Metropolis water supply. Report of Thomas Telford ... February 1834, on the means of supplying the Metropolis with pure water.

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METROPOLIS

Water Supply.

Ordered, by The House of Commons, *to be Printed,*
26 *March* 1834.

176.

METROPOLIS WATER SUPPLY.

REPORT

Of *Thomas Telford*, Civil Engineer, February 1834, on the Means of supplying the METROPOLIS with PURE WATER.

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REPORT

Of *Thomas Telford*, Civil Engineer, February 1834, on the Means of supplying the METROPOLIS with PURE WATER.

TO THE RIGHT HONOURABLE THE LORDS COMMISSIONERS OF HIS MAJESTY'S TREASURY.

HAVING received directions from the Lords Commissioners of His Majesty's Treasury to report upon the means of supplying the Metropolis with Pure Water, I immediately proceeded in the investigation of this important object, and after extensive and repeated surveys, and much consideration, beg leave to make the following Report:—

The Water of the river Thames being strongly objected to by the inhabitants of this great city, and also condemned in the Report of the Commissioners of Water Inquiry [See Report, 21 April 1828, p. 11 *], in consequence of the impurities with which it is contaminated; I therefore perambulated the district on each side of the valley of the Thames, and examined the streams which fall into that river in the vicinity of London.

In the result I found an abundance of pure, transparent water, within the distance of 16 miles on the North, amply sufficient for the supply of three of the present Water Companies on that side of the Thames; and within 10 miles on the South, I found as ample a supply for the three Waterwork Companies on the South side of the River, at a sufficient elevation for both high and low services, without having recourse to filtration, or indeed to pumping, except for a small portion of the high services.

The circumstances of the two Companies supplied with water from the valley of the river Lea, require to be spoken of separately. What relates to the Companies which supply water to the North-western parts of the Metropolis shall first be discussed: these are, the West Middlesex, the Grand Junction, and the Chelsea Companies.

From information obtained by the Commissioners of Inquiry in 1828, the daily supply of water, on an average throughout the year, afforded by each Company, was as follows:

The Grand Junction - - -	2,800,000	gallons.
West Middlesex - - -	2,250,000	–
Chelsea - - - - -	1,760,000	–
In all - - -	6,810,000	gallons, or

1,089,600 cubic feet per day, equal to 78,819 gallons, or (nearly) 13 cubic feet per second.

At the town of Uxbridge, the whole of the river which passes that place is called the Colne, with which a considerable stream, called the Chesham, forms a junction at Rickmansworth: proceeding upwards, between Rickmansworth and Watford, the westerly branch occupies the Berkhampstead Valley, and the eastern branch, called the Verulam, a transparent stream, occupies the St. Alban's Valley; and about half-way between St. Alban's and Watford, the Colne joins the Verulam; but, unless after heavy rains, the Colne is an insignificant stream, and at such times very

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* "Taking into consideration the various circumstances to which we have now adverted, together with the details of evidence by which they were proved and illustrated, and also the facts derived from our own observation and experience, we are of opinion, that the present state of the supply of water to the Metropolis is susceptible of, and requires improvement; that many of the complaints respecting the supply of water are well founded, and that it ought to be derived from other sources than those now resorted to, and guarded by such restrictions as shall at all times ensure its cleanliness and purity."

very muddy, wherefore it is intended to exclude the Colne from furnishing any part of the supply of water to the metropolis.

At Watford Mill in the autumn of 1833, being the driest season, as regards the supply of rivers, experienced during the last half-century, the Verulam River produced upwards of 30 cubic feet of water per second; being more than double the quantity supplied by the three Companies in the year 1828, namely, 13 cubic feet per second, as before stated.

In the Berkhampstead Valley the river Gade, at Hunton Bridge (three miles north of Watford), in the same dry season produced 42 cubic feet per second; but to connect the Gade with the Verulam would cost 50,000*l.*, a heavy expense, which, however, is a small objection compared to the turbid state of the Gade water, produced by its connection with the Grand Junction Canal, and the more decided cause for rejecting it altogether, from its being infected by the deleterious substances used at the paper-mills: so that there being abundance of clear water produced by the Verulam alone, at a sufficiently high elevation, I propose to avoid these annoyances altogether.

Immediately above the commencement of the intended London Aqueduct, about two miles above Watford, the valley of the river Verulam affords a commodious situation for extensive reservoirs of water, and for allowing it to settle, if such should hereafter be deemed requisite.

From this place a covered aqueduct may be made to descend with a uniform inclination of 18 inches per mile to Primrose Hill, terminating in a set of extensive receiving and distributing reservoirs, at the height of 146 feet above high-water, Trinity datum standard, in the river Thames; from these reservoirs each of the three before-mentioned Companies may be supplied separately, and in such proportion as shall be determined.

In order to deliver the water into the reservoirs near Primrose Hill, in the same state of purity as it leaves the Verulam River, it is proposed to conduct it through a covered aqueduct, at such a depth under the surface of the ground as to be secure from the effect of frost, from any mixture of surface water, and from external injury by cattle or otherwise; and to preclude the unavoidable interruptions occasioned by cleansing the waterway and effecting repairs, this aqueduct will be constructed with a double watercourse, separated by a footpath throughout its whole length.

