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**ENGINEER'S REPORT**

TO THE

**LITTLE KANAWHA NAVIGATION CO.,**

FOR THE YEAR

**1867.**

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**PARKERSBURG:**  
**GAZETTE PRINT — OFFICE ON ANN STREET.**  
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Office of The Little Kanawha Navigation Company.

PARKERSBURG, W. VA., January 1st, 1868.

GEN. J. J. JACKSON, *President, &c.*—

As Engineer of the works of your Company I herewith submit my report for the year 1867.

For a better understanding of the subject I have prefaced the same with a brief review of some of the operations of the Company prior to the current year and have appended some general remarks on the probable value of the works when completed.

Your Company was organized under an act of the Legislature of this State with power to improve the navigation of the Little Kanawha River by "removing any or all the dams or any other obstructions existing to the navigation of said river, or by locks, dams, sluices, canals, or by any usual mode of improvement or by a combination of any two or more of them" and "when the obstructions to the navigation of said river shall have been removed from Rathbone [Burning Springs] in the county of Wirt, to Parkersburg, in the county of Wood," to collect tolls upon passings boats and freight at the rates provided by said Act.

During the year 1866 the dams between the points above named were purchased and so much of the same and of other ob-

structions removed as was necessary to permit the passage of boats whenever the water is of sufficient height to float the same over the ripples, which is with much less water than had theretofore been necessary.

The navigation of the river has been thereby materially improved. Though the collection of tolls is authorized by your charter, it has never been enforced.

The natural flow of the river being insufficient to maintain continuously any other than slack water navigation, it was, in Nov. 1866, resolved by your Board of Directors to invite proposals for the furnishing of the materials for, and for the construction of the necessary locks and dams between Parkersburg and Burning Springs, to be built of timber. The President was authorized to employ an engineer, to have prepared plans and estimates, assuming the cost of timber to be fifteen cents per cubic foot, delivered at the several places required, the locks to be twenty-two feet wide in the clear, one hundred and twenty feet length of chamber and designed to maintain a minimum depth of four feet of water. My connection with the work commenced at that time. The



season was too far advanced and the water too high to permit my making any survey or even satisfactory examination of the river for the purpose of determining the proper locations and amount of lift for the several proposed locks and dams, recourse was therefore had to the only sources of information within my reach, *to wit*: a brief report with an accompanying map made in 1838 under the direction of P. Crozet, for the State of Virginia, and a report, map and profile made in 1864, by Col. J. W. Adams for the Rathbone Oil Tract Company.

Assuming five locks and dams to be necessary, that suitable rock foundations could be found for the same, and timber could be delivered at the price above named (fifteen cents per cubic foot), my estimate of the cost upon the plan submitted and approved was twenty thousand dollars for each lock and dam or one hundred thousand for the whole work, exclusive of engineering and superintendence.

The prices bid for the delivery of timber so far exceeded the expectations of the Company that it was decided to construct the work of heavy rubble stone masonry, laid in hydraulic cement mortar, with upright fender timbers, bolted to the inside of the lock walls to prevent the abrasion of passing boats. My estimate of the cost of the work was twenty-five thousand dollars per lock and dam, or one hundred and twenty-five thousand dollars for the whole work, beside engineering and superintendence. The stone for masonry is abundant and very accessible.

The masonry and timber for Lock and Dam number One were contracted for in February last.

Considerable aid was expected in the form of subscriptions to the capital stock of the Company to be made by the producers of petroleum at Burning Springs whose interests are to be subserved by the proposed improvement.

During the early part of the current year the market value of oil declined greatly, and the production of it, at Burning Springs, correspondingly diminished, in consequence of which the expected aid was not received and no further work was put under contract.

The location of Lock Number One on the westerly side of the river at Jackson's Mill, was necessarily made and a considerable part of the materials therefor delivered before the ripple could be examined in low water. The concurrent testimony of the "oldest inhabitants," the report of Mr. Crozet, and the best soundings I could make with a long steel bar, indicated a rock foundation the whole width of the river bed. The continuous high water in the Ohio River, the reflux water from which covered our location during the early part of the past season, delayed the inclosing of the lock site, and the excavation for the foundation till late in August, when too late to change the location, except at great cost, we found the rock bottom terminates at from twenty to forty feet from the westerly bank of the river, the intervening space, covered with flat detached rocks firmly imbedded in a stratum of tenacious clay, gave the appearance to the sounding bar and to the superficial view of residents in the neighborhood who had often seen the ripple beneath a few inches of water only, of a continuous rock bottom.

