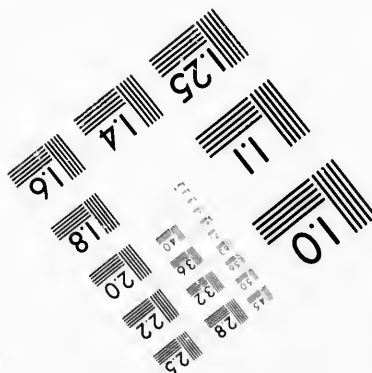
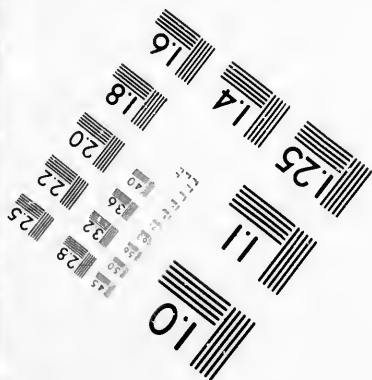
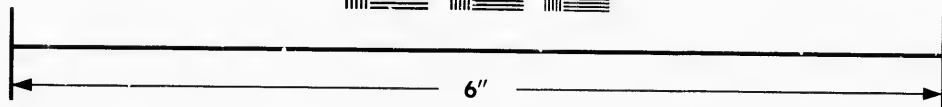
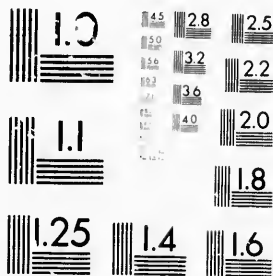


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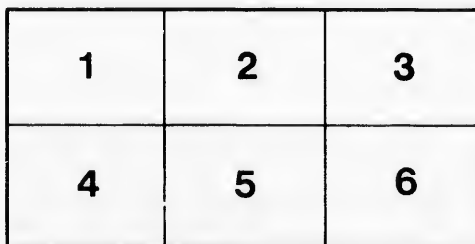
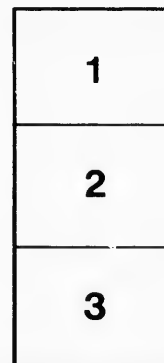
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REPORT ON  
PROPOSED HARBOUR IMPROVEMENT  
AND  
FLOOD PROTECTION  
FOR THE  
CENTRAL PORTION OF MONTREAL

BY  
JOHN KENNEDY, C.E., CHIEF ENGINEER,  
*Harbour Commissioner of Montreal,*

AND  
PERCIVAL W. ST. GEORGE, C.E.,  
*City Surveyor of Montreal.*

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MONTREAL:  
1889

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CHARLES GLACKMEYER, Esq.,

*City Clerk, Montreal,*

AND

ALEXANDER ROBERTSON, Esq.,

*Secretary, Harbour Commissioners of Montreal.*

SIRS:—

In compliance with a resolution passed at a joint-meeting of Committees appointed by the Harbour Commissioners and the City Council of Montreal, held on the 13th of June last, a copy of which is annexed, the undersigned have prepared plans and estimates of different schemes for combining the protection of the city from floods; the widening of Commissioners Street and the Improvement of the Harbour.

As a basis for these schemes we have assumed (1) that the central portion of the city front, or that between Berri Street and the entrance of the Lachine Canal is the only part yet to be provided with permanent works for flood protection, and it is therefore the works for this central part only with which we have at present to deal; (2) that the raising of the whole width of Commissioners and Common Streets to above flood level, or a strong dyke or wall of the same height along their outer side, either of which are approved by the Government Flood Commission, would be an efficient protection against floods and one complying with our instructions; (3) that the widening of Common Street is required and implied in the widening of Commissioners Street, and that the latter may be widened either by encroaching on the Harbour property on one side or private properties on the other, as may best suit the public interest; (4) that the project

for Harbour improvements approved by the Flood Commission and by the Harbour Commissioners last year is that which will doubtless be carried out in its main features, and therefore, the one to be fitted into the general scheme ; (5) that in compliance with the spirit of our instructions, as well as for simplicity, only those features of flood protection, street widening and Harbour improvements which affect one another and in which both the City and the Harbour Board are directly interested, should be at present dealt with by us. Space should of course be provided for surface and elevated railway tracts, freight sheds and other necessary adjuncts to the business of the Port, but these need not be treated of in detail.

