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"Port Nelson - A Hudson Bay Port"

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Abstract

In 1913, the Government of Canada began construction of a deep sea port on Hudson Bay in the estuary of the Nelson River. Construction was pursued actively until the end of 1917. For the next decade, essentially no further work was done. In 1927, after an expenditure of $5,639,000, all work at Port Nelson was abandoned and the construction of a port was commenced at Churchill. This paper outlines the reasons for the original selection of Port Nelson, describes the works constructed and the reasons for its abandonment.

A condensed version of this paper was given by the author at the CSCE Annual Conference at Sherbrooke, Quebec, on 29 May 1997. That particular version has been included in Volume 1 of the Proceedings of the Conference, pages 73-82.

About the Author

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In 1913, the Government of Canada began construction of a deep sea port on Hudson Bay in the estuary of the Nelson River. Construction was pursued actively until the end of 1917. For the next decade, essentially no further work was done. In 1927 after an expenditure of $5,639,000[1], all work at Port Nelson was abandoned and the construction of a port was commenced at Churchill. One must ask why work was started at Port Nelson, what was accomplished, and why was the work abandoned.

Shortly after Manitoba became a province in 1870, and as the the western grain trade developed, there arose commercial pressure to develop a sea port on Hudson Bay. This was partly in opposition to the monopoly of the Canadian Pacific Railway and partly a desire to build an alternative system to carry western produce to world markets[2].

Indeed, the Hudson Bay route was the shortest route from the western grain fields to the world grain markets of Liverpool and elsewhere. Winnipeg was recognized as the centre of the grain trade in Canada. The rail haul from the grain fields of what is now Saskatchewan to Port Nelson is essentially the same as to Port Arthur, now Thunder Bay. The sailing distance to Liverpool from Port Nelson is somewhat shorter than from Montreal, approximately 4800 km. vs 5760 km (2980 miles vs. 3600 miles). However, to this distance from Montreal must be added the sailing distance from Port Arthur to Montreal of 1900 km (1200 miles). Hence, the sailing distance from Port Arthur to Liverpool is about 60% greater than from Port Nelson to Liverpool. Further, the then-existing canals upstream of Montreal limited ships to a maximum length of about 78 m. (255 ft) with a cargo capacity of about 2450 tonnes (2700 tons) requiring trans-shipment at Montreal to larger ocean going ships. The cost of shipping from Port Arthur and trans-shipping at Montreal was nearly as much as the cost of shipping from Montreal to Liverpool. For instance, in 1925 when the price of wheat was about $1.20 per bushel, the cost of shipping from Port Arthur to Montreal was about 12 cents per bushel, and from Montreal to Liverpool about 14 cents[3]. Thus, there appeared to be a real economic advantage to shipping grain to Liverpool through Hudson Bay.

In response to political and commercial pressures, and in keeping with the practice of the day, the Canadian Government promised substantial land grants to any railway that would construct a line to Hudson Bay. Between 1880 and 1912, six different railways received charters to construct rail lines to Hudson Bay. Some of these envisioned a port at the mouth of the Nelson River and others at Churchill. There were, of course, many mergers, acquisitions and name changes of the various railways. In 1906, the Great Northern Railway received approval to construct a line from what is now Hudson Bay Junction in Saskatchewan to Churchill. By 1908, the Great Northern had laid the track as far as The Pas in what was then the District of Keewatin. Of all the railways chartered to build to Hudson Bay, this was the only actual railway construction that occurred prior to 1910.

During the political campaign prior to the 1908 general election, and in response to ever increasing political pressure from western business interests, Laurier promised an immediate start on the railway to Hudson Bay. Following the election, John Armstrong, an engineer with the Department of Railways and Canals, was appointed Chief Engineer for the project and four survey parties were sent into the area to determine the railway location. There had been no decision as to whether the port would be at Churchill or at Nelson and the debate on their relative merits continued. The government did create townsite reserves at both locations[2], and a townsite was laid out at Churchill in 1910. Armstrong was to investigate and to recommend which site should be chosen. In his report, Armstrong praised the Nelson site and claimed that Churchill, though possibly a superior harbour, had little space for rail yards and grain elevators. He was also concerned that expansion of the harbour at Churchill would necessitate expensive rock excavation. In 1909, M. J. Butler, Deputy Minister of the Department of Railways and Canals, accepted Armstrong's recommendation that the port should be built at the mouth of the Nelson River. He did, however, increase Armstrong's estimate of the costs. In his letter to the Minister, Butler stated "From the information, there is no doubt that Nelson is the much better harbour"[4]. He went on to recommend that hydrographic surveys of the site should be undertaken. If Butler was only then recommending hydrographic surveys at Port Nelson, it would suggest that the choice of Port Nelson was based primarily on land-oriented factors and not on marine considerations.

