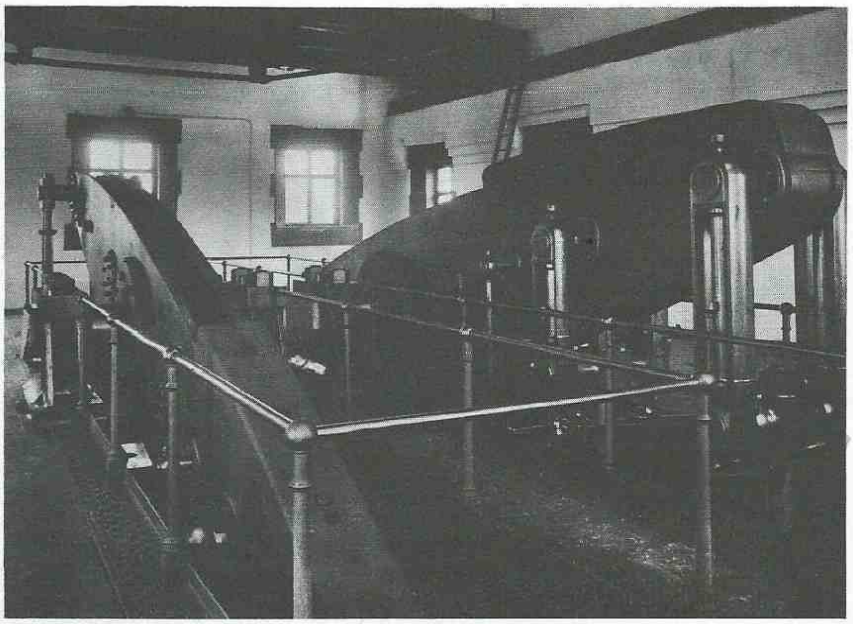
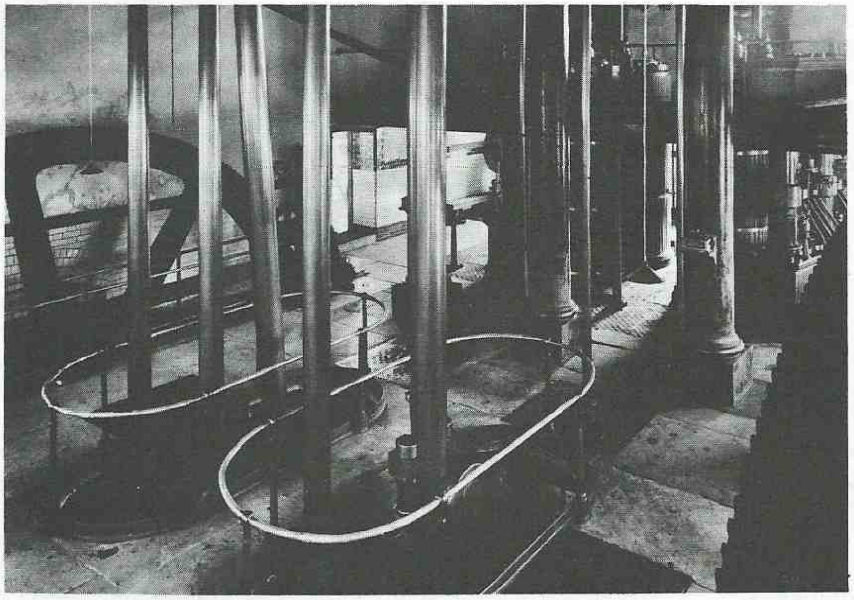
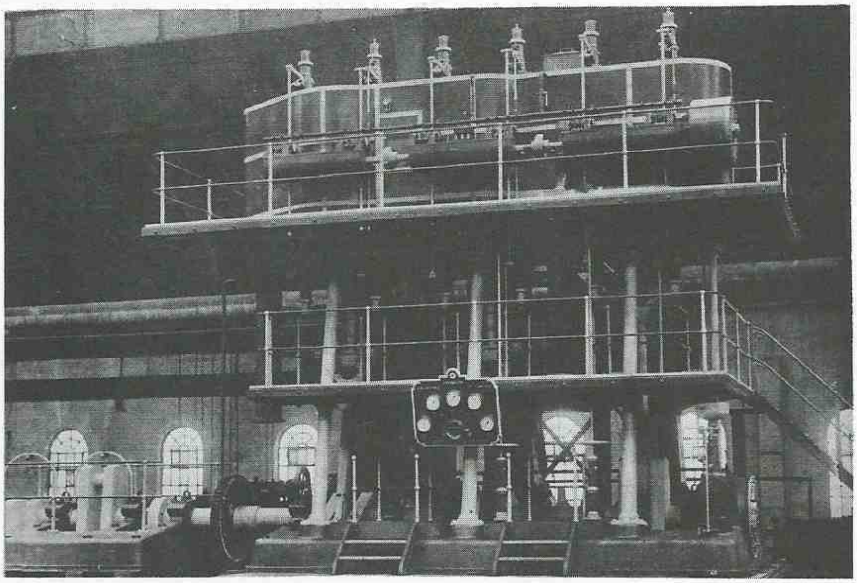


