Two Estates Project

Clackmannanshire Field Studies Society

in partnership with

The Inner Forth Landscape Initiative

The Two Lades Project
The Craigrie Lade

Supported by
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Project Team

Murray Dickie

Susan Mills

Eddie Stewart

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Contents

1. Introduction:

The Clackmannanshire Field Studies Society obtained a National Lottery grant through the Heritage Lottery Fund in partnership with the Inner Forth Landscape Initiative to undertake a four year research project on aspects of the development of the Two Estates of Alloa and Clackmannan, with particular emphasis on the 18th and 19th centuries. The grant enabled local volunteers to be trained and supported to research a number of topics.

The Society had previously published an historical study of the development and decline of the two lade systems of Craigrie and Gartmorn on the Clackmannan and Alloa estates respectively. The Two Lades Project involved identifying, surveying and recording the remains of the two systems and adding any new historical evidence which was uncovered. This report covers the development and the remains of the Craigrie lade system.

2. Acknowledgments:

- Robert Dingwall, Fiona Graham, Margaret Schofield, Marilyn Scott, David Seaton, Eddie Stewart, Jenni Stewart and Andrew Wood, who worked long and hard, sometimes under difficult conditions, to undertake the research, survey work and analysis;
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- Local landowners and residents who have supported our survey work and provided us with local information;
- Ordnance Survey Open Data whose easily accessible maps provided us with a base set of locations for rivers, streams and the boundaries of modern urban areas;
- The National Library of Scotland whose on-line and library-based Ordnance Survey and geological maps provided the bulk of our locational data; their on-

line tools, which hugely simplified measurement and location and their staff, who were always knowledgeable and helpful;

- The National Records of Scotland whose amazing collection of family papers, plans and maps, on-line catalogue and supportive staff made our task so much easier and the many families, organisations and individuals who had safeguarded and made this material available;
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- The University of St Andrews whose work on the Acts of the Scottish Parliament has made the documents easily accessible;
- The University of Edinburgh and Glasgow who have made the Statistical Accounts of the Parishes of Scotland available online in an easily used format;
- Google and Google Books who have made so much previously hard to access material freely available on the internet;
- Google Earth for their satellite imagery and powerful tools;
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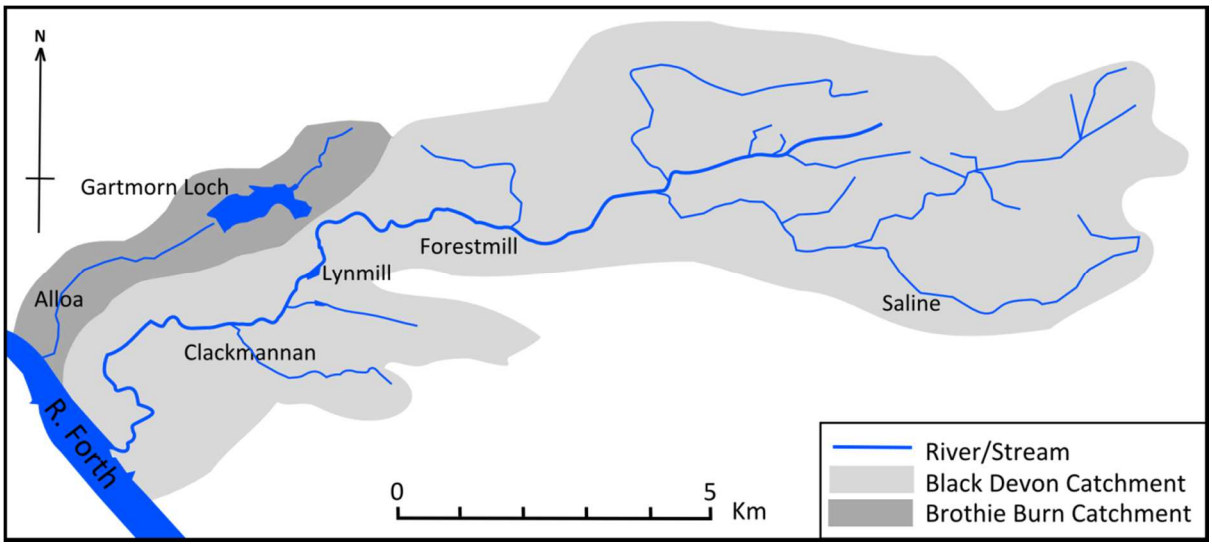
- Clackmannanshire Council for their support with library work

3. General Background:

The two lade systems of Craigrie and Gartmorn shared a common pattern of development. They were initially built at the latter part of the 17th century to supply water to mine drainage engines on the Clackmannan and Alloa estates respectively. The Craigrie lade was fed directly from the River Black Devon [NS255092898] (**1**) and had at some point in time an additional supply from the variously named Gartstank, Garrison or Tullygarth Dam [NS9310892576]. The Craigrie lade initially took water to a drainage engine to the South of Clackmannan Tower [NS9043591505]. **(2)**

The Gartmorn Lade was fed initially from the Gartmorn Dam [NS9133393997], constructed at the eastern end of a marshy hollow on the Brothie burn. By the beginning of the 18th century the supply from Gartmorn Dam was not considered sufficient and reliable to power the drainage engines on the Alloa estate and the dam was extended and a new lade constructed to bring water from the River Black Devon at Forestmill [NS9543693825]. (**3**) The river Black Devon rises in the western area of the Saline Hills and has a much more extensive catchment area than the Brothie Burn.

Figure 1. River Black Devon and Brothie Burn Catchments areas.

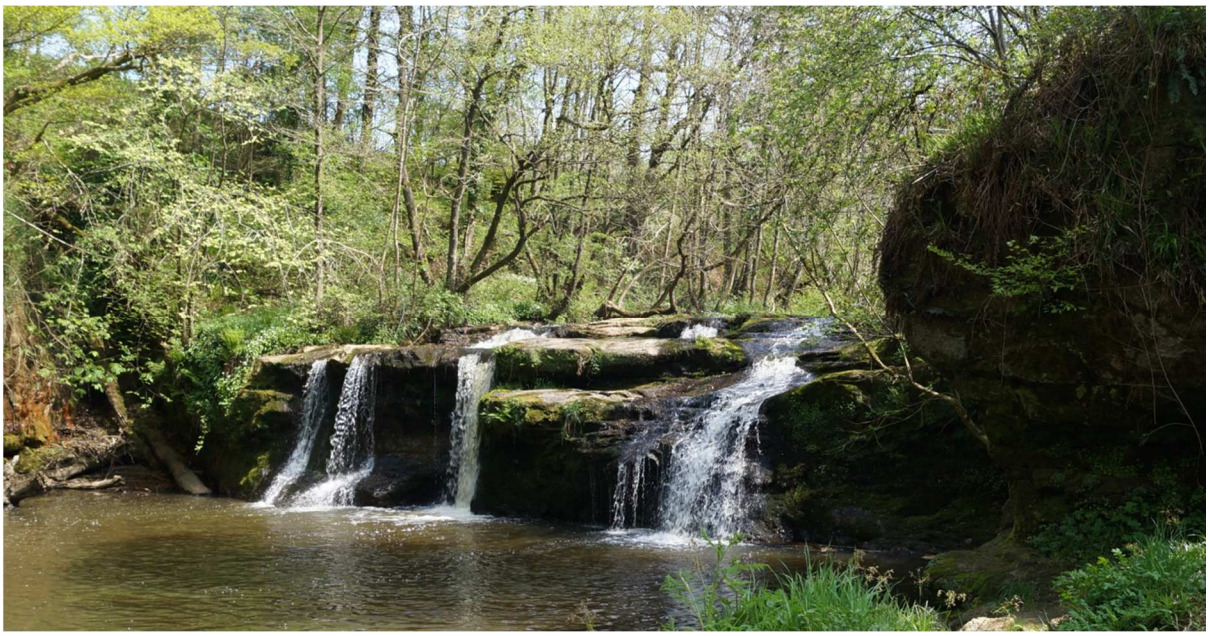


Based on Information from Ordnance Survey Opendata.

The river Black Devon, although having a fairly extensive catchment area, was prone to running short of water during the summer. (**4**) In order to ensure there was no interruption to supplies of water, storage dams had to be constructed. The Craigrie lade had the corn mill dam at Lynmill [NS9262693006] to provide a storage facility. The Gartmorn lade used Gartmorn dam for the same purpose.

There are two major points in the river Black Devon where the river has cut down gorge sections some 10 metres deep into its course. This cutting back has been stopped by the river encountering outcrops of more resistant sandstone. These outcrops result in a sudden drop in level from the more open section of river above into a gorge section below. The lower point is at Lynmill [NS9253092872 to NS9259493012]. Here the river Black Devon drops in a series of waterfalls into a gorge section which continues well below the viaduct of the former Alloa to Dunfermline railway [NS9229492486].

Figure 2. Waterfall at Lynmill.



There is another major waterfall at Forestmill, where the site of the waterfall appears to have been built over by a series of weirs [NS9543293826]. The gorge section starts just upstream from Lynmill and ends at the present weir at Forestmill. Above the weir at Forestmill the river Black Devon meanders across a level flood plain for some three kilometres.

At both these points in the river Black Devon the waterfalls resulted in the level of the river dropping by some 5 to 10 metres. By the 14h century the fall of water at Lynmill on the Clackmannan estate had been utilised to power a corn mill. **(5)** By 1681 a corn mill is shown at Forestmill, owned by the Alloa Estate. There was also a corn mill at Parkmill, also owned by the Alloa Estate, together with a "*wake m*" (waulkmill – for processing flax) powered by water from the River Black Devon **and a** corn mill at Parkmill. (**6)** The 1702 Kirk Session record of Clackmannan parish also notes a "*waulkmill on the Dovan*". **(7)**

4. The Development of the Craigrie Lade:

4.1 Mine Drainage and Industry:

By the late 17th century, the Clackmannan estate, under the ownership of David Bruce, (**8**) had a water powered drainage engine at a colliery to the south west of Clackmannan village close to Clackmannan Pow where "*…a water mill driven by a canal of water from the upper reaches of the Little (Black) Devon kept the Clackmannan mine dry*". This mill seems to have been in use in 1699. (**9**) The drainage engine is shown on a course sketch dated 1713 as a waterwheel, fed by a lade running in a North to South direction. (**10**)

A trough on a framework connected the lade to the waterwheel. The location of this engine is thought to have been the Old Watermill Pit, just to the south of the Craigrie farm [NS9043991502] (later the site of the Craigrie pit). Another water wheel fed by the Craigrie lade is shown at Speedwell on an Alloa Estate plan drawn up for the 6th Earl of Mar about 1710 [NS9025892099]. (**11**)

Following the bankruptcy of David Bruce in 1704 (**12**)**,** the Clackmannan estate was taken over by Colonel William Dalrymple (**13**) and, in 1711, an agreement between Colonel Dalrymple and the 6th Earl of Mar allows for the installation of a gauge plate "*inserted in the the spouts of the trows immediately below the cornmiln dam at Lynmiln.*" This gauge plate allowed the flow of water into the Craigrie lade to be checked, ensuring that the new weir which the 6th Earl was planning to build at Forestmill to supply water to Gartmorn Dam released sufficient water to meet the needs of the Craigrie lade. **(**14**)** The Ordnance Survey First Edition 25 inch map show the course of the Craigrie lade from the river Black Devon at Lynmill to a point just to the North of the Craigrie Farm at Clackmannan. (**15**) The lade is shown as starting directly from the river above the site of a waterfall [NS9254792892]. The overall length of the lade from Lynmill to the Watermill pit was 3.27 kilometres.

The Tullygarth burn, a small tributary of the river Black Devon, had also been dammed at this time. In was recorded that heavy rains had caused a breach in the Gartstank dam in December, 1706. (**16**) This dam has been variously named the Gartstank, the Garrison and, later, the Tullygarth dam. Aerial photographs and fieldwork revealed the remains of the dam and a small lade on the south side of the Tullygarth burn leading eastwards. General Roy's map of 1747-52 shows the dam [NS9311192573] feeding in to the Craigrie lade and also indicates two "*mill*" settlements to the south of the Garrison Dam; "*Oakmill*" and "*Sheilmills*". (**17**)

Stobies' map of the counties of Perth and Clackmannan, 1783, shows the Craigrie lade starting at Lynmill and being fed by water from the Tullygarth Dam. [18]The Ordnance Survey First Edition 25 inch map of 1861 (**19**) shows a lade heading from the dam towards the location of the present Tulligarth farm steading. It also shows the Tullygarth burn feeding into the Craigrie lade [NS9251492562]. It is possible that the Garrison dam was constructed to feed the smaller lade heading south and then the waters of the Tullygarth burn below the Garrison Dam were collected into the Craigrie lade when it was constructed.

The Clackmannan Parish Kirk Session Records indicate that, on the 29th July 1718, a distillery was operating in Clackmannan and that there were two "Gaugers" employed there as well as a customs officer at Powside. **(20**) The site of this distillery is uncertain but the site of a later 19th century nearby distillery (**21)** was uncovered during house excavation work. (**22**) It lay immediately to the north of the Craigrie lade, adjacent to a bridge over the lade. The distillery site [NS9135192227] and bridge [NS9135892218] are shown on the OS First Edition 25 inch map of 1862. (**23**) The proximity of the distillery to the lade suggests that they may have been connected.