In 1910, Captain Irving B. Miles of the Department of Naval Services undertook hydrographic surveys of both sites. In his report, he was outspoken in praise of the Churchill site while he needed three pages to describe the difficulties at Port Nelson[5]. This is in contrast to Armstrong's report of 1909 which had described Churchill as too small, too shallow and unprotected while at Nelson he found adequate "anchorage nine or ten miles in from the mouth of the river and hence no serious seas could ever be experienced"[6].

In 1910, Armstrong laid out a townsite for Port Nelson and again praised the site for its potential for rail access and as favourable for the construction of port facilities. Despite the report of Capt. Miles, he remained adamant in his support of Port Nelson and proposed the construction of wharves and railway terminals along the north bank of the river some 35 kilometres (22 miles) inland from the Bay. That same year, with Government support, construction commenced on a bridge across the Saskatchewan River at The Pas as part of the Hudson Bay Railway. This bridge would have a total span of 259 m (850 feet). The Governor General, Earl Grey, also chose 1910 as the year to lead a party down the Nelson River in canoes and then along the coast to Churchill to view both sites. Despite all this activity, the government postponed any decision on the choice between Churchill and Port Nelson.

The railway and bridge were being constructed as a work of the Dominion Government[9]. However, work on the project was stopped in early 1911 before the bridge was finished. During the election campaign of that year, Borden promised an immediate resumption of the work. After the Conservatives won the election, Borden appointed Francis Cochrane to be Minister of Railways and Canals. As Minister, Cochrane undertook a detailed review of the files for the Hudson Bay Railway. This review revealed apparently unwarranted assumptions and guesswork calculations. Cochrane was so shocked that he ordered the work on the railway halted again pending a full re-appraisal of the project. Prime Minister Borden, flinching from the vicious attacks of western members, overruled Cochrane and ordered construction to continue[7]. In the summer of 1912, the Minister together with W. A. Bowden, the Chief Engineer of the Department, visited both sites. Following this visit, a decision was finally made and Port Nelson was chosen as the terminus of the railway.

Up to this time, the entire west coast of Hudson Bay and of James Bay was within the District of Keewatin. The northern boundary of Ontario was, in part, the Albany River, and Manitoba's northern boundary was about the middle of Lake Winnipeg. Both Ontario and Manitoba wanted their boundaries extended to the Bay to include the two potential port sites. In 1912, the Borden government extended the boundaries of both provinces to Hudson Bay, and gave Manitoba both the Churchill and the Port Nelson sites. Ontario was given a right-of-way to either site in case it wanted to connect to the railway.

The site chosen for the port was on the north (left) bank of the Nelson River some 35 kilometres inland from Hudson Bay. At this point, the river is about 6.5 km. wide and the main channel is nearly two kilometres from the north bank. The shore is relatively flat and rises only about 1.2 m. above the high tide. The tidal range at the site is about 4.5 m. on the spring tides and about 3.2 metres on the neap. At the mouth of the estuary, the banks are only about 0.6 m. above the high tide and the tidal flats extend out 6 to 10 km. from the shore. The approach to the estuary from the Bay enters into shallow water far from the sight of land. To guide ships to the port, it was necessary to erect high beacons as much as 45 km. from the entrance[8]. These could only be seen in clear weather making approach impossible in even a light mist. Throughout the length of the estuary, there is an axial channel, the outer 11 km. of which are shallow being about 6 m. at low tide, the centre 11 km. deep being 9 m. or more at low tide, and the inner 11 km. shallow again[1]. At the outer end of the deep section, the current on the ebb tide approaches a velocity of 13.5 km/hr. The estuary opens directly into Hudson Bay, presenting a fetch for waves of some 1300 km. The port development plan, as envisioned by Armstrong, called for the development of several lighterage wharves along the shoreline, the excavation into the shoreline of a drydock and the construction of a jetty or pier extending a considerable distance into the river.

