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REPORT OF MESSRS. WILLCOX, RAIKES & MARSHALL ON UTTOXETER WATER SUPPLY.

Stock Exchange Buildings,
33, Great Charles Street,
BIRMINGHAM, 3.
29th December, 1936.

To the Chairman & Members of the
Uttoxeter Urban District Council.

Gentlemen,

Uttoxeter Water Supply.

In accordance with instructions received from Mr. Frank F. Hawthorn, to advise your Council on the best method of collecting additional springs and providing increased storage capacity for the improvement of the water supply of the Town, which instructions were subsequently widened by a further request to advise as to the provision of extra power at Crumpwood Pumping Station, and the improvement of the supplies to the high level areas including the village of Bramshall, we now beg to submit our report on the matters referred to.

We have attended at Uttoxeter and made ourselves acquainted with the existing conditions by inspections of the works and springs as well as obtained full information regarding the extensions and alterations which have been made to the scheme carried out by us in 1925. We have also made such investigations and taken all levels necessary for the purpose of this Report.

Under the original scheme, the supply of water was obtained from springs at Somersall and Bramshall and conveyed by gravitation to a storage reservoir at Bramshall having a capacity of 150,000 gallons; from this Reservoir distributing mains were laid throughout the Town.

In 1925, an extension of this water scheme was carried out, which included the collection of an additional supply of water from springs at Crumpwood, which is raised by means of ram pumps driven by water turbines to a high level Reservoir at Prestwood, having a capacity of 100,000 gallons. From here a gravitation main seven inches in diameter is laid to the Reservoir at Bramshall.

Since that date, direct connections have been made with the trunk main for the supplies to Rocester, Denstone, Stramshall and Bramshall and also to certain high level areas in the Town where recently building developments have taken place, as well as to the Housing Estate at Ashbourne Road, which is at a low level.

Owing to the large consumption of water at hours of maximum draw-off, the supply is at times found to be inadequate for the needs of the Town, especially in the high level areas and the Village of Bramshall, consequently the question of still further augmenting the supply has arisen.

Consumption of Water. 157000/5460 = 30 gals per head per day at present

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The scheme carried out in 1925 described above, supplied a population of 5,460, the estimated water consumption being 157,000 gallons per 24 hours and in order to allow for increased demand, provision was made for an ultimate consumption of 219,000 gallons per day.

Since the carrying out of this scheme, the area of the Urban District has been extended and the population of the enlarged area at the 1931 Census was estimated at 6,249. Additional building developments have since taken place, some 331 houses having been erected. Many of these houses however, were required to replace slum clearances or to prevent overcrowding, and it is estimated that the present population of the Urban District is 6,800 which is an increase of 551 over the 1931 figure.

It is anticipated that an additional 100 houses may be built during the next three years, some of which are to further replace slum properties. This figure includes 46 new houses which are at present being built on the "Timber Lane" Estate.

The present maximum daily consumption of water is found to be as follows:-

Quantity used per 24 hours for domestic purposes.	283,000 gallons.
Meter supplies in the Town.	35,000 "
Meter supplies to other Districts including Rocester, Denstone, Stramshall, Doveridge and Bramshall.	21,000 "
Total	339,000 "

This quantity when available is found to be sufficient to meet all present requirements. It will be seen that the quantity used for domestic purposes averages no less than 42 gallons per head, which is exceptionally high, the usual consumption per head for a town of this size being about 30 gallons. The excess is probably due to defective mains and services, many of which are of a considerable age.

There is no doubt that the consumption of water will tend to increase owing to the introduction of baths and water closets in all new houses and possibly by the provision of baths in the old houses where these are not at present installed.

Some years ago, a very careful investigation was made of the mains and services in the Town with a view to locating the leakages and reducing the consumption, the supplies to various areas being metered for the purpose.

As a result, the leakages were found to be general throughout the Town and very little improvement could be effected without considerable cost being incurred in the renewal of mains and services. This being so, it was considered that it would be less costly to provide the additional water required and the 1925 scheme was in consequence carried out.

At certain times of the year, when the Bramshall and Somersall springs are low thus reducing the quantity of water available, there is difficulty in maintaining a supply to the higher levels, namely Highwood, Balance Hill and Bramshall, this being accentuated by the lack of storage and insufficient pumping capacity.