South of the valley occupied by the Colne and Verulam, there is a narrow ridge of land, through which the aqueduct must pass by means of tunnelling; but as this ridge consists of a mass of chalk, no difficulty is to be apprehended in this operation.

I have thus given the outline of the plan I recommend, by which three of the Companies on the north side of the river Thames may obtain a plentiful supply of pure water. It has already been mentioned, that in 1828 these three Water Companies distributed about 13 cubic feet of water per second, on an average, throughout the year; but as the maximum demand of the summer months is stated to be 25 per cent. more than the average throughout the year, the maximum rate of supply by these three Companies, in 1828, appears to have been 16¼ cubic feet per second; in the five years since that period, the quantity distributed is said to have been increased 25 per cent., partly from the increase of population and partly owing to the larger demands of the inhabitants: thus I shall assume the maximum rate of demand in 1833 to be 20 cubic feet per second.

To provide for this and any future increase of water expenditure, I propose to obtain 30 cubic feet of water per second from the river Verulam, which is 10 cubic feet more than the maximum demand in the middle of summer. And if at any future period even a greater quantity should be required, reservoirs may be made for retaining the superfluous water of the Verulam, to ensure a proportionate supply; wherefore I propose that the London aqueduct should be made sufficiently large to convey an extra quantity; and that the whole of the water yielded by the river Verulam be secured for supplying the Metropolis with water, should it ever be required.

SOUTH SIDE OF THE THAMES.

The daily supply afforded by the three Companies on the South side of the river Thames, on an average throughout the year, according to evidence produced to the Commissioners in 1828, was as follows:—

The Lambeth Company - - -	1,244,000 gallons.
South London - - - -	1,000,000 –
Southwark Waterworks - -	720,000 –
	2,964,000 gallons.

This is equal to 474,240 cubic feet daily, or at the rate of 5 ½ cubic feet per second.

Thus the three Companies distributed in 1828 not quite six cubic feet of water per second, all derived immediately from the river Thames.

The supply on this side of the river being under the same circumstances as that on the North side, already described, and requiring similar additions for the summer supply and for general increase during the five years elapsed since that time, the present maximum supply in the summer months may be assumed at 8 ½ cubic feet per second; to provide for this and any future increased demands, I propose to secure 13 cubic feet per second.

The best means of obtaining an ample supply of pure transparent water for these three Companies, is by taking it from the river Wandle at a sufficiently high elevation, which is found on the Croydon branch of that river, at the east end of Beddington Park, 90 feet above high-water in the river Thames. From this place an aqueduct may be carried in nearly a direct line to Clapham Common, and there terminate in a requisite number of reservoirs at a height of 82 feet above high-water in the river Thames, which, except Brixton Hill (supplied by the Lambeth Company), exceeds the present heights of delivery by the several Companies, which are as follows:—

Lambeth - - -	42 feet.
South London - -	65 –
Southwark - - -	56 –

The proposed reservoirs on Clapham Common will therefore ensure a sufficient elevation.

The main branch of the river Wandle takes its rise in a singularly copious spring in the vicinity of Croydon, and after pursuing a westerly course for about three miles, is joined by the Carshalton branch, which likewise derives its origin from several plentiful springs in that neighbourhood.

The water of this river possesses at all times an uncommon degree of purity, regaining its transparency after the heaviest rains in the course of a few hours.

The quantity of water flowing down the Carshalton branch of the river Wandle in the extraordinary dry season of 1833, was at the rate of 13 cubic feet per second; the quantity discharged by the Croydon branch at the same time, was at the rate of 17 cubic feet per second. From this last I propose to take 13 cubic feet per second, being 4 ½ cubic feet per second beyond the present maximum demand in the middle of summer.

From the Clapham reservoirs all the three Companies may be supplied separately, and in such proportion as shall be afterwards decided, at 82 feet elevation above high-water mark, Trinity standard. The new houses on Brixton Hill would be supplied with pure water by 82 feet less expense of pumping than what is at present required for this purpose.

In all the works of the six before-mentioned Companies, on both sides of the Thames, some expense must be incurred in extending and adapting their mains for the reception of pure water. The quantity and method of appropriating the supply, so as to satisfy the demands of all parties, being regulated in such manner as shall, upon conferring with the engineers of the different Companies, be deemed most advisable.

EXPENSE AND REMUNERATION.

Having shown by what means the Metropolis may be amply supplied with pure water by six of the present Water Companies *, without disturbing their present works, at an expense of about 1,177,840 *l.* 16 *s.* 5 *d.*, including the construction of reservoirs, covered aqueducts, and connecting mains, also making compensation for water taken from mills (by substituting steam power in lieu thereof), and the

* See Appendix (A.)

the value of land and damages, I conceive that I have performed the duty imposed upon me by the Lords Commissioners of His Majesty's Treasury; that is, "In what manner the Metropolis can be supplied with Pure Water." The manner in which any advance on the part of the public is to be repaid, being a matter of finance, I leave to be determined by others, and shall only annex a copy of what was recommended by the Directors of the Grand Junction Waterworks Company*, viz. they suggest that the "only course that could be pursued to avoid a ruinous waste of capital, and a consequent loss to the public, is, that the Commissioners should be directed to ascertain the best mode of obtaining the supply required; that Government should advance the sum requisite to bring the water to the spot from whence the Companies could receive it into their several works, upon the security of their respective incomes, as has been done in other public undertakings; that the outlay should be under the supervision of some parliamentary authority, and that the increase of rates to be charged by each Company should be no more than the proportion of interest they should respectively pay to Government."

