

# Lidar and the Historic Land-use Assessment of the King's Park, Stirling

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## Introduction

Recent studies of the Stirling Castle landscape (Harrison 2007; 2012) and the King's Knot (Digney *et al.* 2011; Digney and Jones 2013), together with a background of the transfer of the royal park from Crown ownership to Scottish ministers (concluded in August 2013), provided an incentive to update Historic Land-use Assessment (HLA) data for the King's Park. The potential to combine RCAHMS mapping, aerial photography, historical research, and environmental sampling to produce a comprehensive record was discussed on field visits to the park in 2013. The existence of Lidar data for the Stirling area, held by Historic Scotland (HS), was considered a potentially valuable resource for mapping and interpretation.

HLA has been a partnership project between HS and the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), continuing in Historic Environment Scotland (HES). The aim of HLA has been to produce a digital GIS map of current and historic land use across Scotland. Data gathering began in 1997 and coverage was completed in 2015. The project provides landscape-wide spatial data relating to the historic environment at a scale of 1:25 000.

The sources used to inform the creation and maintenance of HLA data include current and historical OS maps; vertical and oblique aerial photography in the National Record of the Historic Environment (NRHE); Next Perspectives and Getmapping 25cm aerial photographic imagery (2007-2014); archaeological records held in the National Record and by Local Authorities; and up-to-date information provided by website searches. The use of Lidar data as an interpretative source in this case is a first in HLA. This report reviews the use of Lidar in updating HLA data for the King's Park, as well as an additional use for testing a theory about the location and nature of the lost park loch.

## King's Park

The King's Park (Fig 1) was founded by William I, c1165-75 (*RRS II*: 206-207) and is the oldest royal park in Scotland. It performed multiple social and economic functions for the royal court at Stirling (Gilbert 1979). These included activities such as deer hunting, hawking, archery, and tournaments with associated pageantry (Edington 1998: 53-61). The park was also cultivated, used for hay production, pasturage, and the stocking of deer, cattle and sheep. It was used in tandem with Alexander III's larger 'New Park' of c1264, a short

distance to the south (Miller 1922). Both sat within a wider landscape of royal forest and hunting reserves which stretched between the rivers Forth and Carron (Cook 1907: 121; Harrison 2012: 27). The New Park was gradually lost through grants in the 14th and 15th centuries (Cook 1907: 122-6). However, the Old Park, which was revitalised by James IV and his reorganisation in the 1490s and early 1500s, included the creation of a great garden, orchards, fish ponds, and a new park dyke (Ronald 1899: 99-100; Harrison 2012: 31-33).

When the royal court moved to England in 1603 interest in the park waned. However, a major investment in the great garden in the 1620s appears to have funded the construction of the King's Knot (RCAHMS 1963: 219). These geometric earthworks, the foundations of a monumental garden, would have been in place for the Scottish Coronation of Charles I and his visit to Stirling in 1633. The death of Charles II (1685) brought an end to royal usage of the King's Park and it became primarily an economic asset of the Crown Estate. It was leased to tenant farmers, but with some restrictions on agriculture as it was also to be made available for military use when required (Harrison 2012: 38).



Fig 1 Location of King's Park on current OS 1:10 000. © Crown copyright and database right 2016. All rights reserved. OS license number 100057073.

The 18th and 19th centuries brought several new developments in connection with public sport and recreation. Antiquarian interest in the King's Knot led to its restoration in 1867 and current protection. The construction of the Back Walk (recreational pathways below the town wall) began in the 1720s and was later extended round to Gowanhill. The Back Walk became increasingly wooded in the later 20th century. From 1805 to 1854 horse racing was a regular feature of the park and contributed to the 'high park' being turned over to pasture. This pasture proved attractive for golf and in 1869 the Stirling Golf Club was formed. The

golf course was expanded to 18 holes in 1912 and is now the dominant land use within the park. A thin tree belt is all that divides the golf course from the public playing fields in the south-east. Since the late 19th century this public space has been important to Stirling life not only for recreation, but also for major gatherings of various kinds (social, military, political and cultural).

## HLA and the King's Park

HLA data for the King's Park was originally created in 2003-4. Since then advances in GIS and the availability of new resources (e.g. OS MasterMap, Getmapping and Next Perspectives imagery (from 2007 onwards), have refined HLA mapping. As well as new information provided by historical studies, over 10 years of urban development have underlined the need to regularly update and improve HLA data.

The digital map produced by HLA consists of coded polygons depicting the outline of current and relict landscapes. The polygons are coded in relation to specifically defined land-use types. Each polygon consists of a current code and up to three relict codes. The codes are ordered from the most recent land-use to the oldest. With HLA scaled at 1:25,000, areas of land use less than 1ha in extent are not mapped. Thus small scale evidence from prehistoric and Roman periods within the King's Park, as well as several 18th-19th century quarries depicted on early OS maps, are excluded. A full description of HLA codes can be found at:

<http://hla.rcahms.gov.uk/sites/default/files/TypeDefinitions.pdf>

A brief summary of the codes displayed on the maps below (Figs 2 and 3) are as follows:

Current codes:

- 1 - 18th Century-Present Rectilinear Field and Farms.
- 7 - Urban Area.
- 8 - Medieval Urban Core
- 11 - Commercial/industrial
- 14 - 19th Century-Present Golf Course
- 17 - 19th Century-Present Cultivated Former Parkland
- 19 - 18th-20th Century Managed Woodland
- 23 - Transport/Road
- 32 - 18th Century-Present Cemetery
- 35 - 19th Century-Present Recreation Area

Relict codes:

- 101 - Medieval/post-medieval Agriculture and Settlement (broad rig)
- 104 - 18th Century-Present Rectilinear Fields and Farms (straight narrow rig, c.4-5m).
- 107 - Medieval Deer Park
- 111 - Medieval Castle
- 119 - 20th Century Defence Site.
- 122 - 17th-19th Century Designed Landscape

133 - 19th Century Recreation Area (e.g. race tracks) 139 - Post-medieval Fortification.