In the fall of 1912, an engineer, Mr. H. T. Hazen, together with a party of twenty-six men arrived at Port Nelson to prepare for, and to supervise the port development. They passed the winter of 1912-1913 in log buildings on the site. Since the end of the railway was still 640 km. from Port Nelson, all materials would have to come by ship. Hazen was to construct temporary lighterage wharves in readiness for the first materials to come by ship. In the summer of 1913, Duncan W. McLachlan, the Chief Designing Engineer of the Department of Railways and Canals, was sent to Halifax to supervise the loading of the ships with materials and equipment for the site. McLachlan was opposed to the choice of Port Nelson over Churchill. It was therefore over his vehement protests that he was ordered to take charge of the work and to proceed to the site with the ships. It was a difficult voyage. Two ships and two lighters were held fast in the ice of Hudson Strait for ten days. On arrival at the estuary of the Nelson River, and still more than 35 km. from the port site, the *Caerense* grounded and was abandoned. The *Alette* proceeded up the river without benefit of channel markers to within about 14 km. of the port location where it punctured its plates, was beached and burned. McLachlan pointed out that this proved the difficulty of the channel leading to the port site.

When McLachlan arrived, his primary task was to unload the cargo from all the ships before winter set in. He also had to build a camp for the men to live in. About 250 men arrived with McLachlan, and until houses were built, they lived in tents. The first buildings erected were the cookhouses. McLachlan completed the temporary wharf that Hazen had started and erected cranes so the ships could be unloaded. In the end, although much material had been landed, McLachlan was unable to unload all the materials before the onset of winter, and had to send back at least one ship load of heavy timber.

By the end of December, quite a camp had been established for the 180 men who would spend the winter in Port Nelson. It contained three bunkhouses, one dining camp, a retail store and office, two warehouses, a meat house, a root house and a hospital as well as 3 km. of narrow gauge track, complete with some rolling stock. Construction continued throughout the winter. The Marconi wireless station was made operational on February 20. By the spring of 1914, McLachlan had run out of building materials, so he put the men to work clearing sites for future construction and began an extensive drainage system of over 3 km. of ditching, some as much as 1.5 m deep, all of which had to be blasted out of the frozen clay. The excavation of the drydock proceeded, also through frozen clay. A water tank and distribution system were constructed; a coal trestle built; and lighting and telephone systems were set up. A working townsite had been created at Port Nelson, all out of the materials that had arrived by ship the previous fall.

Next, McLachlan proceeded with construction of the port facilities as planned by

Armstrong. This involved substantial rock-filled timber crib wharves along the river bank. In July, the men commenced the assembly of the dredge *Port Nelson*, which was at that time the largest dredge built in Canada. This had also come by ship.

The Armstrong plan included a lengthy jetty extending out from the bank to deeper water. McLachlan questionned the wisdom of this jetty, but, in accordance with his instructions, initiated its construction. By the time the jetty extended about 185 m. from the shore, McLachlan's concerns proved correct. It blocked the tidal currents and rapidly created large silt deposits on both the upstream and downstream sides as well as in front of the river bank wharves. See Figure 1. The dredge could not keep up with the siltation. McLachlan now had proof that Armstrong's plan would not work. Some other scheme was needed if a working port was to be created in the Nelson River estuary.

McLachlan developed a new and innovative engineering plan. He proposed to build an artificial island some 2740 m. long and 1220 m. wide on a rocky ledge about 1200 m. from the north bank of the river. It would lie parallel to the natural channel and about 245 m. from it. In addition there would be breakwaters both upstream and downstream. The island and the breakwaters would be outlined by rock-filled timber cribs. Along the face of the island, a channel would be dredged 9 m. deep at low tide and 90 m. wide so vessels could lie alongside at all stages of the tide. An entrance channel would be dredged to a depth of 6 m. at low tide permitting ships to come and go on the high tide. It was intended that the natural current of the river and of the tides would reduce the amount of maintenance dredging that would be required. The island would contain rail yards, freight sheds and a grain elevator. Access to the island would be by a steel railway bridge consisting of 17 spans of 43 m. See Figure 2.

In the fall of 1914, McLachlan took his idea to his former superior, Sir John Kennedy, the creator of the Montreal harbour, for review. Kennedy agreed with the concept and advised McLachlan to put it forward to his superiors. In the spring of 1915, McLachlan's plan was accepted and Armstrong's plan of shore-based wharves was abandoned.