A painting of Clackmannan Tower by John Clerk of Eldin in 1775 shows the Watermill pit engine and indicates that it was by then fed by means of a syphon. (**24**) The OS First Edition 25 inch map shows that by 1862 the lade was carried under the Goudnie Burn at Riccarton by a similar method [NS9159892174 to NS9151092183]. **(25)**

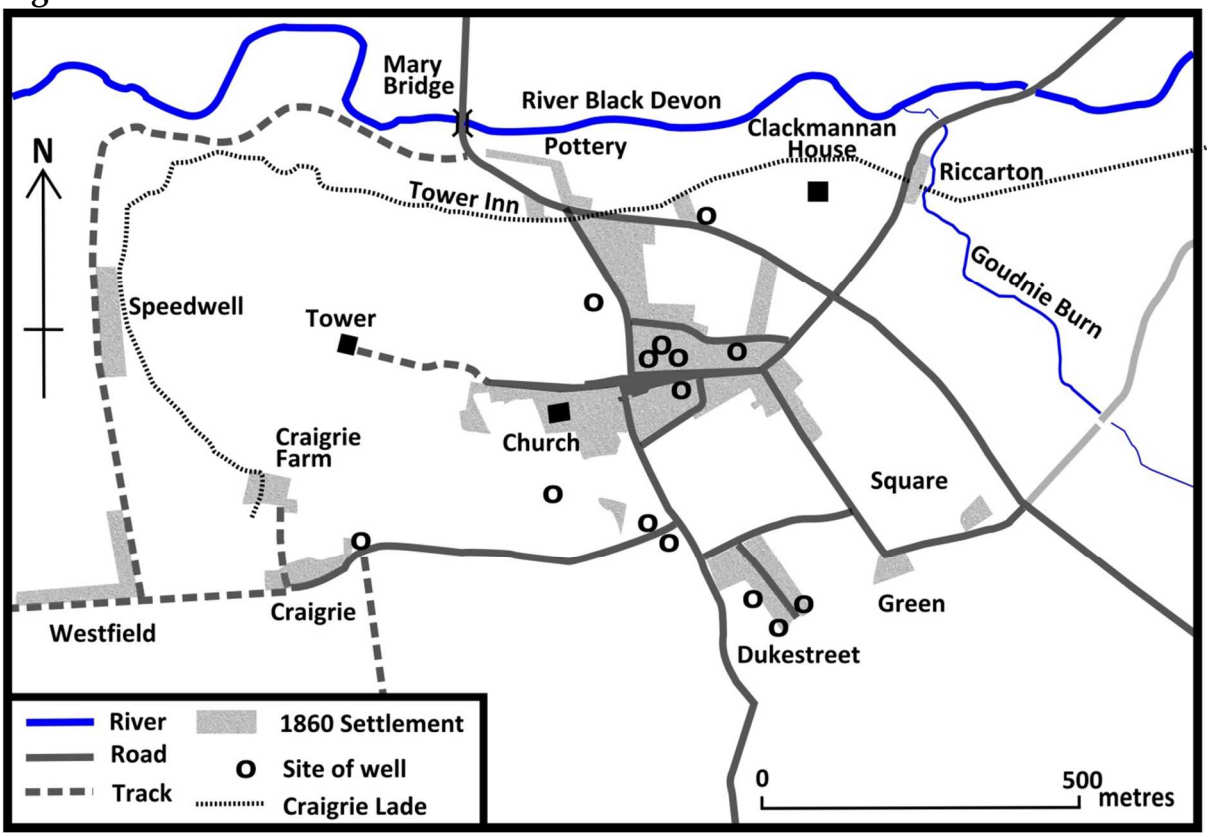
A plan of Alloa estate dated 1814 (**26**) shows an engine pit at Speedwell [NS9025892099] and a plan dated 1832 for a new distillery at Clackmannan **(27)** shows engine pits at Speedwell and Craigrie. It also shows a "To*wer Works*" (perhaps on the site of the original distillery) and the proposed site for a new distillery between the Craigrie lade and the river Black Devon. This distillery is recorded in the Second Statistical Account of Clackmannan Parish in 1841. (**28**)

The Craigrie lade continued to provide a source of power for mine drainage at Clackmannan well into the 19th century, but by 1862 the Ordnance Survey First Edition 25 inch map (**29**) shows that the pits at Speedwell and Craigrie had been abandoned and while the new distillery building is shown it is not listed as a distillery. While this map shows the course of the lade and indicates that it is still filled with water, there is no indication that it was being used to supply power.

4.2 Domestic Water Supply:

Prior to 1860 the town of Clackmannan and the colliery villages and farms around were dependent on wells for the supply of water. (**30)** These wells were mainly fed by water coming through the underlying Carboniferous rocks. As a result, this water was "hard", containing amounts of calcium carbonate dissolved as it passed through the rocks. In addition the wells often dried up in the summer. (**31**)

Figure 3. Water available from wells in 1862:



Based on Information from Ordnance Survey Opendata and First Edition Maps, National Library of Scotland

The lack of well sources proved extremely difficult for many of the outlying mining settlements. In the case of Westfield – "*There is no regular water supply for the village, but Mr Allan, a neighbouring farmer, kindly allows the people to help themselves from his well. In summer this permission is often necessarily withdrawn, and then the villagers go to Wellmyre, fully half a mile away, where good spring water is obtained.*" (**32**)

Given the difficulty of obtaining fresh water, residents of Westfield often went to great lengths to obtain a supply, sometimes with awful results. "*Thursday 05 May 1870 - On Sunday afternoon a little girl named Fife living at Westfield Clackmannan, was drowned in a quarry hole there. She had gone to the place to get a pitcher of water and fell in, and no one being at hand to help her, she perished*". (**33**)

Some residents at the Pottery resorted to taking water from the river Black Devon but it was contaminated by sewage. (**34**) The lack of an adequate, reliable source of fresh water and any form of proper sanitation was a major problem and there were many outbreaks of disease associated with it. In May 1832 there was an extremely serious outbreak of cholera in Clackmannan Parish, with 43 individuals affected, of whom 14 died. The number of people affected in Clackmannan Parish accounted for some 40% of the total cases in Scotland at that time. (**35**) In February of 1849 there was another outbreak of cholera in Clackmannanshire and five deaths in Clackmannan and Westfield. (**36**)

By 1866, as the Craigrie lade was no longer used to power mine drainage or supply industry, the Earl of Zetland, proprietor of the Clackmannan estate, used its waters to gift a new, clean water supply to the village of Clackmannan. This would meet the needs of some 1,300 inhabitants. (**37**) The contract was supervised by Mr Sutter, C.E., of Edinburgh and the work undertaken by Wallace and Connell, plumbers in Glasgow.

The system was designed to deliver 14,000 gallons (63,645 litres) of roughly filtered water each day to a 20,000 gallon (90,922 litres) storage tank situated in Tower Park, just below Clackmannan Tower [NS9084291906]. A new dam was constructed at Lynmill [NS9276593040] above the old mill dam [NS9262693004)], providing a more reliable supply of water, especially in the summer when the flow of the river Black Devon was regularly low. (**38**)

The lade from Lynmill to Riccarton was refurbished (**39**) and a glazed clay pipe was placed in the bottom to conduct water to the hamlet of Riccarton [NS 91591 92183]. Here a wall was built across the lade and a hydraulic ram used the 15 foot (4.57 metres) drop from the lade to the Goudnie burn to force a smaller volume of the water up to the storage tank above the village on the Kings Seat Hill, constructed by Mr Robert Johnstone, Leith.

Water from the lade at Riccarton was partially filtered and then fed down 15 feet (4.57 metres) through a four inch (10.16 cm) supply pipe to a large hydraulic ram located in a brick housing. The ram house was located on the eastern side of the Goudnie burn [NS 91555 92161]. The 15 foot (4.57 metres) head of pressure enabled the ram to force a proportion of the water over 1,000 yards (930 metres) through a two inch (5.08 cms) pipe up to the storage tank 120 feet (36.58 metres) above in Tower Park [NS 90840 91905].

Figure 4. Workings of a Hydraulic Ram:

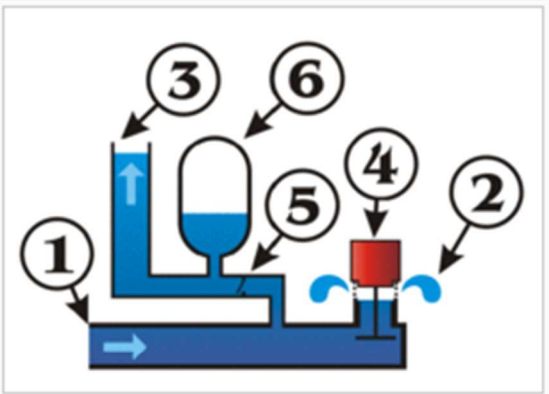


Figure 2: Basic components of a hydraulic ram:
1. Inlet – drive pipe
2. Free flow at waste valve
3. Outlet – delivery pipe
4. Waste valve
5. Delivery check valve
6. Pressure vessel

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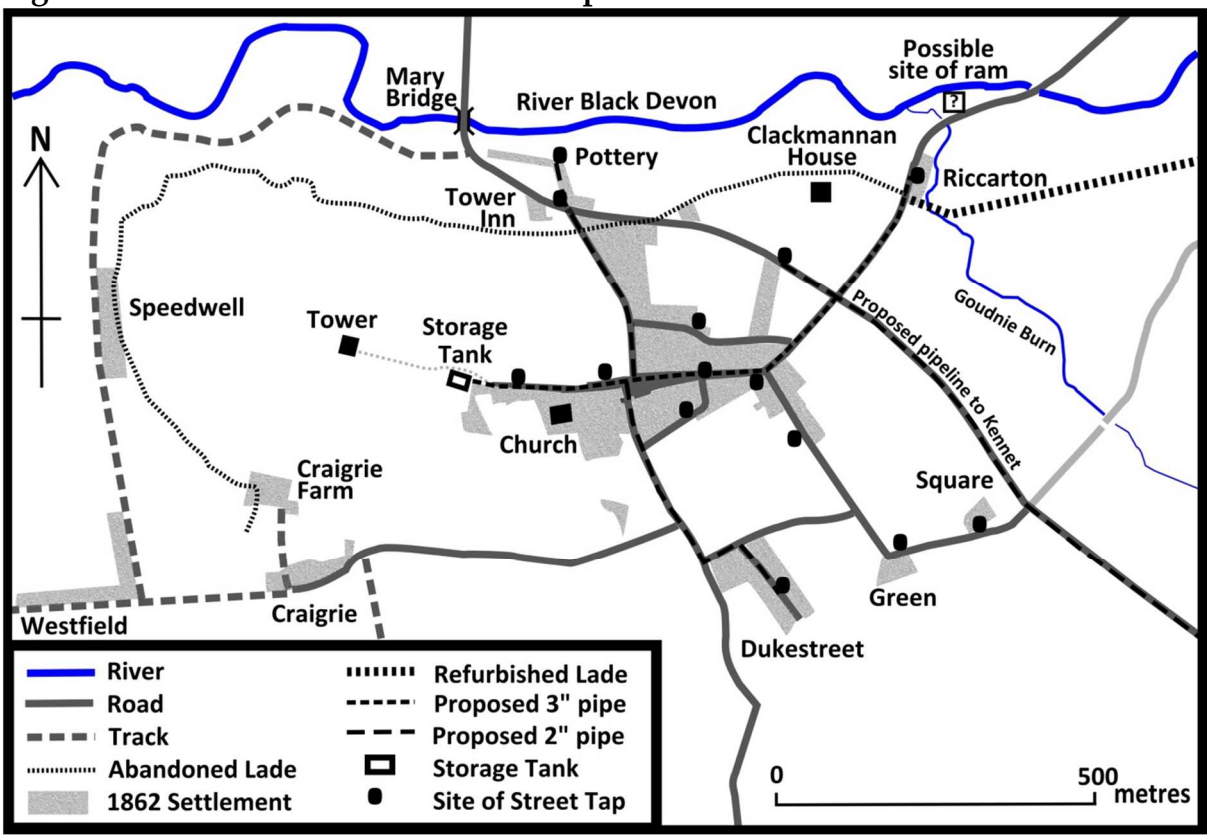
A hydraulic ram is a very simple machine, with few moving parts and, once installed, is extremely cheap to run. The cycle starts with the waste valve {4} open and the delivery check valve (5) closed. Water enters the ram through a larger supply pipe {1} and the flow forces shut the waste valve {4}. The sudden closure of this valve creates a "hammer" effect, a sudden increase in pressure, which forces open the delivery check valve {5} and drives water up the smaller diameter outlet delivery pipe {3}. At the same time, it pressurises the air in the pressure vessel {6} which acts as a shock absorber and helps to maintain a more even flow through the delivery pipe. As the pressure in the drive pipe {1} decreases the delivery check valve {5} closes, the compressed air in the pressure vessel forces a little more water up the delivery pipe, the waste valve {4} opens and the cycle starts again. In 1878 the hydraulic ram was replaced with a water turbine, which was more efficient than the hydraulic ram. (**40**)

The storage tank was sunk five feet (1.52 metres) under the ground, covered with Caithness flags and capable of holding 20,000 gallons (90,922 litres) when full. The water was discharged at about nine gallons (41 litres) per minute, and was piped to water taps throughout the village. The taps only supplied water so long as a hand is held on the tap so that water was not wasted.

