THE SOUTH STAFFORDSHIRE WATER COMPANY

Preserved Steam Engine

at

Sandfields Pumping Station

Viewing by appointment

The South Staffordshire Waterworks Company, Green Lane, Walsall WS2 7PD

Telephone: Walsall (0922) 38282. Telex 336358

INTRODUCTION

The South Staffordshire Waterworks Company

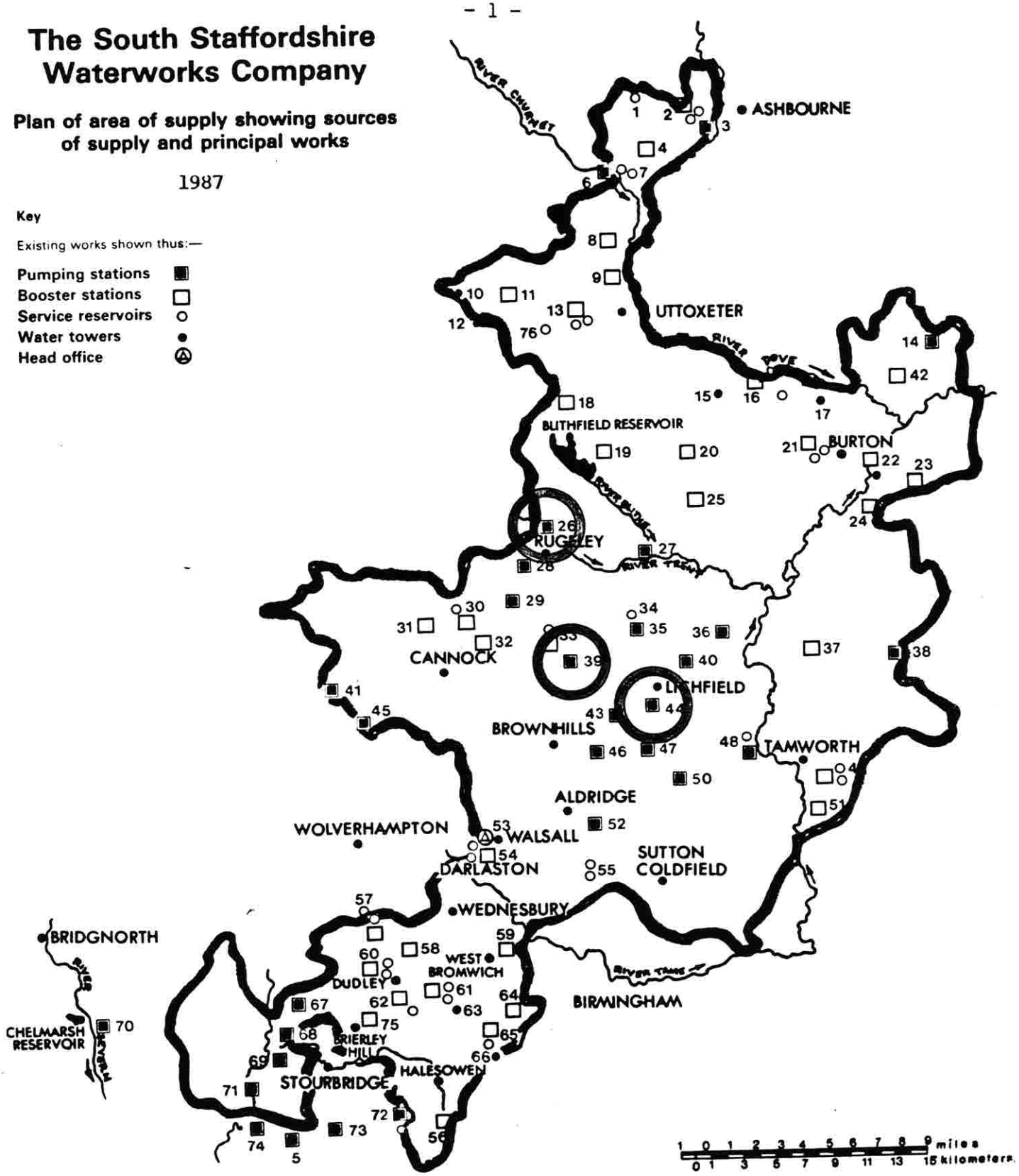
Plan of area of supply showing sources of supply and principal works

1987

Key

Existing works shown thus:—

- Pumping stations ■
- Booster stations □
- Service reservoirs ○
- Water towers ●
- Head office ⊙



Based upon the ordnance survey map with the sanction of the Controller of H.M. Stationery Office

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4 ELLASTONE
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10 MORRILOW HEATH
11 DODS LEIGH
12 OVERPARK
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PRESERVATION OF OUR INDUSTRIAL HERITAGE

The South Staffordshire Waterworks Company has an excellent record in maintaining its historical buildings, and preserving our industrial heritage. At a number of the Company's operational pumping stations the original buildings, which previously housed steam engine powered pumping plant, have been retained. Three former steam pumping stations have been chosen by the Company for preservation namely, Brindley Bank; which also houses a museum, Maple Brook and Sandfields. At each of these old pumping stations the original steam pumping engines have been preserved in their original settings. The pumping station buildings, which are all excellent examples of the architecture of their period, house three different types of steam engine previously operated by the Company. Brindley Bank, which is an example of a Victorian pumping station, has been established as the Company's museum. In addition to the superb example of a horizontal compound rotative steam pumping engine, the museum has a collection of historical photographs, documents, artefacts and numerous examples of pumping plant machinery. Maple Brook pumping station houses a magnificient example of an inverted triple expansion rotative steam engine, and a splendid example of a cornish beam engine is preserved at the Sandfields site. It is noteworthy that the three preserved pumping stations are all fully operational, with modern pumping plant installed alongside the preserved machinery. Together these preserved pumping stations illustrate the Company's use of steam powered plant over a period lasting nearly 115 years (1858 - 1972).

EARLY HISTORY OF SOUTH STAFFORDSHIRE WATERWORKS COMPANY

The South Staffordshire Waterworks Company was incorporated by Act of Parliament in 1853, and was formed by the first Earl of Dudley; who also turned the first sod for the Company's original works at Lichfield on 22 February 1856. The Company was established to meet the need for a pure and plentiful supply of water in the Black Country area. At that time the Black Country was a densely populated mining and iron working area, which had undergone a period of unprecedented growth. There were abundant natural resources of water, but these had been grossly polluted by neglect, through lack of an organised system of public water supply. The quality of life was very poor, cholera claimed many lives, some churchyards were reportedly overflowing with bodies, and the average life expectancy was only 23 years. The original South Staffordshire Waterworks Company supply to Lichfield and the Black Country, was from two impounding reservoirs, Stowe and Minster Pools, located near Lichfield Cathedral. Water gravitated from these two pools, in an addit tunnelled under the City of Lichfield, discharging into a pilot well at Sandfields, the Company's first pumping station, completed in 1858. It was then raised by pumps and delivered to Summit reservoir at Brownhills and thence to the Moat, a reservoir at Walsall, in a 22 inch and 24 inch diameter cast iron, pumping and graviating main, following the route of the Lichfield to Walsall and Dudley railway line. From Walsall it was boosted around the Black Country by individual pumping stations. The original Company offices were situated at Lichfield railway station in 1853.