Beams of the Watt engine at Chelvey,



The Watt engine at Chelvey, 1890—1958



The Chelvey triple-expansion engine assembled for testing at Lilleshall works

Pumping Bristol's water: Part two Chelvey

Peter Skinner

The exceptionally dry summer of 1864 left the Board of Bristol Waterworks Company in no doubt that the city needed further supplies of water. The long drawn out work of sinking a well at North Hill, Winford, had produced but a trickle and not only was the City population increasing; water was being distributed to areas previously without a public supply.

Five or six miles from the city boundary, just west of Flax Bourton, the river Kenn rises to flow a short distance across Kenn Moor to the sea near Clevedon, and near the hamlet of Chelvey waters emerge in marshes from the Midgal Spring (ST 456678) and Chelvey Spring (ST 464683) to join the river. James Simpson, the company's consulting engineer recommended these springs to be impounded and parliamentary powers were sought. To appease landowners along the river Kenn, clauses were included preventing the company from taking water unless at least three million gallons a day were passing over a gauge to be fixed in the river and the Act received the Royal Assent late in May 1865.

The springs, near the Bristol and Exeter Railway Company's bridge over the Kenn, were to be led by conduits to a shaft beneath a pumping station, shown by the parliamentary plans on a parcel of land near Midgal Farm. Cast iron pipes were to be laid underground thence to Barrow where the company's second storage reservoir was under construction. With trial shafts being dug, in August James Simpson proposed a re-location of the pumping station. This advice being accepted, further land was purchased a mile nearer Bristol, just off the Weston-super-Mare road (ST 473679).

The change required a masonry-lined aqueduct from the springs to a suction chamber beneath the pump house. Contracts were let for cast iron pipes at £9389 with Stewart and Company of Glasgow and for a pair of beam engines at £5616 with Robert Daglish of St Helens. The pipes were delivered to Nailsea station, the Bristol and Exeter Railway supplying a portable crane for unloading. Thomas Bell, the company's superintending engineer recorded the scene in his diary; ‘Large quantities of pipes are lying scatterd about. The contractors are removing them as fast as they can. Four pipes out of 135 are cracked; we have great difficulty in finding the weights and various sizes are bundled together.' In the early part of 1866 Kirby and Adams started constructing the aqueduct and the same firm secured a contract to build the engine house and workshops, while Richard Mereweather started his contract for laying the pipes through Backwell and Flax Bourton and up to Barrow. The work occupied over a year, with major parts of the engines being set on foundations in mid-summer 1866. The pipe laying continued along the highways, while steam driven centrifugal pumps (probably bowl type) supplied by Gwynne and Company were fixed in September to de-water the aqueduct and pump suction chamber. On Backwell Hill, along the line of the pumping main, a small reservoir was constructed as a break-pressure tank (later found unnecessary). The engine house roof went on during December 1866 and '12 inch earthen pipes' were laid to lead the spring water into the adqueduct. In the early months of 1867 Thomas Bell complained of slow progress on the part of the engine erectors as the aqueduct works reached completion.