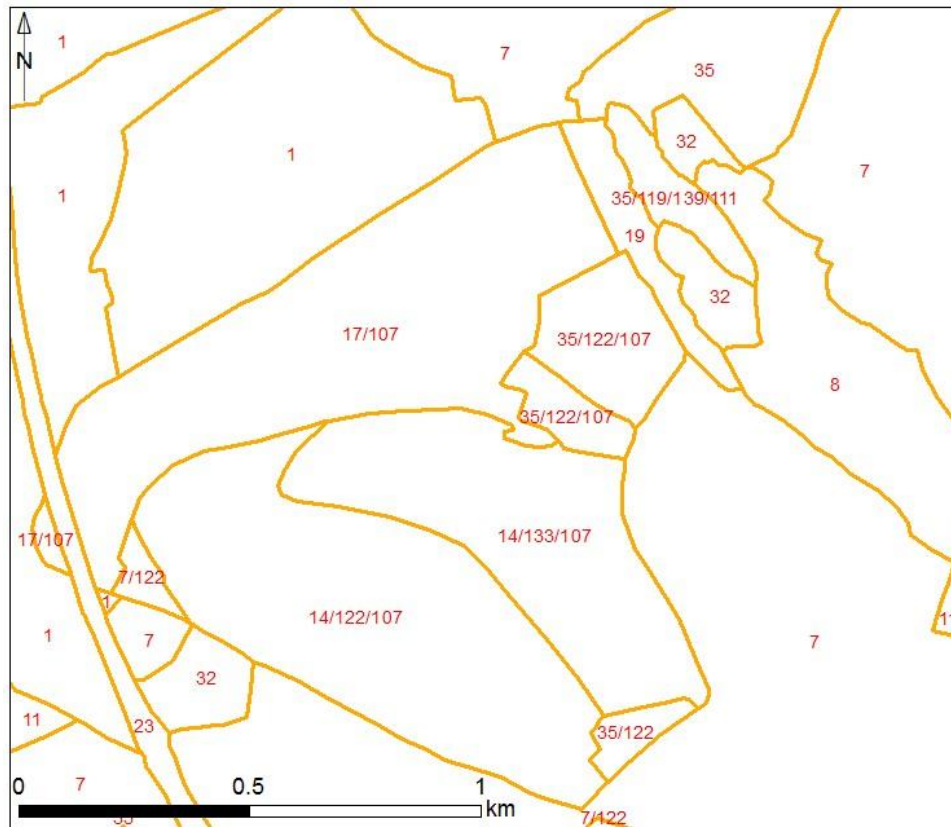


Fig 2 HLA data from 2003-4. © Copyright Historic Environment Scotland: <http://hmap.org.uk/>;  
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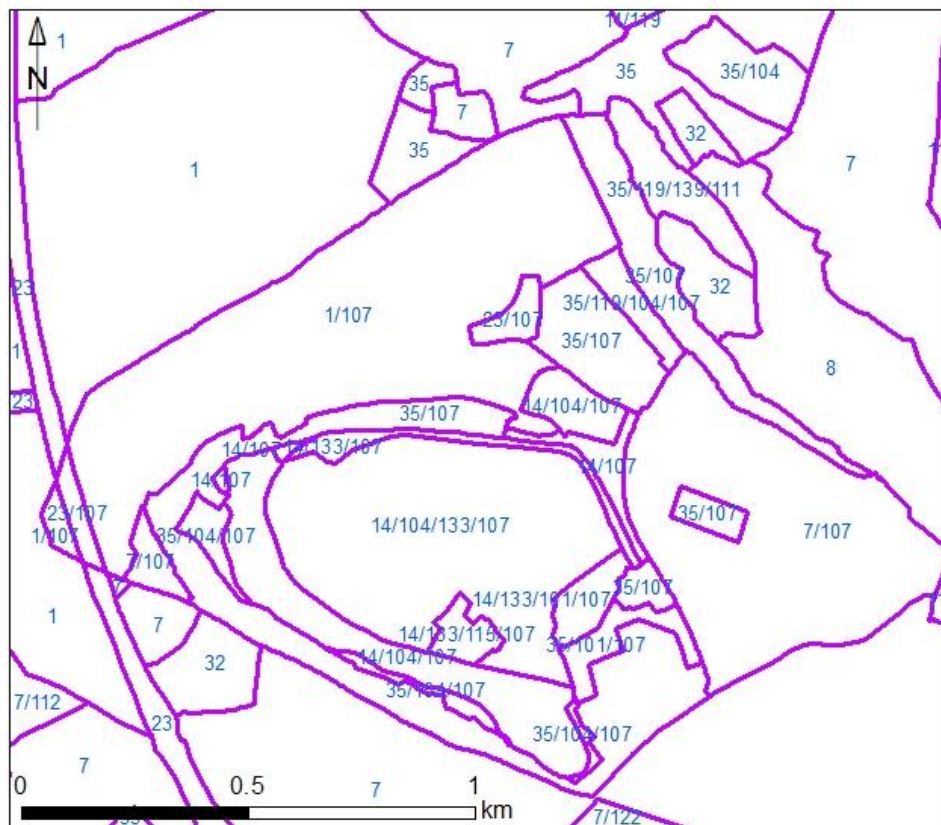


Fig 3 HLA data update 2015. © Copyright Historic Environment Scotland: <http://hmap.org.uk/>;

On reviewing the original HLA data (Fig 2) for the King's Park some minor errors were found and corrected before the use of Lidar. These were partly due to a lack of detailed local knowledge (both current and historical) and some inconsistency in coding. The first of these relates to the boundary of the park and the use of the 107 code.

The park is defined to the north and south-west by a stone dyke. This contains lengths of 17th-19th century builds and repairs, but arguably maintains the footprint of the original park (Harrison 2008: 46-48; 2012: 26, 37). The dyke terminates at King's Park Road in the south, where 19th century railings begin. These railings define the current park boundary in the south and east and this is depicted in the original HLA data. This part of the boundary broadly reflects the shape of the park in 1506 following an exchange of parkland with the burgh for Gowanhill, and earlier 14th century alienations (Ronald 1899: 96-101; Harrison 2012: 28, 31). Prior to these alienations the south-eastern boundary followed the length of King's Park Road (the old Cambusbarron road) towards the site of the former Burgh Gate (Cook 1907: 126). From the Burgh Gate to the north end of the castle, the high ground of the Stirling Sill, occupied by the town wall, completed the park limits. Overall c164ha may have been originally enclosed, reducing to c. 133ha by 1506. On historical grounds it is acceptable to redraw the south-eastern boundary along King's Park Road to the Burgh Gate as a relict footprint – as shown in the updated data (Fig 3). All of the land within can therefore be coded 107. In the previous HLA data this code was applied inconsistently across the park and this has been rectified.

A part of this inconsistency has been the use of codes (17 and 122) which are applied to former areas of designed landscapes of the 17th—19th centuries. James IV's reorganisation in the early 1500s resulted in a designed landscape focused around the great garden, orchards, and loch. Beyond this immediate area the park continued as before with a mixture of animal husbandry, agriculture, hunting and sports. Although the royal park continued in use as a park into the 17th century the designed elements of that period have since been lost. The exception is the earthworks of the King's Knot. For HLA interpretation a decision was made to drop the designed landscape codes and use only the relict park code (107). Using both codes together would also have created a problem in some places where more than three relict codes would have applied, for which HLA does not provide space as it is so rare.