ANNO DECIMO SEXTO & DECIMO SEPTIMO

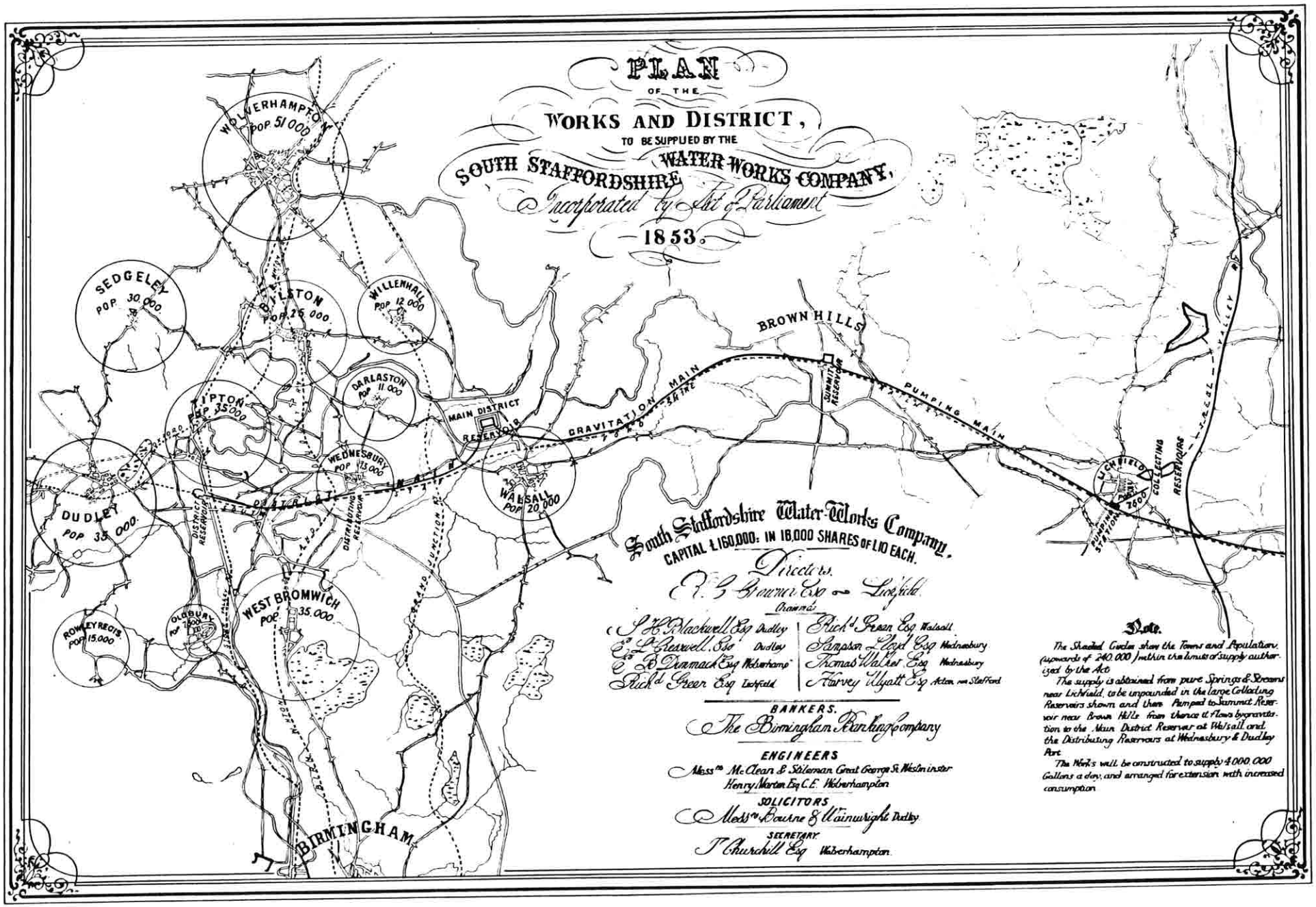
VICTORIÆ REGINÆ.

* *

Cap. cxxxiii.

An Act for supplying with Water the Inhabitants of *Walsall*, *Dudley*, and other Places in the Southern Parts of the County of *Stafford*, and in certain Parts of the County of *Worcester* adjacent thereto. [4th *August* 1853.]

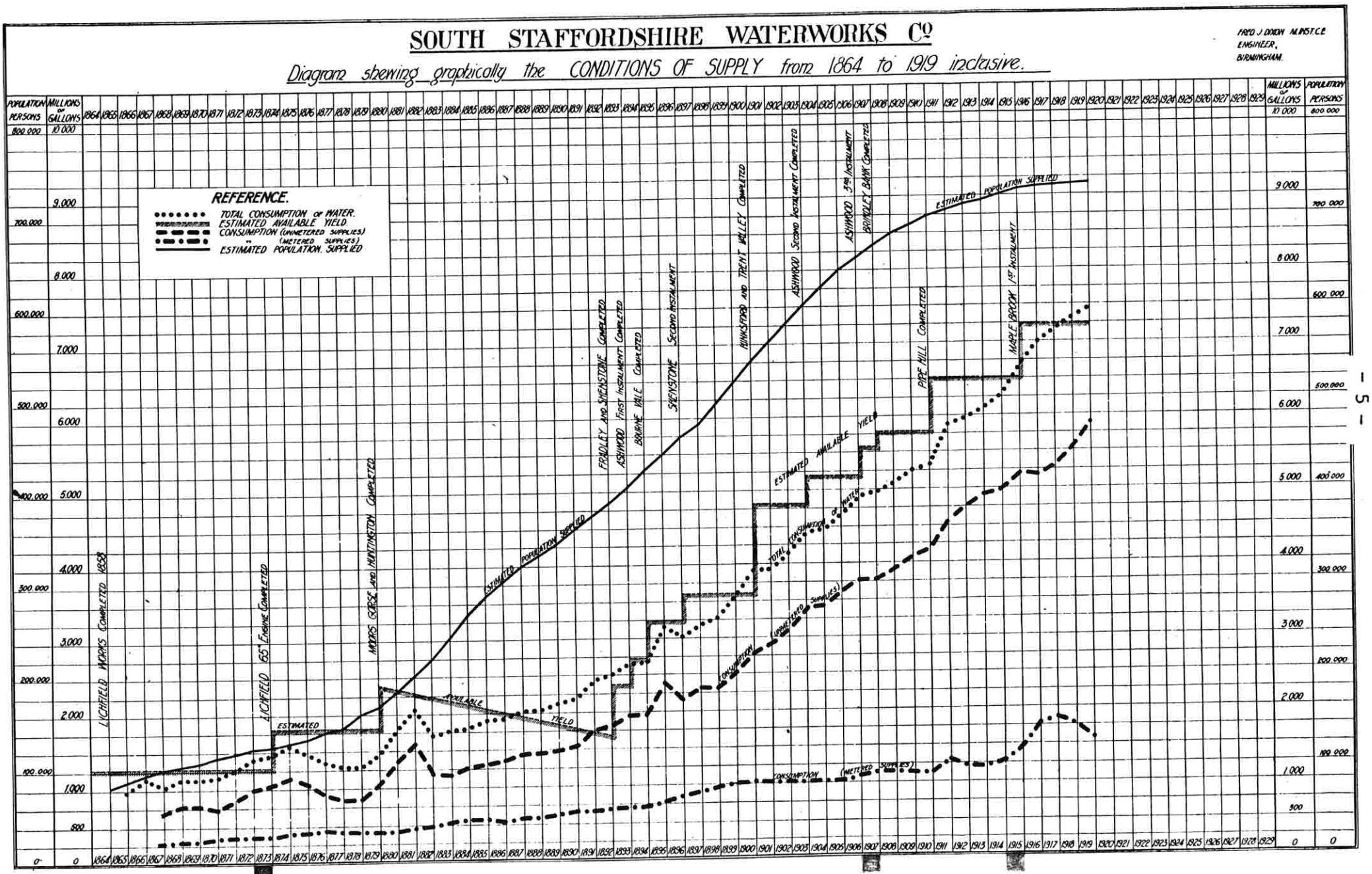
WHEREAS the Inhabitants of the City of *Lichfield*, and of the Boroughs, Parishes, or Places of *Walsall*, *Wednesbury*, *Bilston*, *Darlaston*, *Willenhall*, *Sedgley*, *Tipton*, *West Bromwich*, and *Rowley Regis*, in the County of *Stafford*, and *Dudley* and *Oldbury* in the County of *Worcester*, are not at present sufficiently supplied with Water for domestic, manufacturing, trading, and sanitary Purposes, and it would be of great Advantage to the Inhabitants of such Places if a more ample Supply of pure and wholesome Water were provided: And whereas such a Supply of Water may be obtained from certain Brooks or Streams flowing through the Parishes and Townships herein-after mentioned, and the Construction of Reservoirs and Aqueducts for collecting, impounding, and distributing such Water would be of great public Advantage: And whereas the Parties herein-after named, together with others, are willing to carry the said Undertaking into effect, if authorized by Parliament