The failure to obtain a rock foundation made necessary several changes in plan and directly increased the cost of the lock about three thousand dollars. The lock wall adjoining the river is laid upon rock, the other wall and the chamber foundation upon timbers placed from three to five feet apart (except mitre sill foundations which are of timbers laid side by side) with the intermediate spaces filled with concrete and rubble masonry and covered with plank lined with boards. Transverse courses of sheet piling and a wall of rubble

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masonry four feet deep, at the foot of the lock, are laid the whole width of the foundation. A pavement of quarried stone is yet to be placed at the foot of the foot of the lock, and when completed I believe the walls will be as secure against danger of undermining as they can well be made.

The Company was unfortunate in having contractors, for the masonry, unacquainted with the business. With ample time to have completed the work their progress was very slow, and on the 21st of October last with the lock walls less than half completed they entirely abandoned the work. It was then too late in the season to relet the work or to make the necessary preparations for carrying it on this year, it therefore stands now substantially as left by the contractors. The construction and maintenance of the coffer dams and the pumping of the water from the same, performed by the Company at a cost of about fifteen hundred dollars, would have been sufficient for the completion of the work had it been vigorously prosecuted. The failure of the contractors will entail a loss upon the Company to the amount of whatever the coffer dams and pumping may hereafter cost, that sum cannot be even approximately estimated as it depends upon the amount of water in the Ohio river when the work shall be resumed and on how perfectly the present coffer dams shall withstand the floods till that time.

In July last the Board of Directors resolved to increase the length of the locks to one hundred and forty feet between upper and lower hollow quoins, so as to admit of the passage of boats one hundred and twenty-five feet long, and twenty-two feet wide, drawing three and one half feet of water (four feet being the minimum depth of water intended to be maintained).—Barges of the foregoing dimensions have a capacity for cargo of two hundred and fifty net tons. The change in the length of

the locks will increase their cost about twelve hundred and fifty dollars each.

According to the profile above named the bed of the Little Kanawha River on the first ripple below Burning Springs is forty-one feet and the proposed water surface forty-five feet above low water in the Ohio River as the same was determined by Col. Adams in 1864. I however found the Ohio during the extremely low water of the past autumn to be nearly two feet lower than the line for the same determined by Col. Adams. Assuming two feet below said line as being extreme low water in the Ohio River, the extreme difference in level between it and the proposed water surface of the Little Kanawha River at Burning Springs is forty-seven feet. It is proposed to construct Lock and Dam No. One, with a lift in extreme low water in the Ohio of fourteen feet (ordinarily the lift will not exceed ten feet.) There remains thirty-three feet which may be overcome by four locks and dams having an average lift of eight feet three inches or by three having an average lift of eleven feet. In the former case the dams will average twelve feet three inches in height and the latter fifteen feet, experience having shown that it is better and (generally more economical) to raise the water to the of each height required for navigation at the foot dam than to excavate a channel into each lock.

As before remarked Lock No. One was located and its lift established before the stage of water in the Little Kanawha River permitted a satisfactory location of the remaining locks and dams. The lift so established will put four feet of water on the ripple at Leach's dam and therefore determine the location of Lock and Dam No. Two at that point at which a good rock foundation is to be had.

During the low water of last summer I made a careful examination of the river between Parkersburg and Burning Springs



for the purpose of determining the proper locations for the remaining locks and dams. Should four additional ones be constructed I recommend the location of

Lock No. 2 at Leach's Dam with 8 feet lift, height of dam 12 feet.

Lock No. 3 at Newark with 8 feet lift, height of dam 12 feet.

Lock No. 4 at Elizabeth with 8 feet lift, height of dam 12 feet.

Lock No. 5 at Palestine with 9 feet lift, height of dam 13 feet.

Should but three additional locks and dams be constructed, the following locations are preferred:

Lock No. 2 at Leach's Dam with 12 feet lift, height of dam 16 feet.

Lock No. 3 at Wells' Ripple with 12 feet lift, height of dam 16 feet.

Lock No. 4 at Palestine with 9 feet lift, height of dam 13 feet.

The locations determine the lifts of the locks and heights of dams. At each of the foregoing proposed locations good rock foundations are to be had, which I deem a *desideratum*.

Between Burning Springs and Palestine I could find no such foundation and hence recommend the location of the upper lock and dam at the latter place.

By the adoption of the plan of three additional locks and dams a saving in cost of about ten thousand dollars will be effected, but there will be a loss of water by the increased surface exposed to evaporation and by a greater leakage through lock gates, the wear of the gates will also be greater and consequently the cost of maintenance increased.

By the adoption of either plan the water power at Greenville on Hughes River and at Vernon's mill on Reedy Creek will be destroyed. I am not aware of any other damage to be done by reflux water.

The surplus water which the Company will have at disposal at the several proposed dams will be worth several times the

value of the water powers to be destroyed.