A further alteration to the 2003-4 data is a redrawing of the boundary between the golf course (14) and public recreation areas (35). On the ground there are no physical barriers between the two. The 2003-4 data takes the golf course up to the enclosing fence around the public tennis courts and former putting greens. However, the public footpath around the west of the park and the thin tree belt in the south-east separates the land leased to the golf course from the recreational areas as agreed by the Crown Estate Commissioners and

Stirling Council in 2013 (<http://www.andywightman.com/archives/2970>). The deciduous woodland covering the steep slopes and cliffs around the High Park is included in the recreation area. Other changes made to the HLA data include the mapping of recent constructions such as the expansion of the King's Knot roundabout in 2010, and new recreation, urban and commercial developments close to the park. The changes made to the King's Park data can be seen in Fig 4.

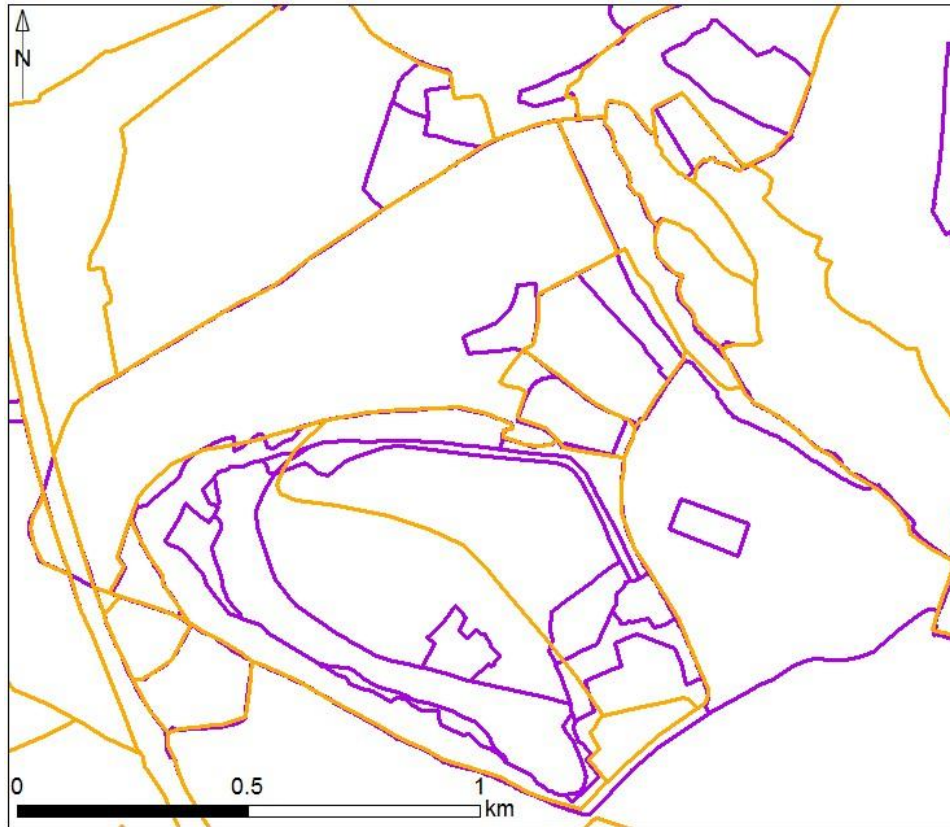


Fig 4 Old and new data (purple) comparison. © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

## Lidar and King's Park HLA

Cultivation rig is widespread across the golf course and is particularly apparent in winter sunlight and a thin covering of snow. A map of the crown land (park, castle and Gowan Hill) from 1806 (NA MF 1/22) depicts the park covered in rig, yet this is not reflected in the 2003–4 HLA data (Fig 5). This is because HLA interpretation at that time was done using primarily 1988 aerial photographs at 1:25 000 which do not always clearly show rig.



## High Park

### Rig

Within the High Park, Lidar reveals the extent of cultivation, race tracks, and earthworks in relation to the development of the golf course (tees, greens, and bunkers) (Fig 6).

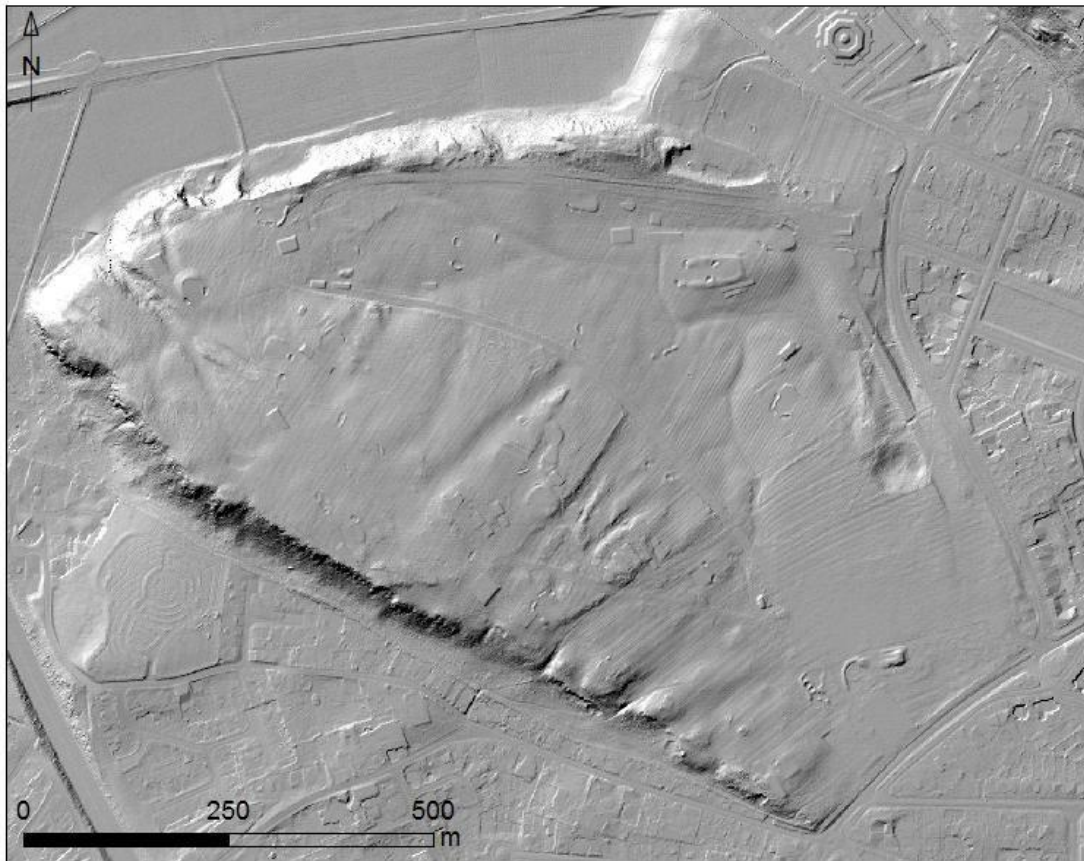


Fig 6 DEM of the High Park produced from Lidar (HS\_A315\_H35). © Copyright Historic Environment Scotland; © Crown Copyright and database right 2016.