This seems a fair and judicious proposal; and as a constant annual outlay for pumping and filtration will be saved to the Water Companies, this sum, and any other that can be saved, would be appropriated towards payment of the interest on the Government expenditure for the new works. By this arrangement only a moderate addition to the present rates will be necessary; and it is presumed that the inhabitants would willingly agree to this new rate being established, thus insuring to themselves a plentiful supply of pure water.

In order that the necessary works may be performed in a satisfactory manner, and that the water may be correctly supplied, in quantity and quality, to each Company, a Parliamentary Commission (as recommended by the Grand Junction Company) should be appointed to manage the whole.

It may be of use to remark, that the course of these aqueducts, on both sides of the river, interferes with no private dwelling or public establishment of any kind; and the same observation is applicable to all the reservoirs proposed in this Report; and as the aqueduct will also be under the surface of the ground for the greater part of the distance, the chance of derangement, after being completed in a perfect manner, is not to be anticipated.

It should also be stated, that all the changes recommended in this Report may be accomplished without interfering with any of the present establishments. When the new works are completed, and the water ready for delivery, the different Companies will have only to shut off communications with the river, and open the pure water supplies; and this is an important advantage, considering the incessant demand for one of the necessaries of life, which admits not of interruption during a single day or hour.

Until the public have by experience acquired a perfect confidence in the quantity, quality, and regularity of the pure water supply, the communication with the river ought to be preserved, but not used unless necessity for doing so should occur.

THE NEW RIVER.

It seems unnecessary to go into a history of this magnificent work, from which the Metropolis derives so great a portion of its supply of pure water, it being well known to have been accomplished by Sir Hugh Myddleton in the reign of James the First, after encountering many difficulties, and not without his royal assistance. I shall, therefore, confine my observations to its present state.

The river Lea is the drain of a valley in the great chalk ridge which intersects the county of Hertford. This is a considerable stream adjacent to the town of Hertford, and in its progress towards the Thames, by Waltham Abbey, its waters are much augmented by a junction with its tributary streams, the Ash and Stort, which fall into the main river some distance below the town of Ware.

In the valley of the Lea, and in the neighbourhood of Ware, two singularly copious springs issue from the foot of the Chalk Hills. The upper, and greater, is named the Chadwell Spring; the other, which is below the town of Ware, the Amwell. The quantity and transparency of these springs were the inducements for taking the water from this place for the supply of the Metropolis; more especially

* See Report, 11 March 1830, p. 3.

cially as the position was found sufficiently high to enable the projectors to carry the water along a very circuitous artificial aqueduct of 37 miles in length to the suburb of Islington, where it terminates at the height of 84 feet above the river Thames, whence it is distributed over a large district; and having been maintained with great care and expense has afforded an ample supply of water to the inhabitants.

But during two centuries the population of the Metropolis has greatly increased, and along the whole length of the aqueduct villages and splendid mansions have arisen, so that the consumption of water has also greatly increased, wherefore by several Acts of Parliament authority has been granted for drawing an additional quantity from the river Lea.

In the distribution of the water produced in the valley of the river Lea, three objects require attention:

1st. The supply of a great portion of the Metropolis with pure water.

2d. The navigation of the river Lea between the town of Hertford and the Thames.

3d. The water-power of the mills upon the river Lea, including the Government mills at Watham Abbey.

An ample supply for the Metropolis ought certainly to be secured in the first instance, because the two other objects may, if absolutely necessary, be otherwise provided for; moreover, upon investigating the subject, I am convinced that by judicious arrangement all these three purposes may be combined and accomplished.

The appropriation of the water of the Lea has, during the last century, been the subject of much litigation, and the most eminent engineers, viz. Sir Christopher Wren, Desaguiliers, Smeaton and Rennie have been employed; and, lastly, the supply of water and the comparative levels have been carefully ascertained under my direction.

Upon consideration of the entire subject, I am of opinion that the law, as it now exists, ought not to be disturbed.

I also understand that since the year 1828 conferences have taken place, and the outline of a scheme suggested, which, with such modification as existing circumstances require, would be satisfactory to all parties concerned; and this, I hope, will be completed without delay.

The quantity of water delivered to the inhabitants of London and its vicinity by the New River Company, as stated to the Commissioners of Water Inquiry in 1828, was at the rate of 24 cubic feet per second, and this being required to supply the usual consumption of the inhabitants, must be carefully preserved.

The entire quantity of water flowing down the river Lea in November 1833 (after supplying the New River), as measured at the King's Wear, above Waltham Abbey powder-mills, was found to be 110 cubic feet per second. As this was at the end of an unusually dry season, there will always be an ample supply for navigation and mill-power, as I do not recommend that any water be taken from the river below the town of Ware until after it has passed the Government establishment at Waltham Abbey.