My present estimate of the cost to complete the work to Burning Springs is as follows:

For five locks and dams of rubble stone masonry.....	\$135,000,00
For engineering and superintendence 10 per cent.....	\$12,500,00
For water power destroyed.....	8,000,00
Total.....	\$145,500,00

For four locks and dams of stone masonry—Total.....	135,000,00
For four locks of stone with dams of timber—Total.....	\$125,000,00

During the past summer and autumn the water in the Little Kanawha River was very low—that it has never been lower, I cannot affirm; not having heretofore been acquainted with the river nor having at hand the necessary meteorological records for an approximate determination of its minimum flow. Judging however from the area and topographical characteristics of its drainage basin, and from the ample margin shown below, I believe it safe to assume that it will very rarely, if ever, happen that the natural flow of the river will be less than the amount required for navigation between this city and Burning Springs. I made several measurements during the time of its least flow last autumn and found the minimum delivery at Lock Number One, to be about 10,000 cubic feet of water per minute. From the area of the drainage basin of the river at Burning Springs, I estimate its minimum delivery to have been not less than 6000 cubic feet per minute.

The amount of water required at Burning Springs for navigation, I estimate as follows:

40 lockages per day, 880 cubic feet per minute.

Leakage through gates, (450 cubic feet minimum), say 900 cubic feet per minute.



Evaporation from increased surface exposed, estimated at 10 miles in length, 150 feet wide and  $\frac{1}{2}$  of one inch in depth, per day, 160 cubic feet per minute.

Total—1940 cubic feet per minute.

It will be seen from the foregoing estimate that there was flowing in the river at Burning Springs during the lowest water this year, three times the amount necessary to supply the probable leakage through lock gates, the evaporation and forty lockages per day. The dams can, and should be made perfectly impervious to water, with a little care, the leakage through the lockgates may be maintained at or below the amount estimated.

Should an additional supply of water at any time become necessary, it can be cheaply obtained from artificial reservoirs to be formed by constructing dams across the headwaters of the river or across its tributaries.

During the five and one-half months, ending December 1st, there had accumulated at Burning Springs, and was stored in barges not less than 50,000 barrels of oil awaiting water for transportation to Parkersburg. It is probable that not less than 15 per centum of the whole amount so stored, was lost by evaporation and leakage, in other words, 50,000 barrels were 85 per cent. of the whole amount stored. The market price of oil fluctuated during the season just closed more than 100 per cent. The 50,000 barrels above named reached Parkersburg when the market was greatly depressed.

On the 14th ult., the river rose sufficiently, so that with the improvements to its navigation hereinbefore described as having been made by your company, these barges were enabled to run to Parkersburg; without those improvements they would probably have been at Burning Springs to-day.

When the water rose, more than ninety barges were started in one day, many of

them unavoidably entrusted to inexperienced pilots. Several barges were wrecked and about 3000 barrels of oil lost.

The following estimate is intended to show the amount which would have been saved to the producers of, and the dealers in oil at Burning Springs during the five and one-half months named, had your proposed improvement been completed.

8,822 bbls lost by evaporation and leakage, @ \$2,	\$17,644.00
3,000 bbls lost by barges wrecked, say	7,500.00
50,000 bbls loss by depreciation in market value, @ \$1	50,000.00
50,000 bbls loss in difference in cost of transportation, @ 50 c.	25,000.00
<b>Total,</b>	<b>\$100,144.00</b>

When we remember that oil is at this time, in this State at least, almost wholly the product of labor, that the price of labor is in a great measure dependent on the cost of supplies for the laborer, that the supplies for the production of the oil above named were mostly transported thirty miles on wagons, at more than quadruple the cost of water transportation, that many holders unable to wait for river transportation, sent their oil to this market by teams at a cost of one and one-half dollars per barrel, it will be seen that with their indirect losses added to the foregoing estimate, the oil producers and dealers at Burning Springs would have saved, had your improvement been in operation the past summer, more than enough to have constructed the entire work.

As before remarked, the year just closed has been one of great depression in the oil trade, the production of this State has been less than one-half that of 1866; yet, there was produced at Burning Springs not less than 125,000 barrels, the toll on which at 10 cents per barrel, the rate allowed by your charter, would have been \$12,500.00. It is probable that while the production of oil shall continue along or near the river, the amount seeking transportation on it



will rarely be less than for the year just closed. Assuming the amount of toll probably to be collected on all freights other than oil, including the lumber trade which will spring up as soon as an open market is afforded, at \$12,500; we have for gross estimated receipts per annum,

Receipts,	\$25,000
Deduct for Superintendent and Repairs,	\$5,000
Estimated net earnings per annum.	\$20,000

Equal to 10 per cent. per annum on a Capital Stock of \$200,000

How long the production of oil is to continue, and what amount is to be obtained, cannot be estimated with any certainty. But a small portion of the "oil break" along and near the Little Kanawha River has yet been developed. The greater cost of boring wells, and the want of cheap transportation, has placed the production of light oil at a disadvantage as compared with the Venango district in Pennsylvania. Whenever a remunerative price shall prevail, it is probable that for many years, the amount to be transported on the Little Kanawha River will exceed the foregoing estimate.