As regards the estimates of cost, it must be understood that the valuations of land and buildings can only be taken as rough approximations, for there is no knowing in advance what such items would actually cost. We have, as a general basis, assumed that all properties wholly or largely cut into could be bought out altogether at about twenty-five per cent advance on the assessed value and that surplus residues could be afterwards sold by the City at fair prices. If this be questioned, other valuations can be made.

It will be noticed in all the estimates for the work of construction that we have included the Guard Pier of the Harbour plans, and this is done because it is an essential feature in all the flood protection works. Its effect will be to entirely guard the City front from the violent shoving of the River ice, and therefore to leave the inner works on Commissioners Street to resist only still water and a smooth sheet of ice. Without such a guard pier the flood protection works proper would have to do their own battling with the river shoves besides holding out the water, and would, therefore, need to be so much the stronger. Without it, too, the City would only have a



single line of defence against both forces. We have, therefore, included the guard pier in the gross estimate of all the schemes. It may be held that in apportioning the cost of the works between the City and the Harbour that the City should be charged with so much of the cost of the pier as it saves in other protection works, but we have not been able to agree as to this and have, therefore, for the present, placed the whole cost amongst the Harbour Commissioners own work.

The widening of Commissioners Street on the Harbour side would encroach largely upon wharf space which has cost a large sum to bring it to its present state of usefulness. This moving out of the shore line also reduces the possible length of the proposed piers, and by that much reduces the ultimate capacity of the Harbour, but the reduction, as will be seen by the appended tables, is not very great and it is attended with some reduction in the cost of construction. We have left this curtailment of the Harbour property and Harbour capacity to be valued hereafter, if thought proper, and in the meantime have confined ourselves to apportioning to the City the cost of moving the wharf line as much further out as is necessary to restore the breadth taken for street widening.

Upon this basis the following schemes and estimates have been prepared :—

**SCHEME 1.**—This project contemplates widening Commissioner and Common streets to 100 feet, mainly by taking ground on the north, or City side, and for flood protection it proposes raising the widened streets about seven feet so as to be above highest flood level. The cross streets, where they approach Commissioners and Common streets would, of course be graded to the high level. The wharves would be raised about three feet above their present level, so as to be above the May freshets, and access to them would be had by ramps as at present. There would be in all seven double ramps and

one single one for carts, and one for railway track, the former being thirty feet wide and fourteen feet high with a grade of one in twenty; that is, they would be half the steepness and a half more roomy than the present ramps, but of a half greater height to climb.

Reference to the plan will show that the street and new ramps would not materially interfere with the wharves, and that the flood protection and street widening could be carried out either with or without the Harbour improvements.

The cost of this scheme would be very great, both in works and land damages. Besides the raising of the streets, the revetment wall would have to be entirely rebuilt and of greatly increased height and strength; four entire blocks of buildings would be permanently swept away, and practically the same would be done with all the other buildings fronting on the Harbour from Bonsecours Market to Prince street. Land amounting to over 350,000 square feet would have to be purchased outright and permanently retained.

The scheme could, of course, be modified and reduced in cost by adhering more closely to the existing line of ramps, and by saving more of the valuable block between St. Peter and McGill streets, but the opinion of many who have considered the matter has been in favour of a liberal widening and rectification of the street lines, and this we have endeavored to embody in this scheme.