Widespread rig, found running in a general south-west to north-east direction, confirms the extent of cultivation illustrated in the 1806 survey. Although mostly straight, there is an example of broad and slightly curving pre-improvement rig in the south-east (Fig 7). This rig becomes less prominent towards the south where it has been smoothed by the establishment of football pitches. Further loss of this occurred in June 2011 (soon after the capture of the Lidar data) when the ground was levelled, reseeded, and a new footpath was inserted (Fig 8). The shape of the polygon (coded 101) in the revised HLA data reflects this recent loss.



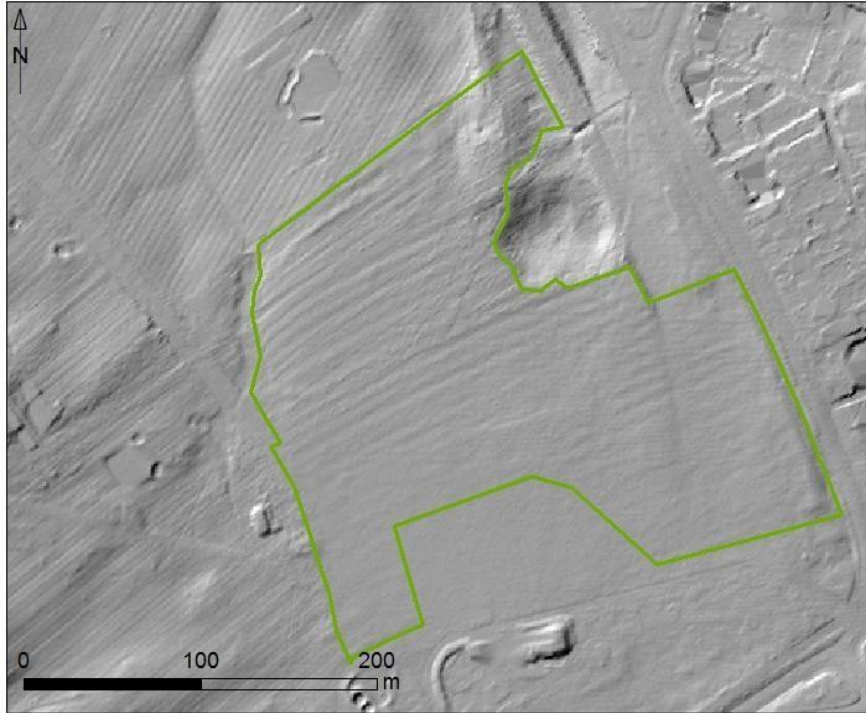


Fig 7 Area of pre-improvement rig outlined in green (HS\_A315\_H35). © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073



Fig 8 Resurfacing and levelling in 2011 within area of rig mapped by HLA outlined in green. © Getmapping plc, 2013; © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

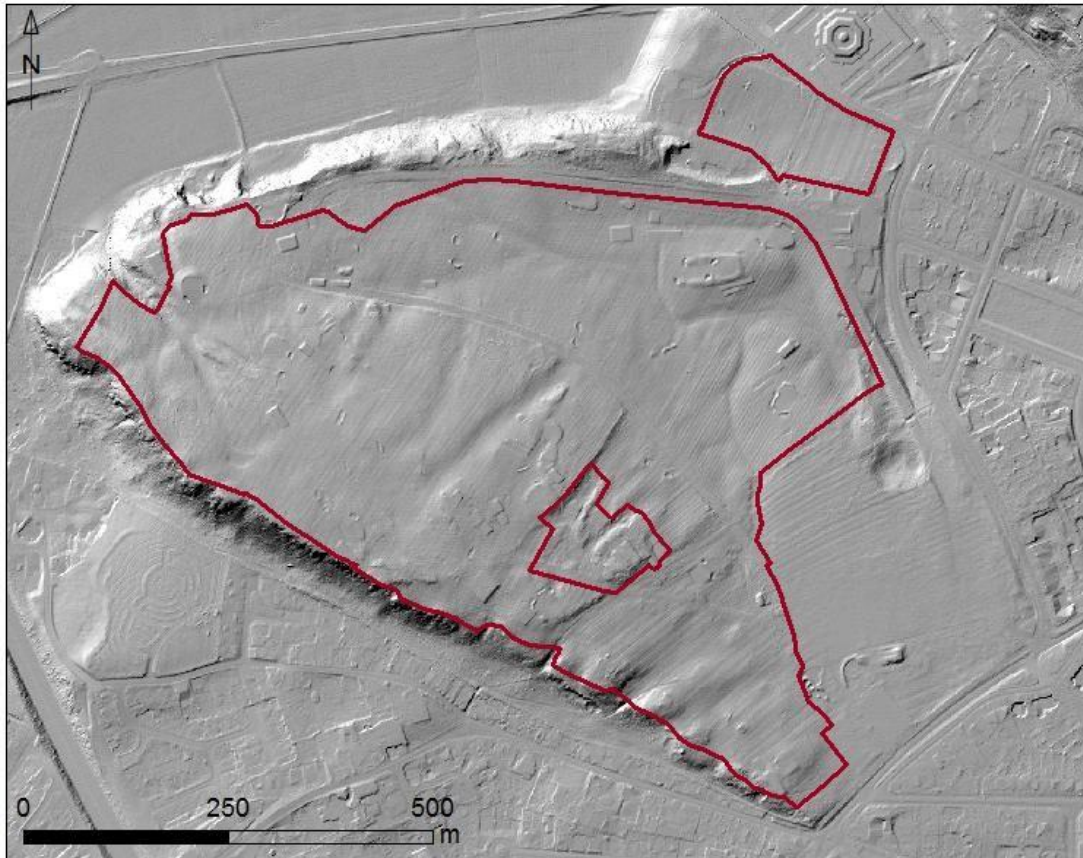


Fig 9 Extents of straight rig (HS\_A315\_H35). Crown © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

Unenclosed straight rig (Fig 9) runs up to the cliff edges in the north and west. The golf clubhouse and practice range also sit within two former fields, the boundaries of which are no longer intact. The scale of cultivation within the park explains why there is little evidence of upstanding remains from pre-improvement periods.