The completion of your work to Burning Springs will furnish 38 miles of slack water navigation, and by it will be transported the supplies to, and the products from at least three hundred square miles of territory, including the villages of Newark, Elizabeth and Palestine. Except in the valley of the Little Kanawha and of its principal tributaries, the major part of the land on either side of the river is now covered with a forest of valuable white oak and poplar timber, when manufactured the transportation of it to the Ohio River, promises to be an important traffic.

In my opinion, the true method of making this improvement more permanently remunerative, to develop the country traversed by it, and to build up a large trade for the city of Parkersburg, is to extend

the improvement to Glenville and perhaps beyond it.

A great bituminous coal basin with accompanying deposits of lime and hydraulic cement stone, salt-bearing rock and iron ore, underlies the western portion of this State. Its northern outcrop in western Pennsylvania furnishes the most important element of the wealth and prosperity of Pittsburgh and its surrounding country. Its western border crops out through Southeastern Ohio, Eastern Kentucky and Tennessee. The eastern border on which the coal deposits are thicker, better and more rich in the accompanying minerals, crops out along the eastern and central portions of this State, from Cumberland, Md., across the Little Kanawha River at and above Glenville, through the valley of Coal river, (a tributary of the Great Kanawha,) into Southwestern Virginia, Eastern Kentucky and Tennessee.

To extend your improvement from Burning Springs to the mineral district will require an additional outlay of probably one hundred and fifty thousand possibly of two hundred thousand dollars.

Beside the transportation of lumber, agricultural products, supplies to and from the country to be traversed by the proposed extension, the important traffic will be in coal, salt, lime, hydraulic cement, and possibly, if not probably, in iron and petroleum.

A large portion of the coal now used at Burning Springs is furnished from the outcrop at Glenville, of the quantity and quality of which, no further explanation is needed here.

The manufacture of salt on the upper waters of the Little Kanawha River, has become historic; having coal in juxtaposition, with cheap transportation, these Salt lines can compete with any others in all the markets along the Ohio and Mississippi Rivers.

The hydraulic cement manufactured near Pittsburgh, and at Cumberland Md.,



from this same outcrop, are standard brands in the market. The limestone district to be reached, is equal to the best in this State for agricultural purposes. Iron ore, in widely varying quantities, is constantly associated with these coal deposits, whether it is to be found on the Little Kanawha River in paying quantities, time will determine.

Petroleum has been found, and is now successfully produced in paying quantities on the western border of this coal basin in Ohio; springs of the same have long been known on the eastern border at its crossing of the Little Kanawha River and their existence was recorded in publications many years ago.

The "oil break" which traverses the central portion of this coal basin, crossing the

Little Kanawha at Burning Springs, has only brought the same rocks which crop out at the borders, within reach of the drill and furnished convenient reservoirs for the storage of petroleum. It is therefore possible that petroleum may yet be found in paying quantities along the proposed extension of your improvement.— With its completion, means of transportation will be furnished for the supplies to, and the products from, over one thousand square miles of our State, much of it rich in minerals. The trade of this city will be increased many fold and the return to your stockholders, though hardly to be computed, even approximately, may reasonably be expected to be liberal and increasing. Respectfully submitted,

JAMES McARTHUR.



Little Kanawha at the Spring has  
only passed the rocks which stop  
out of the water which reach of the  
flat and marshy country reservoirs  
for the storage of water. It is there-  
fore possible that better may yet be  
found in some reservoir along the pro-  
posed extension of your improvement —  
When in completion, access of transport  
will be furnished for the supplies to  
and the objects less over one thousand  
particulars of our plan will be  
in mind. The length of the river will  
be increased many fold and the return  
your projectors though hardly to be  
considered even as a possibility, may yet  
be able to extend to its limit and in  
the future.

from the same source, are scattered  
through the region. The limestone dis-  
tributed to be reached is equal to the best in  
this State for agricultural purposes. There  
is in nearly every part of the State  
large quantities of these rocks, and  
it is to be found on the Little  
Kanawha River in great quantities. The  
will be found.  
The limestone has been found, and is not  
only in the country in great quantities,  
but the western border of the coal field  
of the State of the same nature has  
been found in the limestone at the cross-  
ing of the Little Kanawha. There and their  
existence was reported in publications in  
the year 1840.  
The limestone has been found in the  
western part of the State.