The supply was officially opened on Thursday the 13th of December, 1866. The location of the storage tank and later filter beds for the supply from Gartmorn Dam are shown on the OS Second Edition 25 inch map of 1898. (**41**) A hand coloured OS First Edition 25 inch map held in Alloa Library (**42**) shows the location of the storage tank and the proposed lines of several three inch (7.62 cms) and two inch (5.08 cms) supply pipes. The location of the street water taps is shown on the OS Second Edition (revised) 25 inch map of 1920. (**43**)

Figure 5. Water available from Street Taps in 1866:



Based on Information from Ordnance Survey Opendata; OS Second Edition Revised Map, National Library of Scotland and a hand coloured map from Alloa Library

The hand modified OS First Edition 25 Inch map of 1861 in Alloa library shows the site of the storage tank, built adjacent to a nursery. (**44**) It was located at the top of the High Street and the track to Clackmannan Tower was diverted to the north around the site. This diversion is still there today.

The hand coloured map also shows the lines of the main distribution pipes from the tank into the village of Clackmannan. A three inch (7.62 cms) pipeline ran down the High Street to Riccarton, with two inch (5.08 cms) pipes to Duke Street and the Pottery. A proposed two inch pipe line is shown to Kennet, but there is no evidence to suggest that this was built. The distribution of taps shown on the OS 1920 Second Edition Revised 25 inch map suggests that the network of two inch pipes was extended within the area of the village. The 20,000 gallon (90,922 litres) capacity of the tank is the equivalent of 3,211 cubic feet (91 cubic metres). The tank was set five feet (1.52 metres) into the ground so its area would have to have been some 642 square feet (roughly 60 square metres). The site of the storage tank is shown on the hand written OS First Edition 25 Inch map of 1861 and is 3,154 square feet (293 square metres), more than adequate to house the tank. (**45)**

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The Earl of Zetland also provided Clackmannan with a new street drainage system. The account of the opening of the water supply (**46**) noted that "*the principal streets were drained after the most approved system, gratings with such traps and cesspool bends being placed at every 16 yards* (14.63 metres) *(and in some instances, closer), all being capable of being lifted and cleaned by a scavenger and trapping and preventing any bad smell coming up the drains, and equally preventing any matter tending to choke the drains getting into them. The whole of the above works have been executed in a most substantial manner at Earl Zetland's expense. The contractor for the drainage and tank was Mr Robert Johnstone, Leith."*

The recognition of the value of this water and drainage system is expressed in the address given at a dinner which took place in the Royal Oak Hotel. "*We, the undersigned residents of Clackmannan, desire to avail ourselves of the opportunity now presented by the completion of the works for draining and supplying our town with water, to express our gratitude to the Earl of Zetland, through whose great liberality these works have been executed. We feel that he has thereby conferred a boon on us which we cannot too highly prize. For many years past we have been dependent to a large extent upon a single well for the supply of one of the first necessities of life, and in a dry summer this was found altogether inadequate. When we hear of the fearful ravages which cholera is now making among a population similar to our own in the neighbouring county of Fife, and as the medical men unhesitatingly attribute these to impure water and deficient drainage, we cannot be too thankful to the noble Earl who has done so much to remove these sources of pestilence from amongst ourselves. We now believe that there are few small towns in the country better provided with pure water or with a more efficient system of sewage, and we trust it may be some satisfaction to the Nobleman to whom we owe this, to be aware that his kindness is duly appreciated, and his name thankfully remembered, by those for whose comfort and health he has done so much." (**47***)*

The supply from the Craigrie lade was replaced in 1896 by water from Alloa Burgh's Gartmorn water works. **(48)** The Alloa Water Act, 1891, indicates that water was to be conducted *"from the Service Reservoir South of Gartmorn Dam, at a point near the termination to as far as Fauld not less than 7" pipe then 6" pipe along the line of Tramway to crossing of the Black Devon then to a point opposite Pottery Houses and then in a straight line through Tower Hill Park to the Filters of Tower Hill of Clackmannan at a level 12"* (30.48 cms) *below the cope."* (**49**) The location of the Zetland street "wells" is shown on the OS Second Edition (Revised) 25 inch map of 1920. (**50**) The Ordnance Survey Second Edition 6 inch map (**51**), 1895 shows no trace of the lade and a quarry had cut into the line of it, just to the east of Riccarton [NS91994092266 to NS 9188092260].

5. The Remains of the Craigrie Lade:

A team of volunteers explored, surveyed, excavated and photographed the remains of the Craigrie lade, the Garrison (Gartstank or Tullygarth) Dam and the Tullygarth lade which are still visible. The present remains fall into four sections:-

- The upper section of the Craigrie lade from Lynmill [NS9254792892] across the access road to the former Cherryton Brickworks [NS9222292304] to Riccarton [NS9159292182];
- The centre section of the lade from Riccarton [NS0141692181] to the edge of the Back Wood [NS9078892176];
- The Lower section of the Craigrie lade from the eastern edge of the Back Wood [NS9078892176] to the North side of the Craigrie farm steading [NS9053591786], including the Zetland Storage Tank at Tower Park [NS9083891908]; and
- The Gartstank, Garrison or Tullygarth Dam [NS9311192573] and the upper section of the Tullygarth lade [NS9308192554 to NS9273992583];

5.1 The Upper Craigrie Lade Remains:

The area upstream from the modern road bridge at Lynmill to the line of the Gartmorn Lade has been designated an area Site of Special Scientific Interest. At Lynmill there are the sites of waterfalls, an old corn mill, remains of the mill dam and the holding dam built by the Earl of Zetland to ensure a water supply for his scheme

The remains of the old corn mill at Lynmill [NS9258492996] can still be seen above the modern road bridge. The OS First Edition map of 1862 shows the start of the Craigrie lade just below this bridge [NS9251792839]. (**52**) The map shows no dam or weir at the start of the lade. Instead, the lade is shown as beginning directly from the course of the river Black Devon.

At this point there is a waterfall with a significant drop in level. We identified the course of the lade just downstream from this point and, using a dumpy level and staff, we surveyed from this first identifiable section of the lade back to the river and confirmed that the water above the waterfall (in the gap beneath the fallen tree branch in the photograph below) is level with the top of the lade.

Figure 6. The start of the lade in the course of the river Black Devon.

There is a channel on the eastern side of the river where the OS First Edition map shows the lade starting. A bent wrought iron bar has been secured into the rocks at the edge of the river. It is possible that this was used as an anchor point for a short trough, bridging the gap to the start of the cut lade.

Figure 7. The channel in the waterfall.

This channel, with its firmly embedded wrought iron bar, is a strong candidate for the beginning of the Craigrie lade. Taking the water directly from the river meant that the expense of constructing and maintaining a weir was avoided. The level of accuracy of the survey work which ensured that a lade ending 3.27 kilometres away at the estate pits started in exactly the right place to take water directly form the river is something to be admired, especially given the simple nature of instrumentation available at the time.

Figure 8. Wrought iron bar.

Being in a gorge, at its beginning the lade is partially cut into the bedrock. A short distance from the start we came across this feature in the line of the lade. Due to the wet, stained nature of the infill, we simply noted its basic construction and dimensions. It was made of red, fired, clay bricks and rectangular in shape; with internal measurements of three feet in width and four feet in length (0.91 x 1.22 metres).

Figure 9. Brick built structure.

This construction was an access manhole related to the pipeline constructed at the behest of the 2nd Earl of Zetland in 1866 to supply the town of Clackmannan with a clean supply of drinking water.

Below this point, a well preserved rock cut ditch continued. Unfortunately, this section is very overgrown and difficult to access. This ditch carried the lade down the side of the valley, maintaining a level course, while the river Black Devon dropped away through a serieis of small waterfalls.

Figure 10. Rock cut ditch.

A local resident indicated that he had observed two vertical slots cut into the side of the rock, one on each side of the ditch. He suggested that these would have enabled a wooden gate to be droppped to cut off the supply of water to the lade. (**53**)

Just below this section the sandstone cliffs fall steeply all the way down to the bed of the river Black Devon and the rock cut ditch disappears. Two individuals independently reported that they had observed post holes some four inches (10.16 cms) square in cross section in the rocks on the bed of the stream at this point, (**54** and **55)** They suggested that the lade had been carried across this section in a trough, supported on wooden posts.

Figure 11. A Gap in the lade.

Figure 12. Lade leaves the steep sandstone gorge.

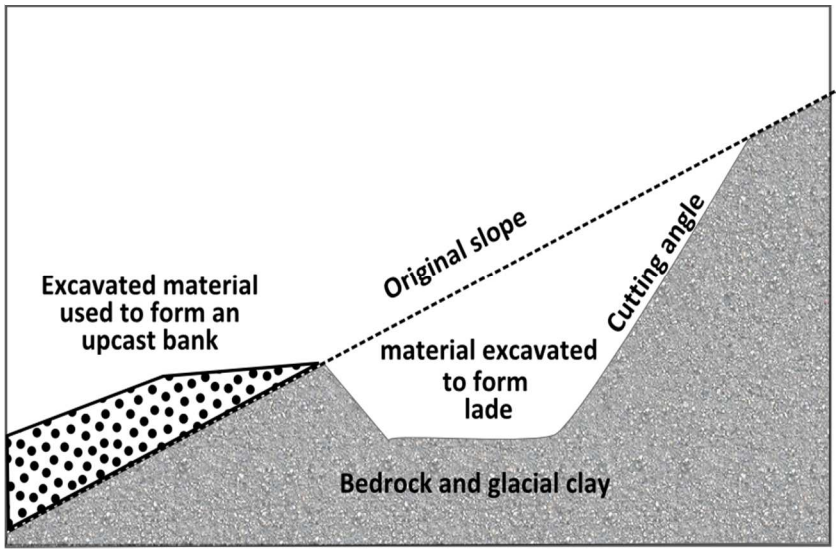
Gradually, the valley broadens slightly and the sides move away from the river. The lade bed has been cut into the base of the sandstone cliff on the right of the picture. It is picked out by the layer of leaf litter lying on top of it. The lade is contained in a rock cut channel about three feet (91.44 cms) wide. The river Black Devon is still dropping slowly away from the level of the lade.

As the valley broadens a little further downstream, outcrops of sandstone are interspersed with deposits of clay on the slopes and in its base. The lade gradually ceases to be a rock cut ditch and becomes a ditch dug into clay. For rest of its journey, the lade is cut into the glacial clay cover.

Here the lade follows the contours along the side of a slope. At this point, the upslope side of the lade still shows small outcrops of sandstone and the cutting angle is very steep.

Figure 13. Lade reaches a broader section of the valley.

Figure 14. Lade formation along a slope.



The lade bed has been created by digging into the slope on the upslope side, with the material excavated from this cutting, together with that from the digging of the lade bed, being used to create an upcast bank on the downslope side. This method of construction has been used for most of the rest of the lade. With the installation of a pipeline in 1866 to provide a water supply for Clackmannan, the open lade had been back-filled.

Here a small section has been reused as a field drain, to remove water coming down from the slope above. This seems to be related to the planting of deciduous saplings in the bottom of the valley. This section of the valley has a large amount of water draining down the slope and a number of sections of the lade have been washed away.

Figure 15. Section of the lade bed re-used as a drain.

Another brick-built manhole was discovered [NS9243292640]. As the outside walls were undamaged and it was filled with dry material, it was partially excavated, measured and photographed. The internal dimensions were identical to that of the first manhole discovered.

Figure 16. A second manhole.

A glazed clay pipe of 18 inches (45.72 cm) internal diameter entered the manhole from the upstream end of the lade and another left from the downstream side. The manhole had been dug down below the level of the bottom of the pipes, creating a sump which would have trapped material coming down the pipe.

The manhole had a rectangular section on the river side. A smaller slot in the side of the manhole led into a rectangular space which would once have held a wooden sluice gate.

Figure 17. The drainage sluice area.

The brickwork was somewhat roughly laid and a substantial layer of lime and sand mortar had been used to create a seal between the brickwork and the wooden sluice gate. While the wooden gate had long since rotted away, the impression was still visible in the mortar, together with plant roots which had grown in the space between.

Figure 18. Lime and sand seal in sluice space.

A glazed clay pipe of 4 inches (10 cms) internal diameter led from the bottom of the sluice gate through the upcast bank. This was a spigot and faucet pipe, with a plain end (spigot) and a belled out end (faucet). A thread had been cut into the faucet (belled out) end of the pipe to allow a good mortar seal when the next spigot end was inserted into this faucet end.

There was a sump dug below the level of the pipes, with a drain leading back down into the valley of the river Black Devon. This sluice mechanism would have allowed the manhole, including the sump, to be drained of water to allow cleaning and maintenance.

Figure 19. End of drain pipe.

By this point the river Black Devon was noticeably further way from the level of the lade. The natural slope was still quite steep and the cutting, lade bed top and upcast bank were clearly defined. From the start of the lade, it had travelled through an area of mixed deciduous woodland, with a small number of coniferous trees. The precipitous nature of the route has helped to protect it. Any damage has been related to excessive ground water and recent deciduous tree planting.

Figure 20. Leaving the river Black Devon.

Figure 21. Entering the coniferous plantation.