The estimated cost of the scheme as drawn out is:—

For Works.....	\$2,496,227
For Land and Buildings.....	2,128,528
Total.....	<u>\$4,624,755</u>

SCHEME 2.—In this it is proposed to widen Commissioners and Common streets on the City side to 100 feet to

preserve nearly their present level: to keep out floods by a strong masonry parapet wall, built upon the revetment wall to above flood level; to raise the wharves some three feet, and to give access to them by ramps with suitable openings, which would be closed at flood time by strong iron water-tight gates.

There would be ten double ramps and one single one for carts, and one for railway tracks, with a lift of only seven feet. The present revetment wall would have to be replaced by a new and much stronger one, and the ramps would also have to be rebuilt. The cost of land and building would be as heavy as in Scheme 1. The new ramps, revetment wall and parapet make the works expensive also.

The estimated costs are:—

For Works.....	\$2,456,461
For Land and Buildings.....	2,128,528
Total.....	<u>\$4,584,989</u>

SCHEME 3.—This scheme contemplates widening Commissioner and Common streets to 100 feet by encroaching upon the Harbour property east of St Peter street, and upon private property west of that point. For flood protection it proposes a parapet wall built upon a new revetment wall, and having openings leading to ramps which give access to wharves at low level. The openings in the parapet would be closed in winter by iron gates. The ramps would be numerous, of easy grade and of only seven feet rise from wharf to street level. The encroachment of the street upon the present wharves is compensated for by moving out the line of proposed new shore wharves.

The other features of the scheme are similar to those of Scheme 2.

The estimated cost is:—

For Works.....	\$2,495,586
For Land and Buildings.....	551,003
Total.....	<u>\$3,046,589</u>

Of this the portion for which the City is clearly liable would be..	\$ 926,704
And the Harbour portion would be..	2,119,885
Total.....	<u>\$3,046,589</u>

SCHEME 4.—In this it is also proposed to widen the street to 100 feet by encroaching on the Harbour property east of St. Peter Street and by taking private property west of this point; the present level of the streets would be preserved and the wharves would be raised up to practically the same height, thus abolishing ramps entirely; flood protection would be attained by a parapet wall and access given to the wharves by frequent roomy openings, which would be closed in winter by iron gates.

The cost of raising the wharves to the Commissioners Street level would, of course, be very great, but this, on the other hand, is largely compensated by the saving in masonry effected by abolishing the revetment wall and ramps.

The estimated cost is:—

For Works.....	\$2,782,942
For Land and Buildings.....	499,254
Total.....	<u>\$3,282,196</u>

Of this the City's portion would be.....	\$1,165,680
and the Harbour portion would be....	2,116,516
Total.....	<u>\$3,282,196</u>

SCHEME 5.—Under this project Commissioners and Common Streets would be widened on the City side to 100 feet, but otherwise its main features would be like those of Scheme 4, that is, it would have high level

wharves and no ramps, and for flood protection it would have a parapet wall with openings closed in winter by iron gates.

The cost, as in all schemes for widening on the City side, would be very heavy. The estimate is:—

For Works.....	\$2,767,658
For Land and Buildings .....	1,145,646
Total.....	<u>\$3,913,304</u>

SCHEME 6.—This is in substance an economical modification of Scheme 4. It contemplates the widening of Commissioners and Common Streets to seventy-five feet minimum, east of St. Peter Street, by encroaching on the Harbour property, and to the same width west of McGill Street by taking private property. Between St. Peter and McGill Streets, where the restricted breadth of the wharf space does not allow of widening on that side and very valuable property opposite makes it costly to widen on the City side, the present width is retained. The wharves are proposed to be raised to Commissioners Street level, so as to abolish the ramps, and flood protection is to be secured by a parapet wall with openings and moveable gates as in other schemes. It will be observed on reference to the plan that Commissioners Street would be seventy-five feet wide at its narrowest, and that its average breadth would be nearly 90 feet.

