

Skirts	24
Aprons....	28
Men's jackets made.....	17
Pants	59 pairs.
Shirts	92
Boy's shirts	13
Woollen mits... ..	46 pairs.
Kitchen rollers.....	10
Bedticks.....	22
Garments repaired.. ..	1843

E. CAMPBELL,

*Matron City Prison.**Outside Carpenters' prices of work done at the City Prison, year ending 30th day of September, 1866.*

Preparing and putting tight board fence round Reformatory yard.. ..	\$32.54
Putting up a new stone shed, 62 feet by 18 feet high, 16 feet at back, 10 feet front, framed, boarded, and shingled, with doors, sashes, frames and finished complete... ..	70.86
A new Van for Prison use.. ..	48.00
Stench traps for City use....	60.00
To fitting up Blacksmith's shop.. ..	4.25
Cheveaudufriz on top of fence... ..	2.50
Gate and fence to female yard... ..	10.00
2 Painter's ladders	3.25
Repairing outside window blinds	1.30
Repairing wheelbarrows.. ..	12.00
Making new do....	17.00
Repairing Prison carts with new shafts, boarding, and other repairs on wheels, &c... ..	7.50
Shafts for Prison sleigh	2.22
Making 4 new coal boxes, and repairing 6 for Prison use.	1.30
Repairing waggon wheels, spokes and fellows.....	3.00
Sundry repairs inside of Prison, 10½ days \$1.30 per day.	13.65
2 trucks, boarded, ironed and fitted up, with hay ladders for each....	9.10
137 feet eave spouting to workshops making and putting up.....	10.00
Lids for Harness casks	1.75
Repairs on spinning wheels for prison use.	2.00
5 tables for prison wards....	5.00
3 benches for prison....	2.00

Gate posts for Farm	1.30
Posts and gate for front entrance	21.00
Stench traps for cellar kitchen.....	1.25
120 feet of drain from new well.. ..	2.00
A floor 60 feet by 20 feet, over coach house....	7.50
Window and shutter to coach house.....	1.30
Repairing 44 wheelbarrows.	12.00
Making new do.	1.50
A frame round top of new wall and plank floor over do..	2.60
Repairing the wheels of old Prison Van....	1.30
Making and putting in 500 stone hammer handles for stone breaking use at 2 cents each.....	10.00
Making and putting in 54 pick handles at 8 cents each	4.32
Making and putting in 40 sledge handles at 8 cents each.	3.20
Making handles for 30 striking hammers for drilling purposes at 4 cents each.....	1.20
	<hr/>
Total.....	\$389.69

Deduct from the above..... \$216.80

In favour of City Prison..... \$172.89

Earnings at City Prison.

1865.	October, paid by Governor.	£9	0	7
"	November, do.	5	9	0
"	December, do.	15	0	6
1866.	January do.	7	11	6
"	February, do.	9	14	6
"	March, do.	23	3	10
"	April, do. ...	77	16	4
"	May, do.	5	16	0
"	June, do.	14	16	5
"	July, do.	17	9	9
"	August do.	20	10	0
"	September, do.	30	4	3
"	October, do.	47	0	0
		<hr/>		
		£383	12	8

REPORT OF LIBRARY COMMITTEE. 99

APPENDIX NO. 12.

REPORT OF LIBRARY COMMITTEE.

HALIFAX, November, 1866.

TO THE CHAIRMAN OF THE COMMITTEE OF THE HALIFAX CITIZENS' FREE LIBRARY:

Sir,—In giving, at your request, a report of the state of the Institution, I thought it best to commence from my appointment as Librarian.

Having understood that the Committee were desirous to obtain the services of a suitable person to re-open the Library, and having the latter part of the day at my disposal, I offered* to open it three evenings in the week, from 4 to 7 o'clock, for \$120; the amount was accorded, but the Committee wanted it open every evening, inadequate as was the remuneration. I then offered to take it if Saturday evening was struck out, which was finally agreed on, and about the first of July I commenced to put the Library in order.

I had first to take every book from the shelves, both for the purpose of having them cleaned and also to purge them from all books requiring repairs, &c., and in order to classify them, *i. e.*, Bound Periodicals, Novels, General Literature, Books of Reference, and Bound Newspapers in separate divisions on the shelves, and when putting them to the places assigned I laid aside all such as required re-binding or repairs, amounting to 200 vols., of which I have prepared a list. I also cast aside a lot as utterly useless, being imperfect.

I next lettered each division of shelves, and numbered the shelves in each division.

On proceeding to mark each book in the catalogue to the place assigned it, so that I might know where to find any given book, I found that the present catalogue was useless for my purpose, so many new books having been added to the Library since the catalogue was published; so that I had to interleave one for my own use, and inserted the names of about 600 new books not before in the printed catalogue. This defect makes it very troublesome both to the Librarian and those

* The proposal for three evenings in the week came from the Committee.

who use the Library as they often have to ask for a dozen books before they can get one; another defect which makes it impracticable for a circulating Library is the classifications; one continuous alphabetical arrangement is alone suitable for that purpose.

Referring to the periodicals taken for the Library, I can find no record of the number taken; or when they commenced (nor anything to shew that the actual receipt of them was checked) except Z. S. Hall's and Miss Katzman's accounts by which it appears that the former supplies 26 and the latter 2, of which a list will be appended with a detailed statement of the number of each at present under my charge, and the deficit in each; also showing the amount required to complete such as are deficient.

These periodicals I found thrown on the shelves in confused masses, the sheets detached and the various kinds mixed indiscriminately, so that it has taken all my spare time every morning since I got the books put in order to sort them, and I now doubt whether the result is worth the labor bestowed.

I have come to the conclusion to advise the total discontinuance of them as quite unsuited for general circulation, and a needless tax on the city funds; as an experiment I stitched some of the magazines in covers and issued them each five or six times, and had then to withdraw them, or they would have been useless to bind as volumes. As it is, if the numbers missing can be obtained (and I suppose they can), 60 vols. of popular reading could be added to the Library at an expense of about \$40 to \$50: at present they are useless.

To re-bind the books I have set aside (and they are mostly such as are every day enquired for) would cost about \$80; and here I would remark that the binding heretofore done for the Library is of a most indifferent description; those that I found newly bound and myself issued for the first time are already going to pieces: slop binding for such a Library is only a waste of money.

The Library was re-opened on the 6th August, and up to the 6th inst. (or three months) I have made 2,500 issues, or an average of 40 per day: during that time I have received thirty new applicants.

There are now on the shelves and on issue 3463 vols., viz.: 1047 works of fiction, 1098 miscellaneous, 498 bound periodicals (magazines and reviews), 136 bound newspapers and scientific journals, 291 books of reference and obsolete works, 200 worth re-binding, and 193 on issue. I know of no funds but what have been collected by myself for fines, renewals, and catalogues, amounting to \$16, which I place to the credit of the Library.

As fears were entertained and expressed that I should find it difficult to manage the Library, and maintain order, I cannot close this report without testifying to the uniform orderly conduct, and ready and cheerful accordance to those rules and restrictions necessary to the well-being of the Institution, of that class of persons for whose benefit

I conceive the Library to have been especially intended, and I can only hope that the time is not distant when means will be found for making it more efficient for the purpose, and more in unison with the other advancements of the city.

I am, Sir,

Your obedient servant,

SAMUEL CREED,

Librarian.