Work immediately started on construction of the bridge piers. By the end of 1915, twelve piers were completed. The piers were made of stone-filled timber cribs, each about 18 m. by 12 m. Prior to the placement of each pier, the clay overburden was removed to allow the cribs to be founded on the underlying hardpan. Additional rock rip rap was placed both upstream and downstream of each crib to control scour and to provide protection from the ice. Much of the rock had to be hauled as much as 20 km. to the site. During 1916, the remaining bridge piers were completed and the timber crib outline of the island began to take shape. The cribs for the bridge piers and for the island were constructed of 300x300 Fir timbers, all of which had to be brought to Port

Nelson by ship.

Dominion Bridge fabricated the steelwork for the bridge at their Lachine plant and shipped all the material to Port Nelson in 1915. This amounted to about 1770 tonnes. A 20-man crew from Dominion Bridge rivetted the various parts together over the winter of 1915-1916. The crew was enlarged to 45 men, and erection commenced in February of 1916.

Work on this project continued through 1916 and 1917. By the end of 1917 the bridge was complete, including the laying of the rails. The island was about 0.8 km. long and about 150 m. feet wide, but the deep water cribs along the face of the island had not been constructed. There was a workforce of about 500 men on site each season and about 100 men worked through the winter of 1916-1917. See Figure 3.

At the same time, work on the Hudson Bay Railway continued. The approved route was 675 km. (422 miles) in length from The Pas to the port site. The bridge at The Pas was opened in July, 1913, and by the end of that year 163 km. of track had been laid. In 1914, 3000 men were employed on the railway construction. By the end of 1917, the grade and bridge structures were completed to "mile 422" at Port Nelson, and the track had been laid and ballasted to Kettle Rapids at "mile 332" (531 km.).

By the autumn of 1917, the project was grinding to a halt due to a shortage of men and materials. The war effort required all the resources and manpower of the nation. A member of the Cabinet declared that Canada had neither the rails to complete the Hudson Bay line nor the coal to operate it. The lack of material for both the railway and the port development together with the losses of men in the war led to a decision to close down work on both the port and the railway in October of 1917. For the next decade, only a very small maintenance crew remained on site.

During the construction period, McLachlan had begun to suspect the accuracy of the charts of the estuary. When the work at the site was closed down in 1917, he obtained permission to build triangulation beacons and to undertake a new hydrographic survey. During the following summer, he discovered shoals on what was supposed to be fairway, and more surprisingly, a wide, deep and serviceable channel that was not shown on the then-existing charts[7]. McLachlan had always remained opposed to the development of Port Nelson despite the implementation of his own design. This new hydrographic information changed the entire situation. In McLachlan's mind, it made feasible the development of the port. Even if not an outright champion of Port Nelson, he was at last convinced that something could be done with it. However, the work had been shut down and would never start again. In 1919, even the wireless station was closed. A staff of only seven men remained on site for any necessary maintenance work.

Even though work on the site had ceased, debate continued as to the need and justification for a Hudson Bay port and whether Port Nelson was the better site. In 1920, a special Committee of the Senate reported its findings on these matters[10]. That report contained quotes from many of the witnesses who appeared before the Committee. Reference was made to a 1911 report by W. J. Stewart which gave one or two instances where vessels were unable to discharge at Nelson because of the high seas. He had reported that

> "In one case, a vessel for forty eight hours had to steam full speed ahead with both anchors down with a heavy sea breaking on board. After remaining in the vicinity for ten days, the vessel had to proceed to Churchill to discharge her Nelson cargo."

It should be noted that this report by Stewart pre-dated the decision to develop Port Nelson and contradicted Armstrong's claim that the site was protected from storms.

Another witness was quoted as saying that "the shores at Port Nelson are all low with a thick growth of small trees" and the "inner part of the harbour is very shallow from Seal Island to Rock Creek where the river is three and a half miles (5.5 km.) wide. The bottom is very uneven with huge boulders that uncover at low water."

On the other hand, Capt. Frederick Anderson of the Hydrographic Branch of the Department of Naval Services testified that "Port Nelson is as good a port as you can get there". He further stated that "Churchill is a very good harbour as far as it goes; it is small though. I do not think it is large enough to accomodate the number of ships you would have to have to make a proposition worthwhile."

Appearing before the Senate Committee, McLachlan outlined his plan for the development of Port Nelson and described how much had been accomplished before the cessation of the work. He claimed that Churchill was very shallow and rocky but believed it would be a better port. He pointed out that the average spring high tide at Port Nelson was 4.5 m (15 ft.), but that because of wind setup, they had experienced a 6.1 m (20 ft.) high tide. He also explained that his recent hydrographic survey had found a new and better channel. He stated that the old charts, by Capt. Anderson, were wrong.