A gap within the rig now occupied by the 3rd green and 4th and 18th tees of the golf course can be explained by historical maps. When overlaid with the 1st edition OS 25-inch (Stirlingshire, 1865, Sheet XVII.3) (Fig 10) this area can be seen to sit beside a farmstead consisting of a single unroofed building with two compartments and an adjoining yard. This farmstead is the subject of an oil painting in the Stirling Smith collection painted in the 1850s by Leonard Baker and entitled 'The Herd's Hoose'. The footprint of the farmstead is still retained in the form of the 17th green. On the 1806 plan two structures and a garden are shown alongside a gap in cultivation (Fig 11). The gap depicted compares closely to that on the Lidar, albeit with some minor differences. This ground is uneven with rock outcrops and the 1806 plan suggests that there may have been some gravel quarrying.

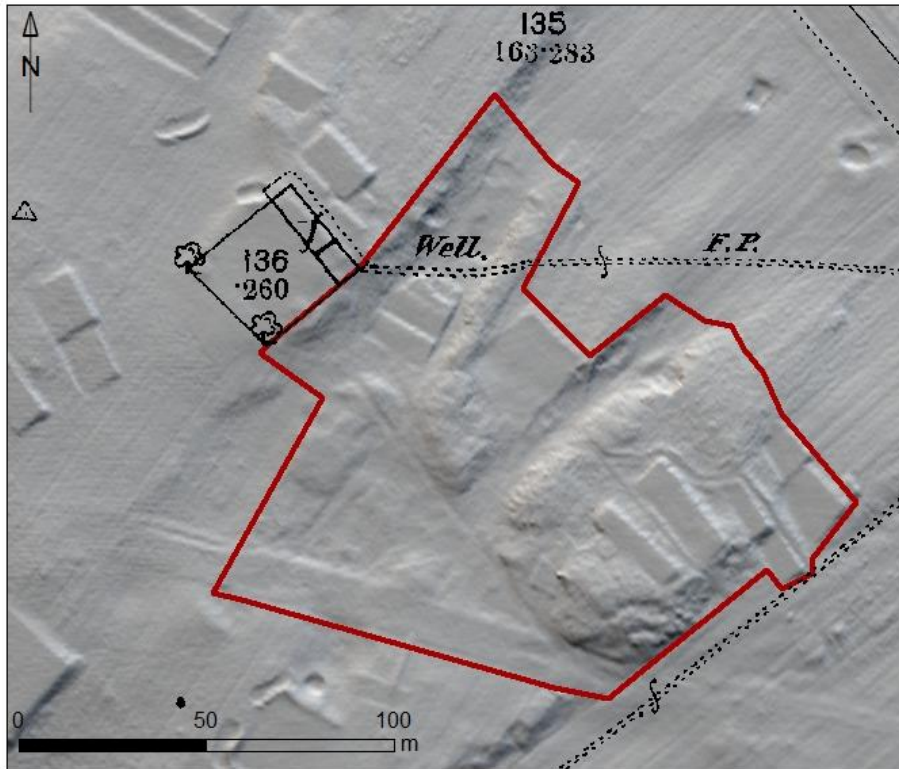


Fig 10 Gap in cultivation mapped by HLA, overlaid on 1<sup>st</sup> OS and DEM (Multi-HS\_D64\_H35) showing farmstead. © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

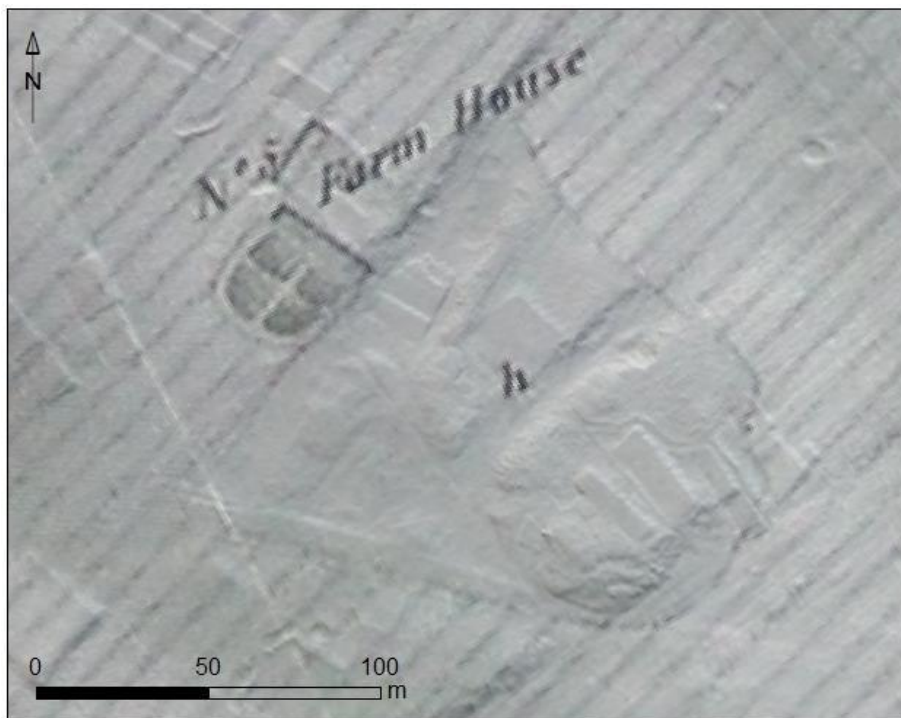


Fig 11 Farmstead with area of gravel extraction depicted on 1806 plan, with DEM underlay (Multi-HS\_D64\_H35). © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

## Race tracks

Also visible in Fig 11 is a broad linear feature running along the southern edge of the gap in cultivation. This was first observed on a field visit, along with a curving segment further to the north near the bend of the race track (Fig 12). This relationship to the track, and similar appearance, suggests that this is an earlier race track or an alteration to the track circuit soon after it was formally set out in 1805. The circuit depicted in John Wood's (1820) plan of Stirling is the same as that on the later 1st edition OS map (c1858) and does not show this earlier track. No tracks appear on the 1806 plan, but that does not necessarily mean one did not exist. There are records of races being held in the park in 1763 and 1776, while a report on the King's Park Farm in 1850 refers to the old and new race tracks (Harrison 2007: 49-50; n99). A significant length of the old track can be traced on the DEM visualisations.

The use of Lidar has made it possible for the first time to plot both old and new tracks (including the grandstand constructed in 1841) (Fig 12). On close inspection a relative relationship can be seen between rig and race tracks (Fig 13). The track cuts a path through the pre-Improvement (code 101) rig towards the south-eastern bend. This evidence is now lost on the ground because of modern resurfacing but is preserved in the Lidar data. Elsewhere the straight rig respects the integrity of the later track. In contrast the older track has been mostly ploughed out. This suggests that the majority of the visible straight rig dates from the early 19th century and post track alteration. It is likely that the circuit of track in the north and east are contemporary with the old length of track in the west as there is no other evidence of track or physical place it could be. If so it is interesting that both circuits are c1.5 miles (12 furlongs) in length, the standard middle distance for racing. The decision to redesign the track may have been done to create a level track for flat racing, thus removing the incline that the earlier track presented. Keeping the track at the lower level would have improved spectator views of the entire race, and the grandstand was positioned to maximise views of the straights.