APPENDIX

30,000.00	Street and Sewer, at 5 per cent.
10,000.00	City Prison, at 5 per cent.
32,000.00	City Hospital, at 5 per cent.
84,000.00	do do at 5 per cent.
84,000.00	Buildings on the Market Side, at 5 per cent.
8,000.00	Borrowed to pay City Debt, at 5 per cent.
24,000.00	Subsidies of Streets, at 5 per cent.
18,000.00	do at 5 per cent.
10,000.00	do at 5 per cent.
17,300.00	do at 5 per cent.
48,000.00	City Water Works, at 5 per cent.
30,300.00	do at 5 per cent.
41,800.00	do at 5 per cent.
10,000.00	do at 5 per cent.
807,500.00	do at 5 per cent.
150,000.00	
\$687,800.00	
RECAPITULATION	
10,000.00	Amount borrowed at 5 per cent.
77,000.00	do
80,800.00	do
450,200.00	do
\$687,800.00	

M. G. W. GREENWOOD

City Treasurer

FALLWAX, Sept 28, 1866

APPENDIX NO. 13.

FUNDED DEBT OF CITY OF HALIFAX.

[30th of September, 1866.]

Streets and Sewers, at 5 per cent.....	\$36,000.00
City Market House, at 6 per cent.....	10,000.00
City Prison, at 6 per cent.....	38,000.00
City Hospital, at 5 per cent... ..	\$4,000.00
do at 6 per cent.	34,000.00
	<u>38,000.00</u>
Buildings on the Market Slip, at 5 per cent.....	8,000.00
Borrowed to pay City Debts, at 5 per cent ..	24,000.00
Sidewalks of Streets, at 5 per cent.....	4,000.00
Do. at $5\frac{1}{2}$ per cent... ..	16,000.00
Do. at $5\frac{3}{4}$ per cent.....	10,800.00
Do. at 6 per cent.....	17,200.00
	<u>48,000.00</u>
City Water Works, at 5 per cent.....	23,200.00
Do. at $5\frac{1}{2}$ per cent.....	61,600.00
Do. at $5\frac{3}{4}$ per cent.....	16,000.00
Do. at 6 per cent.. . . .	360,000.00
	<u>460,800.00</u>
	<u><u>\$662,800.00</u></u>

RECAPITULATION.

Amount borrowed at 5 per cent.....	99,200.00
Do. $5\frac{1}{2}$	77,600.00
Do. $5\frac{3}{4}$	26,800.00
Do. 6	459,200.00
	<u>\$662,800.00</u>

HALIFAX, Sept. 26, 1866.

E. G. W. GREENWOOD,
City Treasurer.

MEMO.

Total Indebtedness of the City of Halifax, on the 30th
Sept. 1866..... \$662,800.00

The above amount is represented by the following, viz :—

Cost of City Water Works.....	\$460,800.00	
Balance due on City Market House, (present value \$32,000)	10,000.00	
City Prison and Farm.....	38,000.00	
City Hospital	38,000.00	
Debt due on Building on the Market Slip, (valued at \$16,000.).....	8,000.00	
		<u>\$554,800.00</u>
Balance.....		<u>\$108,000.00</u>

The above balance of \$108,00. is represented as follows, viz :

Debt contracted for Streets and Sewers, before the Incorporation of the City ...	\$36,000.00	
Borrowed for making Sidewalks.....	48,000.00	
Do. to pay City Debts.....	24,000.00	
		<u>\$108,000.00</u>

The City also owns the following properties, viz :—

- Wharf property adjoining H.M. Dock Yard.
- Water Lots at Africville. Magazine Lot.
- Water Lot at foot of Bates Lane.
- Two Water Lots at Freshwater Bridge.
- Water Lot head of North West Arm.
- South Steam Boat Dock. Fish Market.
- City Court House Building.

REPORT
OF
COMMISSIONERS OF WATER SUPPLY.

OFFICE OF COMMISSIONERS OF WATER SUPPLY, }
Halifax, 5th October, 1866. }

THE original Act of the Legislature referring to Water Supply provides that an Annual Report, embracing all matters connected with the Water Department, shall be submitted to the City Council on or before 31st March in each and every year. For reasons which were stated to the City Council in a communication dated 24th March of the present year, the financial accounts alone were submitted at that time. These were accompanied with a short report from the Commissioners, in which allusion was made to the long-talked-of High Service, and the hope was expressed that Mr Keefer's Report would soon be forthcoming. That report, however, was only received within the past few days, and the Commissioners have now the pleasure of presenting it to the City Council.

It is very gratifying to know that the scheme for leading the water from the Spruce Hill Lakes—first recommended by the Commissioners themselves—is fully approved by Mr. Keefer, after a careful examination of plans, surveys, drainage-area, rainfall, and other necessary information bearing upon the subject.

The Commissioners were quite aware, from the first, that the capacity of the Spruce Hill Lakes is inferior to that of the lakes which at present supply the city; but the great elevation above tide of the Spruce Hill Lakes gave them immense importance, and the only questions to be decided were:—first, whether the Spruce Hill Lakes could be made to yield enough water for the High Service; and next, whether it was possible, for a reasonable outlay, to make that quantity of water available. Mr. Keefer's Report is very clear and satisfactory upon both of these points. He thinks the Spruce Hill Lakes—when the necessary dams shall have been constructed—may be relied upon for a supply of one million of gallons, daily, in the driest years, and probably in average years for a daily supply of one and a half millions of gallons. This quantity of water ought to be largely sufficient for a population of 20,000, or even 25,000. As the portion of our city

population intended to be provided with water from the High Service does not, at present, exceed 5,000 or 6,000 persons, Mr. Keefer thinks the proposed supply will be ample for the upper district for many years to come; and with regard to the mode suggested by the Commissioners for conveying the water to the upper parts of the city by means of a pipe direct from the Spruce Hill Lakes, he observes, that there is no other way in which the same quantity of water can be obtained with the same elevation, so economically or so efficiently.

In the Report upon the High Service question submitted to the City Council from this office, 15th August, 1865, the total cost of the plan proposed was put down at \$105,595; but this plan included the cost of reservoir to be constructed on a hill owned by the city near the Chain Lakes; it also included the cost of machinery for pumping. One of the chief reasons for recommending the construction of a reservoir at this point, was an apprehension on the part of the Commissioners that some of the pipes now laid down would not bear the whole of the increased pressure of the water direct from the Spruce Hill Lakes. Mr. Keefer has no fears on that score, and considers a reservoir unnecessary, at least for the present; an omission which will make a very material difference in the cost of the scheme. Instead of \$105,000, Mr. Keefer calculates that for a total of \$75,000, all the water the Spruce Hill Lakes are capable of giving can be brought into the city. Without machinery the extra annual cost will be little more than the interest upon the capital invested.

By raising the Dam at Long Lake, which Mr. Keefer thinks may be done with safety, there is no reason to doubt that the Long Lake itself will be fully adequate to the supply of all that portion of the city between Barrack and Brunswick Streets, even should the present population be doubled. Leaving out Ragged Lake—which probably might be brought into the system as a storage reservoir, at a moderate cost—it may consequently be assumed, that the arrangements now proposed will enable the City Works to yield enough water for a population of 75,000 souls; and, in fact, if anything like economy could be enforced, the supply ought to suffice for a much larger number. For fire purposes, the scheme if carried out as intended, will command the highest points by gravitation alone. Mr. Keefer strongly objects in our case to the employment of steam power, as indeed, it was fully expected he would.