One of the key Findings of the Senate Committee was

> "That in the opinion of the Committee sufficient care was not taken in the selection of Nelson as the terminus of the railway, and that the Government should not make further important expenditures upon the port without first making a new and thorough examination into the relative merits of Churchill and Nelson as a terminus for the railway."

Having received the Report of the Senate Committee containing Findings such as that, the Government decided to leave the project in abeyance. The operation of the railway had been taken over, in 1919, by the Canadian Government Railways (later the Canadian National Railways) and in April, 1920, a bi-monthly mixed service was inaugurated between The Pas and "Mile 214". The rest of the railway construction contract was cancelled.

In 1924, it was reported that a storm caused a tide 1.2 m. higher than ever before recorded, or 2.6 m. higher than the normal spring tide. The dredge, *Port Nelson*, was lifted by the storm and the resulting high water and was set on top of the timber cribs of the island. It was still there in 1989, 65 years later. See Figure 4. Commenting on this storm, at a much later date, McLachlan stated that "this storm tore adrift a large amount of the plant laid up at Port Nelson and gave the estuarial development a bad black eye[1]".

The political pressure for the development of a deep sea port on Hudson Bay continued. In 1926, needing the support of the prairie-based Progressive Party, the Liberal Government of Mackenzie King promised to complete the Hudson Bay Railway[2]. In 1927, the Minister of Railways, Charles Dunning, retained the well-respected British engineer, Frederick Palmer (later Sir Frederick Palmer), to investigate both Churchill and Port Nelson and to recommend which should be developed. Palmer's report[8] is a masterpiece of clarity and brevity. In forty two pages of text supported by seventeen photographs, seven maps and six sheets of borehole logs, the two sites are described, development plans are explained and cost estimates are set out, together with the unequivocal recommendation that Churchill was the logical choice as a port.

Palmer's description of the natural conditions at Port Nelson have been summarized earlier in this paper. After a brief description of McLachlan's plan, he stated that "it may be mentionned here that both the site selected and the method proposed for providing a wharf afford as satisfactory a scheme as could be devised in this river". This was high praise of McLachlan's work. Palmer did suggest some minor modifications to the proposed breakwaters, with which McLachlan subsequently agreed.

It had long been claimed that the harbour at Churchill was underlain with rock which would make dredging very expensive. Palmer had twenty two boreholes sunk. Contrary to Armstrong's claim, this investigation proved that the bottom of the harbour consisted not of rock, but of gravel and sand with some clay and some boulders. As Palmer said, "it is of a nature easily dredged". He also found that Churchill harbour was protected by rock cliffs, some 15 to 20 m. in height. The entrance to the harbour was through a narrow gap in these cliffs having a width of 490 m. at low water and a width of 260 m. at the 9 m. depth. Once through the gap, the harbour lay at about ninety degrees to the

opening, providing complete protection from storms. Further, and again contrary to Armstrong's report, Palmer found a large area of land adjacent to the possible port site that would be suitable for the provision of railway terminal facilities at relatively small cost. On the basis of the physical conditions, Palmer stated that "the decision has unhesitatingly been arrived at that Churchill is the port to be selected as affording a real and attractive harbour in which shipping facilities can be provided in calm water protected from all storms by the surrounding cliffs and at a minimum of cost and time".

One of the original arguments in favour of Port Nelson was the assumption that it would be impossible to build a railway to Churchill over the muskeg and permafrost[2]. By the mid-1920s, methods had been developed that made such construction economically feasible.

Palmer developed a plan for Churchill (Figure 5) and prepared cost estimates for both sites. He estimated that it would take six years to complete the works at Port Nelson, but only three years to build the complete works at Churchill. His estimate of the cost of completing Port Nelson, including interest on the capital cost during six years of construction, was $26,155,550. His estimate of cost to construct a port at Churchill, including interest on the capital cost during the three years of construction, was $8,450,159. This gave an apparent difference in favour of Churchill of $17,705,391. However, to reach Churchill, it would be necessary to construct an extra 139 km. (87 miles) of railway beyond the requirement at Port Nelson. This extra railway construction would cost $5,085,000, or about$36,500 per kilometre ($58,400 per mile), leaving a net financial advantage to Churchill of $12,620,391. Furthermore, the annual charges for maintenance and operation at Port Nelson would amount to$1,474,594, while the equivalent expense at Churchill would be only $413,980.