PLAN
OF THE
WORKS AND DISTRICT,
TO BE SUPPLIED BY THE
SOUTH STAFFORDSHIRE WATER WORKS COMPANY,
Incorporated by Act of Parliament
1853.
WOLVERHAMPTON POP 51 000
SEDGELEY POP 30 000
BILSTON POP 25 000
WILLENHALL POP 12 000
DARLASTON POP 11 000
TIPTON POP 35 000
WEDNESBURY POP 15 000
DUDLEY POP 35 000
WALSALL POP 20 000
ROWLEY REGIS POP 15 000
OLDBURY POP 7 000
WEST BROMWICH POP 35 000
BIRMINGHAM
MAIN DISTRICT RESERVOIR
DISTRICT RESERVOIR
DISTRIBUTING RESERVOIR
GRAVITATION MAIN
PUMPING MAIN
BROWN HILLS
SUMMIT RESERVOIR
LICHFIELD
PUMPING STATIONS
COLLECTING RESERVOIRS
TRENT VALLEY
JUNCTION
South Staffordshire Water-Works Company.
CAPITAL £160,000: IN 16,000 SHARES OF £10 EACH.
Directors.
E. J. Brewer Esq — Lichfield.
Gentlemen
S. H. Blackwell Esq Dudley
Chas. L. Rexwell Esq Dudley
Chas. B. Dramack Esq Wolverhampton
Richd. Green Esq Lichfield
Richd. Green Esq Walsall
Sampson Lloyd Esq Wednesbury
Thomas Walker Esq Wednesbury
Harvey Wyatt Esq Acton near Stafford
BANKERS.
The Birmingham Banking Company
ENGINEERS
Messrs. McClean & Stileman Great George St. Westminster
Henry Marten Esq C.E. Wolverhampton
SOLICITORS
Messrs. Bourne & Wainwright Dudley
SECRETARY.
T. Churchill Esq Wolverhampton
Note.
The Shaded Circles show the Towns and Population, (upwards of 240,000) within the limits of supply authorized by the Act.
The supply is obtained from pure Springs & Streams near Lichfield, to be impounded in the large Collecting Reservoirs shown and there Pumped to Summit Reservoir near Brown Hills from thence it flows by gravitation to the Main District Reservoir at Walsall and the Distributing Reservoirs at Wednesbury & Dudley Port.
The Works will be constructed to supply 4,000,000 Gallons a day, and arranged for extension with increased consumption.

SOUTH STAFFORDSHIRE WATERWORKS Co

Diagram shewing graphically the CONDITIONS OF SUPPLY from 1864 to 1919 inclusive.

FRED J. DIXON M.INST.C.E
ENGINEER,
BIRMINGHAM.



STEAM ENGINES FORMERLY OPERATED BY THE SOUTH STAFFORDSHIRE WATERWORKS COMPANY

PUMPING STATION	ENGINE Nr	TRIAL DATE	PUMP hp	INDICATED hp	MECHANICAL EFFICIENCY %	ENGINE DETAILS
ASHWOOD	1	4-5-94	–	69	–	SINGLE ACTING EXPANSION CONDENSING BEAM ENGINE
	2	18-7-02	256.7	309	82.6	HORIZONTAL TANDEM COMPOUND EXPANSION
	3	20-2-07	261.7	310	84.4	SURFACE CONDENSING DIFFERENTIAL ENGINE
BOURNE VALE	1	1-4-98	88.9	111.4	79.8	INVERTED COMPOUND EXPANSION SURFACE
	2	8-5-98	143.9	160.5	89.7	CONDENSING ROTATIVE ENGINE
BRINDLEY BANK	1	31-10-07	155	187	83	HORIZONTAL TANDEM COMPOUND EXPANSION SURFACE CONDENSING ROTATIVE ENGINE
CONEYGRE	1	–	–	–	–	25" DIAMATER HORIZONTAL SINGLE CYLINDER ROTATIVE ENGINE
	2	18-1-97	19.9	30.1	66	
	1	25-4-07	53.2	72	74	HORIZONTAL TANDEM COMPOUND EXPANSION SURFACE CONDENSING ROTATIVE ENGINE
FRADLEY	1	19-2-97	80.7	98.6	81.8	HORIZONTAL TANDEM COMPOUND EXPANSION
	2	5-9-94	64	84	77	SURFACE CONDENSING DIFFERENTIAL ENGINE
HINKSFORD	1	24-6-02	180.5	202.8	89	INVERTED COMPOUND EXPANSION SURFACE
	2	23-6-02	182.5	212.6	85.8	CONDENSING ROTATIVE ENGINE
HOPWAS	1	1881	–	50	–	25" DIAMATER DOUBLE ACTING EXPANSION CONDENSING BEAM ENGINE
	2	1881	–	50	–	
	3	1926	–	–	–	HORIZONTAL TANDEM COMPOUND ROTATIVE ENGINE
HUNTINGTON	1	16-11-94	45	53.6	83.9	65" DIAMATER SINGLE ACTING EXPANSION
	2	22-11-94	48.3	55.4	81.7	CONDENSING BEAM ENGINE
MAPLE BROOK	1	1915	–	223	–	INVERTED TRIPLE EXPANSION SURFACE
	2	1922	–	223	–	CONDENSING ROTATIVE ENGINE
MOORS GORSE	1	7-8-94	64	71	90.2	65" DIAMATER SINGLE ACTING EXPANSION
	2	3-11-98	117.8	129.4	91.7	CONDENSING BEAM ENGINE
PIPE HILL	1	27-10-11	302.7	346.4	87.3	HORIZONTAL TANDEM COMPOUND EXPANSION
	2	–	–	–	–	SURFACE CONDENSING ROTATIVE ENGINE
SANDFIELDS	1	19-11-94	103.5	119	87	46" DIAMATER DOUBLE ACTING EXPANSION CONDENSING BEAM ENGINE
	2	1858	–	–	–	
	3	19-11-94	101.5	123.6	83	
	4	1873	–	190	–	65" DIAMATER SINGLE ACTING EXPANSION CONDENSING BEAM ENGINE
	1	1922	351	243	69.1	HORIZONTAL SINGLE CYLINDER UNIFLOW
	2	1922	387	249	64.3	ENGINE
SHENSTONE	1	7-10-97	133.5	158.3	84.3	HORIZONTAL TANDEM COMPOUND EXPANSION
	2	–	–	–	–	SURFACE CONDENSING DIFFERENTIAL ENGINE
SPRINGSMIRE	1	18-6-02	67.2	91.7	73.4	HORIZONTAL TANDEM COMPOUND EXPANSION SURFACE CONDENSING ROTATIVE ENGINE
	2	19-6-02	68.3	91	75	
	3	16-10-08	147	215.5	68.1	TWO CRANK COMPOUND VERTICAL ENCLOSED HIGH SPEED ENGINE
TRENT VALLEY	1	14-5-02	129.6	164	79	HORIZONTAL TANDEM TRIPLE EXPANSION
	2	12-8-07	190.1	222.1	85.6	SURFACE CONDENSING DIFFERENTIAL ENGINE
WOOD GREEN	1	1871	–	–	–	DOUBLE ACTING EXPANSION CONDENSING BEAM ENGINE
	2	3-3-97	83.1	91.2	91.1	65" DIAMATER SINGLE ACTING EXPANSION
	3	1875	–	–	–	CONDENSING BEAM ENGINE
	4	4-4-13	288.7	306.5	94.2	INVERTED TRIPLE EXPANSION SURFACE CONDENSING ROTATIVE ENGINE

