

## Scheme for a Water Supply to Yokohama

### Present Supply

The necessity for a Water supply other than that now existing, is severely felt in the Native portion of the Settlement and an agitation has been going on for some time to improve it —

The impurity of the Water at present used is a matter which must sooner or later attract the attention of all the residents in Yokohama, both foreign and Native

The wells from which it is procured range from 12 to 20 feet deep and are sunk in close proximity to open drains, stables, privies, and ash pits and as their supply comes principally from their immediate neighbourhood, they being so shallow that their drainage area must be of very limited extent. There can be no doubt that along with the water percolating into them through the veins of the earth a large quantity of the obnoxious matter which exists around them must also find its way. As Yokohama grows older the filth will accumulate in the wells the passages through which they are supplied will themselves become contaminated, and the results will speedily become disastrous

The want of water in case of fire



is also an important consideration which requires remedying, the wells being only like small cisterns which may be emptied by a pump in a few minutes and taking hours to refill.

Further the supply being dependent on the rainfall from so confined an area in dry weather it is very liable to fail and in seasons of long and excessive drought Yokohama might become entirely waterless.

#### Proposed New Supply

The general principles on which this scheme is grounded are these: To supply sufficient water for the domestic & public wants of all the Native town including the adjoining districts of Yoshida, Inagi, Honmura and Nakamura as well as the foreign part of the Settlement on the Constant System, that is to say have the pipes constantly full, leaving people to use as much water as they choose and so obviate the necessity for tanks in the dwellings, turnkeys, &c; To bring the water at high pressure from a Reservoir containing a few days supply which will be sufficiently high to enable the water to rise by its own gravitation to the tops of the highest houses and also to throw jets over them in cases of fire. To have the water thoroughly purified by an approved process of filtration before admission to the Reservoir.

Quantity



Quantity. - By information received from the Municipal Director the population to be supplied is at present as follows

Natives Yokohama	12,960
" Yoshida Ningo	}
" Honmura Nakamura	

Total 18,889

Chinese	1,200
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Europeans	600
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Total 20,689

It will be necessary however to make an allowance for a probable increase in these numbers say -

Natives 10 per cent	20,777
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Chinese 30 " "	1,560
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European 50 " "	900
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Total 23,237

London is supplied with 30 Gallons per inhabitant per day, Liverpool with 24 Gallons, Glasgow two Water Works are capable of supplying 50 Gallons per inhabitant per day, and Manchester 42 Gallons - in all these towns more especially the two latter there are manufactories and other works using large quantities of water which must be considered in judging of the amount necessary for the wants of Yokohama -

The habits of the people is also a matter for consideration - The above quantities of course include all that is used for water closets baths or washing

Purposes



Purposes -

From our supply to the native population may safely be excluded the quantity required for Water Closets, and the washing & bath Water will also be less than for European requirements - Ten gallons per inhabitant per day being a quantity which is seldom likely to be exceeded.

The European supply on the other hand should have a liberal allowance for baths & washing and may be put down at 40 Gallons per inhabitant per day being 10 Gallons more than is supplied to London.

The quantity at these figures will be as follows

Natives - 20,777 at 10 Gallons	207,770
Chinese 1,560 at 20 - "	31,200
Europeans 900 at 40 - "	36,000
	<u>274,970</u>

Say 300,000 Gallons per day

X  
Height of Fountain head - The height above the highest points of the Settlement should be as follows

Houses 30 feet

Loss of Head from friction and other causes say  $\frac{1}{2}$  more 15 feet

Total head from the bottom of the reservoir or from commencement of the high pressure pipe 45 feet -  
 & this must be added 20 feet for the depth of the Reservoir & filter giving  
 the



the fountain head a total elevation of 65 feet above the highest streets

### Source of Supply

The source from which it is proposed to take the supply of water is a stream which is formed by the conflux of three mountain streams, at a place about 12 miles from Yokohama called Kawai-mura and which falls into the sea about halfway between Yokohama and Kawagawa. With a map of the district its drainage area or catchment basin could be discovered and with proper returns of the fall of rain its discharge could be calculated at all seasons.