For the purpose of augmenting the supply to the Town we are of opinion that the following immediate provision should be made:-

To meet the present maximum requirements.	339,000 gallons.
To supply an additional 1000 population at 30 gallons per head.	30,000 "
For increased trade purposes.	15,000 "
To meet the future additional requirements of Rocester, Denstone, Bramshall, Stramshall and Doveridge.	16,000 "
Carried Forward:	400,000 "

Brought Forward:	400,000	gallons.
To supply Ellastone & Wootton (minimum supply under Agreement 15,000 gallons per day) say	20,000	"
Total	420,000	"

In order to meet the above requirements, it is necessary to augment the minimum supplies from your present sources by some 120,000 gallons per day.

Sources of Supply.

The water supply to the Town is at present obtained from Springs at Crumpwood, Somersall and Bramshall. The quantity of water which can be utilised from Crumpwood is governed by the capacity of the pumps and rising main and may be taken at 230,000 gallons per 24 hours. This also approximately coincides with the supply available from the Wood Springs after a period of dry weather.

The yields from the Somersall and Bramshall Springs are subject to considerable fluctuations, depending on the rainfall, but for the purpose of estimating the supply available from these sources, it is necessary to take the lowest minimum gaugings recorded as a basis.

The following are the minimum yields of the three springs now being utilised:-

Wood Springs at Crumpwood	230,000	gallons.
Bramshall Spring.	48,000	"
Somersall Spring.	21,600	"
Total	299,600	"

It will be seen that when the springs are down to their minimum yield, there is a shortage of over 40,000 gallons per day on the present maximum requirements.

The sources from which an additional supply can best be obtained are the Railway Spring atCrumpwood and the Hulme and Pond Springs at Alton, all of which are owned by your Council.

The following Table gives the minimum yield of these Springs:-

Railway Spring Crumpwood.	237,600	gallons.
Hulme & Pond Springs Alton.	381,000	"

Collection of Water from Railway & Alton Springs.

We have made investigations and taken the levels with a view to ascertaining how the Hulme and Pond Springs at Alton can best be conveyed to the Pumping Station at Crumpwood.

Owing to the small fall available (15 feet only) the best gradient obtainable is about 1/660 which is very flat and consequently if the whole of the water from the Springs is to be conveyed by gravitation to Crumpwood Pumping Station which is the proper course to adopt, a nine inch pipe would be necessary.

The line we have selected which is the best possible route, crosses the River Churnet twice at shallow points near the Springs, thus avoiding deep cutting in rock which would otherwise be necessary if these crossings were at points lower down stream.

There will be little difficulty in conveying the water from the Railway Spring to the Pumping Station, but this must be effected by means of a separate connection. The connection is a short one but it involves a deep river crossing, and as the point has been raised, we may say that if the water from the Railway Spring was connected

direct into the nine inch pipe conveying the water from the Alton Springs to Crumpwood, so as to avoid a second connection it would, owing to the levels, result in the water from these springs escaping at the Railway Spring.

Softening of Water.

We understand that some trouble is experienced at one of the new Housing Schemes in the Town by reason of the furring of boilers caused by the deposit of lime.

We have been furnished with a copy of the analyses of samples of water from these springs and also from the Wood Spring, from which we observe the relative hardness of the water from the three sources is as follows:-

	Hardness.		
	Temporary	Permanent	Total.
Wood Spring	6.64	4.20	10.84
Railway Spring	6.94	14.06	21.00
Alton Spring	6.39	4.00	10.39

It has been suggested that softening may have to be resorted to, but this is an expensive process to be avoided if possible.

The furring referred to is due to the temporary hardness in the water, and it will be seen from the table given above that the waters from the three sources vary very little in this respect, but the permanent hardness of the Railway Spring water is much in excess of that from either of the other Springs.

We understand that further samples of the water from these springs have been sent to Drs. Beale and Suckling with a view of obtaining a quantitative analysis and an opinion as to whether softening is necessary or desirable.

The temporary hardness of the water from any of the Springs does not we think appear suffieient to justify the cost of a softening process, and assuming the Alton Springs are utilised and mixed with water from the Wood Springs as well as that from Bramshall and Somersall, both of which are very soft, the hardness would be considerably reduced, the amount of reduction depending on the ratio of water used from each source.

Pumping Plant at Crumpwood.

The existing pumping plant consists of three turbines driving Ram Pumps. The plant is in good order, each pump being capable of lifting about 5,000 gallons per hour.