Sandfields Pumping Station

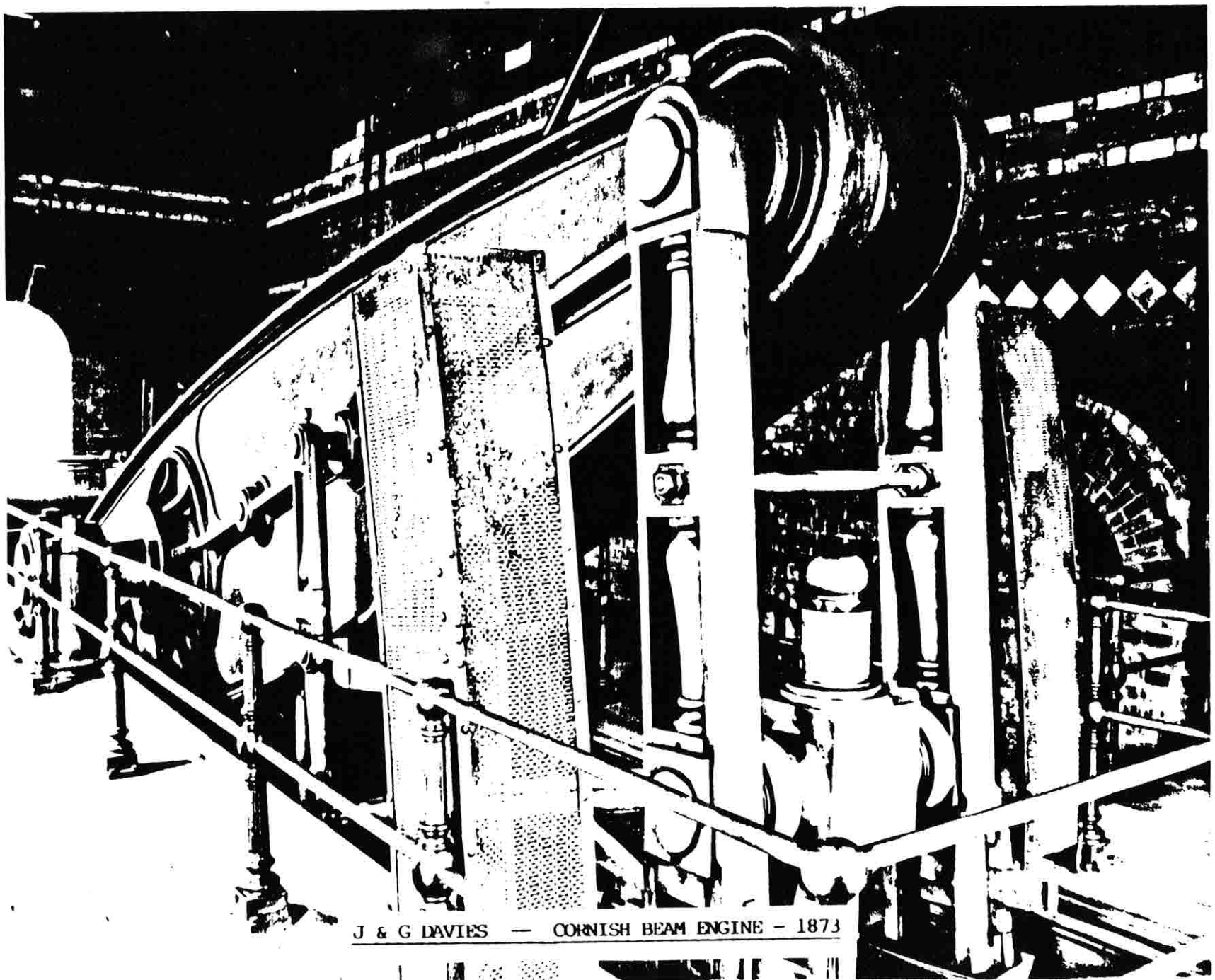
Chesterfield Road
Lichfield
Staffordshire

National Grid Reference SK 112083

Beam Engine House Floor Level 310.85 feet A.O.D.

Major Items of Interest

Beam Engine House	1873
Single acting, expansion, condensing, Cornish Beam Engine. Jonah & George Davies (Tipton)	1873
Operational Filtration Plant	1927
Operational Pumping Plant	1969



J & G DAVIES — CORNISH BEAM ENGINE - 1873

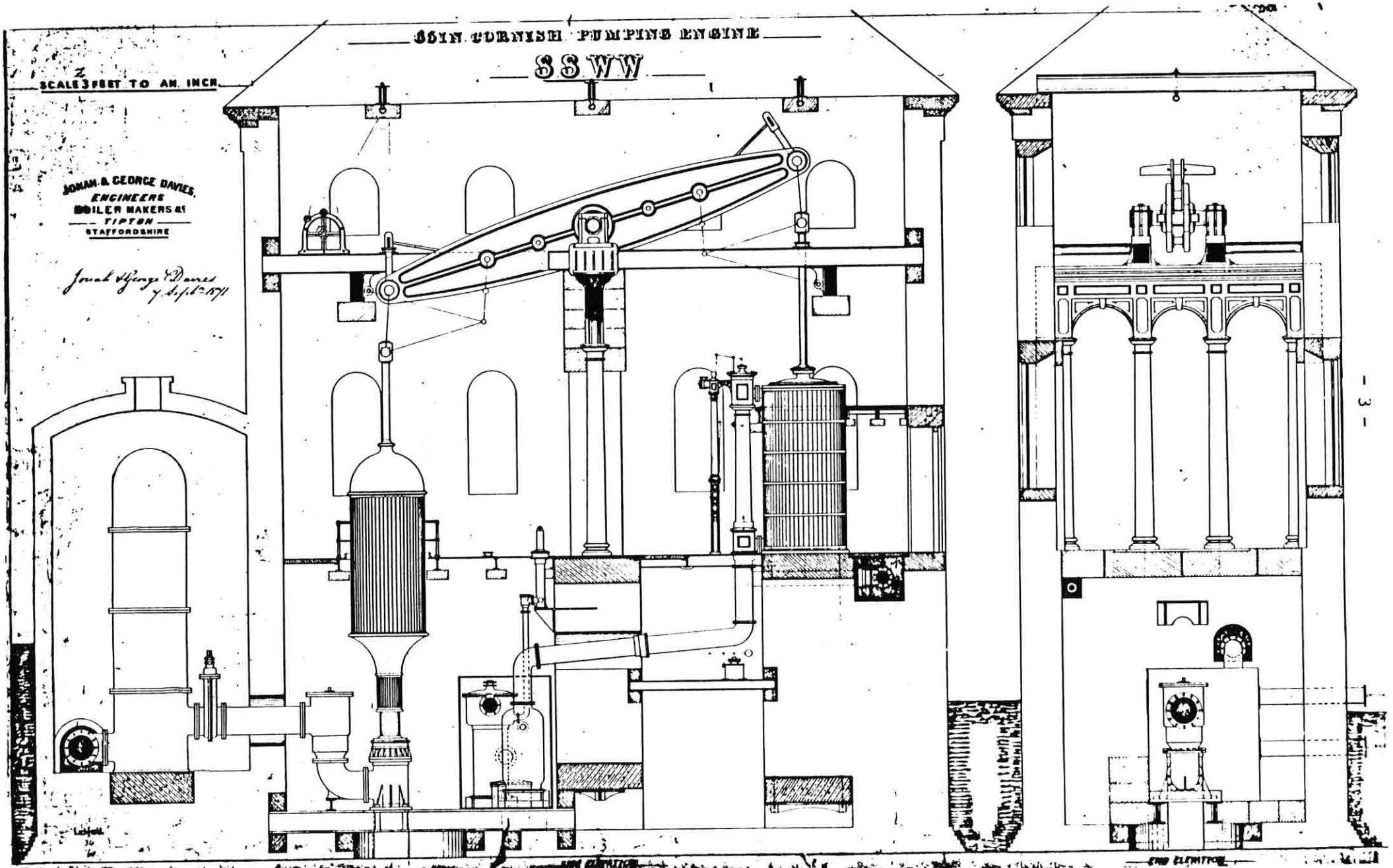
SANDFIELDS PUMPING STATION

Sandfields is the oldest pumping station site belonging to the South Staffordshire Waterworks Company, having once formed a part of the original scheme of works implemented by the Company, shortly after its formation. Under the South Staffordshire Waterworks Company Act 1853, the Company was authorised to provide 'a more ample supply of pure and wholesome water' to Lichfield, Walsall, and other towns in the Black Country area. Originally Sandfields pumping station was the Company's sole source of supply, it was opened as a tablet records, by Lord Ward the Earl of Dudley, on 26th October 1858.