By the contemplated arrangement a division of the water would be adjusted, litigation prevented, and the metropolis supply, to a known extent, secured. But to meet the continually increasing demands of the inhabitants, and to compensate the loss of the Amwell spring (which has abandoned the New River, and now finds its way into the Lea), it is necessary to enable the Company to provide a still greater quantity of water, and also to preserve it in greater purity; but to accomplish this further parliamentary authority is required.

1st. In order to obtain an additional quantity of pure water, without interfering with the contemplated arrangements, the Company should be required to pump water from the river Lea some miles below the Government works at Waltham Abbey, towards which purpose they have purchased Tottenham Mill and 30 acres of land adjacent, and constructed reservoirs to the extent of 30 acres of water adjoining the New River, at Newington, and adjacent to the site of Tottenham Mills; and there being also an old branch of the river Lea at present not in use, it should be transferred to the New River Company, who thereupon should be required to embank and enlarge it, to not less than 20 acres, and convert it into a settling reservoir, upon which the pumping engines should be placed.

In regard to the power of the engines to be constructed and employed, in order to guard against the effects of long-continued frosts, or unusual droughts, or being under the necessity of pumping from the river Thames, at Broken Wharf, the

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engines should be capable of raising two thirds of whole supply. This additional quantity being thrown directly into the reservoirs at Newington, would have the advantage of being in the vicinity of the city, and create no further expense of conduit or other conveyance.

If the water is taken off at Tottenham, all the mills upon the river above that place, including the Royal Gunpowder Mills at Waltham Abbey, would still possess the entire water of the river, and if a quantity equal to two thirds of what is supplied to the Metropolis by the New River (viz. 16 cubic feet per second) were drawn off by the engines at Tottenham, 94 cubic feet per second would still remain for the use of the mills below.

To guard against any injury that might arise to the navigation of the river Lea, in consequence of the powers herein recommended to be given to the New River Company, that Company should be required to rebuild the Lock at Tottenham Mill in a perfect manner, and keep it in repair; also to pay a fair and reasonable sum to the trustees of the River Lea Navigation, to be expended in deepening the river Lea where found necessary.

2d. The quantity of water requisite in aid of the New River being thus adjusted, it becomes of importance to preserve that stream from impurities while passing along a circuitous course of 37 miles in length. I was, at first sight, disposed to recommend its being made more direct, by cutting off great bends, embanking vallies, &c.; but on survey, finding it of quite sufficient dimensions to convey all the water that the Company had a right to take, also that the stream itself is, in effect, a very extensive reservoir, and that much expense would attend the proposed alterations, I consider it more advisable to adopt other means of improvement.

Where the New River commences at the Chadwell Spring the water is generally pure and transparent; but in passing 37 miles of a populous vicinity without protection, it is unavoidably exposed to various impurities; the surface water from the uplands, sewages from the villages, cattle treading down the edges of the river banks, all combining to produce discoloration of the water, which is still more increased by the operations necessary to restore the banks, and near the Metropolis by numerous persons bathing and creating other nuisances. The Company should, therefore, be empowered and required to collect the water and sewage from the uplands and villages, and convey it under the New River to proper watercourses; and they should also be required to fence each side of the river in a proper manner so as to prevent the evils above-mentioned, preserving a space between the fence and water, of at least six feet in breadth, for the passage of workmen, making reasonable compensation to the proprietors of the adjoining lands.

The Company should also have the power of summary punishment of trespassers, on conviction before magistrates; and the land-owners and occupiers should be prevented from digging deep ditches at the bottom of the slopes, thereby weakening and endangering the banks.

3d. In regard to defraying the expense of the improvements here proposed, it appears that since the year 1828, the Company have completed some very considerable works, such as the Newington Reservoirs, of 38 acres, defraying the expense from their annual income; and I understand by their letter to the Treasury of July 1831, that they are able and willing to continue the improvements in the same manner, if parliamentary powers were granted them.

4th. To insure the improvements being properly executed, and the water duly distributed, the before-mentioned Parliamentary Commissioners should be empowered to examine into and decide any differences which may arise among the parties interested in the supply and purity of the water, which would prevent disputes, such as have already been productive of expensive litigation without satisfactory result.

THE EAST LONDON.

The East London Waterworks Company supply a very large and increasing district, being the North-eastern portion of the Metropolis. The Waterworks are situated at Old Ford, in the river Lea, just above Bow Bridge, and consist of a powerful apparatus of steam-engines and pumps, of the aggregate force of about three hundred horses, for raising and distributing water.

The water has hitherto been brought from the river Lea at high water, into a

large settling reservoir on the north side thereof, from whence it passes by pipes under the same river into smaller reservoirs, from which the pumps are supplied.

From this arrangement it is evident, that although the water taken from the reservoirs and distributed is in fact from the river Lea, yet it is the water of the Lea subjected to the contamination of the district through which it passes in and below the neighbourhood of Bow, and to the constant agitation of the tides in driving upwards towards the Waterworks during the flood-tides; thus rendering it no better, as far as regards matter held in suspension, than the water of the Thames taken up in its passage through the Metropolis.