The 2003-4 HLA data records a large part of the later race track, although incomplete, as relict recreation (code 133). The revised data now includes the older track, but the southern end is reduced as the track enters the current recreation area (revised and expanded). North of the race track the site of the grandstand is included in the current recreation area (within trees) while 19th century curling ponds (mapped on the 1st and 2nd OS) are excluded because they are outside this area and below HLA size limits.

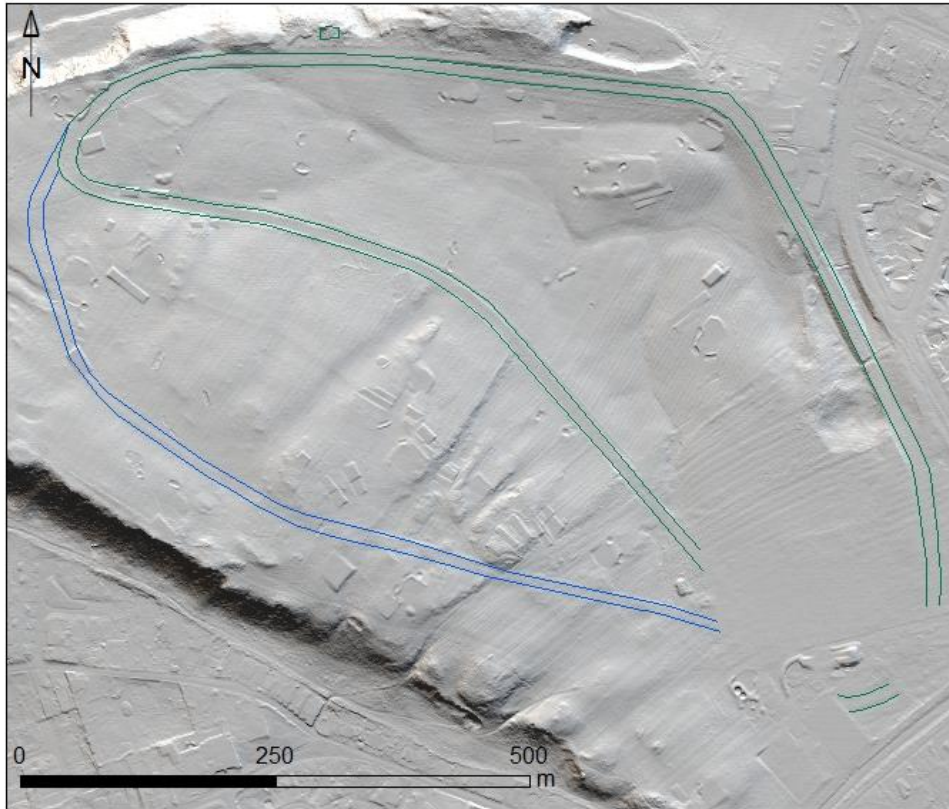


Fig 12 Early (blue) and later (green) race tracks (Multi-HS\_D64\_H35). © Copyright Historic Environment Scotland: <http://hmap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

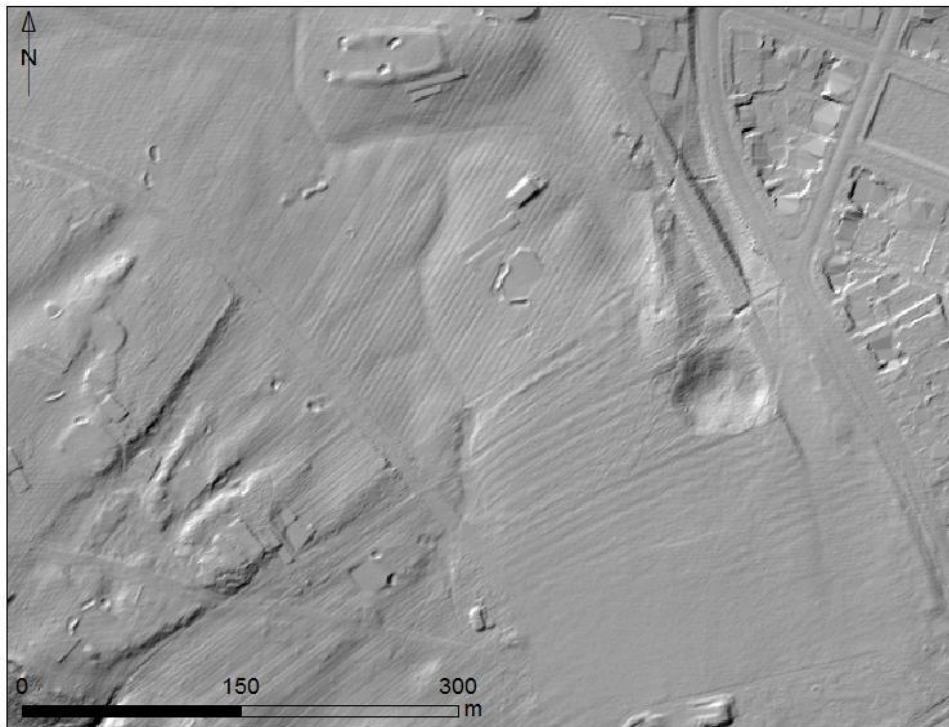


Fig 13 Detail showing relationship between rig and race tracks (HS\_A315\_H35). © Copyright Historic Environment Scotland

## Haining

The Haining ('enclosure') is linked to the King's Knot as part of the scheduled area and is recorded in the 2003-4 HLA data as current recreation with relict designed landscape and medieval park (35/122/107). It is historically connected to the royal garden but from 1582 was included in the Mar (Erskine) property which extended down from the rear of Mar's Wark (Harrison 2007: 31-35). The 2003-4 coding does not reflect that this was once an improved field or that the Haining was used as a military camp from 1941-1945. Some of the Nissen huts continued to be occupied after the war by refugees from Clydebank, and were finally cleared in 1953. The bases of at least 14 Nissen huts can still be found along the western tree line and the northern wall of the field. The remains of a vehicular road and the camp entrance are also visible (Fig 16). The ability of Lidar to penetrate the deciduous tree cover at the Haining (Figs 14 and 15) makes it possible to define the camp and field (based on 2nd edition OS boundaries). The King's Park has a long military history and was used for exercises (including the digging of trenches in WWI), parades, and encampments. The Haining is the only part of the park which can be defined in HLA as a military relic. A new polygon and code (35/119/104/107) has been created for the revised data (Fig 15).