Only two pumps are intended to be run at one time, the other being reserved as a standby, and further, the yield of the Wood Springs in dry times is found to be insufficient to enable all three pumps to be run together.

In addition to the turbines a crude oil engine is provided for running the pumps when the River is in flood. This however, is now practically worn out and requires to be replaced.

In order to maintain the supply to the Town, pumping is practically continuous, averaging about 23 hours out of the 24, the quantity raised during that period being 230,000 gallons.

The present pumping plant and also the rising main are both inadequate for pumping the largely increased supply now needed.

We are of opinion that an additional pumping unit consisting of an automatically-controlled motor-driven Centrifugal Pump, which would

form part of a comprehensive scheme, should be installed at once. This involves laying a cable to the Pumping Station, which we understand the Electric Supply Department are prepared to provide.

It is also necessary to put in an additional rising main nine inches in diameter from the Pumping Station to Prestwood Reservoir.

Owing to the lift, the pump would be of a two-stage type. There is not sufficient room for this motor and pump in the present Engine House, but a suitable building to accommodate it could readily be erected in front of the present pump-well.

We are of opinion that the new Pump House should be built large enough to accommodate a second motor and pump even if it is not installed at once, as no doubt this additional pump will eventually be required to ensure complete safety of the supply in the future.

The suction pipe from this Centrifugal Pump would be taken to a pump-well to be constructed adjoining the existing one which would receive the discharge from the Railway and Alton Springs. There are reasons connected with the relative levels of the springs which render an additional pump-well desirable.

Owing to the condition of the existing oil engine, your Council has had under consideration the provision of a motor for running the turbine pumps, and in this connection we met a Representative of Messrs. Mather & Platt, Ltd., at Uttoxeter on November 18th when the question of an emergency plant was fully discussed. We also obtained an estimate of the cost of a suitable plant, particulars of which have been furnished to your Committee.

The plant suggested consists of a motor to be connected up by means of suitable gearing to the existing Ram Pumps.

As the supply of electricity will be from a branch cable, not a ring main, there is in our opinion a distinct advantage in providing an oil engine as a standby instead of a motor, as it would be available in the event of the electric current being cut off at any time.

It will be seen that for the additional pumping plant we recommend the adoption of electrically-driven pumps, the capital cost of motors being much less than Diesel Engines, added to which they can be automatically controlled and will require less skilled supervision. An electric plant is also more suitable and more convenient for night running which no doubt, with a view to reducing the cost of current, will be adopted here.

Additional Storage Capacity.

As before mentioned, there are at present two Storage Reservoirs, one at Prestwood having a capacity of 100,000 gallons, and a larger one at Bramshall having a capacity of 150,000 gallons, making a total of 250,000 gallons. This however, is altogether inadequate for the needs of the Town and Districts supplied.

The Prestwood Reservoir which was intended to ensure a supply of water to Bramshall Reservoir when the pumps were not running, is now used as a service Reservoir for Rocester, Denstone, Stramshall and Bramshall Villages, and the higher portions of the Town. It is also contemplated that it should be utilised as a Service Reservoir for Ellastone and Wootton.

It consequently becomes necessary to increase the storage capacity here by the construction of an additional Reservoir having a capacity of 100,000 gallons. at Prestwood

This Reservoir, together with the existing one, will serve the dual purpose of ensuring a continuous supply to Bramshall Reservoir in addition to acting as a Service Reservoir for the outside districts.

A float indicator should be provided at the Reservoir connected with one at the Pump House so that the man in charge can readily ascertain the depth of water in the Reservoir.. The pilot wire for these indicators could be fixed for part of the way on the poles taking current to the Pumping Station.

The storage capacity of the Bramshall Reservoir is also altogether inadequate to meet the needs of the Town at times of maximum draw-off, and in our opinion an additional Reservoir of at least 150,000 gallons capacity should be provided here, making a total of 300,000 gallons.

The combined storage capacity of the existing and new Reservoirs at Prestwood and Bramshall would thus be increased from 250,000 to 500,000 gallons. The new Reservoir at Bramshall should be so designed as to be capable of being readily enlarged should further building developments necessitate this.

Capacity of Mains.

The trunk main from the Prestwood Reservoir to the Bramshall Reservoir is seven inches in diameter and 11,720 yards in length. It has an hydraulic gradient of 1 in 314.