Part of the Company's original scheme comprised the construction of a 14 feet diameter by 77 feet deep pilot well connected to three sump wells each 8 feet diameter by 70 feet deep, together with a new pumping station; all located at the Sandfields site. A 3/4 mile long tunnel was driven under the City of Lichfield to connect the new pumping works with two impounding reservoirs, Stowe and Minster pools, located near Lichfield Cathedral. A system of valves enabled Stowe pool (a storage reservoir) to discharge water into the tunnel feeding the Sandfields works in times of shortage, but otherwise Stowe pool would fill by the natural supplies from Leamonsley and Trunkfield Brooks reaching it via an overflow weir sited at one end of Minster pool. Water gravitated along the tunnel from the two reservoirs to the sump wells at Sandfields, where it was raised by pumping plant and delivered to supply in one lift. The supply main comprised a 22 inch diameter pumping pipeline to Summit reservoir at Brownhills, and a 24 inch diameter gravitating pipeline terminating at the Moat, a reservoir at Walsall. This 11 mile long cast iron supply main was laid alongside the Lichfield to Walsall and Dudley railway line from 1856 to 1858. Later in 1880, the source of supply was supplemented by the addition of a $3\frac{1}{2}$ mile long tunnel linking the pumping station to Hanch reservoir located at Seedy Mill.

The original pumping plant was designed and erected under the supervision of the Company's first engineer and orginator, John Robinson McClean M.P., a well known engineer and railway contractor. The original buildings were designed and erected by Branson and Gwyther (Birmingham). Originally the pumping plant installed in 1858, comprised two (Nr.1 and Nr.2) double acting, expansion and condensing, single cylinder beam engines, built by James Watt & Company (Birmingham). The two engines were connected by a common crankshaft to a single flywheel positioned between them. Foundations for a similar, but independent Nr.3 engine, were laid at the same time as those for Nr.1 and Nr.2, the Nr.3 engine was installed at a later date in 1867. Each engine developed 120 hp at 9 rpm and had a capacity for pumping water at the rate of 1,250,000 gallons per day with a delivery head of 355 feet on the force pumps.

In 1873 an additional sumpwell was constructed, and the original beam engine house extended to accommodate the cornish beam engine (Nr.4), which has been preserved in its original setting. In fact this extension is the only remaining building representing the original works. The single acting, expansion and condensing, cornish beam engine was constructed by Jonah and George Davies (Tipton) and ran until 1927, when it was retired from its standby duty service. It has a steam cylinder of 65 inches diameter and a stroke of 9 feet, and once developed 190 hp at 7 strokes per minute, whilst pumping water at the rate of 2 million gallons per day with a delivery head of 355 feet on the force pump. A Tuscan arcade of three arches with fluted columns, supports the bearings for the beam, and the


85IN. CORNISH PUMPING ENGINE
SSWW
SCALE 3 FEET TO AN INCH.
JONAH & GEORGE DAVIES.
ENGINEERS
BOILER MAKERS &c
TIPTON
STAFFORDSHIRE
Jonah & George Davies
7 Sept 1871
END ELEVATION

whole construction, even the smallest moulding, illustrates the close relationship between architecture and engineering prevalent in the second half of the 19th century.

The pumping system associated with the Nr. 4 beam engine comprised a single acting well pump of the bucket type, with a force pump in the same lift which was of the bucket and plunger type with a weight box on top of the plunger, all worked from the beam. The cost of the cornish beam engine, pumping plant and 3 boilers was £6,690.

A surface condenser lay in a cast iron cistern located underground, the circulating water gravitated into the cistern from the Wyrley and Essington Canal (now infilled) which ran alongside the station, a circulating pump was employed to return the water to the canal.

JONAH & GEORGE DAVIES STEAM ENGINE DETAILS

Power 190 hp	Speed 7 strokes per minute
Engine house size	52 feet long, 20 feet wide, 42 feet high
Beam length 36 feet	Weight 20 tons
Steam cylinder	65 inches diameter x 4 feet stroke
Well pump bucket	2 feet 1 inch diameter x 9 feet stoke

Originally in 1858 engine Nr's. 1 and 2 were steamed by a battery of four Lancashire boilers, each 7 feet diameter by 32 feet long, at a daily working pressure of 25 psi. Two additional boilers were installed in 1867 to steam the Nr.3 engine. In 1873 three additional boilers were added, to steam the cornish beam engine at a daily working pressure of 40 psi. Therefore there were originally a total of nine Lancashire boilers employed to steam the four beam engines. The original boilers were eventually condemned, and in 1907 four were removed and three new Lancashire boilers each 8 feet diameter by 30 feet long, and suitable for a working pressure of 100 psi were supplied by Edwin Danks & Co. (Oldbury).

In 1922 the pumping station was remodelled to facilitate the installation of a new filtration scheme, work on which commenced in 1924 and was completed in 1927. The original plant (engine Nr's.1,2,3 & 4) pumped the water from their individual sump wells in one lift to supply. This lift could not be divided to feed the new filtration plant, and although the beam engines were reliable they were very inefficient, and so became redundant. The three rotative beam engines (Nr's. 1,2 & 3) were removed and the engine house transformed. Two Sulzer horizontal Uniflow engines were installed in 1922, they developed 390 hp each at 158 rpm. Each engine drove a 225 volt dc electric generator which powered an electrically driven vertical spindle well pump (to deliver water to the filtration plant), and a belt driven horizontal centrifugal pump (to deliver the filtered water to supply). The duty of each Uniflow engine was 3 million gallons per day against a delivery head of 400 feet, (80 feet to the filtration plant and 320 feet to supply). Together with the installation of the Uniflow

PLATE I.

