REPORT

OF THE

Investigation and Study of the Route of the Improved Erie Canal between the Cities of Tonawanda and Buffalo

New York (State) State engineer and surveyor

TRANSMITTED TO THE LEGISLATURE MARCH 6, 1918

STATE OF NEW YORK

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IN ASSEMBLY

March 6, 1918

Report of the Investigation and Study of the Route of the Improved Erie Canal between the Cities of Tonawanda and Buffalo

To the Honorable, the Speaker of the Assembly, session of the Legislature of 1918.

Dear Sir.— There is transmitted herewith the report of investigation conducted under the provisions of Chapter 743 of the Laws of 1917.

Respectfully yours,

FRANK M. WILLIAMS,

State Engineer and Surveyor.

REPORT

Chapter 743 of the Laws of 1917 authorized and directed an investigation and study of the route of the improved Erie canal between the cities of Tonawanda and Buffalo, and the making of surveys, plans and estimates of cost of an alternate route. The State Engineer and Surveyor and the Superintendent of Public Works were named to make such investigation and study and were directed to report to the Legislature on the following points:

(a) As to the suitability and safety for Barge canal freight carrying craft on that portion of the Niagara river lying between Tonawanda and Black Rock Harbor, which, under Chapter 147 of the Laws of 1903 was made a portion of the route of the Barge canal.

(b) As to the necessity and desirability of retaining for navigation purposes that portion of the unimproved Erie canal from its junction with the improved Erie canal at Tonawanda to Black Rock Harbor, in addition to the Niagara River route.

(c) As to the necessity and desirability of substituting the route of the present Erie canal between Tonawanda and Black Rock Harbor for the route through the Niagara river.

(d) As to the advisability and desirability of improving the portion of the present Erie canal from the junction with the improved Erie canal at Tonawanda to Black Rock Harbor, and the widening and deepening of the same to Barge canal dimensions as specified in Chapter 147 of the Laws of 1903.

(e) As to the advisability of substituting such improved route for the Niagara River route.

(f) To submit an estimate of cost of the improvement of the present unimproved Erie Canal channel between Tonawanda and Black Rock Harbor, including the construction of necessary locks, bridges and other structures.

This report will discuss the above points in the order given.

(a) From the Government lock at Black Rock Harbor to the mouth of Tonawanda creek there is existing in the Niagara river a channel maintained by the Federal Government, 21 feet deep at mean low water, and having a minimum width of 400 feet. At the mouth of Tonawanda creek the Government has provided and maintains a channel at least 16 feet deep at mean low water and with minimum width of 400 feet (except through bridges) to a junction with the Barge canal. These dimensions being greater than those required by the Barge canal project, the question of sufficiency of the channel does not arise. Whether or not it can be operated on by barges such as would naturally operate on the balance of the Barge canal system must depend therefore upon other elements. The Niagara river is the medium through which passes into Lake Ontario the accumulated waters of the western four of the Great Lakes. At a distance of eleven miles below the mouth of Tonawanda creek is situated Niagara Falls. There must of necessity exist a current in such a stream and such current would vary with the stage of Lake Erie and would unquestionably be somewhat increased when a heavy storm from the west drives the waters of the lake into the head of Niagara river.

The investigations and studies upon which this report is based include public hearings held in the city of Buffalo and at Tonawanda at which careful inquiry was made as to the experience of boat operators in all kinds of weather between Black Rock Harbor and Tonawanda during the navigation season. No actual experience with barges designed exclusively for the Barge canal is, of course, as yet available. It was developed, however, that considerable navigation passes up and down that portion of the river lying between Black Rock and Tonawanda, including at times present sized Erie Canal boats.