Passing from the question of Water Supply, it will be proper to refer to some other matters in connection with the Department. A full and detailed account of all the work performed between January and December, 1865, will be found in the Report of the Superintendent annexed. It will be seen that a considerable portion of the work consisted of laying six inch pipes on wharves, for the pur-

pose of fire protection. The Amended Act of 1862, provides specially, that wharves shall be rated upon a scale to be arranged by the Commissioners, and approved by the City Council. In accordance with the terms of the Act, a scale of rates for wharf property, was submitted to the City Council for approval, more than a year ago; the matter was referred to a committee, and the attention of the City Council has been drawn to it several times from this office, but as yet, nothing has been done; and wharf property, though fully as well protected from fire as any other property in the city, pays no assessment for such protection.

It may be, and it has been objected, that pipes are not laid on every wharf; but for fire purposes, that is unnecessary. The Fire Hydrants are placed at regular intervals, alternately upon wharves or in Water Street; they are fed from a large pipe, laid expressly for fire purposes, and it will be found that every wharf, from the Dock Yard to Fresh Water, is completely under the control of these Fire Hydrants. There is no reason whatever, therefore, why buildings upon wharves, should not pay water rates. The only point upon which there seems to be difference of opinion, is, whether the lower portions of wharves—those portions standing in water—should pay the same rate as buildings upon the wharves, or on Water Street; the mere wharf part, it is said, not needing protection from fire as much as other parts. On the other hand, it must be admitted, that valuable property is often exposed upon wharves, and vessels are constantly lying at them; and that such descriptions of property, need protection from fire, quite as much as property in other parts of the city. Taking these facts into account and the difficulty of making separate values for assessment, the Commissioners recommend that one quarter per cent upon the assessed returns, be in future levied as a water rate, for fire purposes, upon all wharf property not hitherto assessed. This will make the rate for fire purposes throughout the city uniform.

Since work commenced this season, main pipes have been laid in Summer Street, as far as the Model Cottages, and in Cunard Street as far as Thornfield Nursery; several additional Fire Hydrants have been put down, and a large number of service pipes supplied to private houses. The intention was to lay a twelve inch main in Inglis Street, but the money voted by the City Council, not having been taken up by loan, as expected, the work was discontinued and the men discharged. The Commissioners beg to remind the City Council, respectfully, that a sum of eight thousand dollars, will be required for the operations of the season; about one half for work performed during the summer, and the remainder for a quantity of materials imported from Britain. As the Water Rates are reserved by Law for the payment of interest and current expenses, it will be necessary to reimburse the City Treasurer, on

or before the 1st January, next, ensuing, at which date the half-yearly interest on Debentures falls due.

The whole amount borrowed on account of the Water Works, up to 31st Dec., 1865, is \$60,000, and the Amount of Water Rates collected in the twelve months ending at that date was \$33,159. Respectfully submitted.

JOHN A. BELL, *Chairman.*

JNO. L. BARRY, }
E. J. LONGARD, } *Commissioners.*

STATEMENT of RECEIPTS and EXPENDITURES for account of the City of Halifax

DR.

To Cash received for Water Rates as follows:—

On half-yearly period ending 1 May, 1863.....	£7	12	7
“ “ “ 1 Nov., 1863.....	24	2	7
“ “ “ 1 May, 1864.....	116	13	10
On yearly period “ 1 May, 1865.....	4531	11	9
“ “ “ 1 May, 1866.....	3609	18	0

Total amount Water Receipts for the year....8289 18 9

To Cash received for Cast Iron Pipes.....	262	2	4½
“ “ “ Pipeage.....	57	13	4
“ “ from Internal Health Committee, 1 year, 2½ months rent of premises.....	14	18	7

334 14 3½

£8624 13 0½

To balance brought down.....£2437 18 2½

WATER WORKS for 1 year, from 1st January, 1865, to 31st December, 1865.

CR.

By Cash remitted Kidstons for iron pipes, &c...	£2077	10	0
Do paid sundries for lead pipe.	11	2	0½
Do do duties £1 4s. 2d.; freight £2 13s. 4d.	} 58	11	3
Do do exchange £5 11s. 1d.; wharfage £49 2s. 8d.			
Do do Gas Company for iron pipes, &c... ..	6	18	9
Do do for hydrants, &c.	201	1	6½
Do do service cocks, lanterns, &c.	153	13	2½
Do do wooden wedges.	5	4	6
Do do work at Pipe house.	19	19	3
Do do bricks, lime, &c.	35	16	11
Do do lumber, wood, &c.	36	11	1
Do do pick handles, &c.	3	17	6
Do do Black, Bros. & Co.'s accounts.	156	11	6
Do do Crown land office for grants and recording Deed thereof.	35	4	0
Do do painting and cleaning office, &c.	12	13	6
Do do advertising, stationery, printing bills, &c.	35	3	7
Do do fuel £11 10s.; tallow, &c. £4 9s. 5d.	15	19	5
Do do cab hire, gas light, &c.	16	3	10
Do do rent of premises.	130	0	0
Do do auditors £6; county rates £2 4s.	8	4	0
Do do Nickerson looking after dam.	14	10	0
Do do W. B. Smellie for surveys, plans, and reports of Spruce Hill lakes.	145	8	9
Do do contingencies.	15	16	3
Do labor during the year	2036	10	7½
Do do salaries of Comrs., Supt., Sec. and Mes.	954	3	4
Balance carried down.	£2437	18	2½
	£8624	13	0½

J. A. BELL, *Chairman.*

J. BOREHAM,

Sec'y. Commissioners of Water Supply.

HALIFAX, Dec. 31 1865.

Balance Sheet, 31st December, 1865.

DR.

To	W. Kidston & Sons.	£20	11	3
	Exchange... ..	5	11	1
	Interest account.	24	7	11
	Duties..... ..	1	4	2
	Expense account.	370	9	7
	Works additional....	38490	13	2
	Labor.	2036	10	7½
	Old works	55244	0	7½
	Salaries	954	3	4
	Difference of dollars and cents....		0	2
			<hr/>	
			£97147	11 11

CR.

By	City Corporation.....	£55492	0	10
	Water receipts to May, 1863.	7	12	7
	“ “ to Nov., 1863.....	24	2	7
	“ “ to May, 1864.	116	13	10
	“ “ to May, 1865.....	4531	11	9
	Pipeage... ..	57	13	4
	City Treasurer.	33307	19	0
	Water receipts to May, 1866.	3609	18	0
			<hr/>	
			£97147	11 11

Halifax, 31st Dec., 1865.

J. A. BELL,
*Chairman.*S. BOREHAM,
Sec'y. to Commissioners.

We have examined and compared these accounts with the original vouchers, books and balance sheet, and find the same to be correct.

W. ROCHE,
STEPHEN TOBIN,
JOHN H. HARVEY.

Halifax, April 24, 1866.

Commissioners of Water Supply in account with E. G. W. Greenwood, City Treasurer.