The ‘parliamentary’ gauge was constructed on the River Kenn, and in the first weeks. of April coal was ordered 'to gradually dry the boiler flues'. On the 25th April one engine was worked, only to be stopped when the pumping main burst. From early May, water was pumped intermittently to Barrow with a number of stoppages due to bursting of the main and for various adjustments to the engines. Later, surge vessels were added to the pump delivery branches, eliminating most of the trouble with pipe bursting and curing engine troubles which had been arising from water hammer. These were 60 hp engines with single 31½ ins x 5 ft 6 ins cylinders and 13½ ins x 4 ft 7 ins pumps, steam consumption being given as 60 lbs/pump hp/hour. There were five Cornish boilers, 30 ft x 5 ft 5 ins carrying a pressure of 40 psi. Working at 17 strokes/minute 958,400 gallons were pumped in a day requiring 4 tons of coal.

James Simpson had advised the changed location for the pumping station believing that a major supply of water could be obtained from underground. Until the turn of the century Chelvey supplied the bulk of the water needed in Bristol beyond the gravity yield of the Mendip springs.

The next development in 1870 was the sinking of a shallow well within the station grounds. This was 32 feet deep with two boreholes driven into the bottom, one to 166 ft depth. A heading led the yield of water into the aqueduct from where it was pumped by the Daglish engines. Then, early in 1871, a 7 ft diameter well was started nearby and sinking continued until December 1873. Considerable quantities of water were met not far below ground and pumping was necessary to allow the well sinkers to continue. Thos Bell clearly notes that 'the 30 horse engine from North Hill is being delivered to Chelvey’. This was the engine obtained from Knight's of Ashton and used at North Hill, Winford, from 1859. It remained at Chelvey until 1923. There was also a 12 horse-power engine and Thos Bell notes 'the hoisting engine is now at work lifting water from the new well.' A sixth boiler, a 6 ft 10 ins diameter Galloway, was put in at the end of 1871 to supply these engines. New pumps of 14 inch bore were delivered from St Helen's, presumably made by Daglish, and were installed on timbers in the 7 ft well. The '30 horse’ engine, a horizontal machine with 20 ins x 4 ft cylinders, was housed in a substantial stone building and coupled by timber rods and a bell-crank to drive these pumps. Repairs to this engine sometimes required spare parts and Thos Bell notes that Messrs Bush & de Soyres had the pattern for a