The question of the strength of currents is of prime importance to Barge Canal traffic inasmuch as it has a very direct bearing upon the cost of boat operation and therefore upon freight rates. A current, the stemming of which makes necessary the over-installation of power to propel barges as compared with the requirements of other portions of the canal, becomes a serious factor in canal rates. On this particular section of channel there

exists but little data on the subject of current. The Lake Survey has made extensive hydrographic studies of the river and has computed discharges, velocities and river elevations, but the velocities given in the Government reports are those taken in the swift current around Squaw Island, and therefore at a point not a part of the channel under consideration. Moreover, the mean velocities given are not significant as they are the average of the channel and shore sections of the river, while navigators are concerned only with actual currents in the navigable channel. Gagings were therefore made by the State Engineer's department at twenty-three points between Black Rock and the mouth of Tonawanda creek. When these gagings were taken the water level of Lake Erie was not high and higher velocities would occur with higher water levels in the lake. Attempts were made to obtain gagings at a higher lake elevation but were unsuccessful except in a limited number of instances, such gagings indicating that an increase of 1 foot in the lake level means approximately an increase of .2 miles per hour in current velocity. The velocities taken were carefully measured by current meter, and the results are as follows:

TABLE OF CURRENT OBSERVATIONS IN NIAGARA RIVER

Observations		Water surface Lake Erie	Velocity of stream, Miles per hour
1	September 19, 1917.....	574.3	
2	September 19, 1917.....	574.3	2.73
3	September 19, 1917.....	574.3	2.44
4	September 19, 1917.....	574.3	2.11
5	September 19, 1917.....	574.3	2.29
6	September 19, 1917.....	574.4	2.11
7	September 19, 1917.....	574.4	2.42
8	September 19, 1917.....	574.4	2.59
9	September 19, 1917.....	574.4	2.54
10	September 19, 1917.....	574.4	2.70
11	September 19, 1917.....	574.4	2.59
12	September 19, 1917.....	574.4	2.29
13	September 19, 1917.....	574.3	2.00
14	September 19, 1917.....	574.3	2.11
15	September 19, 1917.....	574.3	1.97

Observations		Water surface Lake Erie	Velocity of stream, Miles per hour
16	September 19, 1917.....	574.2	2.24
17	September 19, 1917.....	574.2	2.06
18	September 19, 1917.....	574.2	1.96
19	September 19, 1917.....	574.2	2.02
20	September 19, 1917.....	574.2	2.13
21	September 19, 1917.....	574.2	1.68
22	September 19, 1917.....	574.2	1.34
23	September 19, 1917.....	574.2	1.30
3	October 30, 1917 (S. W. gale 76 miles per hour..	575.3	2.54
5	October 30, 1917 (S. W. gale 76 miles per hour)..	575.2	2.49
7	October 30, 1917 (S. W. gale 76 miles per hour)..	574.8	2.50

Station No. 1 is at the downstream entrance to the Government lock.

Stations Nos. 4, 5, 6, 7, 8 and 9 are opposite Strawberry Island.

Stations Nos. 10 and 11 are opposite Motor Island.

Stations Nos. 12, 13 and 14 are opposite the island now occupied by the Wickwire Steel Company.

Station No. 23 is at the mouth of Tonawanda creek.

A chart has been appended showing the locations of these current meter readings.

A study of the above table indicates that the maximum velocity of 2.73 miles per hour was obtained near the head of Strawberry Island and that the velocities between that point and the Wickwire Steel plant range from this maximum down to two miles per hour, and that from the Wickwire Steel plant to Tonawanda creek the velocities range from two miles per hour to 1.3 miles per hour.

Two and seventy-three hundredths miles per hour current velocity is not an impossible current against which to tow. The barges operating on the Barge canal must be propelled by some form of mechanical motive power and if such motive power is not sufficient to propel the power boat with such consorts as it may

be designed to accommodate at a rate of at least six miles per hour in a channel of maximum Barge canal depth and width, it is not believed that such power boat can economically operate on the Barge canal system. From the data available and the evidence taken, there is nothing to indicate during what proportion of each navigation season the current in that portion of the channel which indicates the highest velocity would reach a point which would make navigation against it impossible or impracticable.

The Erie Barge canal will be open for Barge canal traffic during the next navigation season and it will be possible to determine by practical experience whether or not the periods of time when it may be impracticable to navigate this river channel between Tonawanda and Black Rock Harbor are appreciable enough to demand an ultimate change in the canal route.