At this point, the lade enters an area where coniferous planting has been going on for a lengthy period of time. The OS First Edition of the 25 inch map shows a mixture of deciduous and coniferous trees. (**56**) **B**y 1947 (**57**) the area alongside and above the lade had been planted exclusively with coniferous trees. Fortunately, the tree planters had generally avoided the infilled course of the lade bed, perhaps concerned by the softness of the infill.

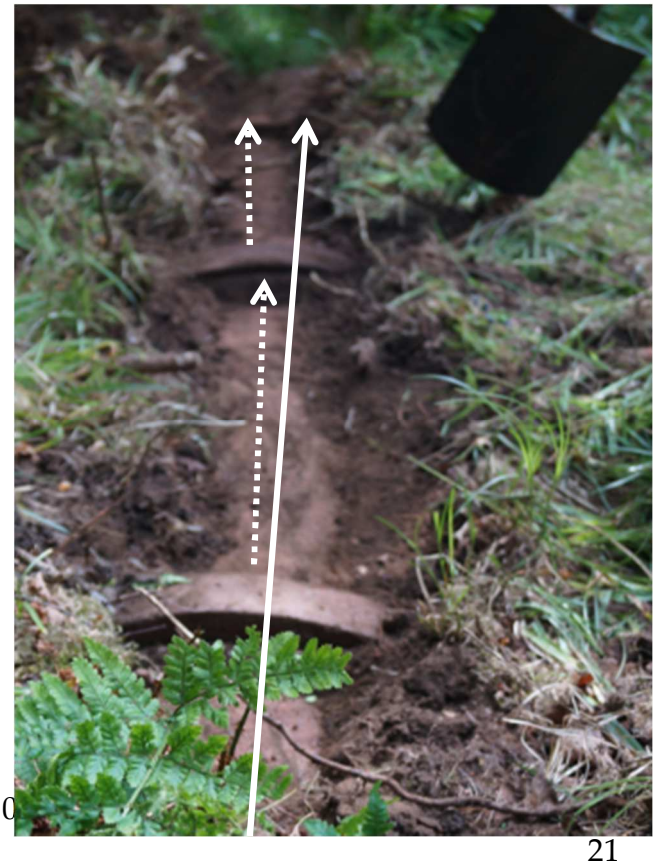
In this section, the upslope cutting, infilled lade bed and upcast bank are well preserved.

The lade contours gently around the northern shoulder of the valley of the Tullygarth burn [NS9243992555]. The coniferous trees are restricted to the slope above the lade. The bottom of the valley is mixed deciduous woodland.

Figure 22. Entering the valley of the Tullygarth burn.

There was a large washed out area [NS9245692553], which had removed the course of the lade. Just at the edge of this, the broken end of a section of pipe from the 1866 Zetland water supply was visible. The line of the pipe at this point pipe had been nearly exposed by erosion, having only a thin covering of turf on top. Several sections of a spigot and faucet pipeline were cleared, giving much more detail about whole sections of pipe and the joints between pipes.

Figure 23. Three sections of pipe exposed.



The pipeline at this point had a slight bend to the left. This was achieved by laying each pipe with the downstream (spigot) end a little further to the left. The resultant slight gaps in the joint were filled with extra mortar.

As the pipe line was carrying running water and was not under any pressure (gravity fed) this method of sealing joints was effective. The first pipe in the section had a very wide gap and allowed us to see a spigot end section in detail.

The spigot (plain) end of the pipe had been shaped to create six small grooves (2 to 3 mms across) separated by ridges. This is likely to have been achieved by turning the pipe against a former before the clay was fired.

Figure 24. Grooves on pipe end.

This pattern of ridges and grooves helped to secure the mortar in the joint with the next belled out (faucet) end.

Figure 25. Detail of pipe joint.

The exposure of this section enabled detailed measurements to be made of the sections of pipe. The individual pipes were four feet long (1.22 metres). They were one inch (2.54 cms) thick with a belled out faucet of two inches (5.08 cms). Unfortunately, there was no access to an exposed, complete faucet end.

Figure 26. Water pipe and section.

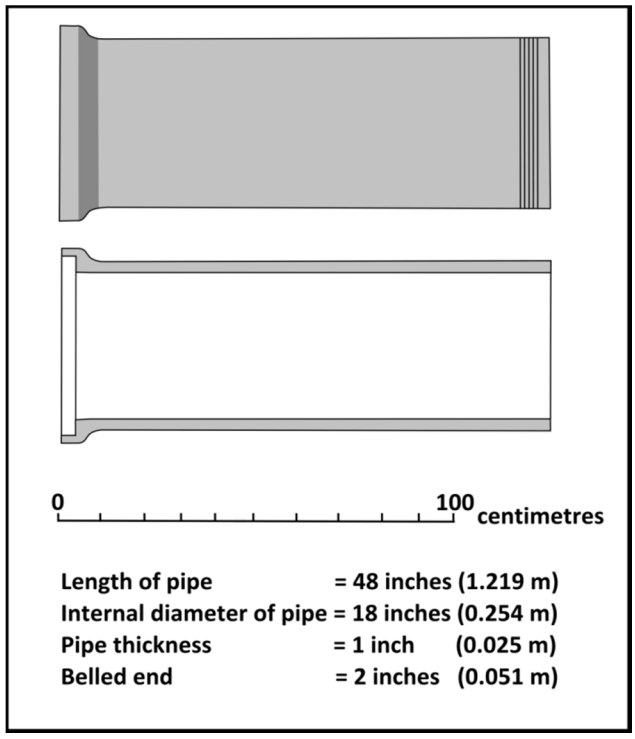
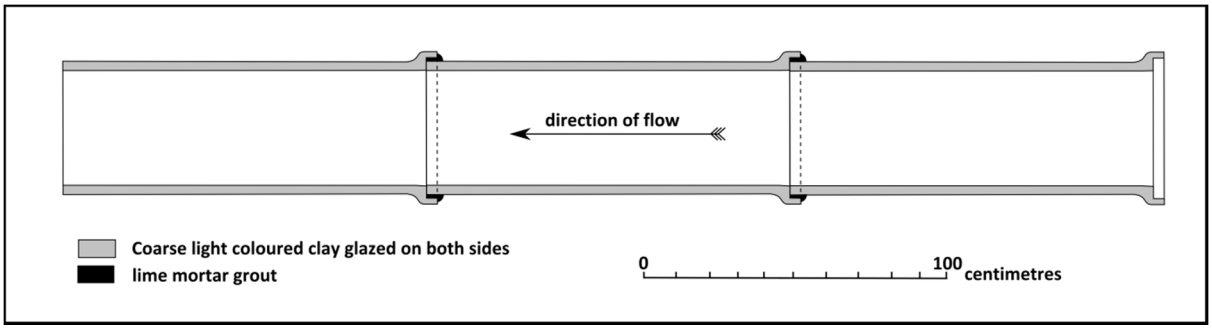
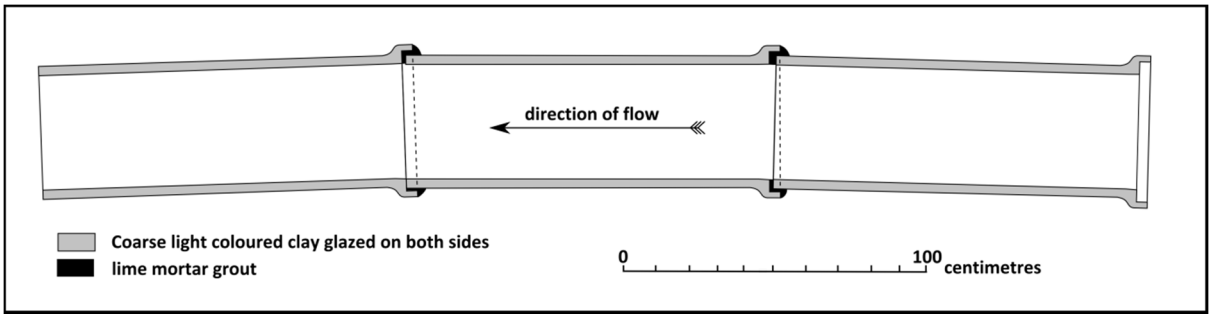


Figure 27. Straight laid section of pipeline.



As the section of pipeline had a small bend to the left (looking downstream) it demonstrated how the pipeline could be laid in a straight line or with a bend. By laying each pipe at a slight angle, the pipeline could be turned, with any gaps in between pipes being filled with extra mortar.

Figure 28. Bent laid section of pipeline.



This view up the exposed end of the broken section of pipe revealed that there was a very small rim of the spigot (plain) end of the next pipe visible at each joint. This was puzzling, as the internal diameter of both ends appeared to be the same.

As the lade was washed out below this point it was difficult to see where it had crossed the Tullygarth burn.

Figure 29. View up section of pipeline.

Figure 30. Survey of crossing point.

fence was followed downslope and a ranging pole inserted into the bank of the stream [NS9245392538].

The remains of the next section of pipeline were found, hidden in the undergrowth, just below and to the right of the base of the ranging pole. The section of pipe was cleared. The down valley side of the pipe had been torn away, suggesting that the crossing had been washed out at some time.

Fortunately, modern aerial photographs showed that the field boundary marked on the OS First Edition 25 Inch map above the lade crossing was still present. Using measurements from the map, a line was measured from a clear change of direction in the fence to immediately above the point where the map showed that the lade had crossed the stream. The line at right angles to the

Figure 31. Location of pipe.

Figure 32. Pipe end cleared.

Figure 33. Faucet pipe end details.

Despite the damage to the pipe, it provided good evidence as to the nature of a faucet end. It also provided details of the size and possible manufacture of the pipe sections. The internal diameter of the pipe was confirmed as 18 inches (45.72 cms). The faucet joint consisted of a two inch (5.08 cms) face topped by a two inch (5.08 cms) projection. There was also a very slight widening of the mouth of the internal end of the pipe.

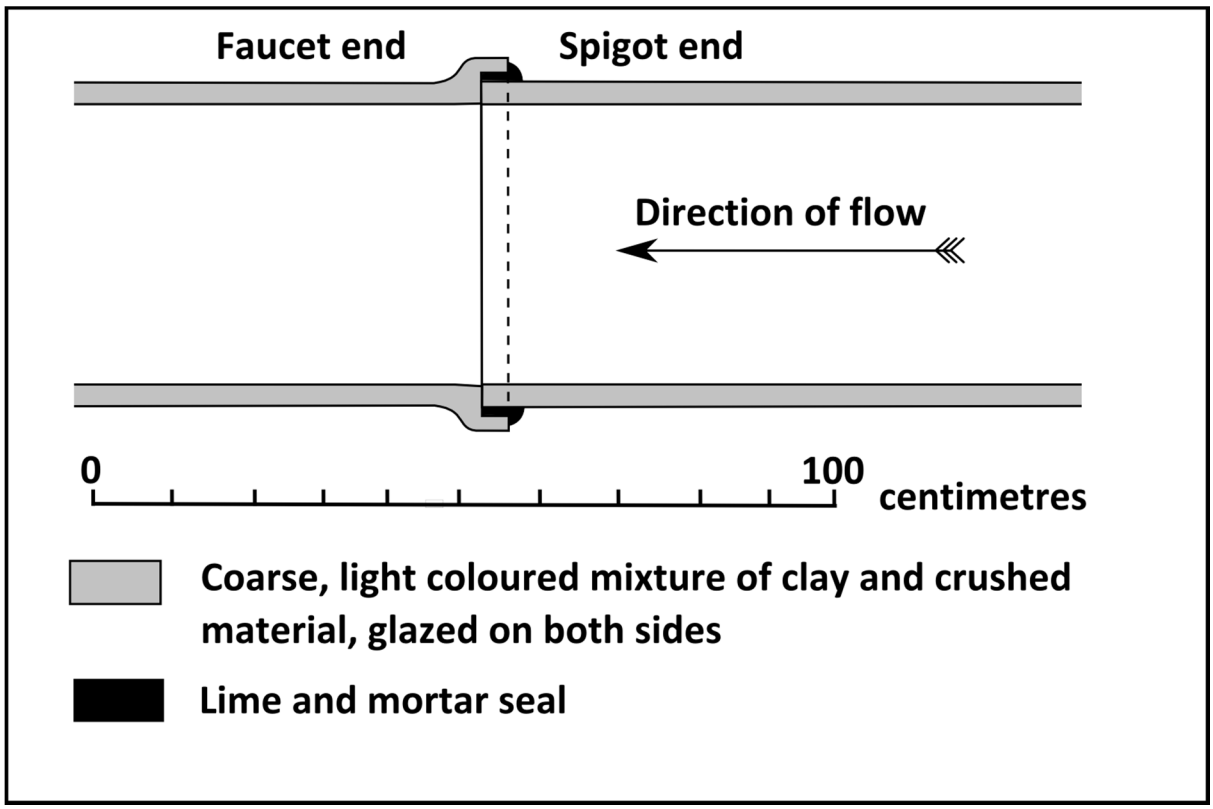
This slight widening showed up as a change in the reflection of light in the inner lip of the mouth of the pipe forming a light rim at the mouth of the pipe (marked with the arrow in the photograph to the right.

Figure 34. Faucet pipe end detail.

Figure 35. Detail of mortar seal.

The lime and sand mortar had been caught between the spigot end of the next section of pipe upstream and the faucet face of this pipe. It had not completely filled the gap between the two sections.