1865.		DR.				
Jan'y	31.	To Cash paid Commissioners Orders this month.....				\$7,921.08
		Do. do. 6 mos. Int. on Debentures, £111,000....				13,040.00
Feb'y	28.	Do. do. Commissioners Orders this month.....				3,819.52
March	31.	Do. do. do. do. do.				740.57
April	30.	Do. do. do. do. do.				1,032.00
May	31.	Do. do. do. do. do.				666.75
June	30.	Do. do. do. do. do.				1,043.35
	23.	Do. do. A. Pillsbury, 8 days interest, on 1st July.....			\$4.21	
		Do. do. A. Pillsbury, 4 days interest, on 1st July.....			1.32	
						5.53
July	1.	Do. do. 6 mos. int. on Debentures for £113,000..				13,270.00
	31.	Do. do. Commissioners Orders this month.....				1,621.67
Aug.	31.	Do. do. do. do. do.				2,125.91
Sept.	30.	Do. do. do. do. do.				1,549.98
Oct.	31.	Do. do. do. do. do.				2,023.89
Nov.	30.	Do. do. do. do. do.				1,105.10
Dec.	31.	Do. do. do. do. do.				826.75
	31.	To balance carried down.....				15,166.21
						<u>\$65,958.31</u>

1865.		CR.				
Jan'y	1.	By balance.....				\$8,307.83
	3.	By cash for Debentures, Directors of King's College....				2,400.00
		By City of Halifax on account Loan of \$20,000.....				4,000.00
		By cash for Debentures, W. H. Hill and others.....				5,600.00
	31.	Do. from Commissioners this month.....				2,138.73
Feb'y	14.	Do. City of Halifax, balance of \$20,000.....				4,000.00
	28.	Do. from Commissioners this month.....				751.38
March	31.	Do. do. do.				6,152.47
April	30.	Do. do. do.				2,772.82
May	31.	Do. do. do.				1,935.41
June	23.	Do. A. Pillsbury and al., for Debentures.....				6,000.00
	30.	Do. Commissioners, received this month.....				3,542.95
July	31.	Do. do. do.				1,446.81
Aug.	12.	By Debentures and 55 days' interest from 1st July...				1,210.85
	31.	By cash from Commissioners this month.....				363.12
Sept.	26.	Do. for Debentures and interest to 25th Sept.:				811.41
	30.	Do. from Commissioners this month.....				230.30
Oct.	31.	Do. do. do.				4,190.87
Nov.	30.	Do. do. do.				3,325.14
Dec.	31.	Do. do. do.				6,778.22
						<u>\$65,958.31</u>

1866.			
Jan'y	1.	By balance.....	\$15,166.21

E. E. HALIFAX, January 1, 1866.

EDW. G. W. GREENWOOD,
City Treasurer.

*Detailed Statement of Labor, &c., on City Water Works from 1st
January to 31st December, 1865.*

<i>Upper Water Street.</i>	
326½ days' labor.....	\$290.87½
Materials in pipes, stop cocks, &c.....	787.38½
<i>Lower Water Street.</i>	
1,128½ days' labor.....	1,029.03½
Materials in pipes, stop cocks, &c.....	2,561.32½
<i>Tobin's Wharf.</i>	
85½ days' labor.....	76.82½
Materials, pipes, stop cocks, fireplug, &c.....	177.99½
<i>Collins' Wharf.</i>	
82½ days' labor.....	75.53
Materials, pipes, fireplug, &c.....	153.89½
<i>Butler's Wharf.</i>	
73½ days' labor.....	68.75½
Materials, pipes, stop cock, fireplug, &c.....	190.18
<i>Caldwell's Wharf.</i>	
50½ days' labor.....	83.40½
Materials, pipes, fireplug, &c.....	193.72
<i>Kinnear's Wharf.</i>	
119½ days' labor.....	110.92
Materials, pipes, fireplug, &c.....	224.41
<i>Fairbanks' Wharf.</i>	
110½ days' labor.....	103.81½
Materials, pipes, stop cock, &c.....	217.00½
<i>Lawson's Wharf.</i>	
94 days' labor.....	86.65½
Materials in pipes, stop cock, fireplug, &c.....	222.67½
<i>Boak's Wharf.</i>	
59½ days' labor.....	55.31½
Materials in pipes, fireplug, &c.....	129.57
<i>Stevens' Wharf.</i>	
78½ days' labor.....	75.59½
Materials in pipes, fireplug, &c.....	168.76½
<i>Bennett's Wharf.</i>	
135½ days' labor.....	127.87½
Materials in pipes, stop cock, &c.....	184.30½
<i>Pryor's Wharf.</i>	
76 days' labor.....	77.04
Materials in pipes, fireplug, &c.....	165.82½

<i>Steamboat Wharf.</i>	
30 days' labor.....	28.10½
Materials in pipes, fireplug, &c.....	85.76½
<i>Queen's Wharf.</i>	
2 days' labor.....	1.95
<i>Hollis Street.</i>	
52¼ days' labor.....	50.80¾
Materials in pipes, lead, &c.....	43.47¾
<i>Rink.</i>	
1½ days' labor.....	1.25
<i>Bishop Street.</i>	
1 stop cock, pipes, &c.....	38.33
<i>Gottingen Street.</i>	
191¼ days' labor.....	180.15½
Materials in pipes, stop cocks, &c.....	61.27¼
<i>Inglis Street.</i>	
266¼ days' labor.....	248.65¾
Materials in pipes, stop cocks, &c.....	589.95¼
<i>Victoria Road.</i>	
659 days' labor.....	605.41¼
Materials in pipes, stop cock, &c.....	335.39¼
<i>Quin Pool Road.</i>	
4½ days' labor.....	4.38¾
<i>Spruce Hill Lakes.</i>	
173½ days' labor.....	168.80
<i>Fireplugs.</i>	
176 days' labor.....	173.04¼
Materials on pipes, fireplugs, &c.....	305.79
<i>House Service.</i>	
1,051 days' labor.....	1,021.11
Materials, street cocks, lead pipe, &c.....	1,160.11
<i>Repairs.</i>	
543¼ days' labor.....	468.16¾
<i>Long Lake.</i>	
34 days' labor.....	36.29
Materials, powder, &c.....	1.43¾
<i>Sounding Dam at Long Lake.</i>	
20 days' labor.....	22.63
<i>Withrow, Chain, and Bayers' Lake.</i>	
96¾ days' labor.....	101.09½
<i>Spring Garden Road.</i>	
5½ days' labor.....	5.50

<i>Queen Street.</i>	
31 days' labor.....	28.15
Materials, pipe, lead, &c.....	10.11½
<i>Stowing Pipe on Common.</i>	
15 days' labor.....	13.55
<i>South Street.</i>	
69 days' labor.....	65.65½
Materials in pipes, stop cock, &c.....	78.73½
<i>Commissioners of Common.</i>	
15½ days' labor.....	16.19½
Materials in pipes, stop cocks, fountain, &c.....	109.05
<i>Fish Market.</i>	
8¾ days' labor.....	8.18
Materials in pipes, stop cocks, &c.....	36.49½
<i>Shop.</i>	
2,564½ days' labor on premises.....	2,635.48¾
<i>Summary of the whole for 1865.</i>	
8,470½ days' labor.....	8,146.12½
Materials, pipes, stop cocks, fireplugs, powder, masons' work, &c..	8,233.07¾
	\$16,379.20¼

JOHN P. MUIR,

Superintendent City Water Works.

REPORT of T. C. KEEFER, C. E., upon the proposal to conduct
water from the Spruce Hill Lakes.

OTTAWA, Sept. 25th, 1866.

JOHN A. BELL, Esq.

Chairman Board of Water Commissioners, Halifax, N. S.