(b) It is recommended that the present unimproved Erie canal lying between the junction with the Barge canal at Tonawanda and Black Rock Harbor be retained and that for the present the existing "river lock" at Tonawanda and the guard lock at Black Rock be retained and operated; and that in order to maintain the present Erie canal water level in this section for the coming season a temporary dam be constructed across the channel at a point between the "river lock" and the Webster street highway bridge.

(c) It is not recommended that at this time a substitution of the so-called "inside route" for the river channel route be attempted. Such substitution, to be effective, would necessitate the immediate reconstruction of the "inside channel" and its enlargement to Barge canal dimensions. The estimated cost of accomplishing this purpose is given in a subsequent portion of this report, but until such time as the demands of Barge canal navigation and its efficient operation demonstrate that the route laid down by the Barge Canal Law is not thoroughly practicable, such substitution should not be recommended. Any attempted substitutions of such route without provision for its enlargement would be ineffective and of no purpose, as owing to the limited dimensions of the "inside channel" and its limited bridge clearances, barges designed for taking advantage of the much larger

dimensions of the Barge canal proper would be unable to successfully navigate this channel in its present state, particularly if they carried loads. However, by maintaining the present water level in this channel and the two locks, as recommended above, present sized canal boats may still continue to operate in this stretch of canal as heretofore.

(d) For reasons noted above, it is not recommended that the "inside route" or present canal channel from Tonawanda to Black Rock Harbor be enlarged at this time to Barge canal dimensions. The reservation of this property in the State, however, will permit of such enlargement should the demands of the future make it desirable.

(e) This point has already been disposed of under "c."

(f) Under the requirement of the law which calls for an estimate of cost of the improvement of the "inside route" including all structures, several alternate propositions have been studied and are presented herewith. The estimates in each case include the necessary right-of-way. It should be noted that these estimates are based on present day prices for construction work and may be subject to considerable modifications either in upward or downward direction, depending upon the time at which any of these propositions might be carried into effect:

The following are presented:

Propositions 1 and 2, high level lines, Tonawanda to Black Rock.

Proposition 3, low level line, Tonawanda to Black Rock.

Proposition 4, high level line, Black Rock to foot of Rattlesnake Island.

Proposition 5, low level line, Black Rock to foot of Rattlesnake Island.

Proposition 6, high level line Erie canal dimensions, Tonawanda to Black Rock; clearing out channel without widening; two Barge canal locks.

The length of the line under any of the above propositions is approximately 8 miles.

Proposition No. 1

Under Proposition No. 1 it is proposed to build a lift lock at Tonawanda with a water surface above the lock of 570.0 for the low water and 571.0 for the maximum navigable stage; to build a guard lock at Black Rock; to excavate and widen the channel between Tonawanda and Black Rock to Barge canal dimensions.

Under this proposition it is proposed to use a bottom width of 75 feet with side slopes of 1 on 3 on the land side and 1 on 2 on the river side, and for a considerable portion of the length to build a low concrete wall along the Niagara river raised on a crib docking. The spoil taken from the canal to be placed back of the river wall and extend, in most cases, to new canal prism.

It appears that the United States Government has prescribed a harbor line at the upper section under consideration beyond which no obstruction can be placed and which requires that no filling shall be done between the existing shore and the harbor line unless a bulkhead is first built on the line. This harbor line is likely to be extended at any time to cover the entire distance between Black Rock and Tonawanda. For the foundation of the harbor wall a small amount of dredging will be necessary. The crib would extend up to the low water surface of the river and would be filled with stone taken possibly from the spoil banks along the Barge canal west of Lockport. The concrete wall need not extend more than 10 feet in height above the crib. For about 2,000 feet the harbor line is too near the canal to afford space for the prism slope and a substantial spoil bank back of the wall. There seems to be no reason why the harbor line should not be thrown slightly toward the river at this point and it has been assumed that such a concession could be secured from the Government. With a spoil bank of fine material never less than 50 feet wide at the top, and for the greater part wider than this, and with the cribs necessarily sheeted to hold the stone filling, the seepage from the canal due to a maximum head of 4.5 feet should be small, and in any case it is immaterial as the supply of water from Lake Erie is ample.