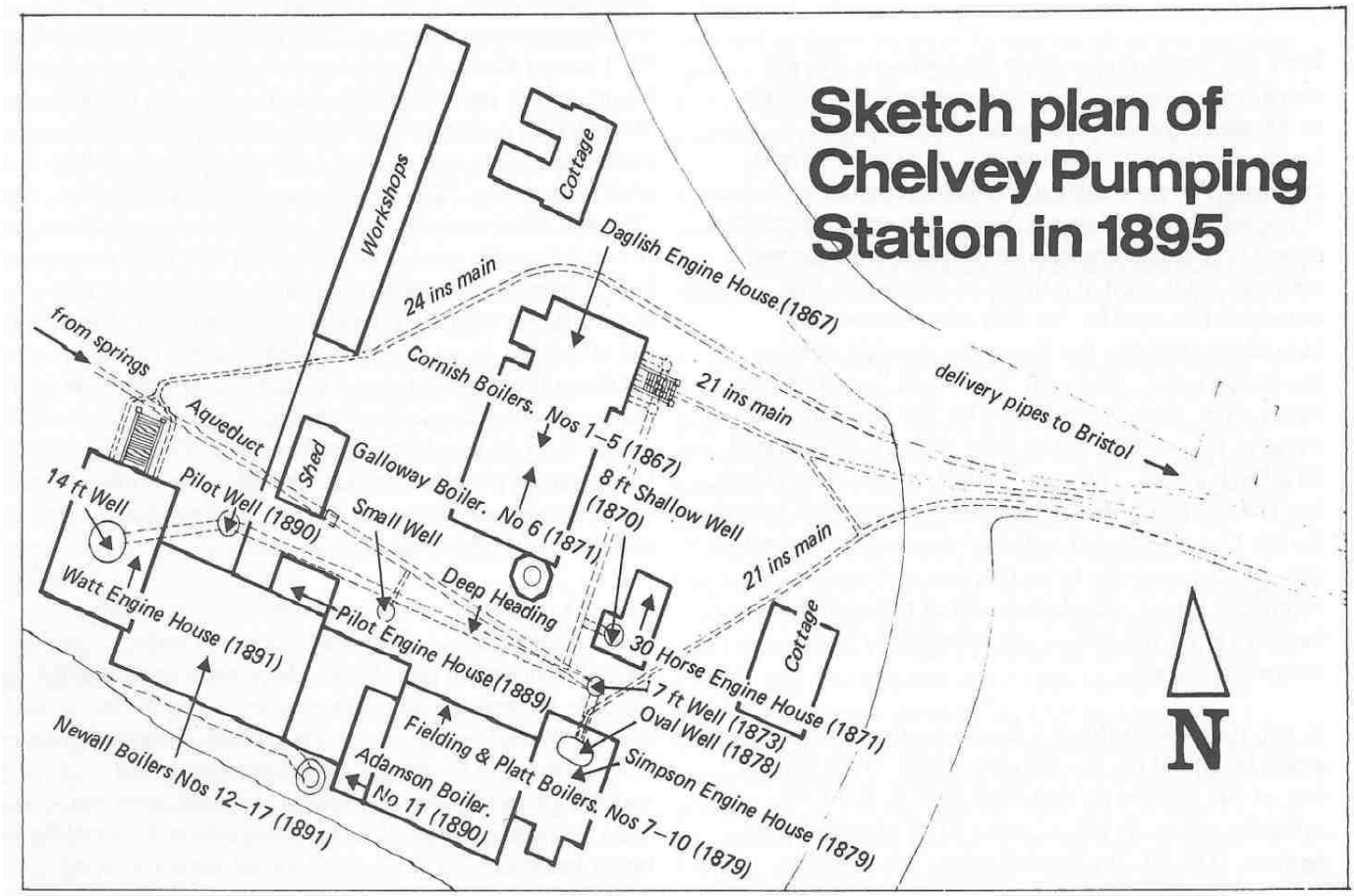
steam chest cover, so it appears that this firm was the original maker.

The sinking of this well continued until the end of 1873 with considerable flows of water encountered. These were 'walled back' and 'brattice cloths' used to 'conduct the water down'; presumably reducing the spray over men working below. There was a pause in the work during the summer of 1873 while the 30 horse engine was coupled to 8 inch upper pumps drawing from the aqueduct and discharging through a 9 inch pipe into the Barrow pumping main. With the two Daglish engines as well and the 30 horse doing 14 strokes/minute, a total of 1,730,000 gallons/day was gauged flowing into the store reservoir during a trial. Throughout this and subsequent work the coupling of engines to pumps was frequently changed, and the 30 horse went back to pumping out the 'new' well when sinking was resumed in the autumn. Finally a 4" borehole was driven to a total depth of 290 feet below ground, the well bottom being at 163 ft 6 ins.

Having completed this well there seems to have been some delay and uncertainty about bringing it into use. The 14 inch pumps installed in it could be worked only if the 30 horse engine was uncoupled from its 8 inch force pumps, reducing the capacity to pump water away. Earlier references to pumping with a 12 hp engine do not recur and it seems this and a 'loco-boiler' were removed when sinking was finished. Early in 1876 a heading was made, about 40 ft below ground, from the well into the aqueduct 'to utilise the water rising in the well'. This allowed the Daglish engines to pump well water but only if the water rose to the heading level which was not the case in summer. In August 1876 instructions were given to take in water from the Springs 'if found to be good' but this had to be stopped because the flow to the River Kenn over the gauge fell below the statutory minimum.

John Taylor, who had taken over James Simpson's position as the company's consulting engineer, now recommended the sinking of 'a pumping well' and the installation of two 100 horse-power pumping engines . It should be noted that the company believed it could take all the water it wished from wells beneath its own land at the pumping station, since the 1865 Act merely prevented the taking of the Midgal and Chelvey Springs if the Kenn flow fell below three million gallons a day. This was to have repercussions later. In retrospect it seems odd that another well should be sunk only a few yards from the recently completed and under-utilised '7 foot well'. Perhaps it was thought too small for the necessary pumps, the second well being a 9 ft x 13 ft 6 ins oval section, always referred to as 'The Oval Well'.