The main when new, was capable of discharging 288,000 gallons per 24 hours from floor level at Prestwood (500 feet above Ordnance Datum) to the top water level at Bramshall (388 feet above Ordance Datum).

Although as far as can be ascertained this main is still in excellent condition, its discharging capacity has probably diminished and could not be relied upon to discharge more than 260,000 gallons per 24 hours which is insufficient to meet the requirements of the enlarged Urban District as well as the outside districtsnow supplied when the yield of the Somersall and Bramshall Springs are low, and at times of maximum draw-off.

Other mains in the Town are found to be too small for the adequate supply of the areas served by them, particularly the main to Highwood and the Ashbourne Road Housing Estate, and in consequence it has been found necessary to supply this Estate direct from the seven inch high pressure main instead of from the supply mains from Bramshall Reservoir to the Town as should be the case.

Balance Hill, Blount's Green, and Bramshall Village are all fed direct off the seven inch high pressure trunk main, and these connections reduce the quantity which can be discharged from Prestwood into Bramshall Reservoir.

In order to afford a sufficient supply to the Highwood and Blount's Green areas, it is necessary to extend the five inch high pressure main from the junction of Smithfield Road and Stone Road, along Stone Road, Oldfields Road, Hockley Road, Balance Street, Pinfold Street, Balance Hill and Leighton Road to its junction with the Burton Road, with a five inch branch from Oldfields Road to Timber Lane in order to provide for the building Estate here.

An extension of the three inch main which now terminates at Leighton Cottage is required in order to supply the elevated tank which it is suggested should be erected on the high ground near Toot Hill Tumulus to serve the high lying houses in this area.

An elevated tank may also be required to supply Bramshall Village, unless "boosting" for this area is resorted to, but we have not included for it in our estimates as we understand this would be

a matter for the Uttoxeter Rural District Council who provide their own mains outside the Urban District.

The remainder of the Town is supplied from Bramshall Reservoir, the main therefrom being eight inches in diameter, but occasionally when complaints arise, other parts of the Town are temporarily supplied from the high pressure mains, as for instance at the Laundry and Infirmary and houses in the vicinity.

When an adequate supply of water is available, it is very desirable that all the low level areas should be served from Bramshall Reservoir, but to effect this and at the same time afford provision for fire protection, it will be necessary to lay a six inch main from this Reservoir to Ashbourne Road at the north end of the Town and continue it four inches in diameter along this road to the end of the Housing Estate.

It will be understood that if all the low level areas of the Town are supplied from Bramshall Reservoir, the pressure on those mains now supplied from the Prestwood Reservoir will be considerably reduced, and this should result in a reduction of the quantity of leakage which now takes place.

We understand that Mr. Proud is at present making investigations with a view of locating and remedying the defective mains and services and should these measures result in a considerable reduction of leakage, it may be possible to modify some of the recommendations made in this report.

After allowing for the quantity of water obtainable from the Bramshall and Somersall Springs, we estimate that the trunk main from Prestwood should be capable of discharging at the rate of 350,000 gallons per day.

As previously mentioned, the existing main is only able to deliver about 260,000 gallons per day and there is little doubt that if the present rate of development continues, it will in the course of a very few years be necessary to provide an additional main from Prestwood Reservoir to Bramshall Reservoir.

The provision of an additional main from Prestwood to Bramshall Reservoir would be the most satisfactory and the best method to adopt of increasing the supply to Bramshall Reservoir and the Town, but such a main would entail a very considerable expenditure.

The quantity of water which could be discharged from Prestwood Reservoir into Bramshall Reservoir by means of two seven inch mains is 520,000 gallons per 24 hours which is considerably in excess of any quantity which is likely to be required for many years to come.

We do not advise the laying of a main of smaller diameter than seven inch, but in order to reduce the immediate capital outlay we suggest the laying of a section of this main only as a first instalment in order to increase the discharging capacity at Bramshall Reservoir to such a quantity as will supply the needs of the district for the next few years.

We have made calculations with sections of various lengths and find that if the main is duplicated from Prestwood Reservoir to Alders Brook, a distance of 6,000 yards, it will be possible to discharge the required quantity of 350,000 gallons per day into Bramshall Reservoir.

This would be a much more economical method of increasing the discharging capacity to Bramshall Reservoir than the proposal to "boost" from a low point in the main, which alternative we also very carefully considered.