After the Commissioners of Inquiry into the quantity and quality of water supplied to the Metropolis had made their Report in 1828, the East London Waterworks Company took immediate steps to improve their water both in quantity and quality, by obtaining powers under an Act of Parliament, in the year 1829 [10 Geo. 4, cap. Local and Personal], to take water from the river Lea at or near Lea Bridge Mills, above the influence of the tide, and to convey it from thence to the Works at Old Ford, by means of a new aqueduct (insulated from all other water), into settling reservoirs upwards of eighteen acres in extent, from which it passes into reservoirs, out of which the pumps are supplied as before stated.

These Works are now on the eve of completion, and will be in action in the month of June of the present year, within the time allowed by the Act of Parliament.

In the prosecution of these improvements, the East London Waterworks Company have expended upwards of 50,000 *l.*, without having the power of imposing additional rates or charges on their customers; the maximum charges of housekeepers or private consumers being fixed by the Act.

Having assured myself, by a personal survey of the Waterworks at Old Ford, and by an inspection of the new aqueduct and reservoirs now near completion, for taking water from the river Lea at the tail of the Lea Bridge Mills, that the above statements are correct; in which survey and inspection every facility was afforded by the Directors of the Company, in furnishing information, and in the production of all documents deemed by me necessary for the investigation of the subject, I have no hesitation in stating, that, as far as the East London Waterworks are concerned, the improvements necessary for ensuring a better supply of pure water to their district have been anticipated by that Company.

The only point upon which any question might arise is rather of a prospective nature, inasmuch as it relates to the sewage of the district on the west side of the river Lea, between Tottenham Mills and Lea Bridge Mills, which sewage is now discharged into the Lea; but should a greater number of buildings, or a town, grow up on that side of the river, it would then be advisable to carry the sewage of that district clear of the portion of the river above named, either by conveying it under the river at one or more points, or by connecting it with the Hackney sewage, which goes into the tideway of the river Lea below Old Ford Lock. But this is a part of the subject which might with propriety come under the control of a general commission for the conservation of the water supplied to the Metropolis.

Regarding the quantity of water now used, or likely to be required by this Company, there is no doubt the river Lea possesses an abundance.

By the returns made to the Commissioners of Inquiry in 1828, it appears that the quantity then distributed by this Company was 11 cubic feet per second in the aggregate; and making the due allowances for the extra quantity used in the warmest weather at 25 per cent. increase, adding moreover 25 per cent. for increase since that time, the amount would now be about 16 cubic feet per second, and allowing another 25 per cent. for future demands, it gives a total of 20 cubic feet per second, as the greatest probable quantity required by this Company.

Now, it appears that the river Lea (as above stated in the Report on the New River) produces, in the times of shortest water, a surplus quantity of 94 cubic feet per second, after deducting what might probably be wanted by the New River Company in times of drought; and as the quantity required for the East London Company is not taken off until after passing through Lea Bridge Mills, and supplying all the wants of the navigation, there will still remain the above surplus of 94 cubic feet per second, for supplying the probable maximum demand of 20 cubic feet per second required by the East London Company.

Thomas Telford.

London, 17 February 1834.

Appendix (A.)

NORTH SIDE OF THE RIVER THAMES.

ESTIMATE of the EXPENSE of Constructing a Line of Aqueduct and other Works requisite for conveying Water from the River *Verulam* (from *Bushey Mill* near *Watford*) to a Reservoir on *Primrose Hill*, for supplying with Pure Water Three of the Northern Districts of the Metropolis; including Purchase of Land and Compensation to Mill-owners.

	£.	s.	d.
Small reservoir and works for regulating and drawing the supply from the river Verulam, and diverting the course of the river Colne	11,500	–	–
Earthwork in cutting, embanking and tunnelling on the line of aqueduct from the river Verulam to Primrose Hill £. 53,240 10 6			
Add 10 per cent. for contingencies 5,324 1 –			
	58,564	11	6
Iron pipes for conveying the water across the two vallies of the river Brent 24,280 – –			
Two small bridges for ditto 1,400 – –			
25,680 – –			
Add 10 per cent. for contingencies 2,568 – –			
	28,248	–	–
Brickwork in aqueduct, with a double watercourse, separated by a foot-path, from the reservoir of the river Verulam to the reservoir on Primrose Hill, being a distance (including the length of the above iron pipes) of 15 miles 490 yards £. 325,005 – –			
Concreted lime and gravel in foundation of aqueduct 13,937 4 –			
Culverts for land water 729 6 –			
339,671 10 –			
Add 10 per cent. for contingencies 33,967 3 –			
	373,638	13	–
Forming reservoirs at Primrose Hill, including the necessary works for dividing the supply of water to the respective Water Companies or Districts	20,000	–	–
Main pipes to connect the reservoirs at Primrose Hill with the present mains of the Grand Junction, West Middlesex and Chelsea Water-works Companies	57,500	–	–
	549,451	4	6
Land on the line of aqueduct	12,200	–	–
Compensation to mill-owners for water taken from all the mills between Bushey Mill and the river Thames	224,314	7	–
TOTAL £.	785,965	11	6

SOUTH SIDE OF THE RIVER THAMES.