SIR:

I have the honor herewith to submit my report upon the questions referred to me respecting the Halifax Water Works, in your several communications of Novr. Decr. Feby. May and June last, which were accompanied by the plans and statements called for by me. I subsequently had the advantage of an interview with one of your Commissioners, Mr. Longard, who afforded me much additional information. From these I understand that the City of Halifax possesses an efficient supply for all purposes in all parts not elevated more than about 100 feet above tide, but that those districts above this level comprising more than half of the area and about one third of the present population have little or no fire pressure from the hydrants, and that a portion of these districts are too elevated to receive a supply, even for domestic purposes, from the present sources at the Chain lakes. These lakes are upon the same level with the higher table land within the city, being 200 feet above tide, and though now connected with the latter by mains of ample dimensions (24 inch and 15 inch) are nearly three miles distant. Beside the elevated table land there are I understand several eminences within the city or upon the Peninsula such as the Citadel, Camp Hill—Vieth's hill and the summit along the road from "St. Andrew's Cross" to the "Three Mile House" &c. which are from 20 to 40 and 50 feet above the present source of supply, and therefore unprovided with water from the Water Works for any purpose. As the city consumption increases from year to year the loss of head which is now probably trivial must increase so that during the hours of greatest draught and during fires the water will fall away in houses now receiving it on the second and third floor, to the first floor and basements—and from more elevated houses altogether. If Halifax be like other cities, some of your most profitable water tenants will be those upon the upper levels. To such, not only security from fire but a pressure giving distribution up to the attics will be paid for: and, if you have the compulsory assessment law of many cities, and your high level population is paying pro rata, without the protection from fire or efficiency in domestic distribution which the lower districts enjoy, this fact would create an obligation to obtain a high service if practicable. Moreover, with the growth of the city the limits of an efficient pressure for fire purposes from the present head level will descend from the loss of head due to increased draught, until your hydrants cannot be relied upon for levels much above 100 feet over tide,—for the consumption of water (including waste) increases much more rapidly than the population.

The value of the proposed high service, therefore, which your city has wisely determined upon, will not be confined to the districts now deficient; but important districts now adequately supplied with fire

and domestic pressure from the present works, will in all probability be hereafter dependent upon the high service for a continuance of this efficiency, not from want of water, but from want of head in the present sources.

Various schemes have been proposed for the high service embracing both Gravitation and Pumping plans. For the gravitation system there has been proposed the Spruce Hill lakes, $6\frac{1}{2}$ miles distant, and 354 feet above tide,—and the Ragged lake, five miles distant, and 325 above tide: while the pumping scheme has been confined to one for raising water from the Chain lakes by steam power, into a reservoir upon an adjoining hill 300 feet above tide.

Ragged lake, I am informed, has a drainage area so limited—under 300 acres—that it alone would be insufficient for the purpose required; so that it becomes necessary to go to the Spruce Hill lakes for a gravitation supply for a higher level,

The capacity of the Spruce Hill lakes though three times greater than Ragged lake—and probably sufficient for the wants of the upper levels in Halifax for many years to come—is still so limited—that looking to the future it has been assumed pumping must sooner or later be resorted to, and, therefore, it has been proposed to provide at once for high level wants by that method. But in your case the advantages are altogether in favour of the Gravitation plan—because you have only to extend the smaller of your supply mains about four miles further to reach the natural reservoirs of the Spruce Hill lakes—and you then obtain a summit level capable of giving a fire pressure to the highest points on the peninsula, and a supply sufficient at least for present wants, and one which will cost less than any pumping system which would produce equal results. From the great head obtained, the smaller of your two mains will be able to deliver all the water which the Spruce Hill lakes supply. This quantity will exceed a million of gallons of water daily—and whether it prove sufficient for all future wants—or no—there can be no question about the propriety of going after it, because there is no other way in which the same quantity of water can be obtained—with the same elevation—so economically, or so efficiently.

In the gravitation plan you have the cost of four miles and one-third of main—three and one-sixth miles of 15 inch and one and one-sixth mile of 20 inch, with a dam and gate-house at the outlet of the Spruce Hill lakes—against an engine a pair of engines, engine and boiler-houses, pumps and air vessels, and connections, a short rising main and an artificial reservoir. The first outlay for the pumping plan would nearly equal that for the gravitation, and the annual cost of working would represent a greater capital than either, and, with the greater risk attendant thereon, would decide the question in favour of gravitation.

The quantity of water which the Spruce Hill lakes will afford in dry years will not I think, be less than one million gallons per diem—and this should be a liberal supply for 20,000 persons, or about double the number assigned, to the high level districts. The 15 inch pipe extended within one mile of the Spruce Hill lakes, and then connected with a 20 inch one for the level mile leading out from the lake, will deliver 2 millions of gallons at the highest levels in the city; and 3 millions per

diem at a level 100 feet above tide, or at the lower line of the high districts.

GRAVITATION PLAN—The registered rainfall at Halifax for the last seven years is reported as follows.

1859.....	49.95 inches.
1860.....	39.51
1861.....	47.61
1862.....	51.82
1863.....	68.48
1864.....	52.79
1865.....	51.22

This would give a mean annual fall of 51.62 in. and as the reported average at St. John, N. B., is 49.75 inches, it is probably a fair average, Halifax doubtless having more rain than the former city. It is, however, the minimum rainfall, and not the average with which we have to do in Water Supply, except in cases where it may be practicable to store the surplus of wet years to supply the deficiency of dry ones. Seven years is rather a short period from which to derive the minimum rainfall, but as in the seven observed years the maximum was 68 and the minimum 39 inches—a variation of 29 inches—while all the other years only ranged from 47 to 52 inches—a variation of only five inches, there cannot be much risk in taking 39 inches, or one foot less than the average, as the minimum rainfall for the Spruce Hill lakes.

The deductions for evaporation, vegetation, &c. depend upon the character of the catchment basin. If sand or gravel overlies the rock to any extent, or if vegetation protects the rainfall from the sun and wind, the loss will be less than on an impervious surface. The evaporation from the surface of the lakes, I have no local data for estimating. The mean for both United States and Great Britain is reported 32 to 33 inches annually. There is much discrepancy in the results and opinions deduced from experiments on this head, particularly as the depth of Water greatly affects the question, but with your high rainfall and frequent fogs I think it will be safe if we allow that the evaporation from the water surface may equal the rainfall; and, therefore, in estimating the rainfall from the 1000 acres drainage area of the Spruce Hill lakes, deduct the 160 acres of water surface and take the remaining 840 acres as the available area.

Taking the minimum rainfall at 39 inches upon this 840 acres of the catchment basin around the lakes, about fifteen inches should be deducted for losses from evaporation, vegetation, &c. Fourteen inches is an average deduction for England. This leaves two feet of available water over a surface of 840 acres; a quantity which will afford a daily supply of 1½ millions of gallons. Of course without an inspection of the gathering grounds and better information as to local evaporation, approximate estimates only can be made—but I am of opinion that the Spruce Hill lakes may be relied on for a daily supply of at least one million of gallons in the driest years, and that in wet years this quantity could be doubled. As an average, the rainfall should give from the area one and a half million gallons daily supply.

The 15 inch main 6½ miles long, feeding from Spruce Hill lakes at

354 feet above tide, and discharging in the city at the following elevations above tide, would deliver nearly as follows:

		Galls. per minute.	Galls. per diem
At 250 feet, fall 16 ft. per	mile.....	1413	2,035,000
" 200 " " 23.7 "	" "	1726	2,485,000
" 150 " " 31.4 "	" "	1914	2,871,000
" 100 " " 39 "	" "	2218	3,194,000

a fall
The delivery depending upon the inclination—the minimum fall in the first mile should be made equal to the average of the whole, and as this is not practicable at a reasonable cost a larger pipe with a less fall per mile for the first mile from the lakes will be advisable. The 15 inch pipe with ~~the fall~~ due to the remaining five inches will deliver over two millions of gallons in the 24 hours and the corresponding dimensions for a pipe with only a fall of 5 feet for the first mile should be 20 inches. This quantity, 2,000,000 gallons, which the 15 inch pipe is able to pass, is greater than the estimated average supply; but it is none the less desirable that the pipe should be arranged for the greatest efficiency throughout. Not only will the consumption of the daily supply of one million gallons when reached take place chiefly in the 12 hours of day and therefore require a capacity double the average for the 24 hours—but until that consumption is reached and at all times in the night and day when a fire occurs the demand upon a reservoir six miles distant requires the utmost efficiency throughout every part of the pipe and the largest supply it is capable of passing down.