Figure 36. Spigot and faucet pipes.

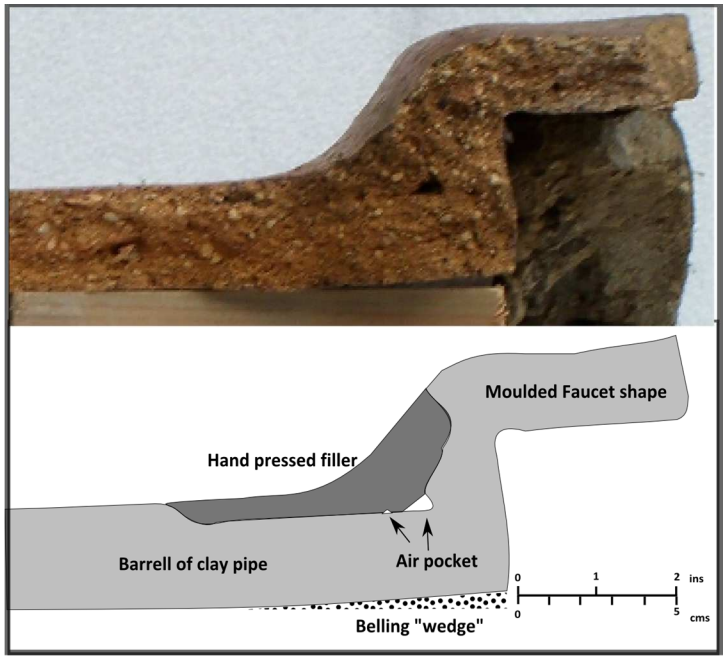


An examination of a broken section of pipe revealed that it was made from a mixture of clay and small particles of crushed material, perhaps old bricks or tiles.

Spigot and faucet pipes were developed to enable effective seals to be made between sections of pipe and are still in use today. The principle is very simple. Each pipe is made with a plain (spigot) end and a belled-out (faucet) end. The belling out of the faucet end is broad enough to accommodate the width of the spigot end and leave a space for a seal to be inserted.

These clay pipes are 18 inches (45.72 cms) in internal diameter and one inch (2.54 cms) thick, giving an external diameter of 20 inches (50.80 cms). The spigot end has a plain face and the faucet end has a two inch (5.08 cms) long, flanged section. This creates an internal diameter of 22 inches (55.88 cms), two inches (5.08 cms) broader than the external section of the spigot end of the pipe. This belled out end section enables the spigot end of the next pipe to be inserted and still leave a one inch (2.54 cms) space all round for a seal. The two inch (5.08 cms) long flange gives a degree of freedom to enable pipe sections to be angled to let the pipeline run around a bend. The grooves in the spigot end of the pipe help the sand and lime mortar to grip and seal the gap. The very slight widening of the internal diameter of the faucet end exposes a very slight rim of the inserted spigot end, which shows up when looking up the line of the pipes.

Figure 37. Cross section of faucet "bell".



A small broken section of the pipe provided some evidence of the manufacturing process. The colour of the clay mix which forms the "bell shoulder" of the pipe is a slightly darker colour than that of the main pipe. There are small inclusions of air, particularly in the bend. The irregular shape of the faucet form suggests that it was created by forcing a mould into the mouth of a standard cylindrical pipe. The deformation of the shoulder was then pressed in by hand, using a slightly different clay mix. In addition, this process created a slight widening of the internal circumference of the pipe at its mouth, the belling "wedge". This slight increase in the width of the end of the pipe exposed a short rim of the next spigot pipe end.

Figure 38. Spigot overlap

Historical maps showed that the lade had contoured along the side of the Tullygarth burn and then crossed over to head down the other side. In 1862, when the lade was an open ditch, the Tullygarth burn is shown as entering it. **(58)** The easiest way to get the lade across the burn and capture the water coming down it would have been to build a dam across the burn. Exploring the bed of the Tullygarth burn, a bed of laid sandstone blocks was found close to the point where the OS map showed the lade had crossed.

Figure 39. Stone structure in Tullygarth burn.

The course of the lade down the southern side of the Tullygarth burn was very clear. It continued contouring down the side of the valley, with an upslope cutting and a well-developed upcast bank. The bed of the lade has been backfilled.

Figure 40. Tullygarth burn manhole.

The remains of another brick-built manhole were found in the line of the lade [NS9242292532]. This was partially excavated to reveal the main features.

Figure 41. Excavation of manhole.

The walls were made of two rows of well-made red bricks, nine inches by four inches by three inches (22.86 x 10.16 x 7.62 cms) with a lime and sand mortar. The internal dimensions of the manhole were 3 feet wide and 4 feet long (0.91 x 1.22 metres).

Figure 42. Survey of lade features.

The bottom of the pipeline was three feet (0.91 metres) below the top of the infill level of the lade bed. The horizontal area of the top of the infill was consistently six feet (1.83 metres) wide. This suggests that the original lade bed was a three foot deep by six feet wide (0.91 metres x 1.83 metres) ditch.

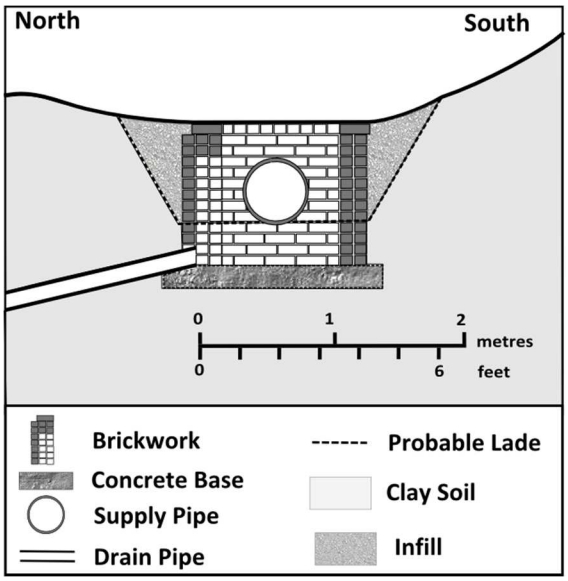
The brickwork was laid on top of a concrete base, of unknown thickness. Two glazed, fired clay pipes were located at either end of the manhole. On the upstream side a spigot-ended pipe of 18 inches (45.72 cms) internal diameter entered the manhole. A similar sized faucet-ended pipe led out from the downstream side. (Spigot is a plain end to a pipe which fits into a belled out other end of the next pipe, the faucet end). Unfortunately, the faucet ended pipe had been damaged.

Figure 43. Inlet pipe and concrete base.

Figure 44. Drainage Sluice.

The Tullygarth burn side of the manhole had an entry into a brick-wide space. At the base of this was a four inch (10.16 cms) diameter glazed clay drain pipe which led through the upcast bank into the valley of the Tullygarth burn. Again, a wooden sluice gate was fitted into the space to seal off the drain. The standard of brickwork was practical, but rough. In order to create a seal around the wooden sluice gate, the space between it and the brickwork had again been packed with lime and sand mortar. There were four courses of bricks creating a foot (30.48 cms) deep space below the level of the pipe. This would have acted as a sump to catch loose material which had been carried down the pipe. When excavating into this area, the material turned from loose debris to stiff, sticky clay.

Figure 45. Section through manhole.



The manhole space was then excavated to a lower level to provide a sump, sluice gate and drainage point. The bed of lade was then filled to protect the pipeline. The smaller drainage pipe led into the base of the valley of the Tullygarth burn.

The drain, being at the foot of the manhole, would have allowed the water to be removed to clean the sump. There was a large broken slab of sandstone in the manhole, suggesting that it might at one time have had a flagstone cover. Detailed measurements enabled a section and plan to be drawn. It is likely that the pipe was laid in the base of the old lade.

Figure 46. Plan of manhole.

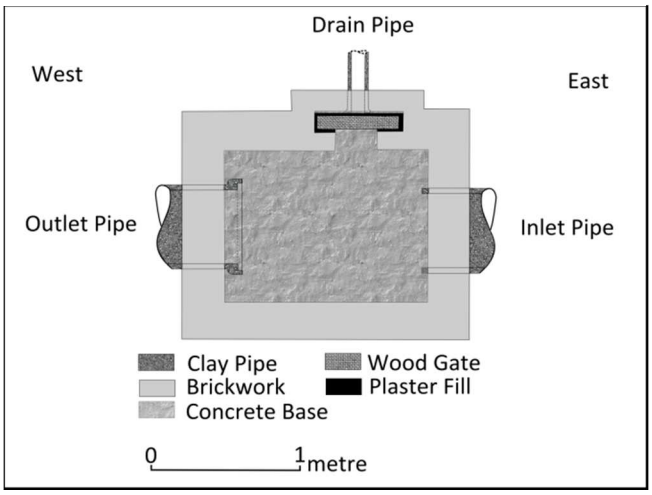
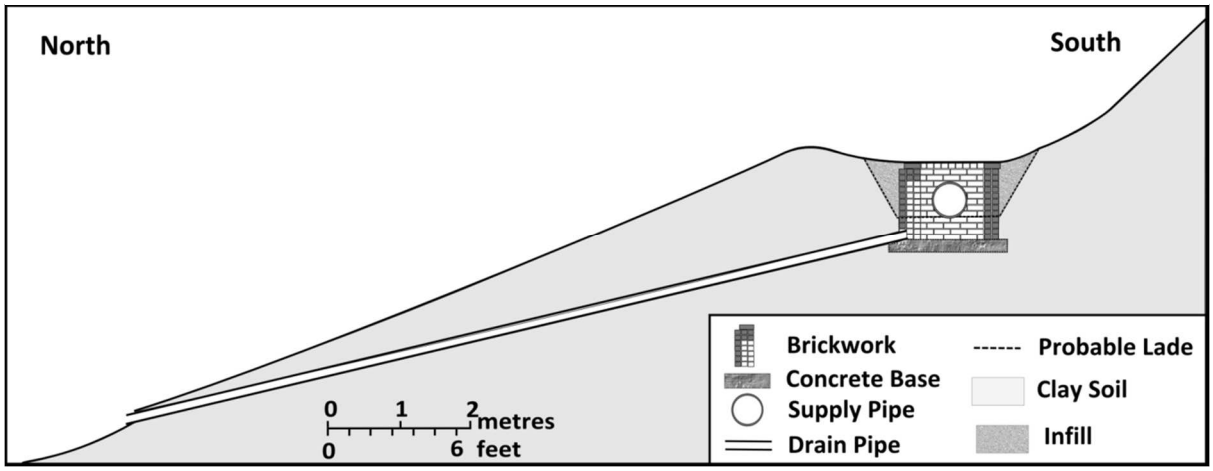


Figure 47. Section through manhole and drainage pipe.



The pipe, manholes and drains are part of the improvements provided by the Earl of Zetland when he gifted a new water supply to the town of Clackmannan. The overall length of the lade from Lynmill to Riccarton is about 1.3 kilometres. As each length of pipe is 4 feet (1.17 metres) the pipeline would have required the purchase and installation of over 1,100 sections of pipe.

The lade continues along the shoulder of the valley of the Tullygarth burn and then down the eastern shoulder of the valley of the river Black Devon.

The form of the lade is extremely well preserved at this point, with a steep upslope cutting, well developed lade bed and upcast bank.

Figure 48. Lade between viaduct and the Tullygarth

Figure 49. Lade passing under the railway viaduct.

The Stirling to Dunfermline railway reached Clackmannan in 1850. (**59**) This large stone built viaduct [NS9229592482] carried the railway across the river Black Devon and the course of the lade. The lade nestles under the eastern end of the arch of the viaduct and its bed is now a pathway. This section of the railway line is now a cycle path and there is a set of access steps leading down from the viaduct to the pathway.

The two volunteers are standing in the centre of the filled in bed of the lade, which continues southwards through deciduous woodland. Until recently the course of the lade was a countryside path leading to the access roadway to the old Cherryton brickworks.

The lade crossed a small stream and the lade crossing and pathway have been washed out. The path was moved upslope onto a new line, with a wooden bridge now crossing the stream. The present pathway can be accessed from the roadway to the old Cherryton brickworks site [NS9230392298].

Figure 50. Lade and path washed out.

Figure 51. Lade Bed through woodland.

The line of the lade continues through the woodland until it reaches the roadway to the old brickworks. As it has been used as a pathway, its form is altered, looking more like a roadway than a lade.

Once out of the woodland and across the roadway to the site of the old brickworks [NS9212092306], the course of the lade to Riccarton has been lost to ploughing, the extension of a small quarry [NS9194192268 to NS9186692256] and, finally, the construction of the Clackmannan bypass road [NS9167592215 to NS9157492191].

Figure 52. Lade lost to ploughing

Similarly, the site of the Zetland storage tank has gone, leaving only the dog leg in the road to the Tower.

5.2 The Central Craigrie Lade Remains:

The entire central section of the lade has been lost to residential developments.

Fortunately, in constructing a driveway for his house, Ian Russell uncovered the remains of the old lade bridge and distillery building shown on the OS First Edition 25 inch map of 1862 and measured and draw sections of them. We are grateful for his permission to include his sections here.

Figure 53. Location of Lade Bridge.

His measurements indicate that the open lade bed in this central section was a three foot (0.91 metres) deep by six foot (1.83 metres) wide ditch. The closeness of the lade with eth distillery remains suggests that there was a relationship between the two, possibly in terms of water power, and/or water supply.