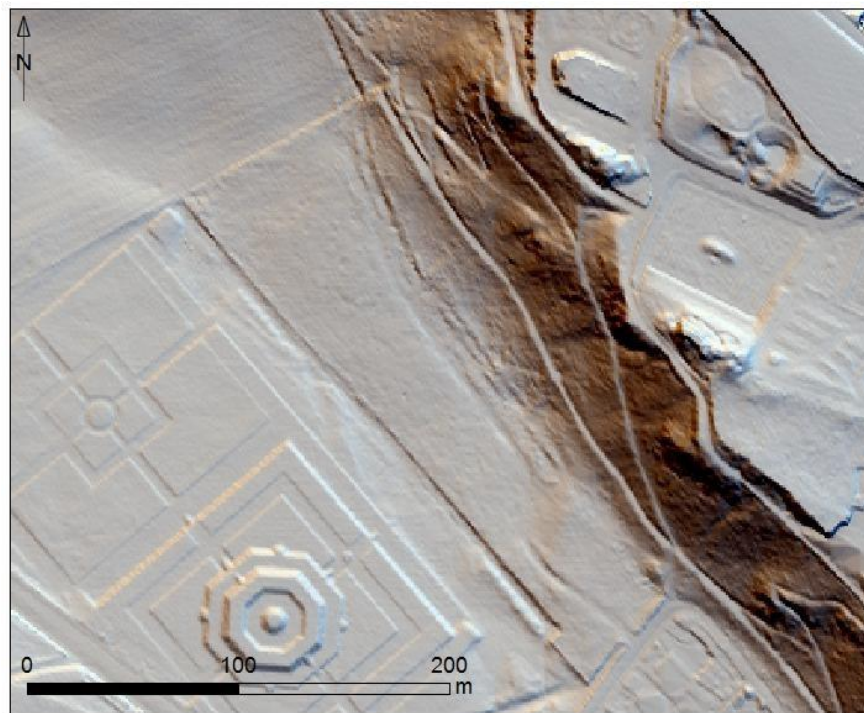


Fig 14 The Haining (centre) showing hut bases and vehicular road in the field to the NE at the foot of the castle (Multi-HS\_D16\_H45). © Copyright Historic Environment



Fig 15 The Haining (centre) with new HLA coding (SVF\_R10\_D16). © Copyright Historic Environment Scotland: <http://hlamap.org.uk/>; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073

## The Park Loch

The earliest reference to the Park Loch is in 1434 when a net (*herywatter*) was bought for the 'pond of Stirling' (*stagno de Strivelyne*) (*ERS* vol IV: 593). During the reigns of James IV and V it was stocked with trout, pike and perch, as well as ornamental swan and herons. In the early 1500s stakes were placed around it (possibly as fencing) by the park keeper, and reeds were harvested. In March 1631 'a great spait of water' broke out damaging the area around the Burgh gate and the lower end of the town (*ERRBS*, vol. 1: 165). A sluice was inserted into the loch in 1654 (*ERRBS*, vol. 2: 320), perhaps to prevent further floods by controlling water levels. The loch appears in Vosterman's painting of Stirling from the park (c1675) and is the only contemporary representation of it.

The loch is absent from Roy's map (c.1747-55) which might suggest that it was gone by the mid-18th century. However, Harrison (pers. comm. 2015) has found it mentioned in a sub-tack of the King's Park, dated 1754, but registered in 1746 (NRS SC67/49/17: 439-40). Ronald (1899: 100) believed it was still present at the end of that century and that it may have been drained when the race track was formed. Ronald (1899) produced a map of Stirling (with the loch) as it may have looked in 1745. His plan of the loch was based on local knowledge and observations of the park terrain and he estimated that it would have been c. 6 acres in extent (1899: 99). Ronald's map shows a sluice or channel running out of the loch, down what is now Dumbarton Road, passing under the town wall near Port Street and joining the Burgh Mill pond (near the Bus Station today). This is probably the sluice constructed in 1654, however as the Burgh Mill dates from the 12th century it could be earlier. The Park Loch therefore functioned as a fish pond, an ornamental landscape feature, a possible supply of water for the royal gardens and orchards, and a supplementary water source for the Burgh Mill.

On a field visit in 2013 Richard Tipping confirmed that the loch must have been artificial, based on geomorphology. This led to a suggestion by Piers Dixon that the embankment, on which part of the race track runs (the eastern straight), could have been a purpose built dam for the creation of the loch. The detailed DEM produced from the Lidar data made it possible to test this theory by 'flooding' the park landscape with contour levels.

The height of the embankment at its centre is a little over 29m OD, and would be the maximum water level before overflowing if the embankment was a dam. The levels at 29m or under, on the west side of the embankment, should therefore accurately reflect the shape and extent of the loch. The results shown in Fig 16 produce an image where the extent of the loch at flood level (29-30m OD) can be seen to pass over the top of the embankment. The modern intrusion of the 14th green disrupts the north-eastern horn of this flood level.