ESTIMATE of the EXPENSE of Constructing a Line of Aqueduct and other Works requisite for conveying Water from the River *Wandle* at *Beddington Park* to a Reservoir on *Clapham Common*, for supplying with Pure Water the Districts on the South side of the Thames; including Purchase of Land and Compensation to Mill-owners.

	£.	s.	d.
Machinery for regulating the quantity of water taken from the river Wandle, including a wear across the river, sluices, &c.	2,000	–	–
Earthwork in cutting and embanking on the line of aqueduct from the small reservoir near Beddington Park to the reservoir on Clapham Common £. 16,488 5 –			
Add 10 per cent. for contingencies 1,648 16 6			
	18,137	1	6
Brickwork in aqueduct, with a double watercourse separated by a foot-path, from the small reservoir near Beddington Park to Clapham Common (being 6 miles and 20 yards in length) £. 141,942 10 –			
Concreted lime and gravel in foundations of aqueduct 6,821 16 –			
Culverts for land water 948 12 –			
149,712 18 –			
Add 10 per cent. for contingencies 14,971 4 –			
	164,684	2	–

	£.	s.	d.
Forming reservoirs on Clapham Common, including the necessary works for dividing the supply of water to the respective Water Companies or Districts - - - - - - - - £. 10,660 4 4			
Add 10 per cent. for contingencies - - - - 1,066 - 5			
	11,726	4	9
Main pipes to connect the reservoirs on Clapham Common with the present mains of the Lambeth, South London and Southwark Water-works Companies respectively - - - - - - - - - -	40,432	-	-
	236,979	8	3
Land on the line of aqueduct - - - - - - - - - -	4,800	-	-
Compensation to the mill-owners for water taken from all the mills from Beddington Park to the river Thames - - - - - -	150,095	16	8
TOTAL - - - £.	391,875	4	11
Total for Three of the NORTHERN DISTRICTS of the Metropolis -	785,965	11	6
Ditto for the Districts on the SOUTH SIDE OF THE RIVER THAMES	391,875	4	11
GRAND TOTAL - - - £.	1,177,840	16	5

Appendix (B.)

No. 1.

Copy of LETTER from Dr. *Bostock* to Mr. *Telford*, with Analysis of Water.

Sir, Upper Bedford Place, 28 Nov. 1833.

I BEG to inform you that I have examined the two specimens of water, marked B (from the river Wandle) and C (from the river Verulam or Colne), which you placed in my hands. I proceeded on the same plan as in the former examinations; and, by way of comparison, I made a corresponding set of experiments on the water of the New River.

The water marked B, I found, both in its sensible properties and in its chemical relations, to be of considerable purity. It was perfectly transparent, without colour, taste, or odour, of low specific gravity, and containing only a moderate quantity of saline matter in solution. Its solid contents did not appear to be more than in the proportion of 1·5 grain in 10,000 grains of the water, being somewhat more than the solid contents of No. 1 of the former specimens, but not more than the average of the whole of them, while it is less than that of the New River. A small quantity of carbonic acid was discharged from it by boiling, but no perceptible quantity of earthy matter was deposited from it by this process. By the application of the appropriate tests, it was found to contain lime, soda, muriatic acid, carbonic acid, a minute quantity of sulphuric acid, and a trace of magnesia. The quantity of lime was about one grain in the 10,000, being nearly the same quantity as in the New River water, while the muriatic acid is considerably less in quantity.

The water marked C is, in most respects, inferior to B. It was transparent, without colour or odour, but it had a very slight musty flavour, (perhaps depending upon the cork,) and it contained a few floating particles, to which minute air bubbles were attached; they appeared to consist of vegetable fibres. It did not affect the test papers until after it had been boiled, when it indicated the presence of a small quantity of an uncombined alkali or alkaline earth; it likewise deposited a minute film of white particles. The amount of its solid content was somewhat greater than that of B, being nearly two grains in the 10,000, almost precisely the same with that of the Thames at Richmond. It contained more lime and muriatic acid than B, and in addition it exhibited a trace of potash. It contained rather more lime than the New River, but rather less muriatic acid: it must therefore be consided not quite so applicable to domestic purposes. But although it appears from the above examination that B has a decided preference over C, yet it is necessary to observe, that C is equal or even superior in purity to many waters that are employed for the supply of cities, and could not be considered as objectionable for this purpose.

I beg to add, that as on former occasions, I have given a general statement only of my results, without detailing the exact processes by which I arrived at them, but that I shall be happy to afford you any more specific information, if you conceive it to be necessary.

I remain, &c. &c.

(signed) *J. Bostock.*

No. 2.

Copy of LETTER from Mr. *Mitchell* to Mr. *Telford*, respecting the Water of the River *Verulam*.

Sir, Watford, 28 January 1834.

In answer to your inquiry, the river water of this place is used by the inhabitants living near for brewing, washing, cooking, making tea, and other domestic purposes.

(signed) *John Mitchell.*

No. 3.

Copy of LETTER from Mr. *Barnard*, of *Watford*, to Mr. *Telford*, respecting the Water of the River *Verulam*.