Figure 54. Section of Lade Bridge and lade.

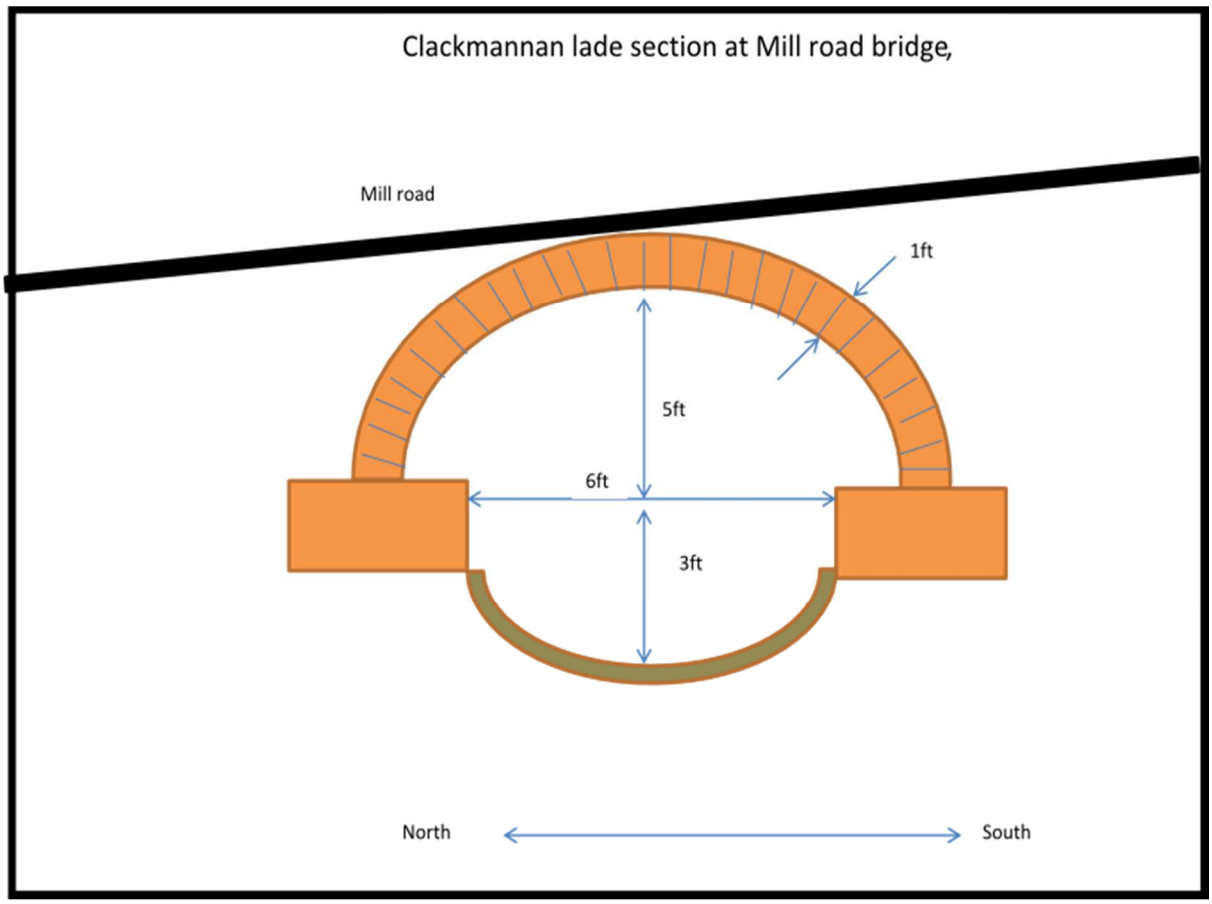
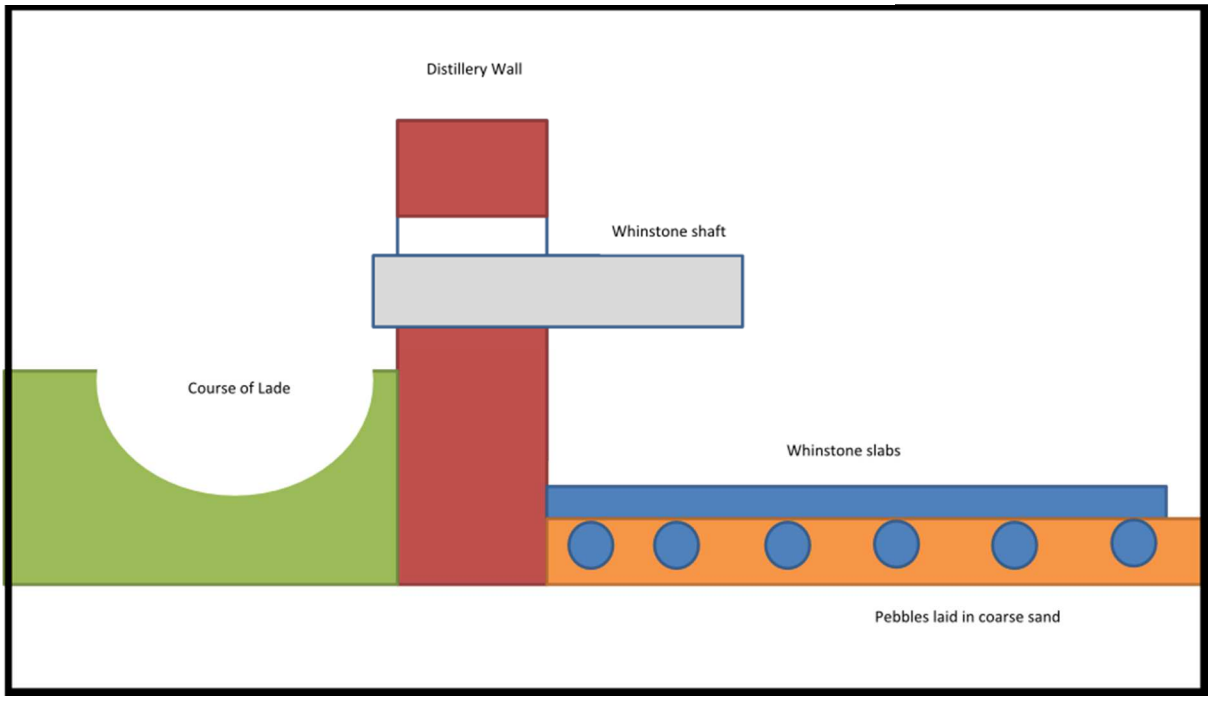


Figure 55. Section of the distillery building and lade.



5.3 The Lower Craigrie Lade Remains:

The remains of the lower section of the Craigrie lade were identified by walking up the fence line to the west of the modern blocks of flats at Backwood Court [NS908922]. The fence is on the same line as the one shown on the OS First Edition 25 inch map of 1862 (**60**) and we were able to confirm the location of the lade [NS9078492176] by measuring down from the Tower Park to the edge of the lade. This whole area is underlain by glacial clay, into which the lade has been cut.

Figure 56. The Craigrie lade on the Back Wood.

The lade bed is still evident all the way through the Back Wood as a substantial ditch, contouring the slope. The area has been planted with coniferous trees but, as in the case of the upper section of the lade, they have not been planted in the lade bed.

Figure 57. Lade continues through the Back Wood

A number of recently built pathways cut across the line of the lade. While some have caused minor damage to the lade bed, many of them have been bridged across the lade, leaving the line intact. The network of pathways offers easy access to the line of the lade from the public footpath along an old waggonway through the Back Wood from the B910 next to the Mary Bridge [NS9085292253] to the western edge of the Back Wood [NS9037592295]

Figure 58. Lade exits the wood into the Craigrie Farm.

Eventually, the lade crosses over from the Back wood into the fields of the Craigrie farm on the western slope of Kings Seat hill [NS9039192251]. The lade is cut into the slope, with the material from the cutting and the construction of the lade bed being used to create an upcast bank on the downslope edge.

This area is a large grass park with a linear area of trees and bushes along the course of the lade. In addition, there are still many trees and bushes along the former field boundaries. Two very small sections of the lade have been lost; one where a footpath crosses its line and another where cattle have eroded it in passing. Apart from this, the line of lade is well preserved until the last 150 metres, where the line has been ploughed out.

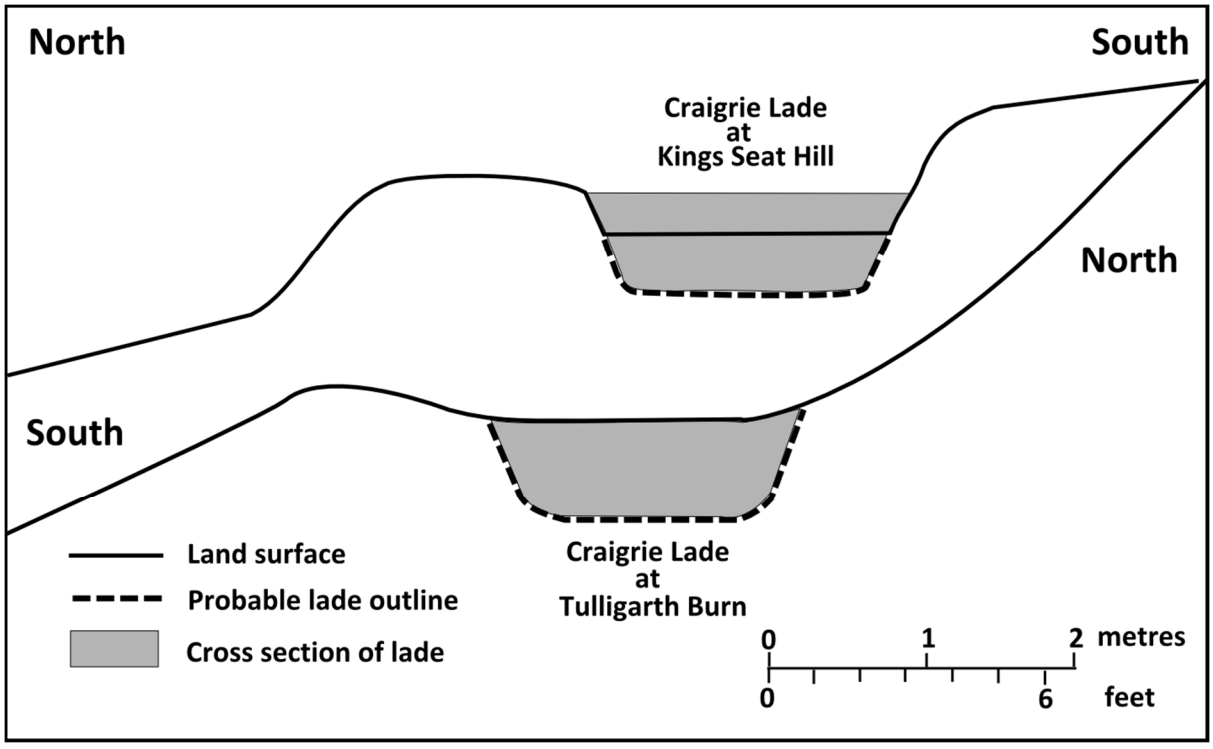
Figure 59. The lade contours round Kings Seat Hill.

The existence of the trees and bushes around the lade have been of significant value in protecting its line since it was abandoned.

Figure 60. Surveying the profile of the lade.

A number of sections were surveyed to establish the profile of the lade as it neared its end point. The manner of the lade's construction reflected the underlying glacial clay material. A simple cutting was made, using the material excavated to create an upcast bank on the downslope.

Figure 61. Profiles of the Lade at Kings Seat Hill and Tullygarth Burn.

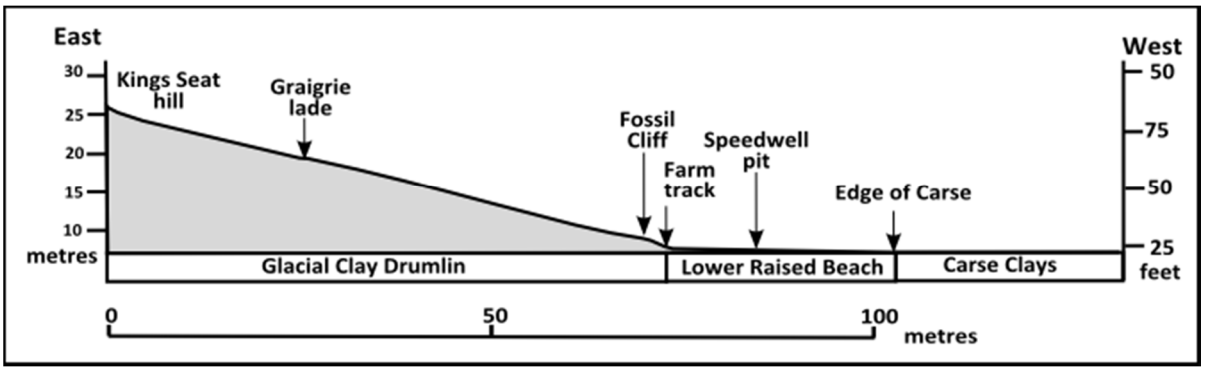


The surveys revealed that the profile of the lade at these two points was almost identical, with similar methods of construction and a similar sized lade bed, approximately six feet (1.83 metres) wide and some three feet (0.91 metres) deep. These measurements accord with those taken by Ian Russell at the lade bridge. The width of the upcast mound varied from 4 feet to 6 feet (1.22 to 1.83 metres).