I understand the present population of Halifax to be about 30,000, of which two-thirds reside at elevations not exceeding 100 feet above tide. The present sources supply efficiently except for fires, about three-fourths of the population and to levels 150 feet above tide. If the line between the Upper and Lower districts be established at 100 feet above tide you will have Long lake with its 24 inch main for the lower district; and Spruce lake with the 15 inch main for the upper one. The highest points in both districts being fully 100 feet under the head level. This with proper connections should give an efficient fire pressure everywhere on the peninsula. I see it stated that your present consumption is 2½ millions daily, and as I suppose not more than 25,000 souls receive water you have already reached the high daily average of 100 gallons per head.

If as may be presumed the large consumers who bring up this high average per head are in the commercial and manufacturing quarter in the Lower district—the average for the Upper district may be much below that for the whole city. The Spruce Hill lakes can supply 100 gallons daily to the 10,000 inhabitants in the Upper district and if the consumption does not exceed 50 gallons daily in this district these lakes will supply that district until the population is doubled. When no longer able to supply the district down as far as within a 100 feet of tide level the 15 inch pipe may be restricted to a district above the line of 125 or 150 feet above tide, and the ample main and larger reservoirs of the lower district should be able to back up the domestic supply to the new line. In this future case some further provision is necessary to afford a fire pressure upon the district so vacated by the 15 inch—and supplied for domestic purposes only by the 24

inch. In whatever way it may be found most expedient to effect this there is at least no present necessity for a resort to pumping: for, whether Spruce Hill lakes yield one or two millions of gallons daily—the quantity more or less can be obtained cheaper and in less time than by resort to pumping.

COST OF PUMPING.—To lift as much water as the 15 inch pipe under the head from Spruce Hill lakes will deliver at the level of 250 feet above tide (being 2,000,000 galls. per diem) 100 ft. high, by steam pumping, would require about 45 horse power working constantly, say duplicate engines of 50 horse power each (one as reserve) the cost of which with buildings, pumps, &c, complete would be about \$40,000.

Interest and depreciation on Engines 15 pr ct.....	\$6000.
1060 tons coal at \$4.....	4240.
Attendance, stores, &c., \$5 per diem.....	1825.

Making a Total annual cost of..... \$12,065

exclusive of any allowance for reservoirs and pipe connections therewith:—equivalent to a capital, at 6 per ct, exceeding \$200,000. These prices may not agree closely with your own, but I think you could afford to expend \$200,000 on the gravitation plan in preference to a resort to pumping if that expenditure would produce the same results. The pumping plan would require the additional cost of a reservoir and rising main to same, and the only advantage it could possess over the gravitation one is that it would deliver daily two millions of gallons into a reservoir 300 feet above tide; whereas the daily supply from Spruce Hill at an elevation of 50 feet higher might not exceed one and a quarter, to one and a half, millions in some years: But whatever the supply which those lakes may afford, the quantity could not be raised from Long lake to the same height without an annual outlay (exclusive of the interest upon the cost of the pumping works) greater than the interest upon that required to obtain it from Spruce Hill lakes; besides the manifest advantage of gravitation plan over the pumping one, all things being equal. The greater elevation of the Spruce Hill lakes over the reservoir site for the pumping scheme at Chain lakes, is worth a great deal, as it would give a fire pressure at the highest points on the peninsula, which the other would not be capable of doing.

Lastly, if, as seems probable, the whole supply of the Long lake basin will be required for those portions of the city which are commanded by it—there will not be any to spare for a supply (by pumping) to the higher districts—resort to other sources therefore would be prudent in any case. In connection with this subject it would be well to ascertain the value of Ragged lake and its gathering grounds, and to secure the same with any other sources as high or higher, with a view hereafter to make them subsidiary reservoirs. The difference of level between this lake and Spruce Hill lakes is not so great as to make it apparently impracticable to work them in connection; and in case of any natural obstacles to a sufficiently high dam to retain all the flood water of the Spruce Hill lakes in wet years the surplus might be stored in the Ragged lake: if this lake offers facilities for storage as a reserve to be drawn upon in time of need.

COST OF GRAVITATION PLAN.—With respect to the cost of the gravitation plan there are many items which I have no means of estimating, but I believe you have had several estimates from other Engineers who have inspected the route. The cost of the necessary dams—the grading and excavation for the laying of the pipe I cannot speak to without a knowledge of the material to be encountered, whether rock or earth, hard or soft. But the extension of the four miles and over of main from the present gate house to the Chain lakes—in ordinary excavations, should not exceed \$50,000. Of course much grading, bridging or culverts would increase this. The only other items are the Dam and gate house at the lake. No reservoir is needed as the lakes themselves will be a better reservoir than any intermediate one between them and the city. There is a probability that some lengths of the 15 inch between the Chain lakes and St. Andrews Cross (upon the mile around the N. W. Arm) may give way under the increased pressure from Spruce Hill—but, unless defective castings, and less than $\frac{1}{2}$ in thickness of metal, such pipes are usually safe under 500 feet head of water. When pipes have been cast on the side they are not often of even thickness of metal and the thin sides may give way under the increased pressure. It would be advisable to provide a few tons of strong fifteen inch to repair such failures, which if properly done will make it stronger than a new main of heavier pipe—and at much less cost.

The extra excavation and embankment in grading the pipe track, together with the construction of the Dam and gate house at the Spruce Hill lakes according to Mr. Smellie's, estimate would add about \$25,000 to the cost for the main, or a total of \$75,000 for which sum I think you could bring all the water from the Spruce Hill lakes into the city.

but little
I estimate for 16000 feet lineal of 15 in. pipe $\frac{1}{2}$ in thickness of metal or 750 tons, and 6000 feet of 20 in pipe same thickness 375 tons. If these distances taken from the plan are not sufficient, the quantities should be increased. As the 20 inch will have $\frac{1}{2}$ pressure it may be half inch in thickness of metal or less if you can get the manufacturer to agree to furnish a good article thinner. The thickness of pipes is generally regulated by what is required to make a good casting and this in the case of all pipes under 24 inches is more than any ordinary water pressure they are called on to bear. Light pipes of the larger sizes are more liable to breakage in transit on ship board, in the handling while hauling and laying—and in the ground by settlement and street traffic.

On the score of economy therefore I think you will obtain one or two million gallons of water by gravitation from Spruce Hill lakes for about one third the sum which the same supply pumped from Long lake would represent, including the capitalization at 6 pr.ct. of the annual expenses; and upon the score of efficiency the gravitation supply, to the extent to which it is sufficient, is in every way to be preferred.

The Spruce Hill lakes being more elevated may have a greater rainfall than that observed at Halifax; and if there are no serious obstacles to forming a sufficient storage they may be made to yield as much water as the 15 in. main will pass, which should be fully 2,000,000 gallons per diem. The only contingency which for years to come

should make any further provision necessary is that state of things in which by excessive consumption and draught you become unable to keep the Long lake water at such a level in the city that the portion of the city above that level will not require more water than Spruce Hill lake can afford. In such a case you must either resort to local reservoirs on the peninsula (which would only partially supply the need) or lay a third main from the Long lake catchment Basin to be confined to the intermediate district between the lines served by the present 24 inch from Long lake and the 15 inch from Spruce lakes. This main, if fed from Long lake, would be efficient for domestic purposes for the district as high up as 175 feet or more above tide, and a fire pressure could be thrown upon it from the Spruce Hill main when required.