The estimated cost of carrying this proposition into effect is $6,252,507.

PROPOSITION No. 2

Under this proposition a lift lock would be built at Tonawanda and a guard lock at Black Rock as by Proposition No. 1, but for a considerable portion of the distance concrete walls would be constructed on each side of the new canal prism and form the sides of the canal channel.

In this case the concrete wall is designed to serve the structural purpose and the spoil is held waste. It is deemed advisable to drive a steel sheet piling cut-off along the river toe of the wall near the river which would prevent undermining by floods and could be used for cofferdam purposes. It is to be noted that for about 2,600 feet this wall will be founded on rock. The wall would constitute a more waterproof barrier than any of the others, and it appears to have been the design considered in the 1900 estimate. However, in 1900 the harbor line had not been established and the requirement of a bulkhead on the river side probably was not considered.

The estimated cost is $6,121,798.

PROPOSITION No 3

Under Proposition No. 3 it is proposed to carry the normal Barge canal water surface from Tonawanda to Black Rock and to place a lift lock at Black Rock. The canal prism would be excavated with side slopes and crib type of walls would be placed along the river front as by Proposition No. 1.

One advantage of Proposition No. 3 is its lower water surface elevation which enables bridges crossing the canal to be at a lower elevation than by Propositions Nos. 1 or 2.

The estimated cost by this proposition is $7,211,130, due mainly to the increased amount of excavation.

PROPOSITION No. 4

Under this proposition it is proposed to follow the Niagara river from Tonawanda to what was formerly the foot of Rattlesnake Island, a short distance down the river from the Wickwire Steel Company's plant; to place a lock just west of the

Wickwire railroad bridge and to excavate a short canal to the present Erie canal and then deepen and widen the Erie canal to Black Rock and place a guard lock at Black Rock, using the crib type of channel retaining walls throughout.

The estimated cost is $3,195,675.

Proposition No. 5

This proposition is the same as No. 4 except that the lift lock would be placed at Black Rock and the canal between the lift lock and the foot of Rattlesnake Island would be excavated to a depth that would give 12 feet of water below the lowest surface of the Niagara river at the foot of Rattlesnake Island.

The estimated cost is $3,619,563.

Proposition No. 6

Under Proposition No. 6 it is proposed to build a lift lock of Barge canal dimensions at Tonawanda; to deepen the present canal to provide a depth of eight feet and to build a new guard lock at Black Rock.

The estimated cost of carrying this proposition into effect is $737,000.

It would not be possible to deepen this section more than to eight feet without undermining the bridges which span it and rendering unstable the retaining walls and embankments which bound the channel. The bridges have now a clearance of eleven feet, too low to accommodate light barges adapted to take full advantage of the Barge canal bridge clearances of 15½ feet. It is estimated that to adjust them to the greater clearance would cost $400,000 as most of them would not stand raising but would require rebuilding.

Should this be done, barges loaded to somewhat less than full capacity could navigate this channel deepened to eight feet, but two barges would be unable to pass each other in a considerable portion of it.

It would appear that to attempt to deepen the channel to provide for more than eight feet of water would require so great an

expenditure in reconstruction of retention walls and embankments, which would be rendered unstable, as to make it desirable instead to adopt one of the five propositions above described.

Under this proposition, the lock at Tonawanda would be located in the vicinity of Seymour street in Tonawanda and it is recommended that until the question of the improvement of this channel is disposed of, the bridge across the present canal at Main street, Tonawanda, be retained and no filling be permitted in the channel between the proposed temporary dam east of the "River Lock" and Tonawanda creek. The cost of a lock of Barge canal dimensions at this location is estimated at $330,000.

LOCATION OF TONAWANDA LOCK

Several studies have been made to determine the best location for the lock at Tonawanda. It has been suggested that it be placed at Webster street, but the adopted location just west of Seymour street seemed to be the most economical and to serve all purposes better than any of the other locations.

SPILLWAY

A new concrete spillway with a crest of 50 feet long and one sluice gate has been provided for at practically the location of the present spillway. This length of crest is considered ample to take care of flood flows and the maximum flow in the canal.