Having finally arrived close to the site of the old Speedwell pit, it was clear that the line of the lade was considerably higher than the site of the pit. Surveying down from the lade to the old waggonway adjacent to the pit site showed a drop of 10 metres (32.81 feet).

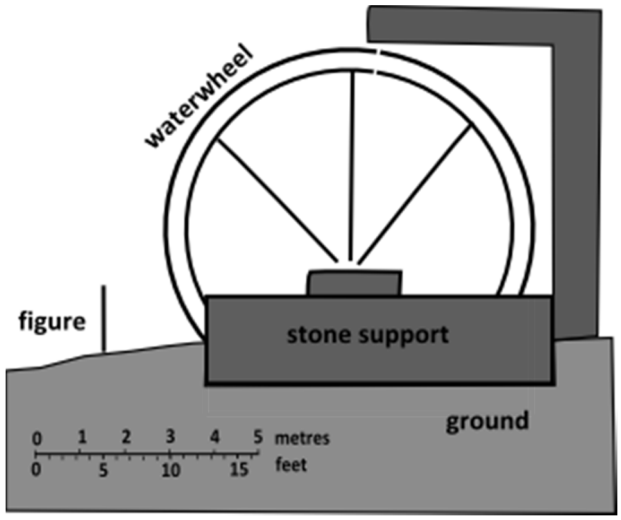
Figure 62. Surveying the drop from the Lade.

Figure 63. Section through Kings Seat Hill to the Carse lands.



Clerk's painting of Clackmannan Tower in 1775 (**61**) shows a waterwheel at the neighbouring Watermill pit (later the site of the Craigrie pit). There are two figures shown, roughly the same size. Assuming they represent a person of about five feet in height, the diameter of the wheel would have been in the order of 30 feet (just over 9 metres). The Watermill pit at the Alloa colliery had a wheel of this size. (**62**) The syphon would need to be higher than the top of the wheel and the lade even higher still in order to get water to flow down the syphon at a reasonable rate. The use of a large waterwheel was the driver for the lade being constructed so high up the slope of Kings Seat hill. In addition, in order to end at this height, the lade had to be started as far upstream as Lynmill.

Figure 64. 1775 Waterwheel.



The lade continues southwards for another 350 metres, with many mature trees and hawthorn bushes around it. About 159 meters before reaching the Craigrie farm steading the lade loses its tree cover and has been ploughed out. The extension of the Craigrie quarry and Craigrie pit in the 19th century has removed all traces of the lade and syphon.

Figure 65. The lade approaches the Craigrie Farm.

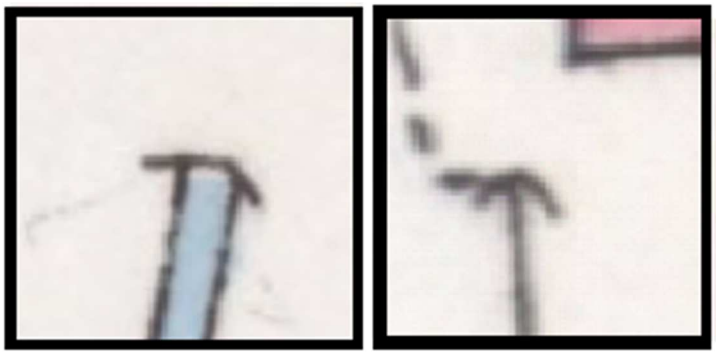
Figure 66a. Lade entering the ground.

Riccarton **Craigrie Farm**

The OS First Edition of the 25 inch map gives indication of locations of syphons. (**63**) The lade is shown as entering into the ground at two points; at Riccarton and at the end of the lade at the northern edge of the Craigrie farm steading. In both cases the same graphic is used.

Two instances of the lade emerging from below ground are shown, at Riccarton and at the site of the Craigrie pit. Again, in both cases, the same graphic is used. This suggests that the Craigrie lade finally entered a syphon at [NS 902523911720] and ended somewhere in the area of the site of the Craigrie pit [NS 904915].

Figure 66b. Lade exiting the ground.



Riccarton **Craigrie Pit**

The Zetland storage tank:

This old postcard was shot from the top of Clackmannan Church tower. It shows the Clackmannan County Council water works (with most of the walls painted white), the cottages at the top of the High Street and the road to Clackmannan Tower. The site of the Zetland storage tank was in the bottom right hand corner of the water works. The road from the High Street to the Tower still retains its dog leg.

Figure 67. Clackmannan County Council Water Works and site of storage tank.

Old Postcard of Clackmannan Tower, unknown provenance, courtesy of Andrew Wood.

The water works and the site of the storage tank (white rectangle) is now an overgrown tangle of brambles and weeds. The dog leg in the road to the Tower has been preserved.

Figure 68. Modern aerial view of storage tank site.

© Google Earth, 2016

5.4 The Garrison Dam and the Tullygarth Lade Remains:

There are several sources which mentioned a dam named Gartstank, Garrison or Tullygarth and several maps showed its location, lying on the Tullygarth burn to the east of the Craigrie lade. As the valley of the burn is heavily overgrown, access was gained from the cycle path on the former Alloa to Dunfermline railway [NS9264592447].

Figure 69. Track leading to Tullygarth burn.

A track leaves the cycle path, heading towards the line of the Tullygarth burn [NS9264792453]. The width of the track was about 10 feet (3 metres). There were signs that the bank to the east had been cut into recently to make it wider. There was a very slight ridge on the downslope edge of the track.

Figure 70. Profile of track.

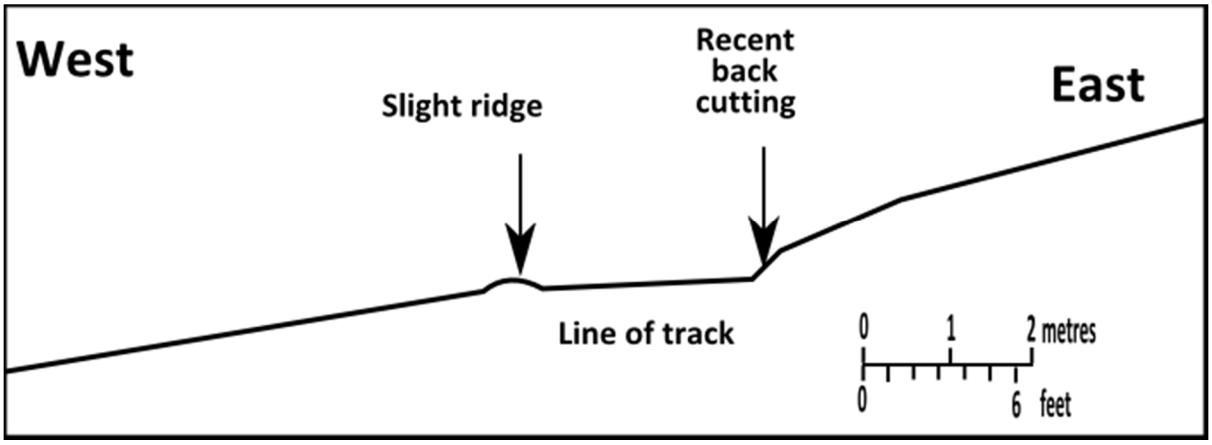


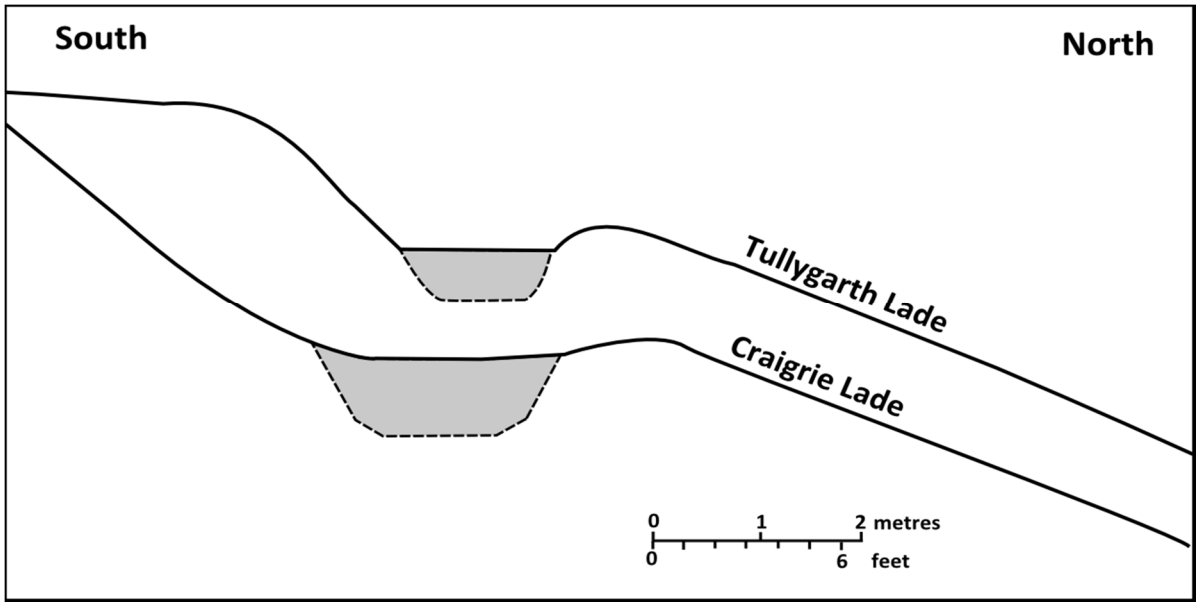
Figure 71. Remains of the Tullygarth lade.

On reaching the point where the track crosses the Tullygarth burn a well preserved section of lade was found, contouring down the south side of the Tullygarth burn [NS9274092582]. The most westerly part of the section turned southwards towards the line of the track (bottom right hand corner of the photograph above). The lade continued eastwards towards the site of the Garrison Dam. Upstream, the steep slope of the valley of the Tullygarth burn, together with mature trees and hawthorn bushes, have protected the lade from ploughing.

Figure 72. Centre section of the lade.

The centre section of the lade was well preserved. It was located at the top of the steeper section of the valley of the Tullygarth burn. The bank had been cut back and the spoil, together with that from the excavation of the lade bed, had been used to create an upcast bank below.

Figure 73. Cross sections of the Tullygarth and Craigrie lades.



The profile of the lade was surveyed and compared with that of the Craigrie lade at the foot of the Tullygarth burn. The Tullygarth lade was considerably smaller than the Craigrie lade.

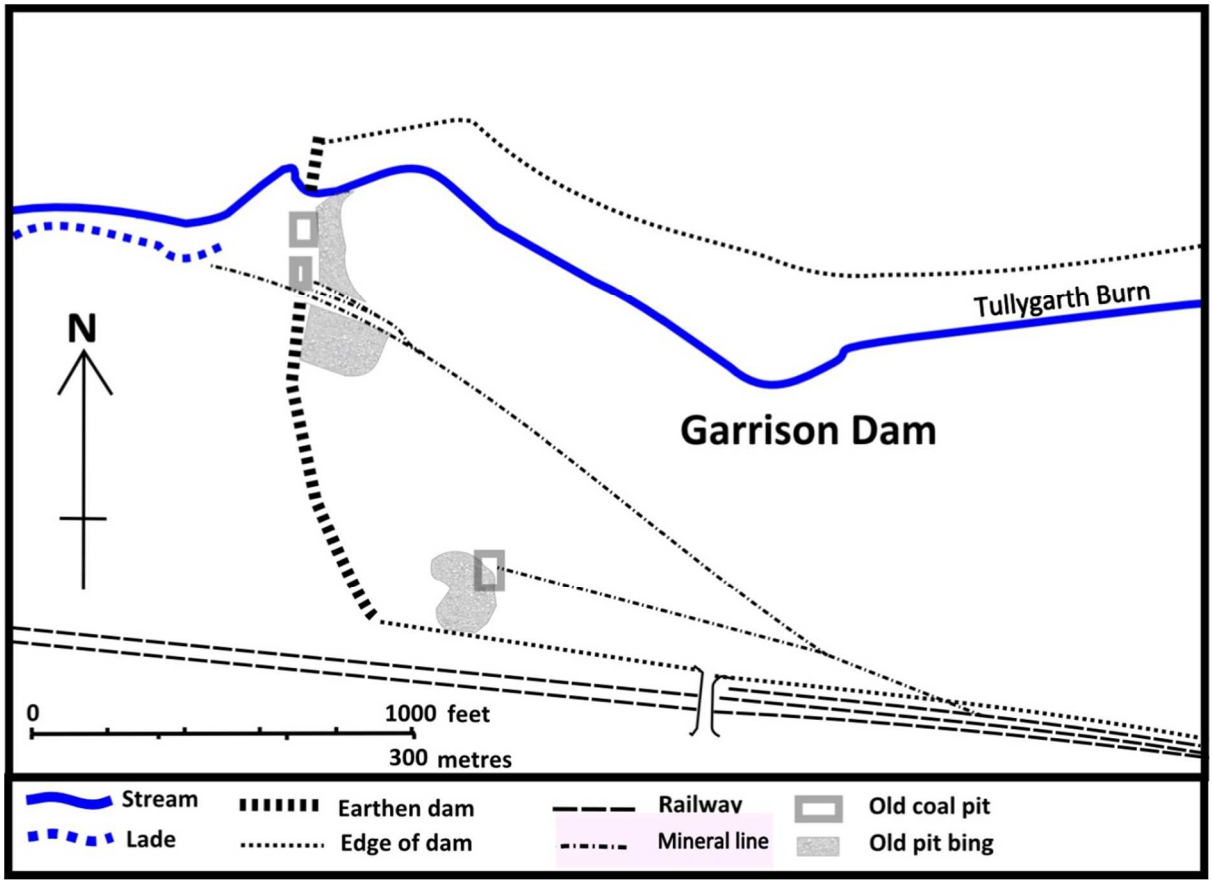
Parts of the of the Garrison dam are still visible. The most northerly section is almost complete. An examination of the remaining sections revealed that it was an earthen dam. Much of the centre section of the dam has been severely reduced in height or is missing. The line of the Tullygarth burn now cuts through the dam and stone piers have been built on either side, possibly to support a bridge.