But if as appears to me probable a sufficient supply for this intermediate main could be intercepted on its way into Long lake, at a level some fifty or seventy five feet above it, then the object you have in view would be accomplished without resort to pumping or the opening of valves in case of fire: namely, an efficient fire pressure and ample supply for every part of the city without the necessity of seeking fire pressure temporarily for a lower district from a higher one.

RESERVOIRS.

The lakes which now supply Halifax are the city reservoirs—and their distance from the centre of distribution is no greater than in many large cities even where the reservoirs are within the corporate limits. If you are compelled to pump, a reservoir would be almost indispensable, and would in fact be only an insignificant artificial lake created for want of a natural one capable of affording the required supply. In the Spruce Hill and Ragged lakes you have natural reservoirs infinitely more capacious than any artificial one you would establish in connection with a pumping scheme, and so much higher that they would be practically nearer the city than one at the Chain lakes hill, that is, the same sized pipe would deliver more water from the distant than from the nearer source, because of the greater head under which it would work.

Whenever the Spruce Hill lakes can no longer efficiently supply the upper district down to the limit of fire pressure from the 24 in. Long lake main, and it becomes necessary to contract the district, a reservoir if practicable in the catchment basin, above the level of Long lake, will be desirable for the intermediate district. If the water can be intercepted 50 to 75 feet above the level of Long lake a reservoir at this level (in the valley of Beaver Dam brook or any other suitable point) sufficient for the intermediate district is all that would be required. If found impracticable to intercept the water before it descends to the level of Long lake—a large pipe from Long lake will supply this intermediate district for domestic purposes throughout, and perhaps the lower portion of it for fire purposes—but whenever required for fire purposes the Spruce Hill water could be turned on. This would complete your system without pumping at the cost only of a main from Long lake and would make it for domestic purposes absolutely perfect so long as there was water enough in Long lake and Chain lake to supply that part of Halifax below 180 feet above tide—and in Spruce Hill and Ragged lakes, to supply all above that level.

When the intermediate district becomes necessary, or rather when Spruce Hill lakes can no longer supply down to the level where Long lake gives the fire pressure, it will be found preferable to establish this intermediate system rather than to back up a domestic supply from Long lake into that part of the upper district vacated by the Spruce Hill water, and rather than to look to pressure from Spruce Hill for this vacated district in case of fire, because so long as you have only the two systems the moment Spruce Hill is turned on, Long lake ceases to act, and the former would be incompetent to make head against the draught from the lower district, and at the same time bring up a fire pressure in the intermediate one. If it did so, it could only be at the expense of losing this pressure in its own district.

To recapitulate: Long lake is stated to be able to supply five to ten millions of gallons daily, in any case all or more than is required for the whole city—but it lies too low for the upper parts of the city. Spruce Hill lakes, are not able to supply the whole city, perhaps not the upper half (in elevation) of it; but the quantity they will afford, whether one or two million gallons daily can be delivered with all the required pressure, more economically and efficiently than it can be raised from the superabundant stores in Long Lake. But though for years to come Spruce Hill may be able to afford, both the domestic supply and the fire pressure (to all that part of the city above the fire pressure influenced by Long lake,) there is reason to suppose that from increased consumption in both districts, the line of supply will descend in the one and be made to ascend in the other, until a gap occurs, requiring an independent supply, or an increase in quantity to the upper one. The water for this is to be found in the gathering grounds, belonging to Long and Ragged lakes. From an inspection of the map and profile sent me, it appears that much of the water shed around Long lake is elevated one hundred feet or more above it, and it would seem practicable to intercept water enough for the intermediate district, at the required level,—and thus give the city three mains, and three distributions, each fed from sources ample for their respective district, and each possessing an efficient fire pressure, and all upon the same simple gravitation plan, by which the greater portion of the city is now so efficiently supplied.

The advantages of Reservoirs within the city limits, are that by impounding a large body of water, with sufficient head, near the centres of distribution, a better pressure is maintained in the service pipe and hydrants, than where these are fed by a long line of country main, subject to temporary loss of head by sudden draughts. They also secure a supply proportionate to their capacity, in the event of accident or repairs to the country main. But their chief value is in the practical increase in the capacity of an overtaxed main, which they effect. With a reservoir a main can be worked to its full capacity of delivery at the reservoir level, at all hours of day and night. Thus when the draught during the hour of greatest consumption, is too great for the main—a local reservoir will receive the discharge of the main during the hours of the least consumption during day and in the night, (when the capacity of the main always exceeds any legitimate demand) and feed it out when the main is overworked. The main will not deliver as much water into the reservoir, as it will directly into the distribution, while its full capacity is exerted—because in the latter case it will always be discharging under a lower head—but its *useful* delivery during the 24 hours will be greatest into the reser-

voir. With a local reservoir and proper distribution, the high levels cannot be robbed of their constant supply, as is now the case in all towns, where there is great pressure, long mains, little supervision or power of control, and no regulating reservoirs. In St. Rock's, Quebec, where the streets are 469 feet under the reservoir at Lorette, seven miles distant, the pressure in the main is so reduced by the excessive draught, that the water does not rise more than 81 feet—less than one fifth of the height. The night flow of the 18 in. main is at the rate of 2,400,000 gallons per diem. Of course this is unnecessary, but it shews what may be done. In Halifax, the reports go to shew that your consumption of water is nearly equal to that of Quebec, but your mains give you the power to do this, without much injury at present to the supply. Having a separate main for the upper district, and an abundant supply from Long lake, you can afford to let the Lower district take all the water they can get from the 24 inch, until even its capacity is overtaxed, and the upper sections of the lower district begin to complain. All systems of water supply looking to the future, are in excess of immediate demands, and therefore as in other matters, habits of extravagance are engendered:—but there is no doubt that the maxim "resist beginnings!" should be adopted. It is impossible to say what the per capita quantity should be, as it varies with the peculiar wants of every city, and especially with the greater or less inducement there be to check the evil of waste in the bud. In gravitation systems, there is less likelihood of restrictions until deficiency occurs, than in pumping systems, where every increase of consumption is represented by an increase in cost. In every city the daily average is annually increasing, (to a certain extent legitimately) as the value of water for public and private purposes is more and more appreciated:—if this increase continues, the demand can only be met by works rivalling those of ancient Rome.

Looking at the difficulty of checking waste, and the impolicy of restricting every legitimate use of the water, those cities which possess the means, will find it the safest course to provide for as profuse a supply as can be afforded. In Halifax there is nothing to be enlarged—nor has there been anything wasted—and your system of supply, as far as carried is as ample as necessary. Your 24 in. main is capable alone of delivering into the Lower district, all the water which is estimated, can be obtained from the Long lake; and your 15 in. when extended to Spruce Hill, as proposed, will be capable of bringing in all that district can afford. If an intermediate reservoir be hereafter required, and can be established between these Lakes, it seems quite practicable to bring the Ragged lake water, into this or into the pipe leading from it—and thus all the water which the gathering grounds near Halifax afford, may be utilized, in the most efficient and economical manner.

With the ample dimensions of your main from Long lake, and the abundant altitude of the Spruce Hill lakes—and the power you possess of relieving the upper district, by establishing an intermediate one when required, I see no probability of your requiring city reservoirs, (or any reservoir, but the one which may be required to feed an intermediate district,) as a matter of necessity, in order to keep up the pressure in any districts. Large storage reservoirs are most important in connection with pumping supplies, not only to provide against repairs and break downs to machinery—but often as subsiding reservoirs, to allow disturbed water to become purified by subsidence; but in your system the Lakes perform

these functions, and city reservoirs may be postponed, until the capacity of each country main is exhausted—or until it be found desirable to store a quantity of water upon the peninsula, to provide against any temporary interruption of the supply.