In his conclusion, Palmer stated that "notwithstanding the predisposition of the Government to Nelson, the facts concerning physical conditions, the estimates of cost and the time required for construction are overwhelmingly in favour of the selection of Churchill as the terminal for the Hudson Bay Railway, and it is recommended that the works commenced at Port Nelson should not be proceeded with, and that Churchill should be selected for the Hudson Bay Port".

The Government accepted Palmer's recommendation. Port Nelson was abandoned. Work commenced, in a limited way, at Churchill before the end of 1927. All useable materials were transported from Port Nelson to Churchill, either by sea or overland by sleigh trains. Work on the harbour and on the railway proceeded rapidly in 1928. The rail line to Churchill was completed and in operation by September 14, 1929. At long last, building materials and equipment could arrive at the port development by an overland route, rather than only by sea. Work on the port facilities proceeded rapidly,

and the first commercial cargoes of grain left from Churchill on September 20, 1931. These were in the ships *Pennyworth* and *Farnworth*.

Finally, after nearly fifty years of agitation, political manoeuvering and delays, the western business interests had a deep sea port on Hudson Bay. In less than four years, and under sub-arctic conditions, a complete port had been created at Churchill, including docks, freight sheds, power house, grain elevator and storage bins and a dredged channel. A truly amazing feat.

And what remains of Port Nelson today? In 1989, the Historic Resources Branch of Manitoba Culture, Heritage and Recreation had the site examined by a team of archeologists[11]. The railway bridge, complete with rails, is still in place although some of the bearings have settled as much as 150 mm. The cribs for the island remain and the dredge, *Port Nelson*, is still balanced on top of the cribs. Ice has damaged some of the cribs. The original wharves planned by Armstrong and built by Hazen and McLachlan have survived but are silted up. Some of the buildings remain as well as some of the narrow gauge track and rolling stock. That is the only remaining evidence of McLachlan's ingenious engineering scheme, five years of work by several thousand men and the expenditure of nearly six million dollars. See Figures 6, 7 and 8.

In retrospect, there remain a few questions about the original choice of Port Nelson, and the subsequent debates.

Armstrong claimed that the Port Nelson site was protected from storms and that the site presented a better location for rail yards and terminal facilities than did Churchill. On the other hand, in 1910 Capt. Miles of the Department of Naval Services spoke highly of Churchill and listed the difficulties of Port Nelson. In 1911, W. J. Stewart reported the case of a ship that could not enter the Nelson River for ten days due to a severe storm and finally had to seek refuge in Churchill to unload its Port Nelson cargo. Still, M. J. Butler, the Deputy Minister of the Department of Railways and Canals, accepted Armstrong's 1909 recommendation despite the contrary reports, and in 1912 Francis Cochrane, the Minister, agreed. When McLachlan showed that Armstrong's plan of development was unworkable, he developed a workable plan but remained convinced of the superiority of the Churchill site. Why was the choice of Port Nelson not reviewed and reconsidered at that time before expending huge sums of money? Did this have to do with a mind-set by the Department? It was, of course, a department of railways and canals, not of ports and harbours. Indeed, as late as 1933, McLachlan's official title was "Engineer-in-Charge, Hudson Bay Railway Terminus", not the "Engineer-in-Charge of the Port of Churchill". What is being suggested here is that the Department saw their role as building a railway to, and a railway terminus at, Hudson Bay, not as building a sea port on Hudson Bay. Was the Department (McLachlan excepted) oblivious to the

needs and concerns of mariners?

Another outstanding question is the matter of the preferred channel from Hudson Bay to the port facilities in the Nelson River. In 1910, Capt. Anderson charted the estuary of the Nelson River. These charts were used throughout the construction period of 1913 to 1917. In 1918, McLachlan completed a new hydrographic survey of the river and found a new and better channel. In his testimony before the Senate Committee, McLachlan said that Capt. Anderson's charts were wrong. Were they? We have the results of only two hydrographic surveys. We know from McLachlan's reports and evidence that the tides and the currents within the river caused serious siltation on both sides of the jetty. This could indicate a silt-laden river. Did the jetty, together with the bridge piers and the island cribs, cause the river currents to shift scouring a new channel? Did the many and frequent storms cause scouring and siltation that moved the channel or created new ones? Would other hydrographic surveys have shown a constantly shifting channel?