The estimated cost of the scheme is:—

For Works.....	\$2,739,372
For Land and Buildings.....	88,522
Total.....	<u>\$2,827,894</u>
Of this the City's portion would be.....	\$ 708,428
and the Harbour portion would be....	2,119,466
Total.....	<u>\$2,827,894</u>

Several other schemes and modifications have been con-

sidered, but none of them possess merits in proportion to their cost, and we have, therefore, confined the plans and descriptions to those above enumerated.

On taking a general view of the projects thus sketched out, it will be seen at once that they are all large and expensive. The cheapest will cost the City nearly three-quarters of a million dollars and the Harbour Commissioners over two millions more, making nearly three millions for the two bodies to contribute. From this sum the estimates for the different schemes rise to over four and a half millions for the most costly.

It must be noted, too, that the estimates do not include railway tracks and freight sheds for the wharves, nor paving for either streets or wharves. The magnitude of the proposed works is also on a commensurate scale; a mile and a quarter of street is to be doubled in width in a place where it must be done either by destroying valuable property or building costly works; the St. Lawrence is to be banked out along a mile of one of its most violent parts; the whole central section of the Harbour is to be remodelled and over three miles of deep water wharfage built new.

On comparing the different schemes it will be seen that No. 1 is that which most disturbs existing conditions. It proposes to build a broad earth embankment, as high as the present wooden dyke and of the same length. This high embankment and street would be below the level of St. Paul street, at St. Sulpice Street and eastward, but at Custom House Square and all westward the approaches to the Harbour would be banked across as high as by the wooden dyke; but unlike it, the high level street would have no openings leading through to the wharves. All traffic between this part of the City and the wharves would have to be carried on over the elevated street, involving an ascent or descent of fifteen and a half feet on the Harbour side and seven feet on the City side, at Custom

House Square and westward. It would be a delightful riverside avenue on which to drive lengthwise, but a permanent nuisance to heavy cartage crosswise. The high street has obviously very serious disadvantages, but on the other hand it has the merit of being an absolutely safe protection from floods up to the limits of its height. There would be neither parapet nor gates to break down, nor go wrong, nor to be maintained.

In common with Scheme 2, this project involves the demolition of many buildings, including whole blocks where the remnants of lots would be left uselessly small, and the throwing of their sites into streets and open space. We are aware that this has been considered a favorable feature in projects for widening on the City side, but we cannot help looking on it otherwise. It involves the utter destruction of many business buildings and putting useful land to comparatively useless purpose, and that at heavy public expense. The open spaces which would be made are not needed as breathing spaces alongside the open river; they would be too narrow for squares and inconveniently wide for streets. We, therefore, think that the widening of Commissioners street on the City side would involve an annihilation of property which would be unjustifiable, while new ground can be reclaimed from the River as easily as it can.

Scheme 2, which also contemplates widening the streets on the City side is subject to the objection just urged. As regards flood protection, its safety rests in the strength of the proposed parapet wall and its winter gates. These in our judgment can be made amply strong by sufficient material and good work, and they are provided for in the estimates. In the matter of access to the wharves, the scheme would be only fairly satisfactory. The ramps would be only seven feet high and of easy grade, but they would still be ramps, costly to build, taking up

valuable space and to be climbed up by loaded carts, so long as goods continue to be carted.

A point less important but still worth mention, is that the parapet, in this and all schemes except the first, must always give a shade of the feeling induced by the present dyke; it will be a wall bounding the river side of the street and shutting off something of the river view. But the wide street proposed will give ample room in fact and in feeling; the roadway and outer footpath can be made high enough to allow of seeing over the wall, and the wall itself can be made sightly.

Scheme 3, by encroaching upon the Harbour property avoids the heavy cost of private land and buildings east of St. Peter street, but it is objectionable as taking up more wharf area and affording less wharf frontage than any other of the schemes. In the matter of ramps and flood protection it is substantially the same as Scheme 2, and the same remarks apply to both.