A Mr Rowse secured the contract for sinking to 153 ft at £1439 in September 1876 while Messrs Simpson & Co contracted to supply and erect the pair of 100 hp engines and four 30 ft x 7 ft Lancashire boilers (sub-contracted to Fielding & Platt) at £13,470. At the same time a new 21 ins pumping main was laid, through Long Ashton, so that water from Chelvey could be supplied directly to the City. The 'oval well' was marked out and started in October 1876 and water was found only 20 ft down. Rowse, the well sinker, got into difficulties as he went deeper, having made no provision himself for 'overpowering the water' although it was his responsibility under the contract. He drove a bore-hole into the adjacent 7 ft well, thinking to drain water off,



but in fact flooded his works from the higher level there. The 30 horse engine was started, coupled to the 14 in pumps in the 7 ft well but could lower the water no more than 11 ft.

The company offered to lend Rowse a 12 inch pump, but there was an argument over who should meet the cost. The company wanted to take over the pumping and make a deduction from the contract price; Rowse wanted to arrange his own pumps but he proposed altogether smaller machinery than John Taylor would accept as adequate. In the event the 12 in pump went down, and a bell-crank was installed. No further engine was mentioned at this stage, so one assumes the '30 horse' drove it. For a time sinking went on but soon the pumps were again overpowered. In February 1877 the company hired a 'locomotive engine' from Llewellin and James which was coupled by bell-cranks to two 15 in pumps, lowered by shear legs in the new well as sinking progressed. £200 was to be deducted from Rowse's contract for this. There were numerous interruptions due to engine breakdowns, and another 'locomotive engine' was brought in by the company to drive a 10 inch pump, belonging to Rowse, in the 7 ft well, but slowly the new 'pumping well' went down.

H W Pearson, assistant to Thomas Bell for a time had now become the company's resident engineer and Edward Taylor, one of John Taylor's sons, represented the consulting engineer on the site. As 1878 passed, the Taylors felt they had gone deep enough, but the board insisted on 'the contract depth'. Poor Rowse more than once pleaded to be released from his contract 'and work at an hourly wage', but the company refused to hear of this. Full depth was reached in March, but a large amount of work remained in opening out and bricking. Pump parts started to arrive from Simpsons and a Mr August Krauss started building the new engine house under contract for £6,215.

There was trouble on the site in June and July. Pearson complained of Edward Taylor giving counter instructions to the company's men, and several times there was insufficient steam for pumping to Bristol and de-watering the works. Pearson's opinion was that this should not happen 'if the working of engines and boilers were properly attended to' and he gave one fireman a week's notice. Pearson was obviously in the habit of arriving 'on the ground' (the expression then used for 'on site') unannounced, and complained at finding five firemen on the night shift 'not four as instructed', He several times found David Cuss, the engine driver, absent from the works. This man was in full charge of the pumping station plant and staff and was paid 28 shillings a week. The board applied itself to the problems, too, and instructed Pearson by a minuted resolution 'to work the five Cornish boilers if sufficient steam cannot be kept up with four only and also to see that the relief valve is not improperly loaded'. For dealing with all these problems Pearson's salary was £400 a year, second only to the company secretary.

In July Rowse was paid off but work continued with the engine house and the new Simpson pumps. These were, in fact, of 120 nominal hp, had single 45 in by 5 ft 6 ins cylinders, and ran at 12 rpm, using 40 lbs of steam/pump hp/hour, at 50 psi. The nominal output was 3 million gallons a day (MGD) and the pumps were 24 inch by 4 ft 7 ins stroke. The well pump rods were an extension of the upper (force) pump rods through a lower gland, with ladders and staging right down the well to lower pump level. This allowed access to the pumps for repairs; always supposing the water level could be kept down!