One of the great arguments against Churchill was that the dredging of a channel or anchorage would involve rock excavation. Palmer had test drilling done. This showed that there was no rock to be excavated - only sand, gravel, mud and some boulders. The rock cliffs along the shore of Hudson Bay at Churchill could possibly lead one to ask if there might be rock to be excavated for the port, but surely not to conclude absolutely that there was rock. Why was this assumption never checked before the site selection was complete?

These questions, which must be of interest to engineers, remain unanswered. In the event, Palmer's recommendations were implemented and a successful port was created at Churchill, and it was completed nearly within Palmer's predicted time frame and cost estimates.

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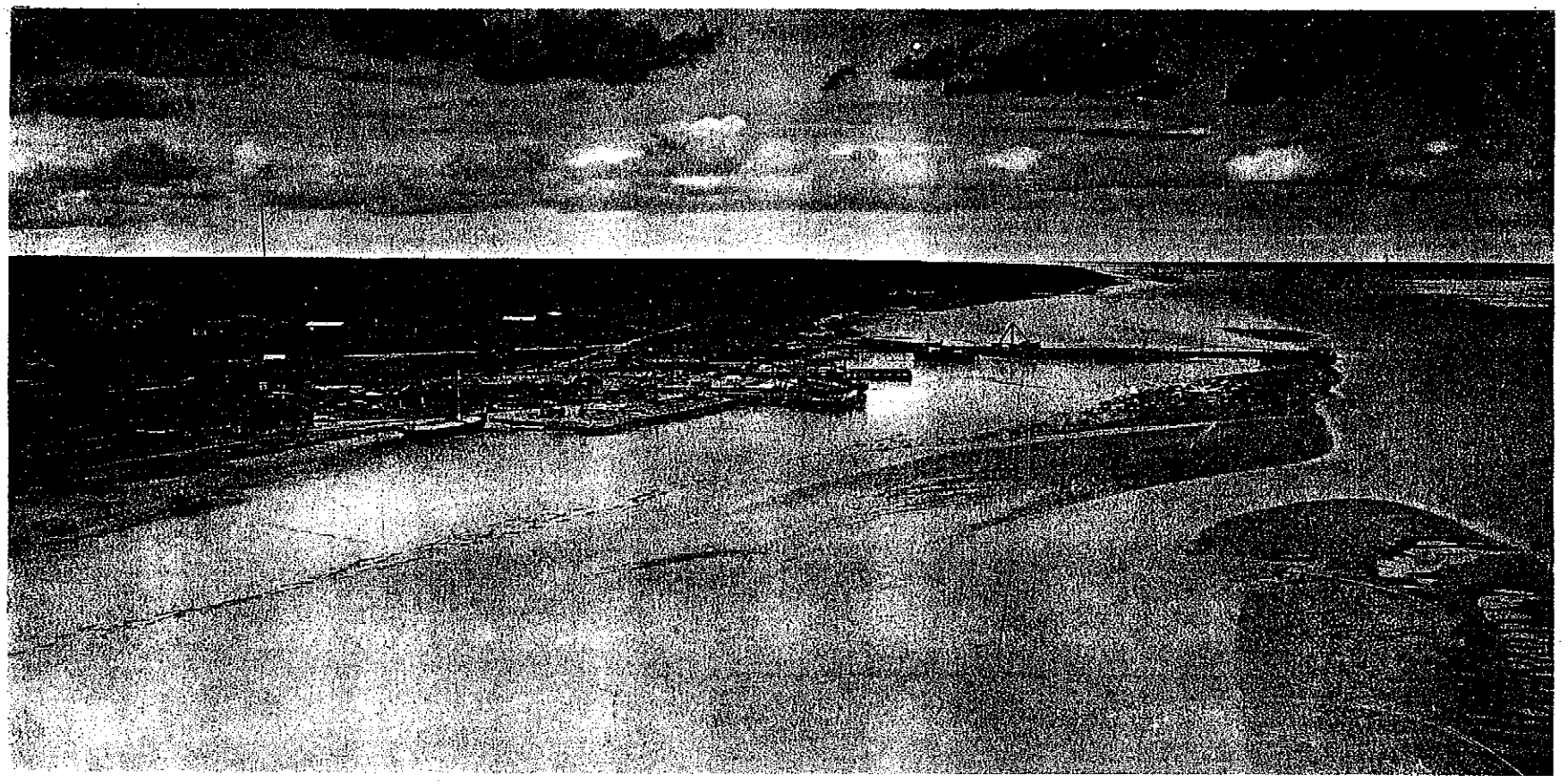