Sir, Essex Arms, Watford, 27 January 1834.

I had the honour to receive your favour yesterday, and should have answered by return of post, if I had got the necessary information.

I understand upon inquiry that the river water is used by more than a fourth of the inhabitants of this town for domestic perposes, for washing, making tea, brewing, &c. &c., and is considered good wholesome water. I can answer for the fine quality of the trout and eels that come out of it.

I am, &c. &c.

(signed) *Francis Barnard.*

No. 4.

Copy of LETTER from Mr. *Dalton*, of *Watford Mill*, to Mr. *Telford*, respecting the Water of the River *Verulam*.

Sir, Watford Mill, 26 January 1834.

In reply to yours of yesterday's date, respecting the quality of the water in our river; it is used by more than a third of the people in the town for all purposes, and would, in all probability, be more extensively used, were it not that the upper part of the town is well supplied by other means.

I am, Sir, &c. &c.

(signed) *C. Dalton.*

No. 5.

Copy of LETTER from Mr. *Charles Lambert* to Mr. *Telford*, respecting the Water of the River *Wandle*.

Sir, Beddington Mills, 13 Feb. 1834.

In reply to yours of the 8th February 1834, I consider the water of the river Wandle is well adapted for general domestic uses: I employ it in my own family for brewing, washing, and all culinary purposes, it being very clear, except for a few hours after very heavy rains. In my mill-dam, I can discern an object the size of a sixpence under a depth of five or six feet.

(signed) *Charles Lambert.*

No. 6.

Copy of LETTER from Mr. *P. Dove* to Mr. *Telford*, respecting the River *Wandle*.

Sir, Waddon Mills (near Croydon), 13 Feb. 1834.

It is my opinion that the water of the river Wandle is of the purest quality for all domestic uses.

(signed) *P. Dove.*

No. 7.

Copy of LETTER from Mr. *Rickman* to Mr. *Telford*.

Dear Sir, House of Commons, 7 Feb. 1834.

I promised that Mr. Postlethwaite (of our Journal Office) should try experiments at Harting in aid of your Metropolis Water Inquiry; and the result of my application to him is more satisfactory than any formal experiment, as you will perceive from the following detail.

The family supply of water is from three several sources at pleasure; from a well of some depth, from a tank of rain water, and lastly, from a small stream which issues from under the South Down chalk-ridge of Sussex, at the distance of a mile, and supplies a mill-pond one-third of a mile distant from Mr. Postlethwaite's house.

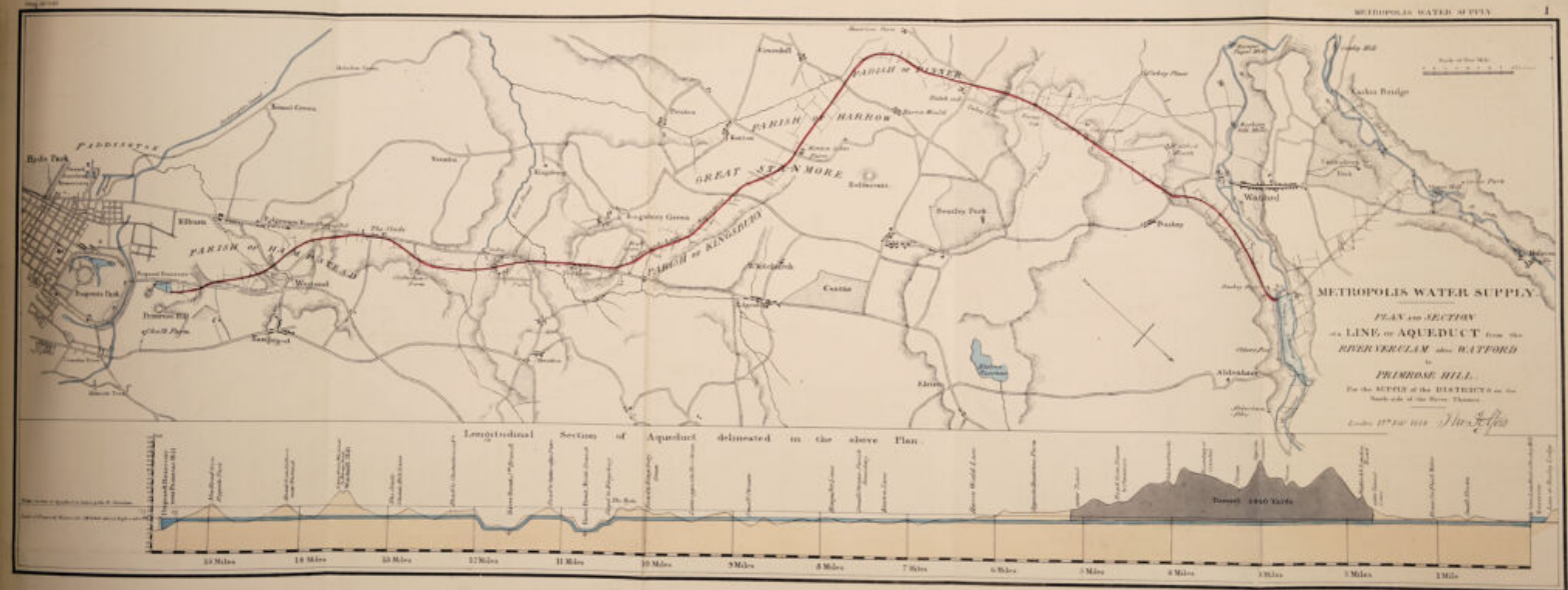
In my opinion, the most important part of your inquiry relates to tea-making, this foreign plant now furnishing the beverage of all classes, and the use of hard water making a great difference in the strength of the infusion, thus taking money from the pocket of the consumer of the tea, not without also injuring the flavour on his palate. For this purpose of tea-making, and for personal use, a servant is daily dispatched to the mill, dipping for water below it, which water therefore has always been exposed to the influence of the atmosphere while in the mill-pond, where it deposits a small quantity of chalky matter.