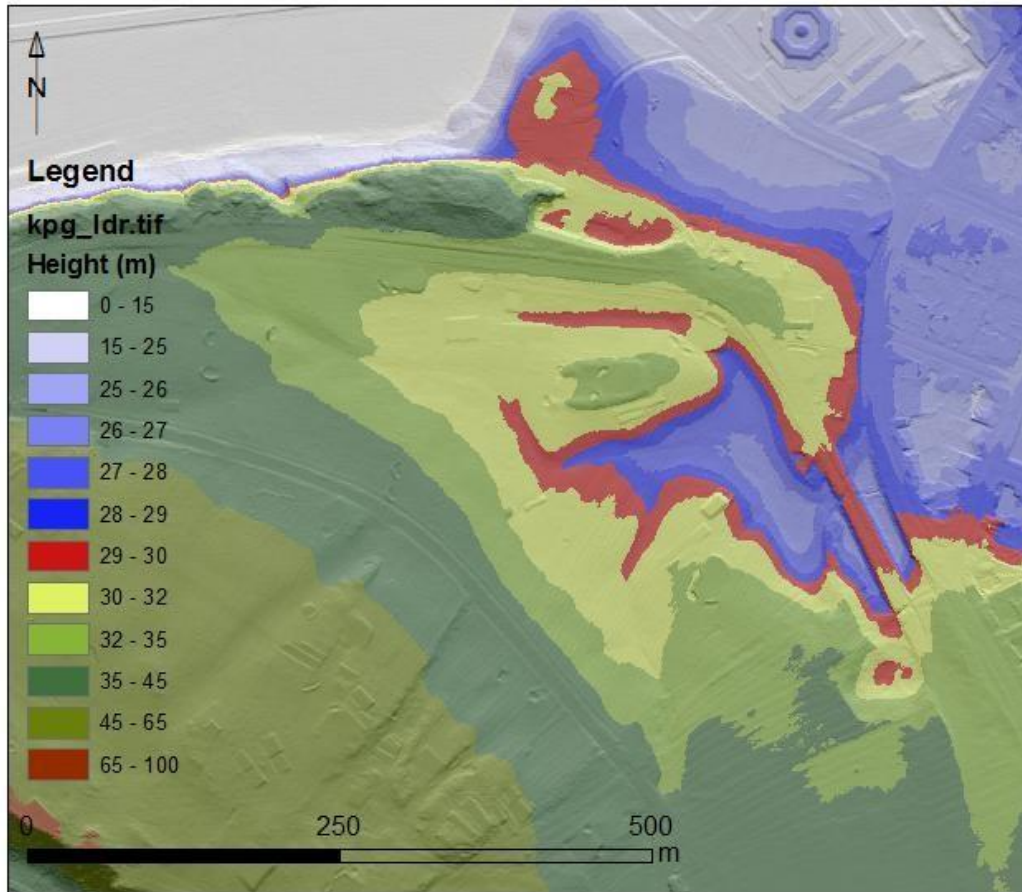


Fig 16 Contour levels above Ordnance Datum added to DEM (Multi-HS\_D16\_H45) to reveal the lost Park Loch. © Copyright Historic Environment Scotland

At a maximum level of 29m the loch would have had a surface area of c4 acres, and would have approached c6.5 acres in flood. Ronald's estimate of 6 acres would therefore be accurate for a flood event. This is based on the assumption that the current height of the embankment has not been lowered by 0.5 -1m since drainage. If it has, then c6.5 acres could have been the maximum extent before flooding. At the high level of 29m the loch may have been up to 3m deep. Some caution should be attached to this depth however as the 1806 plan (Fig 18) seems to indicate a possible area of gravel extraction which corresponds closely with the 26-27m level. At 28m, which may have been a more typical water level, the loch would have covered c2.5 acres or c1ha up to a depth of c3m. It is possible that a border of reeds may have grown on the 28-30m levels.

By comparing Ronald's map with the loch levels revealed by the DEM, the location and shape of the loch in both can be seen to be broadly in agreement. A body of water this size and shape could only exist if the embankment is indeed a dam. This may have been considered by Ronald, judging by his plan, although he does not state this. The dam is therefore a major engineering work of the medieval period. It was in place by the early 15th century (ie pre-1434), but could have been constructed earlier.

The loch may have been fed by what appears to be two relict water channels, which cross the golf course from the south and west (Fig 17), as well as by hill slope run off. These channels perhaps fed into a boggy hollow before the dam was constructed. The western channel which was described in 1746 as ‘a green ditch leading from the north west corner ... in a straight line to the said Loch’ (NRS SC67/49/17: 439-40), formed the basis of the field boundary depicted on the 1806 plan (Fig 18). This ditch appears to have been ploughed out in the early 19th century, as did the southern channel and basin of the former loch. Both relict channels however continued to be the focus of later drainage works (NRS RHP 2934).

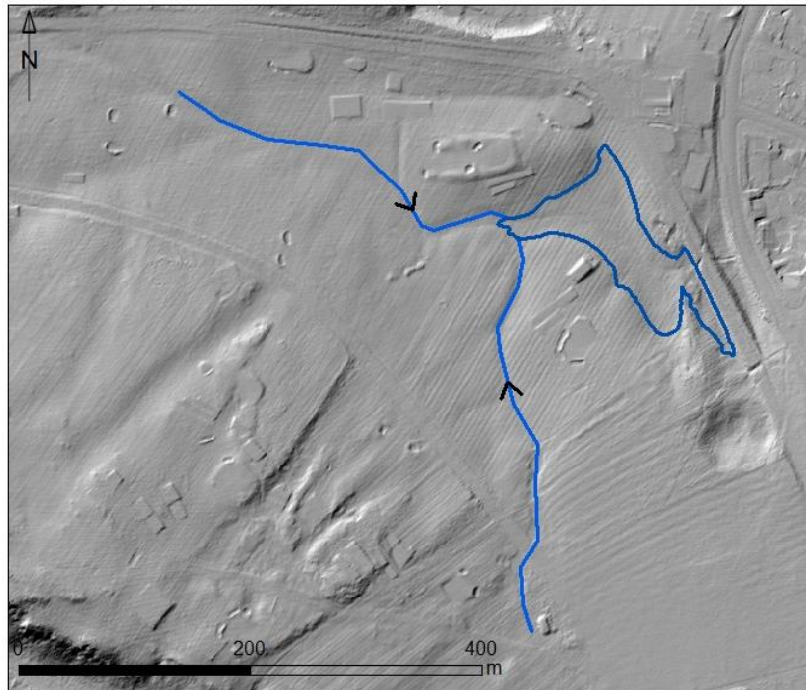


Fig 17 Possible relict water channels with loch at 28m level (HS\_A315\_H35). © Copyright Historic Environment Scotland; © Crown Copyright and database right 2016. All rights reserved. OS Lic. No. 100057073



Fig 18 Extract from the 1806 plan showing post-loch ditch and drainage (h on plan), with DEM underlay (Multi-HS\_D64\_H35© Copyright Historic Environment Scotland)

## Conclusion

The use of Lidar data has contributed significantly to the reinterpretation of HLA data for the King's Park. The DEM visualisations produced from this data have made it possible to view the extent of improvement agriculture and consider the impact this would have had on the survival of earlier remains. It has provided new insights into the development of the racetracks, and revealed the military camp at the Haining.

The modelling of the loch has confirmed the identification of a medieval dam. By flooding the DEM with contours the extent of the Park Loch can now, for the first time since drainage, be accurately mapped. This new understanding will aid the targeting of soil sampling which could provide important information about the origins of the loch and the history of the park environment, although the amount of disturbance to the loch sediments from the extensive ploughing that occurred after drainage will have to be assessed.

Although not attempted for HLA purposes, the DEM could be used in combination with map and aerial photographic evidence to produce detailed maps on the development of the Stirling Golf Course from two nine hole courses in the 19th century, to an 18 hole course in 1912, and redesign in the 1960s.

Lidar data clearly has the potential to be a valuable addition to the source materials used in the creation of HLA. Together with new research and higher resolution aerial photographs, it

could be used, as it has here for the King's Park, for the future revision and improvement of the HLA resource.

## Acknowledgements

This report was written by Stephen Digney, based on field visits to the King's Park in 2013 attended by Murray Cook, Piers Dixon, John Harrison, Richard Tipping and the author. The Lidar data was made available by Historic Scotland and the DEM visualisations were created by Oscar Aldred. I would like to thank Oscar Aldred, Piers Dixon and John Harrison for their valued comments on earlier drafts of this report.

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