With some knowledge of the Geological formation of the country its mineral ingredients could be got at and with some means of Aqualization its purity could be further tested.

But all these we are without and it only remains for us to get all the information possible regarding the water by such observations and inquiries as are at present within our reach —

The necessary height of the fountain head or 65 feet can be got at about a distance of 6 miles from Yokohama at a place called Bok-a-jemura

On the 27+28 of February last after 4 or 5 months dry weather the flow of water in the stream by three separate gaugings was as follows

1st



(6)

1<sup>st</sup> at the rate of 3,047,040 Gallons per day  
2<sup>d</sup> " " " " 3,490,560 " " " "  
3<sup>d</sup> " " " " 3,831,840 " " " "  
Making an average of 3,456,480 " " " "

And from information received on the spot from several persons who had been 30 and 40 years there this quantity is seldom less - Two years ago and ten years ago after on each occasion long dry summers the stream was reduced to about one tenth of its present size but it only lasted so for about 20 days and this only occurred on these two occasions in the recollection of the oldest men - In wet weather the stream has sometimes six feet depth of water in it. One objection to taking water from this stream is that it is occasionally used for the purpose of irrigating the rice fields in its neighbourhood - Several dams with sluices having been formed to lead the water into separate channels for that purpose when required. It will be seen however that less than one tenth of the present flow or 300,000 Gallons is all that is required to supply Yokohama and though on the two occasions mentioned above that was nearly all the water in the stream, they are of such rare occurrence that no extensive provision need be made for them.

If it should be found necessary to make such provision it could be done in two ways viz by an impounding Reservoir



Reservoir to collect a large store of water in the wet season or by diverting another stream which exists about 6 miles beyond Kawaiemura into this the two combined giving an abundant supply.

The cost of neither of these works is allowed for in the following estimate, because they are certainly not required for the wants of Yokohama and it is hardly probable after further investigation they will be found to be required at all.

Quality of Water - That the water is collected from a partially cultivated partially waste area and flows for about 6 miles through a cultivated district is all that can be known of it without elaborate investigations requiring much time and attention - The impurities it is likely to collect are the pollution from the manure of the cultivated ground decayed earthy matter and mineral matter in suspension or solution - From the high esteem in which the water is held in the District for drinking purposes we presume that none of these exist in it to any great extent - The process of filtration to which it is proposed to subject it will be very efficacious in ridding it of a great portion of what



what impurities may exist —  
 By passing it through layers of  
 fine sand, coarse sand, shells, fine  
 gravel & coarse gravel, the organic  
 and earthy matter as well as the  
 mineral matter in suspension  
 may be separated almost entirely,  
 leaving only the chemical im-  
 purities such as gases or matter  
 in solution to cause any serious  
 apprehension — These as far as  
 can be judged by superficial  
 observation, are not in any large  
 quantities, but specimens of the  
 water should be laid before Analytical  
 Chemists to be tested before these  
 proposed Works are carried out

#### Works at Fountainhead

Weir — A weir must be formed  
 across the stream at the point at which  
 it is proposed to abstract the water, of  
 such a height, that only the surplus  
 water over & above the quantity  
 required shall fall over it. Behind  
 it being the sluice through which the  
 water gets admission to the filters

Embankments — As in floods the  
 stream overflows its banks, embankments  
 will require to be formed  
 to protect the Sillus, Reservoir, and  
 other Works from the flood waters.