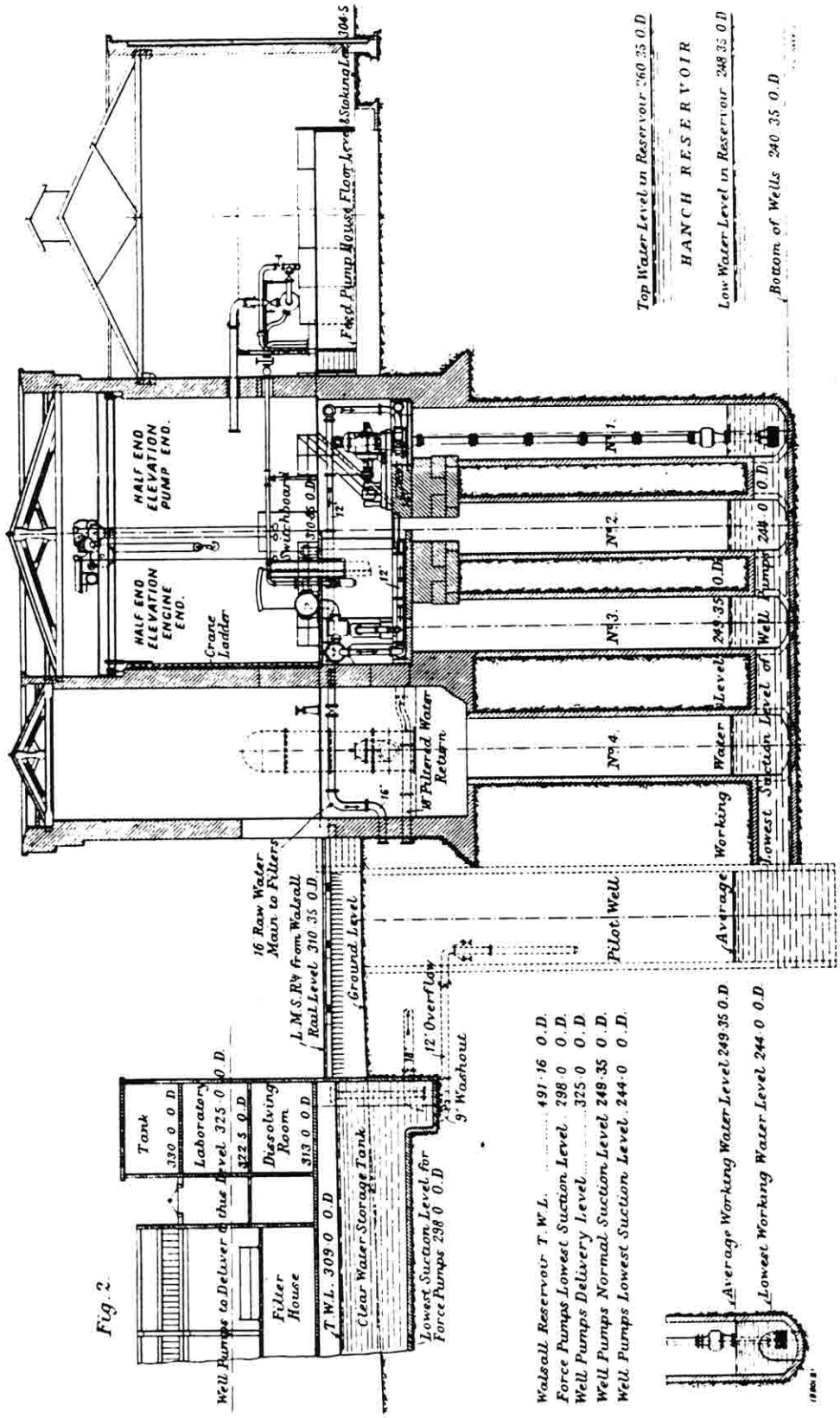


Fig. 2

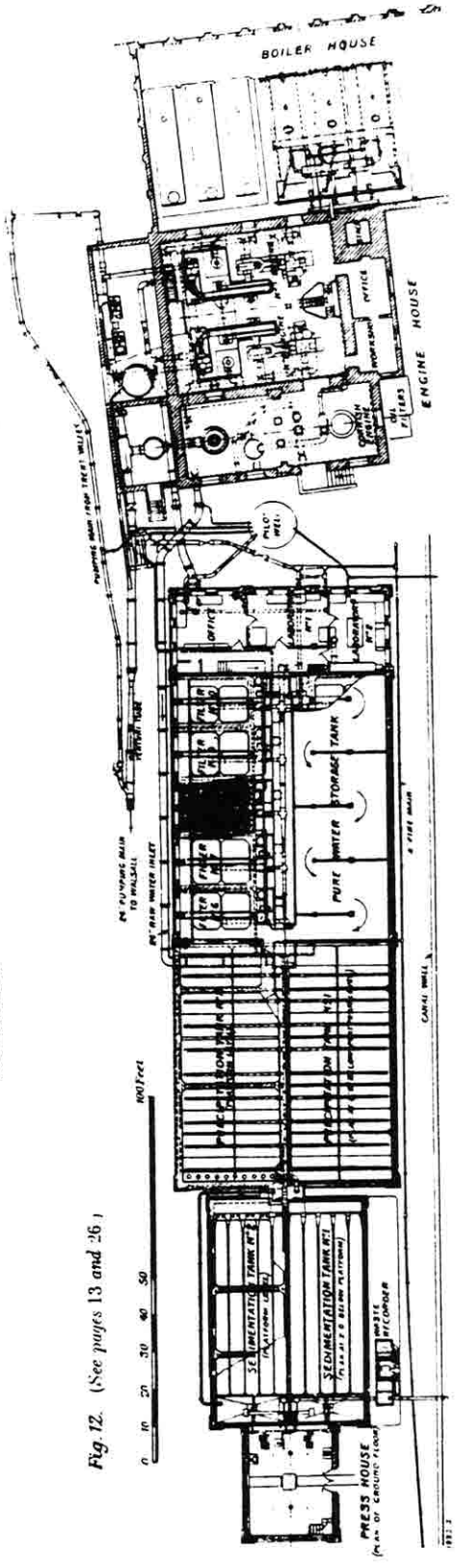


Fig. 12. (See pages 13 and 26.)

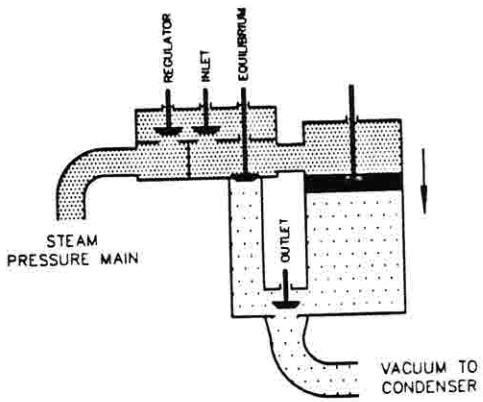
engines, the three boilers previously installed in 1907 were fitted with superheaters, to steam the new engines more efficiently.

Finally in 1966 the pumping plant was fully modernised with the construction of a new pump house building, and the installation of new electrically powered pumping plant. The new pump house was constructed on the site of the old Uniflow engine house, using the original basement and wall footings, and was designed to blend into the cornish beam engine house. Parts of the external walls were reconstructed to match the cornish beam engine house, and the chimney stack and boiler house were demolished. The present pumping plant comprises 2 well pumps and 2 booster pumps supplied by Sulzer Bros. Ltd., each having a maximum designed output of 3 million gallons per day against a delivery head of 85 feet (well pumps) and 230 feet (booster pumps). Each pump unit is variable speed, the well pumps have a speed range of 745 rpm to 875 rpm and develop 80 hp at 825 rpm, the booster pumps have a speed range of 850 rpm to 1025 rpm and develop 194 hp at 950 rpm.

By 1968 Stowe and Minster Pools were no longer required by the Company, and were subsequently returned to the Mayor, Aldermen and Citizens of Lichfield by Conveyance of 11th October, 1969.

The power is supplied by the Midlands Electricity Board by duplicate feeders at 11,000 volts. This supply terminates in a separate switchgear room and is transformed down to 415 volts by means of the duplicate transformers which are located inside the station building.

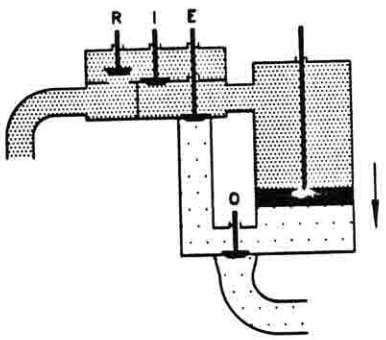
THE CORNISH CYCLE



START OF POWER DOWN STROKE BY STEAM PISTON

STEAM INLET VALVE –I– OPEN
STEAM OUTLET VALVE –O– OPEN
EQUILIBRIUM VALVE –E– CLOSES

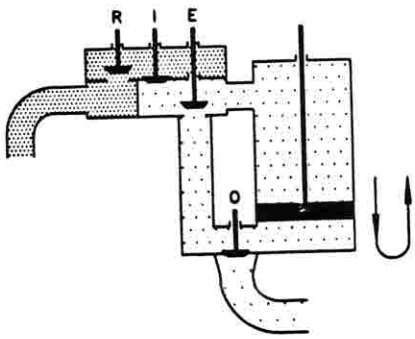
1 Steam enters through the inlet valve –I– and exerts a force on top of the steam piston, forcing it to move downwards.
2 The water pump piston is rising, drawing water into the working barrel beneath it, and forcing the water above it through the delivery check valve and into the main.
3 Spent steam on the underside of the steam piston is passed through the outlet valve –O– and into the condenser, which is under vacuum. The vacuum is maintained by the air pump piston which is also rising.



