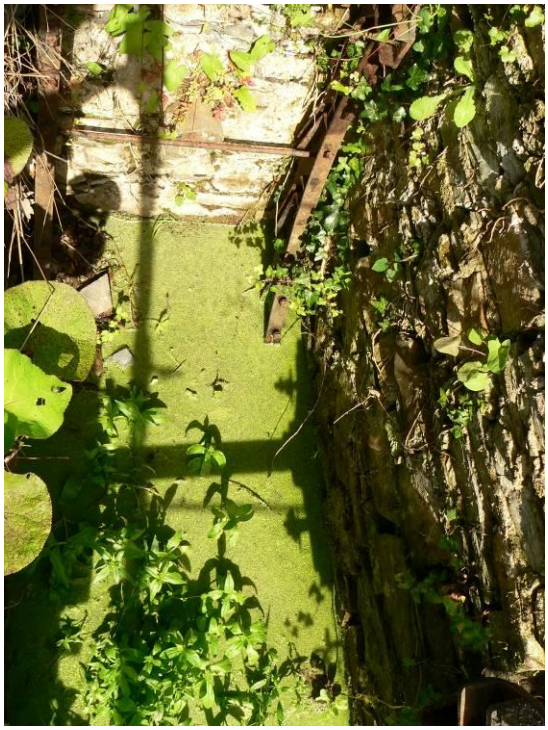
Maker's inscription on shroud casting

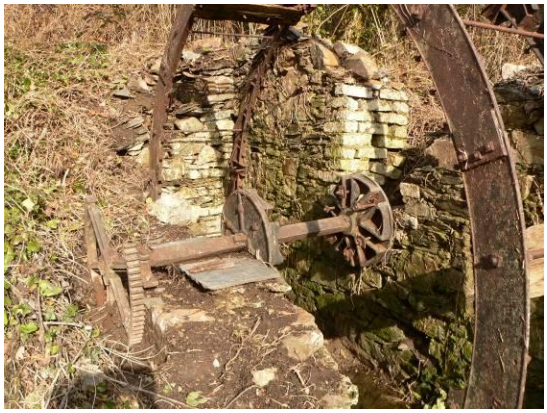

Shroud detail showing joining plate


Detail of shroud castings with cross tie rods and remains of sole boarding


Inside of shrouds showing bucket flanges and location for arm end


Inside of shroud, showing bucket flanges


Standing water in wheelpit


Wheelshaft and slate slab on west side


Spur gear on west end of wheelshaft


Wheelshaft and naves


Inner (west) bearing and spur gear


Outer wheelshaft bearing, fixed down to slate


Broken sections of spur gear


Wheel, drive and course of tailwater


Tailwater channel across end of garden

Appendix

Langdon of Launceston

William Langdon, aged 40, is listed as a white and blacksmith at St Thomas', Launceston, in the 1841 Census (HO 107/134/12) and in 1844 as blacksmith and iron-founder (Pigot's *Directory*). The 1851 census records him as a widower, aged 51, working as an iron and brass founder and employing 6 men and 10 boys. One of these employees appears to have been his son William, 21, described in the census return as a moulder (Census, HO 107 1899 f306 p3). In 1861 William Langdon, aged 31, is listed as iron founder in St Thomas' Street. He was then married to Jane Ann. There is no mention of William senior (Census, RG9 1520 f55 p7). In 1871 William, aged 41, is described as an iron and brass founder. He and Jane Ann had two daughters, and one Thomas Crocker, 19, an apprentice moulder, is listed at the same address (Census, RG10 2225 f 58 p 4). In 1878 he is listed as iron and brass founder of St Thomas', Launceston, in Harrod's *Directory*. In 1881 William, aged 51, is described as a Master Iron Founder, employing 5 men (Census, RG11 2277 f65 p9). He died in the third quarter of that year. His wife Jane Ann Langdon, died at Launceston in the second quarter of 1889, aged 57. It appears therefore that Langdon senior was active as an iron founder by 1844, and the business was taken over by his son by 1861, presumably after the father's death. William junior died in 1881, so the waterwheel at Lower Marsh Farm must date from the period between about 1844 and 1881.

Only one other surviving waterwheel bearing the name Langdon is known to the writer. This is also a farm wheel, an installation built onto the side of pre-existing barn at Quither, Milton Abbot, in West Devon. The waterwheel at Quither, which is of significantly larger diameter than that at Marsh Farm, was overshot, fed by an overhead aqueduct, and formerly drove a threshing machine.

(Notes from censuses and information courtesy of Martin Bodman)