Filters — The general construction of  
 Filters in England varies very  
 slightly



(9)

Slightly - taking one recently constructed  
viz. that for the New Chelsea Water Works  
as an approved sample the filtering  
material in it is as follows -

1 <sup>st</sup>	a layer of fine sand	2 feet 6 inches deep
2	" " " Course	6 " "
3	" " " Shells	6 " "
4	" " " Fine gravel	4 " "
5	" " " Course	2 feet 0 inches deep
Total depth		5 feet 10 inches

The water being admitted on top of  
the first layer of fine sand, percolates  
through the different layers and finds  
egress through a series of perforated  
pipes laid in the bottom - This  
filter is known to pass 700 gallons  
in 24 hours per square yard of area  
therefore  $428\frac{1}{2}$  square yards will  
be required for the 300,000 gallons  
to be supplied to Yokohama. But  
to this should be added an allowance  
for any extra demand of water or  
to make up for lost time during the  
cleaning of the filters or other  
contingency say 530 square yards  
or a size of 80 feet by 60 feet and a  
filtering capacity of 371,000 gall.  
ons per 24 hours.

Service Reservoir - This should  
be of sufficient size to contain  
3 or 4 days supply so that a good  
quantity may be at hand in case  
of fire, also to allow time for clean-  
ing the filters or for repairing



repairing works &c. — Four days supply is 1,200,000 Gallons and to contain this the Reservoir will require to be 192 feet long x 100 feet wide x 10 feet deep — All recently <sup>service</sup> constructed Reservoirs are covered and this is considered beneficial as it keeps the water in them at a uniform temperature and free from vegetation — An open Reservoir on the other hand with concrete sides and bottom might be constructed at about one half the cost and with careful watching and cleaning might be kept tolerably clean but the water in it would be exposed to the heat of the sun and the action of the air and light In this climate notwithstanding its excess in cost a covered Reservoir may be considered essential and its cost is allowed for in the Estimate which follows. —

Piping — The line of piping should follow the valley in which the Stream flows and enter Yokohama beside the new Road now in course of formation at the foot of Mt. Meigi hill, To convey the water at high pressure from the Kawai mura to Yokohama and distribute it through the Streets, no piping can with safety be used except cast iron jointed in the usual



usual way with lead - A pipe 9<sup>in</sup> turned & bored joints inches in diameter with a head or fall of 45 feet and a length of 6 miles will discharge 389,700 Gallons per day and this size of pipe will be required to carry the total volume of Water. When however, Niunagi, Yoshida, and the Native Town of Yokohama have been supplied the size of the pipe might be reduced, a quantity of 180,000 gallons per day having already been carried to its destination leaving only 120,000 gallons to be further conveyed. For this a pipe of 6 inches diameter will suffice, its carrying capacity being 141,480 gallons per day while 8 inch pipes capable of discharging 24,930 gallons per day would be a sufficient size for most of the branch streets.

This however is only the size of pipes required for the domestic supply, and to make provision for fires these sizes must no doubt be increased. A 9 inch pipe discharging 389,700 gallons per day, or 270 $\frac{1}{2}$  gallons per minute, will throw jets equal in volume to 3 or 4 ordinary Yokohama fire Engines, and this together with the supply now existing may be considered sufficient. Nine inch pipes should therefore be laid in all the principal thoroughfares while in the smaller streets



6 inch pipes discharging 984 Gallons per minute would suffice, 3 inch pipes being used to supply solitary houses or very unimportant streets. These pipes should be laid all the way 3 ft 6 inches below the surface to keep them out of the reach of frost or other disturbing influences —

Distribution of the Supply.

Hydrants constructed so that fire hose could be coupled on to them, should be placed in every street at a distance of 100 yards apart — In the Native Town Water Columns of cast iron fitted with keys may be placed at the corners of streets or in other convenient places from which water could be drawn when required, the key being given only to those who pay the Water rate as is done in many towns in England at the present time.

The manner in which the water should be distributed among the foreign residents will be a matter for future arrangement and need not be discussed here.