CUT–OFF AT BETWEEN 2/3 & 3/4 STROKE

STEAM INLET VALVE –I– CLOSES
STEAM OUTLET VALVE –O– CLOSES
EQUILIBRIUM VALVE –E– CLOSED

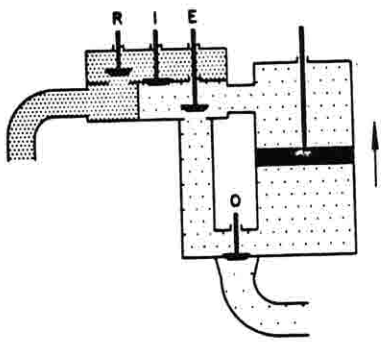
4 The admission of steam is stopped, but the steam remaining in the cylinder continues to expand and exert a downward force on the piston.
5 The outlet valve –O– closes, but as there is still a vacuum on the underside of the steam piston, it continues its downward movement.
6 As the expanding steam falls in pressure the force necessary to lift the counter–weight, pump and pump rods, decreases towards the end of the stroke and eventually the motion reverses as the counter–weight takes over.



EQUILIBRIUM

STEAM INLET VALVE –I– CLOSED
STEAM OUTLET VALVE –O– CLOSED
EQUILIBRIUM VALVE –E– OPENS

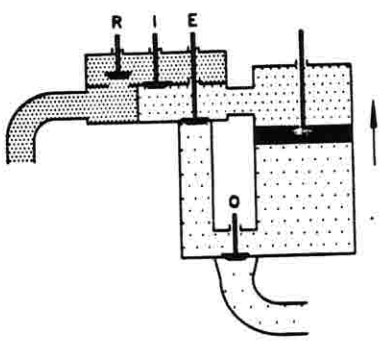
7 At the bottom of the stroke the equilibrium valve –E– opens and the pressure above and below the steam piston pressures are equalised, no live steam is admitted.
8 The steam piston now starts to move upwards under the influence of the counter–weight.
9 The pump foot valve closes and as the water piston moves down it displaces the water below it which passes through the clack in the water piston to the topside of the water piston.



UP STROKE IN EQUILIBRIUM

STEAM INLET VALVE –I– CLOSED
STEAM OUTLET VALVE –O– CLOSED
EQUILIBRIUM VALVE –E– OPEN

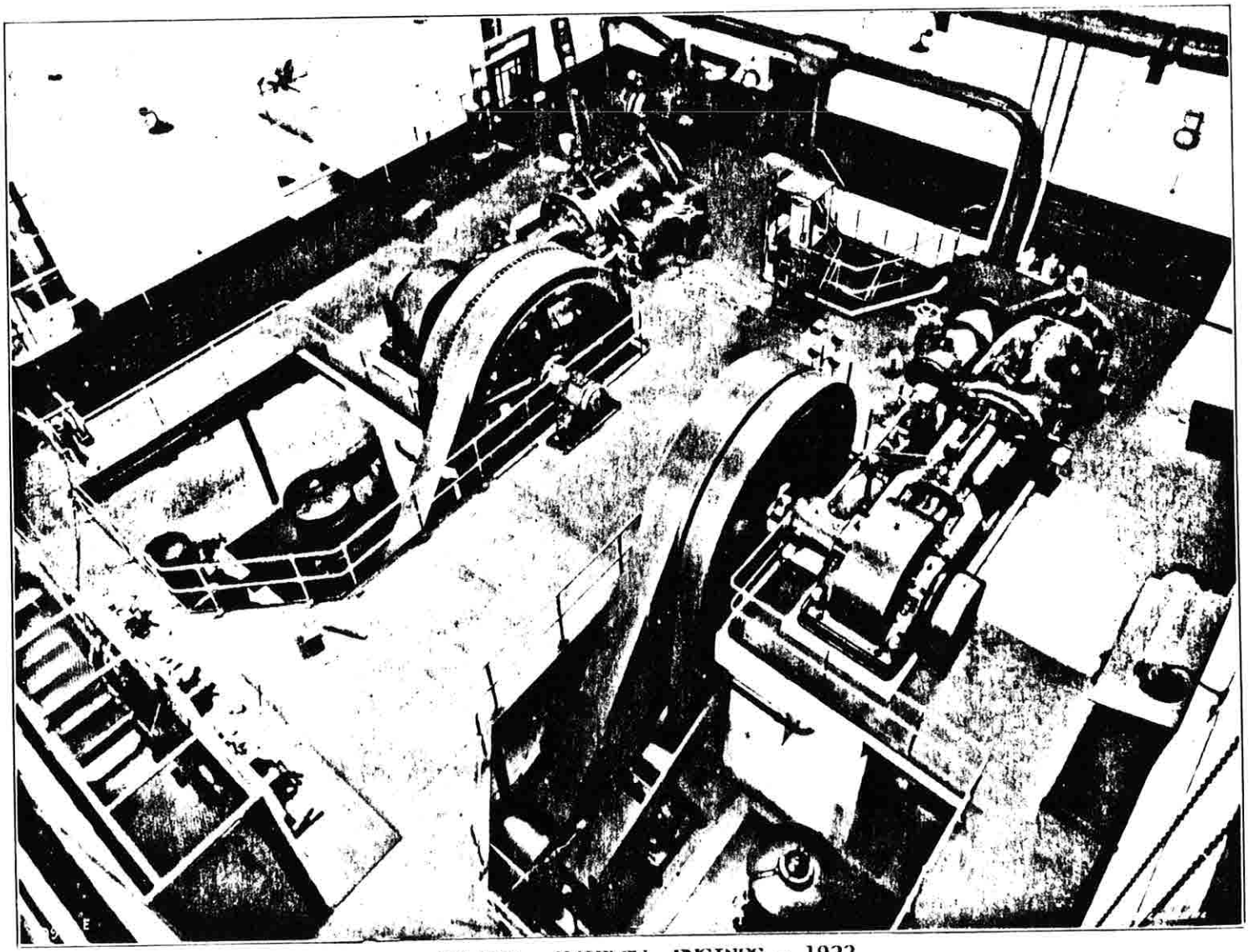
10 The steam piston continues to rise.
11 The water piston continues to fall.
12 As the steam piston approaches the end of its stroke the equilibrium valve –E– closes.



UP STROKE CUSHION

STEAM INLET VALVE –I– CLOSED
STEAM OUTLET VALVE –O– CLOSED
EQUILIBRIUM VALVE –E– CLOSES

13 At about 7/8 stroke the equilibrium valve –E– has closed and the continued upward movement of the steam piston compresses the spent steam above it. This forms a cushion which causes the piston to decelerate and ultimately stop.
14 As soon as it stops, the inlet valve –I– opens to admit live steam to the topside of the piston, the outlet valve –O– opens to expose the underside of the piston to the condenser vacuum, and the cycle recommences with the downward movement of the steam piston.



SULZER - UNIFLOW ENGINES - 1922

SANDFIELDS PUMPING STATION

SUMMARY OF COSTS 1856 - 1924

		£. s. d.	
LAND: 1857	SITE OF PUMPING STATION		
	Foreman's House and 2 cottages		
	Conveyance No. 11 Freehold 37 perches	178. 0. 0.	
	" No. 13 " 1 Rood 28 "	84. 0. 0.	
	" No. 14 " 3 " 37 "	257. 10. 0.	
	Total Area 1 Acre, 2 Roods, 22 perches		519. 10. 0.
WELLS & HEADING TO HANCH:	Well sinking	2500. 0. 0.	
	Driving tunnel through sandstone rock to Hanch Reservoir etc.	45562. 0. 0.	48062. 0. 0.
OLD PLANT 1858 - 72:	Engine Nos. 1, 2 & 3 built by James Watt & Co. 1858 & Boilers.	16850. 0. 0.	
	Engine No. 4 Cornish type by J.G. Davies, Tipton, 1872 & Boilers.	6690. 0. 0.	
1907:	Boiler replacement by 3 new Lancashire type 30' x 8' by Messrs Edwin Danks including flue reconstruction etc. 1907. Repairs to Engines Nos. 1, 2 & 3, and foundations to same 1909. (Nos. 1 & 2 Engines sold 1923).		23540 0. 0.
BUILDINGS:	Engine House, Boiler House and Stack by Branson & Co., 1854. No. 2 Engine House and extension of Boiler House by Becket & Co., 1870 Slack shed by E.C. Keay & Co. and Sundry charges, Boundary wall etc.	11187. 0. 0.	
	Cottages by Becket & Co.	1048. 0. 0.	12235. 0. 0.
	COST OF ORIGINAL INSTALLATION		84356. 10. 0.
OLD PLANT: 1925:	Two uniflow Engines, Well pumps, Force pumps and Motors.	25354. 0. 0.	
	Generating Sets, Switchboard & crane by Messrs Sulzer Bros. Building and reconstruction costs in connection with new plant	9731. 0. 0.	35085. 0. 0.