RETAINING WALLS

Through Tonawanda the present canal lies between two important streets and the available space for widening is too small to avoid the reconstruction of expensive walls through the city. The banks are high and their support during construction will constitute a difficult problem.

At Black Rock also extensive walls are required to avoid the appropriation of too costly property. The difficulties of construction there are not, however, as great as at Tonawanda.

Guard Lock

The proposed Black Rock guard lock has been located on the site of the existing east lock, leaving the possible space for the second lock to the westward when required. Conditions are not favorable for shifting this location north or south so as to utilize the present lock as a cofferdam.

Bridges

The estimate provides for rebuilding completely all existing bridges including one superstructure which has been removed. Six of these bridges, including one foot-bridge, are located in the country. Of the remainder three are in Tonawanda and four are in Black Rock. A foot-bridge at Riverside Park would be rebuilt, using the trusses which formerly carried highway traffic at another location and are well enough preserved to last some time longer. The two change bridges for the towpath are omitted as are the three railroad bridges and all industrial spur lines and the three private bridges at the Wickwire and General Electric Companies' plants.

For most of these railroad and private bridges revocable permits have been issued, and it is thus assumed that since the State will not require new land at the site, the expense of any necessary reconstruction will fall, in all cases, on the owner of the bridge. Six of the city bridges have been estimated to be rebuilt with concrete floors and sidewalks.

Sewers

Two large cast-iron sewers (44 and 42 inches in diameter) now pass under the canal at Tonawanda, and two water-pipes 12 and 24 inches in diameter, respectively. Provision is made for lowering these, but it is marked contingent as it is possible that the local authorities owning the sewers and water mains should rebuild them.

Power Lines

The power line of the Niagara Falls Power Company follows the east canal bank throughout most of the distance. Where this

line is located on State property it will be disturbed, but it is assumed that the cost of relocation will fall on the company. Where, however, the pole line lies outside the State blue line, an effort has been made to locate the improved canal so as to avoid interference with the poles. It is thought that this is the only power line affected except 16 poles of the General Electric Company which are now on State land.

STREAM ENTRANCES

Provision for protection at ten stream entrances or ditch entrances has been included in the estimate.

RIGHT-OF-WAY

One of the most perplexing features of this improvement is the valuable property it traverses. The operations at Tonawanda are absolutely restricted to the present narrow limits, and at Black Rock adjoining land on the east is crowded with structures and on the west devoted to manufacturing and lumber storage. The latter property would seem likely to be improved by grading, but interested parties give no encouragement as to granting release. It is intended therefore to convey the excavated material north about two miles where it may be spoiled.

The question of the value of the lands has been reduced largely to determining the values of undeveloped property near the Wickwire and the General Electric Companies' plants. A continued inquiry leads to the conclusion that the $3,000 per acre used in the estimate should be sufficient. These values are based on manufacturing possibilities. A list of assessed values in this locality has been obtained.

At Black Rock lands are considered too valuable to appropriate for spoiling and walls have been designed at some places to avoid even minor encroachments thereon.

At Tonawanda no additional land will be required, but a succession of claimants to lands between canal and river and a study of the grants of lands under water indicate that there may be claims along these locations for reimbursements.

TABLE SHOWING ESTIMATED COST OF IMPROVEMENT OF THE ERIE CANAL BETWEEN BLACK ROCK AND TONAWANDA BY VARIOUS PROPOSITIONS.

Proposition No. 1 — High level, crib type walls..	$6,252,507
Proposition No. 2 — High level, crib type walls..	6,121,798
Proposition No. 3 — Low level, crib type walls..	7,211,130
Proposition No. 4 — Black Rock to Rattlesnake Island, high level, crib type walls	3,195,675
Proposition No. 5 — Black Rock to Rattlesnake Island, low level, crib type walls	3,619,563
Proposition No. 6 — High level plan, Black Rock to Tonawanda, present canal	737,000

FRANK M. WILLIAMS,
State Engineer and Surveyor.

W. W. WOTHERSPOON,
Superintendent of Public Works.

March 4, 1918.