I have been obliged to speak approximately and conditionally, upon many conditions connected with the Spruce Hill lakes, and Long lake, catchment basins—from want of personal acquaintance with the character of the former, its capabilities for storage, its liability to evaporation or filtration losses, and its minimum local rain fall; and with regard to the latter because no survey of its gathering grounds, has hitherto been necessary. I observe that the Beaver dam, and Pugwash brook, are in some places nearly as elevated as the Spruce Hill lakes. If it be found that the Spruce Hill lakes do not yield water enough to supply fully the 15 in. main—it may be found practicable to supplement the quantity from the more elevated portion of the Long lake gathering grounds, and thus postpone, if not obviate altogether, the necessity for an intermediate system. Or what would appear still more practicable, if the Ragged lake level (which would give a fire pressure on all the peninsula, except perhaps upon the highest hills,) be considered high enough, the Spruce lake water could be brought down to a fountain head, where it could be reinforced by Ragged lake, or by that from the upper levels of the Long lake catchment basin, or by both, and thus supply the full capacity of the 15 inch. This would secure an average delivery of about 2,500,000 galls., daily, to that portion of the city lying above 100 over tide—which should be ample for some time to come—and would render a third or intermediate main unnecessary.

A survey of the Long lake catchment basin, will shew how far it is practicable, at a reasonable cost. (by means of a system of catchwater drains, or otherwise,) to intercept the required quantity at the required elevation. It would seem practicable to intercept this water before it descends to Long lake, at a less cost than after it has descended, to lift it back again to the level from whence it descended, and where it is wanted.

With respect to the question, submitted to me, as to the safety of raising the Long lake dam, three or four feet, I do not think there is any risk with ordinary care. The top of the dam being four feet above the present water line, the new water line would not be above the old and consolidated embankment. If the dam has been built according to the specification sent me, it is a reliable one; and the dimensions are liberal and well proportioned. In raising the dam the old puddle wall should be got at and carried up above the new water line, the top and face of the bank above water being first stripped of vegetation, and benched out as well as broken up, so that the old and new embankments may be well connected together. The width of present dam, on water line, being forty feet and over, I think it could be raised without a wider base provided the front slope is well protected with stone, the rear one if necessary, to be similarly supported. If there is much exposure, the face of the bank will require protection from the action of the waves in any case, and by using heavier stone the slope can be reduced so as to avoid the necessity for widening.

But, if the draught upon Long lake is to be reduced by withdrawing the 15 in. main from that lake and extending it to Spruce Hill, it may not be found necessary to raise this dam in order to increase the storage. And if it be found advisable and practicable to intercept a portion of the

Long lake area, this may be done to such an extent that no further storage will be needed to retain the remainder of the available yield of that catchment basin.

In conclusion (as respects a future possible resort to pumping) as nearly as can be ascertained from the map sent me, the drainage areas of Long, Chain, and Ragged lakes, would be about four thousand acres. And in a year of minimum rainfall this district might not afford more than five to six million gallons daily. As the whole of this may be required hereafter for the Lower service of Halifax, (or what may be left of it) if any portion be diverted to the High Service, or to an intermediate one, it seems to me that the only condition in which pumping need be contemplated, is *when all the water above the Chain lake level is absorbed*, and an increase of supply beyond gravitation sources is needed. In this case the pumped supply must come from the water shed below the Chain lake level, and from sources not otherwise available for the city.

I have the honor to be, sir,

Your obtd. servt.,

THOS. C. KEEFER.

ALDERMAN'S OFFICE,

January 30th, 1867.

The Committee to whom were referred the Annual Report of the Commissioners of Water Supply, and the Report of T. C. Keefer, Esq. upon the High Service, have to inform the City Council, that they met at the Water Commissioner's office on two separate occasions—the Commissioners being present.

The first thing that engaged the attention of the Committee, was, the Report of the Water Commissioners, and in carefully reading over that document, they found that there was only one portion that required the immediate attention of the Council. It is that portion which refers to the propriety of levying a Water Rate on all Wharf Property, beyond sixty feet from the east side of Water Street. The Committee found, that the Water Commissioners had called the attention of the City Council to this subject some two years ago—and that the Council had referred it to a Special Committee to report on, but strange to say, no attention had been paid to it by that Committee.

The Committee find that special provision has been made to protect all wharf property, from fire, quite equal to any other portion of the City, by placing Fire Plugs either on the wharves, or at the head of wharves. This special fire protection for wharf property, has been completed at a very heavy cost to the city—but up to this time such property has paid no fire Tax.

The Committee therefore recommend, that, in future a Water Rate of one quarter per cent on the assessed value, be levied on all Wharf Property located beyond sixty feet from the east side of Water Street, as a Fire Tax, and as provided in the Act relating to Water Supply, chap. 81, sec. 609.

With regard to the latter portion of the report, which refers to financial matters, the Committee have to inform the Council, that since the Report was submitted—the Interest on the Water Debentures and some other sums that were owing, have been fully met, out of the Water Rates—and the sum of twelve hundred pounds which was loaned to the Water Department. And therefore no further action need be taken on the part of the Council.

Your Committee next turned their attention to Mr. Keefer's report upon the high service of the water works, and after repeated careful readings, and satisfactory explanations from the Water Commissioners, the Committee could not help coming to the unanimous conclusion that Mr. Keefer's report is a very valuable document.

The Committee do not see the necessity of entering into lengthy details, upon this subject—from the fact that the whole subject is amply

discussed in the Reports of Messrs. W. Gossip, and W. B. Smellie, civil engineers, and also in the Report of the Commissioners of Water Supply, all of which are to be found in the published City Reports of 1865 and 1866.

The advantage of the Spruce Hill lake scheme, we understand from these documents to be very great. The water is of the purest quality, and the lakes are so elevated, that the highest parts of the City can be supplied from them without the aid of machinery. There are no mill privileges or other private claims attaching to these lakes, and the quantity of water they will yield though limited compared with Long lake, will be ample for the purposes required. Mr. Keefer states, that there is no other way in which the same quantity can be obtained at so small a cost. The lakes have been already secured by a grant from the Crown Land Office.

The Committee after due deliberation—and seeing the necessity of the High Service being carried out in good faith—recommend that Mr. Keefer's report be adopted, and that the work be carried out in accordance therewith so soon as practicable, and funds can be obtained for that purpose.

Your Committee feel it to be their duty to report for the information of the Council, and the Rate Payers, that, in their opinion, no additional tax will be required in carrying on the High Service Work. It is true that the work will cost from 75,000 to 80,000 dollars—and the interest will have to be annually paid—but the work will extend at least over three or four years—and there will be ample means from the present water rates to meet the interest on the first year's outlay. From a steady annual increase of consumers, and other resources which can be relied on, the rate payers may rest assured that no additional burthen will be placed upon them in perfecting the high service of the Water Works.

In conclusion, your Committee would recommend, that the Report of the Water Commissioners and the Report of T. C. Keefer, Esq., be published with the Annual Report, for the information of the citizens.

All of which is respectfully submitted for the consideration of the City Council.

W. ACKHURST, *Chairman.*

ERRATUM.—On page 9 of Mayor's Report, 5th line from bottom, for Donation of four thousand pounds—read five thousand pounds.