In October 1878, the portable engine having been returned to Llewellyn and James, the Company succeeded in beating them down from £1,033.00.8d, to £700 for the total period of hire. At the sime time Krauss was in trouble for slow progress on the. building and he discovered he had forgotten to price for some items in the Bill when he tendered. He must complete the contract said the Board, but they relented to the extent of allowing him £600 for the unpriced work. Severe weather was a hindrance that winter, but as spring 1879 followed, better progress led the Board to 'require to have the works ready by July 1879'. But the Daglish engines and the '30 horse' had to maintain the supply that summer. David Cuss overlooked orders to start the '30 horse' in July and had to journey to Bristol for a reprimand in the Board room and 'fined two weeks pay'. In October 1879 the necessary new 21 inch pumping main connections were made to the Simpson pumps and they went into service.

As the demand for water rose means were tried to get more water from the wells. Early in 1886 the Diamond Rock Boring Company were engaged to drive an 18 in borehole from the bottom of the 7 ft well, but before they started repairs were needed in the Oval Well, which gave a glimpse of problems to come. 'After very hard pumping', Pearson noted, 'succeeded in getting the water low enough to enable the bucket and glands of No. 3 lower pump to be packed. So much water was passing through the well that the men were unable to keep their lamps properly burning'.

When boring started in May obstructions and debris were encountered at the bottom of the 7 ft. At the same time No 3 pump failed again and this time no amount of pumping would uncover the Oval Well pumps so a diver was engaged. The old 14 in pumps were re-fixed in the 7 ft and the '30 horse' drove them, lowering the water enough to allow the diver to repair the '12 in auxilliary pump' in the Oval Well. (This was driven by No 4 engine). It then became possible to repair the main pumps in the Oval Well and it was only in September that the diver got so far as clearing the debris in the 7 ft. Then boring proceeded quickly and from the end of October to the 1st January 1887 the 8 in bore was put down 165 ft below the well bottom. In June that year Pearson reported 'the water at Chelvey keeps up to the level of from 70 ft to 80 ft from the ground; 20 ft to 30 ft higher than at this time last year, although there is now more pumping and the season is drier'. The improved position was attributed to the new borehole.

Pearson's reports show that repairs were constantly being made to pumps and engines. Steam and water leaks, clacks (ie non-return valves) letting by, wear in motion pins, glands to be repacked; the catalogue, fascinating to the steam enthusiast, is too long to give in detail. But clearly, it was all too easy for there to be less pumping power available at Chelvey than was needed and repair work was often very difficult, sometimes requiring a diver. Fortunately labour was cheap and, if any were needed, these diaries are

a reminder that the 'romance' of reciprocating steam plant is something we could not afford commercially today.

In 1888 it was decided that another set of deep well pumps was needed. Referred to as the Chelvey Duplication this work started with Pearson visiting Phillips of Newport and buying a 40 horse power engine and by June 1888 the 'engine, faceplate, pump, T bob, suction pipes, soleplates and glands were delivered on the ground'. This pump, of 26 in bore and 6 ft stroke was installed by Messrs Docwra, in the 7 ft well, along with the old 14 in pumps. The 'Auxilliary Engine', as it was called, was housed in a corrugated iron shed, the engine fitting being done by Bush and de Soyres. It was set up to work the pump through a bell-crank and delivered water via a new heading into the aqueduct, being ready in October 1888. This would help summer output; the previous June the Daglish engines had been unable to pump full output because 'Kenn Moor gauge falling below the statutory quantity, the valve was closed'.

In 1889 a further well was sunk, some 50 yards west of the earlier wells. This was 8 ft diameter and was taken to 175 ft depth, the contractor being Thomas Docwra & Sons. A pair of 40 hp coupled engines drove 27 in well pumps, lifting 3 MGD from the pilot well, and pipes allowed this water to go into the aqueduct when required. An extra boiler, No 11, an Adamson Lancashire, was added in 1890 Then a 14 ft diameter well was sunk close to the pilot well, to 168 ft depth, a heading connecting the two at the bottom. Thus the Pilot Engines could dewater the new '14 ft' for construction of the engine house and installation of the 150 hp pumping engines. These were Watt compound beam engines, with 33½ ins x 5 ft 4 ins high pressure and 52 ins x 8 ft low pressure cylinders. The well pumps (double) were 27½ ins x 2 ft 3 ins stroke and the upper pumps 20¼ ins x 8 ft. At 12 rpm the engines each pumped 2½ MGD taking 27 lbs of steam/pump hp/hr at 70 psi supplied from a new boiler house with a rank of six Lancashire boilers by Newall. The new plant first worked on 5th May 1891. Underground, a heading was driven at well bottom to connect the 'Pilot' to the 7 ft well.