FILTRATION PLANT SUMMARY

FILTER HOUSE 1924-5	Administration Block Filter House Reaction and Precipitation Tanks Sedimentation Tanks and Press House, Constructed 1924-5 by Messrs. Gray's Ferro Concrete Co. Ltd., Glasgow.	25135. 2. 10.

FILTRATION	Installed by Messrs. Paterson's Engineering Co., London, including motor driven Air Compressors and Air Receiver, Presses etc., 1924-5.	26588.13. 9.	
PALATINE RECORDER	Palatine Recording Instrument and Kiosk installed by S.S.W.W.Co. 1926.	150. 0. 0.	
FENCING ETC.	Concrete posts and wire fence along Railway bank. Retaining wall steps and iron gates and fence to Railway siding. Drains and Inspection Chambers, Completion of pitching and Tarmac to yard space, etc.	3699. 10. 0.	
		----------	55573. 6. 7.

THE SOUTH STAFFORDSHIRE WATERWORKS COMPANY

SANDFIELDS PUMPING STATION - CORNISH BEAM ENGINE

PARTICULARS OF ENGINE AND PUMPS

Steam Cylinder

Diameter of cylinder	...	65 inches.
Stroke of engine	...	9 feet.
Diameter of piston rod	...	6 3/4 inches.
Piston rod packing	...	Soft.

Cylinder is steam jacketed.

Type of Piston Ring

Broad cast iron packing ring fitted with coach springs.

Type of Engine Valve Gear

Cornish gear with drop valves operated by plug rods.

Steam Nozzles

Daimeter of regulator valve to cyline	...	12 3/4 inches.
Daimeter of steam valve to cylinder	...	12 7/8 inches
Daimeter of equilibrium valve to cylinder	...	14 3/8 inches.
Daimeter of exhaust valve on bottom nozzle	...	15 1/2 inches.

Type of Air Pump

One Single Acting Vertical Pump Operated by Rod from Main Engine Room

Distance of air pump gudgeon pin from main gudgeon on engine beam	...	9 feet.
Daimeter of air pump	...	22 1/2 inches.
Stroke of air pump	...	4 ft 8 inches.
Type of valves	...	India Rubber.
Diameter of bucket valve	...	16 inches.

Diameter of bucket rod	...	2 1/2 inches.
2Diameter of outlets for condenser water	...	6 inches.
Size of inlet for condenser water	...	20 inches.
Bucket rod packing	...	Linch Hemp.

Type of Condenser

Open type with tube screwed into lower tube plates and secured by nuts and rubber washers against the face of the upper tube plates.

Condenser placed in a cast iron cistern through which the water from the canal gravitates, circulating pump being employed to pump the water back into the canal.

Cooling surface	...	661 square feet
Number of tubes	...	202
Diameter of tubes, externally	...	2 inches.
Length of tubes	...	6 ft. 7 1/2 ins.
Number of stay rods	...	7
Diameter of stay rods	...	1 1/2 inches.
Pitch of tubes	...	4 ins. x 3 1/2 ins.
Distance apart of over tube plates	...	6 ft. 5 3/4 ins.
Diameter of exhaust inlet	...	15 feet.
Diameter of exhaust outlet	...	22 1/2 inches.

Cast Iron Condenser Cistern

Depth of cast iron cistern	...	11 ft. 4 ins.
Length of cast iron cistern	...	10 ft. 6 ins.
Width of cast iron cistern	...	7 ft. 6 ins.
Thickness of metal in cistern	...	7/8 inch.
Diameter of water inlet	...	15 inches.
Diameter of water outlet	...	15 inches.

Type of Delivery Air Vessel
Cast Iron

Total height inside	...	25 feet.
Diameter inside	...	5 ft. 6 ins.

Height above inlet branch	...	21 ft. 9 1/4 ins.
Thickness of metal	...	2 3/4 inches.
Working Pressure per square inch	...	165 lbs.
Capacity above branches	...	493 cu.ft.
Total capacity	...	570 cu.ft.
Diameter of branches	...	24 inches.

Rising Main Air Lift

Each lift is made up strainer, clack box, well pump working barrel, force pump barrel, with two piece lengths of 9 ft. 6 ins. and one of 4 ft. 6 ins. with the force pump delivery valve box bolted to the side of the force pump barrel.

Strainer

Outside diameter	...	3 feet.
Length of strainer.	...	3 ft. 3 ins.

The strainer is perforated all round with oblong holes 8 1/4 ins. x 1 ins. and a pipe length without flange is secured to the top of the strainer.

Diameter of above pipe length	...	2 ft. 3 ins.
Length of above pipe outside strainer	...	8 ft. 10 ins.
Diameter of flange on the top of same	...	3 feet.
One pipe length flanged at each end	...	4 ft. 6 ins.

Clack Box

Length of clack box	...	6 ft.2ins.
Thickness of metal	...	1 3/4 inches.
Diameter of clack box, largest inside diameter	...	3 ft. 4 ins.
Diameter of clack box at top inside	...	2 ft. 5 3/8 ins
Diameter of bottom flange	...	3 ft. 2 ins.
Diameter of top flange	...	3 ft. 5 ins.

Working Barrel

Diameter of working barrel	...	2 ft. 1 ins.
Length of barrel	...	11 ft. 8 ins.

Thickness of metal	...	1 3/4 inches.
Diameter of bottom flange	...	3 ft. 5 ins.
Diameter of top flange	...	3 ft. 1 ins.
One pipe length flanged at each end	...	9 ft. 6 ins.
Diameter of pipe	...	2 ft. 3 ins.
Diameter of flanges	...	3 ft. 1 ins.

Force Pump Barrel

Distance of main gudgeon to centre of force pump gudgeon on main beam	...	17 ft. 4 1/2 ins.
Total Length of barrel	...	13 ft. 10 ins.
Inside diameter of barrel	...	2 ft. 7 ins.
Thickness of metal	...	1 3/8 inches.
Diameter of bottom flange	...	3 ft. 1 ins.
Diameter of top flange	...	3 ft. 4 1/2 ins
Diameter of branch to delivery valve box	...	2 feet.
Diameter of flange on branch	...	2 ft. 10 ins.
Diameter of plunger	...	17 13/16 ins.
Stroke	...	9 feet.
Gallons discharged per double stroke	...	200.9
Diameter of inlet and outlet branches on force pump valve box	...	2 feet.
Diameter of iron pump rod inside plunger	...	6 inches.

Well Pump Clack

Type Cast Iron Hat Band Valves.		
Diameter at bottom of seat	...	2 ft. 5 1/2 ins.
Number of tiers of hat bands	...	5
First India Rubber band inside diameter	...	14 3/4 inches.
Second India Rubber band inside diameter	...	17 3/8 inches.

Third India Rubber band inside diameter	...	20 5/8 inches.
Fourth India Rubber band inside diameter	...	23 1/4 inches.
Fifth India Rubber band inside diameter	...	26 inches.

All the above bands are 7/8 inch. thick x 8 inches deep.

Well Pump Bucket

Type double beat with white metal beats and Gutta Percha bearings of special design.

Diameter of bucket	...	25 3/4 inches.
Stroke	...	9 feet.
Free Lift of valve on bucket	...	3 inches.

Force Pump Delivery Valve

Double beat valve with white metal beats. Seat of valve cast iron and valve gunmetal.

Diameter of seat	...	2 ft. 8 ins.
Free Lift on valve	...	3 inches.

The above engine is 43 ft. long and 8 ft. wide; the engine house floor to beam in level position 33 ft. and 36 ft. with the beam at the top of the stroke.