Figure 74. Garrison Dam and start of lade.

The piers lie in front of the figure in the background centre of the photograph. The figure in the foreground stands at the end of the lade in front of a large hollow. Map research showed that this hollow and the reduction of height of the dam were related to the sinking of coal pits and the building of railway sidings in the mid-19th century.

The area of the Garrison Dam is outlined on the OS Second Edition Six inch map (**64)** as a marshy hollow 16.8 hectares (46 acres) in extent. This is about 30 percent of the size of Gartmorn Dam. (**65**) The remaining dam head on the north side of the dam is some 15 feet (4.6 metres) above the level of the Tullygarth burn. Given the relatively small size of the Tullygarth lade, this is a comparatively large dam. The Geological Survey Six inch map (**66**) and Ordnance Survey First Edition 25 inch (**67**) maps show that by 1861 the area of the Garrison dam had two coal pits sunk into it worked by the Clackmannan Coal Company (**68**) with a connection to the rail network.

Figure 75. Site of the Garrison Dam in 1861.



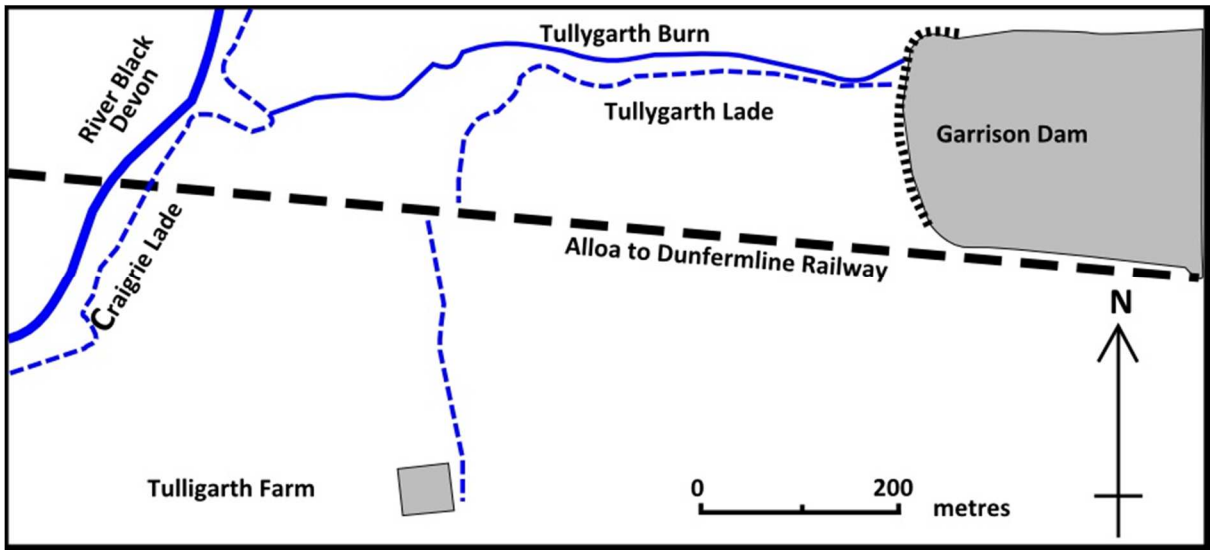
Based on Information from Ordnance Survey Opendata and First Edition Maps, National Library of Scotland

The size of the spoil heap of the mine next to the Tullygarth burn reflects the small size of the working. The presence of these two pits indicate that the Garrison dam had been abandoned prior to 1861.

Figure 76. Pit spoil heap at the Garrison Dam.

The same OS map shows that, at that time, the Tullygarth burn flowed directly into the Craigrie lade. The line of the burn is not shown below the lade. Roy's map (**69**) of 1747 to 1755 shows the Garrison Dam as feeding directly into the Craigrie lade, although it does not show the Craigrie lade connecting to Lynmill. Stobie's map of Perthshire and Clackmannanshire, 1783, (**70**) shows the Craigrie lade starting at Lynmill with the Tullygarth burn feeding into it from the Garrison dam.

Figure 77. Garrison Dam, Tullygarth lade and Craigrie lade in 1861.



Based on Information from Ordnance Survey Opendata and OS Maps, National Library of Scotland

Putting all of the historical and field survey evidence together, the Tullygarth burn is a small stream with a small catchment area. Gartstank dam was in existence in 1706 (**71**) and possibly fed into a small lade heading towards an old mill site near to the present Tulligarth Farm steading. By 1747 the Garrison dam was supplying water to the Craigrie lade (**72**) and was still doing so in 1783 (**73**)**.** Finally, by 1862, the dam was no longer in use, but the waters of the Tullygarth burn were still being captured by the now redundant Craigrie lade (**74**). The Second Edition of the Ordnance Survey 25 inch map (**75**) shows the Tulligarth farm had a well for a supply of water and a horse mill for power.

Given the disparity in size between the remains of the Garrison dam and the Tullygarth lade it is possible that the original dam might have been smaller in size and fed the Tullygarth lade. Once the water was being used as a feeder for the Craigrie lade, the dam may have been extended in size, increasing the volume of water available. Further examination and excavation of the remains might help to a better inform the development of the dam and the lade.

6. Conclusion:

The lade systems of the Craigrie and Tullygarth appear to have been constructed at the end of the 17th century as a supply for waterwheels. For the construction of nearly all of the lades, a simple cutting was made in glacial clay. Where the lade was running along a slope, the material excavated was used to create an upcast bank on the downslope side. The glacial clay base and sides of the lade bed would have been practically waterproof, particularly where the boots of workmen would have "puddled" the clay (forced out any air making the clay more dense and waterproof). Close to Lynmill, the Craigrie lade was running along the side of a steep sandstone gorge for a short distance. Here the lade was cut into the sandstone, sometimes as a stone-cut channel and sometimes with a clay upcast mound. There was a short section of trough leading into the lade and, possibly, a longer section bridging a short missing section of the stone-cut channel.

The Gartstank, Garrison or Tullygarth dam appears to have been in use at the time of the construction of the Craigrie lade. The short, relatively narrow Tullygarth lade is out proportion to the very large size of the dam as it was recorded in all of the maps (Roy, Stobie and Ordnance Survey). All these maps show some connection between the Garrison dam and the Craigrie lade. It is possible that the Tullygarth lade was originally related to a smaller dam which was extended when it became associated with the Craigrie lade. Further research would be required to settle this question.

The Craigrie lade appears to have been abandoned as a supply of water for power to the mines and distillery between 1841 (when the distillery was mentioned in the Second Statistical Account of the parish of Clackmannan) (**76**) and 1862 when the First Edition 25 inch map shows the pit sites and distillery as abandoned but the open lade still water filled. There is no historical information about the abandonment of the Tullygarth lade, other than the OS First Edition 26 inch map, which does not show it connected to a water using site.

The refurbishment of the upper section of the Craigrie lade circa 1866 as a public water supply for the town of Clackmannan was a magnificent gesture on the part of the landowner, the 2nd Earl of Zetland. Pumping a supply to the Tower Park was no mean feat at the time. However, the low level of the Craigrie lade at Riccarton was a severely limiting factor. The flow was not sufficient to supply individual houses, but fed a number of street wells or taps in the town. This low level also constrained the

development of water powered sites along the course of the lade, in contrast with the numerous sites which developed below Gartmorn Dam. (**77**) and (**78**)

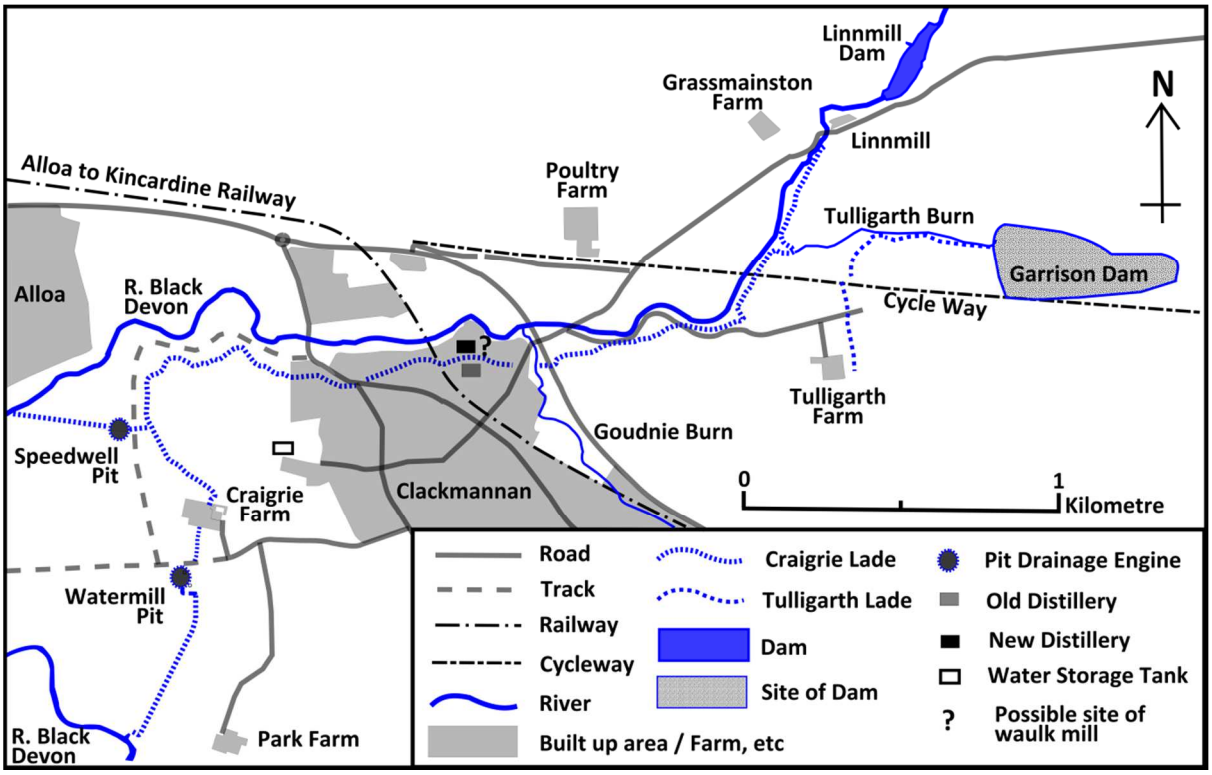
The height of Gartmorn Dam at 171 feet (52 metres) meant that it had a much greater potential for the development of power and water supplies. In 1891 to 1896 Alloa Burgh redeveloped Gartmorn dam as a water supply for the Town of Alloa. In order to service the higher parts of the town, a supply of unfiltered water was delivered by a town gas powered pump at the base of the Gartmorn Dam to a storage reservoir at height of 54 metres at the south end of the dam. (**79**)

A proportion of this water was fed to new filter beds adjacent to the reservoir, with a piped supply to the town of Alloa. A proportion was piped across by Clackmannan Station to new filter beds built on Tower Hill, immediately on the south side of the Zetland storage tank. (**80**) Only 30 years after the Craigrie lade first supplied the town of Clackmannan with a limited supply of clean water, Clackmannan County Council created a new, much larger supply fed from Gartmorn Dam. Close to that date the entire Craigrie lade was abandoned.

The Ordnance Survey Second Edition 25 inch map of 1896 (**63**) shows practically no trace of the lade, other than the remains of a shaft at the Riccarton where a syphon once started [NS9160892185] and a very small section of lade on the Craigrie farm adjacent to the Back Wood [NS9039792252 to NS9030992180].

A surprisingly large proportion of the lade system has survived. The remains have been protected by areas of woodland, steep slopes, poor drainage and chance burial. Areas across open ground or within the area of the present town of Clackmannan have been lost to ploughing and development. The survival of so many different elements and rich historical resources have enabled all of the different periods of use to be examined, surveyed and recorded.

Figure 78. Overall developments in a modern context.



Based on Information from Ordnance Survey Opendata and OS Maps, National Library of Scotland

We hope that this report will encourage others to continue to explore this fascinating topic and that more evidence will be uncovered.

Further details of the history of the Craigrie and Gartmorn lades is contained in the booklet, *The Craigrie and Gartmorn Lades*, published by the Clackmannanshire Field Studies Society. Copies may be ordered on-line at

http://www.cfss.org.uk/cfss_publications.php

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