Chelvey was now at the peak of its development as a steam pumping station. Three pairs of beam pumping engines and three auxilliary engines stood over an underground complex of four deep wells, boreholes, culverts and headings, and there was a total of seventeen boilers. With workshops, offices, stores, mess-rooms and company cottages, the engine and boiler houses made an imposing range of solidly constructed stone buildings. The Watt engines were now used as first choice, but one Simpson was required with them to pump 5 MGD, the maximum capacity of the mains. This consumed 20 tons of coal every 24 hours. When repairs were required other engines had to be steamed but the original Daglish engines were disused after 1902.

J A McPherson, the company's engineer from 1904 advocated the scrapping of all but the Watts and Simpsons to be followed by the installation of a modern engine to pump from the 7 ft well. Known as the 'Chelvey renewals', this was implemented in 1922-23 with the ordering of a 400 hp triple expansion rotative engine with the Lilleshall Company. The long serving '30 horse engine' went for scrap, to make way for a new engine house, enclosing the 7 ft well, while the original Cornish boilers and the Galloway went too, leaving space for an enlarged boiler house to accommodate three 30 ft x 7 ft 6 ins diameter Lancashires by Edwin Danks. This new plant was set to work in 1924; the new engine pumping 4 MGD and taking 12.43 lbs of superheated steam/pump hp/hr at 160 psi. An extension of the crankshaft drove the two 22 in x 42 in well pumps by cranks and rods, whilst the three force pumps of 17⅝ in diameter were below the floor, driven directly from the cross heads. A suction tank was provided outside the building and there was a substantial surge vessel on the delivery main. The engine cylinders were 20 in, 35 in and 56 in diameter respectively with a common stroke of 42 ins and normal speed was 22 rpm. This engine was a beautifully constructed example, of reciprocating steam power at the peak of its development and it reached the highest efficiency for plant of its type. In pumping the full 5 MGD, with one Watt engine, the coal consumption was reduced to 13 tons a day. In 1927 three new Lancashire boilers by Tinker Shenton & Co were put in to supply the Watt engines; the last steam plant to be installed at Chelvey. There was a clear-out in 1937, the Daglish engines and pumps, the Simpson engines and upper pumps and three boilers were sold to Cashmores of Newport for £1,700.

The Land Drainage Act of 1930 set up the Somerset Rivers Catchment Board who questioned the company's right to take water from the Chelvey wells. (Water had not been taken from the springs since the turn of the century). A writ was issued in 1936 claiming that the 1865 restriction on abstraction, relative to the Kenn gauge, applied to the underground water. The company maintained the well supply did not affect the flow in the river and during some drought years in the 1930 s pumped when the Kenn flow was nothing! After inconclusive tests, adding salt at the springs, the parties entered into an agreement to regularise the position in the Bristol Waterworks Company Act 1939, which gave the company full powers to operate the Chelvey Station provided a minimum flow of 1½ inches (about 1 MGD) was maintained over the Kenn gauge.

The end of steam at Chelvey came in 1956, the 'Simpson' engine and boiler houses having been demolished in 1950. The Oval Well was cleared and electrically driven submersible pumps were put down, with control gear and electric force pumps in a new building. Tests were made late in 1956 with the 'Triple' engine and the electric plant together and, since a new main laid to Portishead allowed water to leave the station more freely, a total rate of 6.6 MGD was pumped. This was steam's last fling; the Watt engines and their boilers going for scrap in 1956 and the 'Triple' remaining disused from 1957. This impressive engine can still be seen in situ, but the boilers have been removed, and the Watt engine house was demolished to ground level in 1965.

Sources Bristol Waterworks Company: Board Minutes, Engineers Report Books and drawings
G A McPherson (Chief Engineer)'Consideration of Waterworks Pumping Plant', presented to the British Waterworks Association, 1926.

Acknowledgements The author wishes to express his appreciation to Bristol Waterworks Company for access to company records.