In Scheme 4 the high level of the wharves is by far the most important feature. It does away with all ramps, except one pair at the lower end, and thus not only gives complete freedom for cartage and tramway traffic between the City and wharves, but it saves the space which ramps would occupy and the money they would cost both to build and maintain. In the matter of flood protection the high wharves would contribute towards safety in preventing the ice from ever touching the parapet and gates. For the freight sheds on the wharves the high level would also be of much advantage. It would not keep the sheds above flood level, but it would keep them above the level at which heavy ice forms, and therefore make them less liable to damage from it.

As to the question of the effect of high level wharves upon the convenience with which vessels can be discharged and loaded, a point already discussed by some of those interested and well able to judge, we need only say



that looking at it from a technical point of view, we consider the height of the wharves, within reasonable limits, as of really small importance. No fixed height can suit all conditions; the water fluctuates ten feet during summer; ships vary greatly in their height, and the same ship varies between her loaded and light lines. Modern freight handling appliances can be easily adapted to meet these varying conditions, and such appliances are of course to be reckoned upon in considering plans for new wharves and permanent freight sheds. The one serious objection to a scheme with high level wharves is the necessarily heavy cost of the works, and it is at least questionable whether the manifest advantages are a sufficient offset.

Scheme 5 is obviously a combination of 2 and 4 and its cost is, we think, out of all proportion to its advantages.

Scheme 6 has, we think, the chief merits of all the other projects with a saving in cost which outweighs its defects. The width of wharf and street which it gives between McGill and St. Peter Streets are both less than desirable, but yet all that appears to be needed at that particular place; in any case the benefit to be had from greater breadth cannot be considered worth the cost of obtaining it. The breadth of Commissioners Street and the other part of Common Street is not as liberal as in the other schemes, but taken in connection with the high level wharves we think it would be ample. Traffic of all sorts could circulate freely between them, and any strain upon one would always be relieved by the other.

After carefully considering the questions submitted to us we are of opinion that scheme 6 answers all necessary conditions, and that in proportion to its cost it better suits the combined interests of the Harbour and the City than any other scheme of which we have knowledge, and we therefore recommend the adoption of its main features

with a view to it being carried out at such rate as circumstances may warrant.

Yours respectfully,

(Signed) JOHN KENNEDY,  
*Chief Engineer, Harbour Commissioners of Montreal.*

(Signed) PERCIVAL W. ST. GEORGE,  
*City Surveyor.*

*Montreal, Jan. 21st, 1888.*

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RECAPITULATION OF COST.

Estimated cost of Scheme No. 1.....	\$4,624,755
“ “ 2.....	4,584,989
“ “ 3.....	3,040,589
“ “ 4.....	3,282,196
“ “ 5.....	3,913,304
“ “ 6.....	2,827,894

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HARBOUR COMMISSIONERS OF MONTREAL.

Extract from Minutes of Meeting of the Board of Harbour Commissioners held June 19th, 1888.

A joint-meeting of a sub-committee of the Inundation Committee of the City Council and a Committee of the Harbour Commissioners was held at the Harbour Commissioners' Office, at 10 a.m., June 13th, 1888, when there were present Aldermen Jacques Grenier, Laurent and Wilson, representing the City, and Messrs. Andrew Robertson, Bulmer, and McLennan, representing the Harbour Commissioners, when it was

Resolved :—That it appears expedient in the interest of the City and Harbour of Montreal that there should be

joint action in plans covering the following improvements :—

- (1) An elevation of the front of the City securing the City from flood inundations.
- (2) A sufficiently commodious street, enlarging the present Commissioners Street.
- (3) A plan of Harbour improvements specific in detail in so far as it may connect with the City improvements above referred to.
- (4) The appointment of the City and Harbour Engineers to furnish plans providing for above improvements, make estimates of probable cost, and, so far as practicable, the proportion of total cost that should be assumed by the City and Harbour respectively.

In the forthcoming plans and estimates it will be well to indicate the cost of alternative width of Commissioners Street, also, the elevation of said street and the elevation of the wharves of the Harbour.