Estimate

The following is a liberal estimate of the cost of works which there is little probability will be exceeded

For bringing Water to Yokohama

Works at Fountain head	Dollar
Weir across River 40 feet long built of Stone	3,000
Embankment to protect works from floods	1,800
Bay 300 Yards @ 6 Dollars	1,800
Carry forwards	4,800



(13)

Amount Carried forward 4.800

Filters, Sides & Bottom to be  
Concrete and including  
the necessary sluices for  
regulating the supply of  
Water 530 square yards @ \$15 = 7.950

Service Reservoir to be built  
with stone or brick with  
arched roof & including  
the cost of Sluices  
Capacity 1,200,000 gallons  
at 25 Dollars per thousand  
Gallons

Keepers dwelling &c say 1,000  
30,000  
43,750

Piping:

nine inch cast iron pipe 4 1/2  
miles long weight at 16 lbs per  
yard 410 tons at 48 dollars 19,680

Freight on 410 tons @ 13 dol 5,330

Making 2,640 joints for ditto at }  
30 cents } 792

Digging trench for pipes 3ft  
6 inches deep filling in ditto  
and making good surface  
7,920 yards at 30 cents 2,376

Extra price for carrying pipes  
across Streams, Roads &c say 1,000

29,178

72,928

Add 10 per cent for contingencies 7,292

Total Dollars 80,220



For the Distribution of Water

Nine inch pipes in all the  
 main thoroughfares, 8 miles  
 @ 116 lbs per yard 729 Tons @ 48 dollars 34,992  
 Freight 729 Tons @ 13 dollars 9,477  
 Making 4,700 joints for ditto @ 30 Cts 1,410  
 Digging trench for do filling in  
 and making good surface  
 14,080 Yds @ 30 Cents 4,224  
 Extra Cost of carrying pipes  
 across streams. — 1,000  
51,103  
 Six inch pipes in the smaller thorough  
 fares 10 miles @ 78 lbs per yard  
 613 Tons @ 48 dollars 29,424  
 Freight on 613 — @ 13 — 7,969  
 Making 5,866 joints for ditto  
 @ 30 Cents 1,760  
 Digging trench for pipes filling  
 in and making good surface  
 17,600 Yds @ 30 Cents 5,280  
44,433  
 Three inch pipes for minor streets  
 &c 3 miles at 28 lbs per yard  
 66 Tons @ 50 Dollars 3,300  
 Freight 66 Tons @ 13 dollars 858  
 Making 1,760 joints for ditto @ 20 Cts 352  
 Digging trench for pipes filling  
 in and making good surface  
 5,280 Yds @ 20 Cents 1,056  
5,566  
 Hydrants in Streets every 100 yds  
 Say 300 at 10 Dollars 3,000  
104,102  
 Carry Forwards \$



(15)

Carried Forwards	104,102
Public Water Columns say 150	
@ 50 dollars	<u>7,500</u>
	111,602
Add 10 per cent for Contingencies	<u>11,160</u>
Total Dollars	<u>122,762</u>

Totals

For bringing Water to Yokohama	80,220
For the distribution of the Water	122,762
Engineering fees Superintendence	
and other expenses - say	<u>7,000</u>
Dollars	<u>209,982</u>

Estimated Revenues

As in England the Water Rates should bear some proportion to the value of property - This being a matter for future arrangement - If the following average Rates were charged

Viz Native houses 5,059 @ 4 } dollars each per annum	20,236
Chinese Houses 200 @ 6 dols each per an	1,200
European 250 @ 7 dols " " "	<u>1,750</u>
	23,186

Less Cost repairs Salaries & say 2,000  
Dollars 21,186

The Amount realized would give a dividend of 10 per cent in the expended Capital per annum, the rates being on the average with the present population - Natives



Natives 1 dol 7 Cents per inhabitant per annum

Chinese 1 dol " " " " " "

Europeans 2 dols 91 Cents " " " " " "

The low rate for Chinese is on account of there being so many of them merely domestics in European houses and therefore not chargeable.

As the population increases so of course will the Revenue.

It may be mentioned for information that in England, two ~~separate~~ compulsory Water Rates are levied

One being as an equivalent for water used in household purposes, the other as an equivalent for the advantages it affords in the case of fire, for watering Streets, for flushing drains, or other Public purposes.

The Domestic rate varies in different towns from  $\frac{1}{6}^d$  to  $9^d$  per pound Billing, on the annual value or rental of property.

The Public rate from  $6^d$  to  $1^s$  per pound on the same

A. Henry Bruntor

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To Home