It is probable that the laying of a section of this additional main from Prestwood would result in such an increase of pressure,

owing to the reduction of friction, as to enable the higher portions of the Town and Bramshall Village to be supplied with sufficient water to meet their requirements under present conditions without "boosting" by providing Storage Tanks which would be filled at night when the maximum pressure is available, but this must depend on the extent of the building developments at the highest levels.

Such high level supply tanks would enable the demand to be met during the time of maximum draw-off, reflux valves being provided at suitable points to ensure that the tanks are available for the high level areas only.

With an additional main however, no "boosting" would be needed for the supply to Bramshall Reservoir, and if "boosting" was eventually found to be necessary for the high level areas, small plants could be readily and economically installed to serve Bramshall Village and the Highwood Areas.

An alternative to the provision of an additional main from Prestwood is to instal a "boosting" plant for increasing the discharge through the seven inch trunk main to the Bramshall Reservoir, thus postponing for a few years the expenditure upon an additional seven inch trunk main from Prestwood, the length of time depending on building developments, but we are unable to recommend this course inasmuch as during the time "boosting" is in operation, it involves raising the whole of the water to the Bramshall Reservoir and probably affecting the pressures over portions of the areas supplied, added to which the interest on capital cost together with running charges of a "boosting" plant would be more than the loan charges on the provision of a duplicate seven inch main as proposed.

The following are the estimates of cost of the various sections of the work described in this report, including provision for the general charges such as Engineering, Clerk of Works, Loan and Legal Charges, Easements, Contingencies, etc.,

Collection of Water from Hulme & Pond Springs at Alton and the provision and laying of 9" cast iron pipes from here to the Pumping Station at Crumpwood.	£4,880. 0. 0.
Collection of Water from Railway Spring at Crumpwood and the provision and laying of 9" cast iron pipes from here to the Pumping Station including deep river crossing.	£860. 0. 0.
Provision of Pump-Well and erection of Pump House of sufficient size for duplicate pumping plant.	£786. 0. 0. 400
Provision of a complete automatically controlled pumping unit including motor and two stage centrifugal pump, suction pipe and connection to rising main and transformer and erection complete.	£510. 0. 0.
Provison and laying of 9" cast iron rising main from Crumpwood Pumping Station to Prestwood Reservoir.	£1970. 0. 0.
Additional Reservoir at Prestwood having a capacity of 100,000 galls, including indicator and pilot wire.	£2340. 0. 0.

Provision and laying of a duplicate 7" main from Prestwood Reservoir to Alders Brook, a distance of 6,000 yards.	£5820. 0. 0.
NOTE:- This is about one half the distance from Prestwood to Bramshall Reservoir.	
Additional Reservoir at Bramshall, having a capacity of 150,000 galls.	£3000. 0. 0.
Provision and laying of a 6" main from Bramshall Reservoir, via Holly Lane to Ashbourne Road and 4" main in Ashbourne Road to end of Housing Estate.	£2840. 0. 0.
Estimate of cost of extending 5" high pressure main from junction of Smithfield Road and Stone Road to junction of Leighton Road and Burton Road, together with 5" branch from Oldfields Road to Timber Lane.	£2016. 0. 0.
Estimate of cost of 3" main from Leighton Cottage to site for Storage Tank near Toot Hill Tumulus, including elevated Tank having a storage capacity of 5,000 gallons.	£1190. 0. 0.

The above estimates are based on current prices for work of a similar character now being carried out under contract elsewhere.

We would however, point out that there is a tendency for prices to rise owing to the large amount of constructional work now being carried out by Local Authorities under Grants and by the Government in connection with the Defence Programme with the result that most of the Public Works Contractors are so busy that there is very little competition.

It will be observed that the estimate for each section of the work has been given separately so that the cost of any portion of the comprehensive scheme which your Council may decide to carry out can readily be ascertained.

The question of whether the Alton or the Railway Springs are collected for the purpose of augmenting the supply will no doubt largely depend on Messrs. Beale & Suckling's report, but there will probably be no necessity to utilise more than one of these sources of supply at present.

Mr. Willcox will be happy if desired, to attend a Meeting of your Council in order to discuss the various matters dealt with in this report.

We have the honour to be,
Gentlemen,

Your obedient Servents,

(Sgd) WILLCOX, RAIKES & MARSHALL.

MM.Inst.C.E.

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