The water of the well is used for brewing, and the rain-water (elsewhere so much prized) merely serves for the common purposes of the wash-house, saving the trouble of drawing water from the well.

You will be pleased to learn from this detail, that water from a well-known chalky source (not dissimilar from that of your North and South streams of intended supply,) is habitually preferred to rain water, although the distance of the mill-pond imposes a daily task on the servants, and the rain water pump is at hand in the wash-house.

Always yours faithfully,

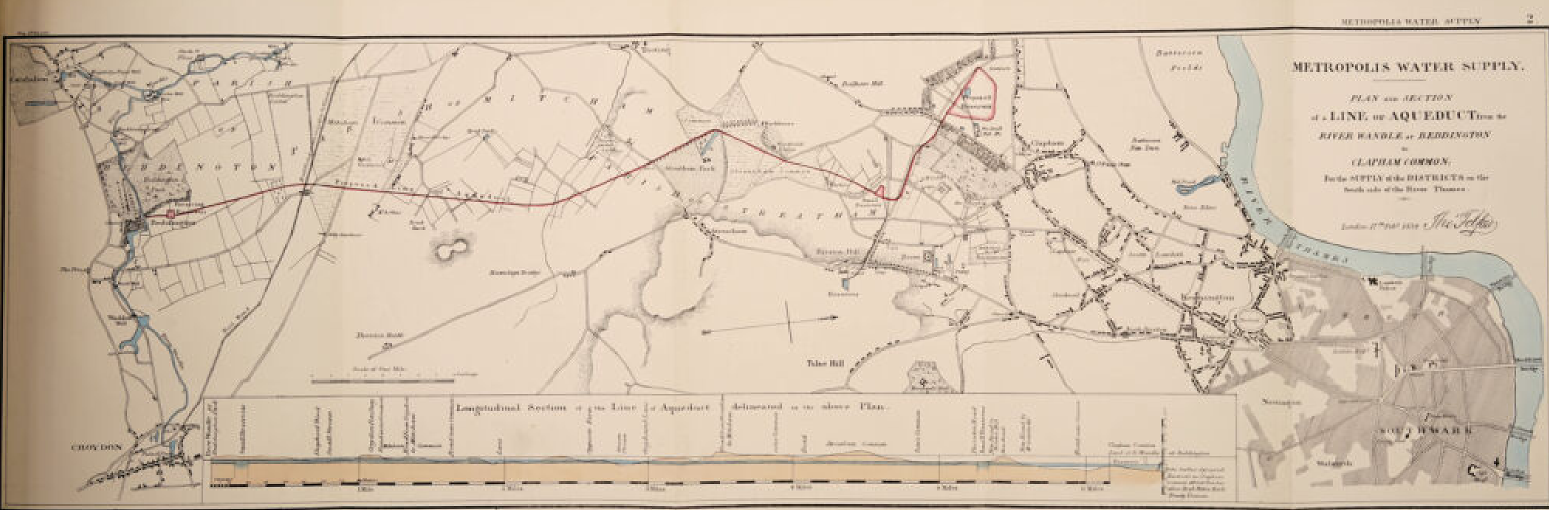
(signed) *John Rickman.*



METROPOLIS WATER SUPPLY.

PLAN and SECTION of a LINE of AQUEDUCT from the RIVER VERULAM above WATFORD to PRIMROSE HILL.

For the SUPPLY of the DISTRICTS on the South side of the River Thames.


METROPOLIS WATER SUPPLY.
PLAN AND SECTION
of a LINE OF AQUEDUCT from the
RIVER WANDLE at BEDDINGTON
to
CLAPHAM COMMON.
For the SUPPLY of the DISTRICTS on the
South side of the River Thames.
Longitudinal Section of the Line of Aqueduct delineated on the above Plan.
CROYDON
Tulse Hill
Streatham
Brixton Hill
Kennington
Newington
Walworth
SOUTHWARK
Clapham
Battersea Fields
RIVER THAMES


MAP
of the
NEW RIVER
TOWN OF WARE TO LONDON,
and part of the
RIVER LEA.
Scale of Miles
HERTFORD
WARE
Waltham Abbey
Highgate
LONDON
SOUTHWARK
NOTE

METROPOLIS

Water Supply.

Ordered, by The House of Commons, *to be Printed,*
26 *March* 1834.

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