Figure 1: View of the attempt to run out a solid jetty from the shore at Nelson, causing rapid silting on either side and excessive scour at the end. (from report by F. Palmer, 1927)

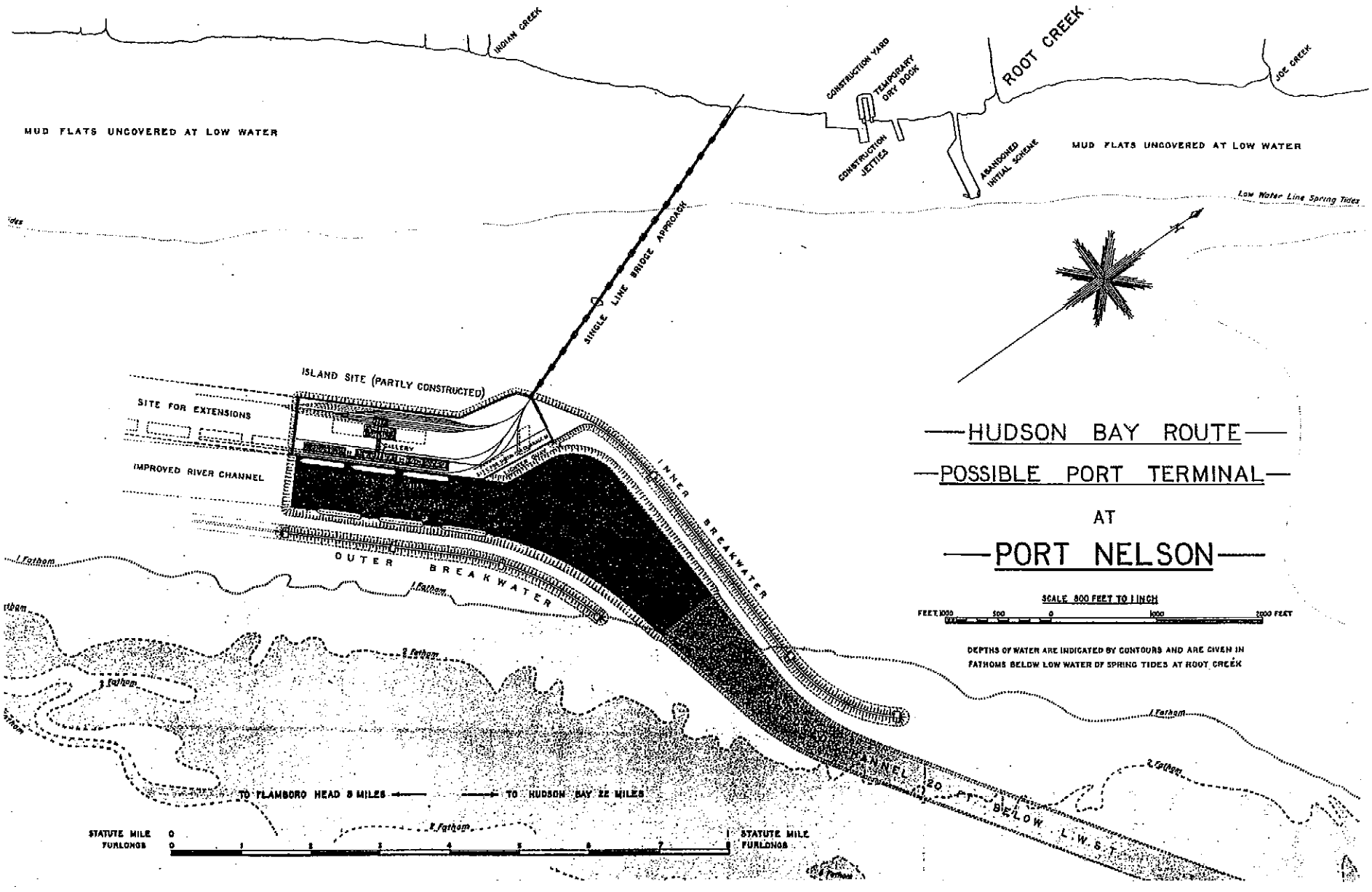

Figure 2: McLachlan's plan for a terminal at Port Nelson (from report by F. Palmer)

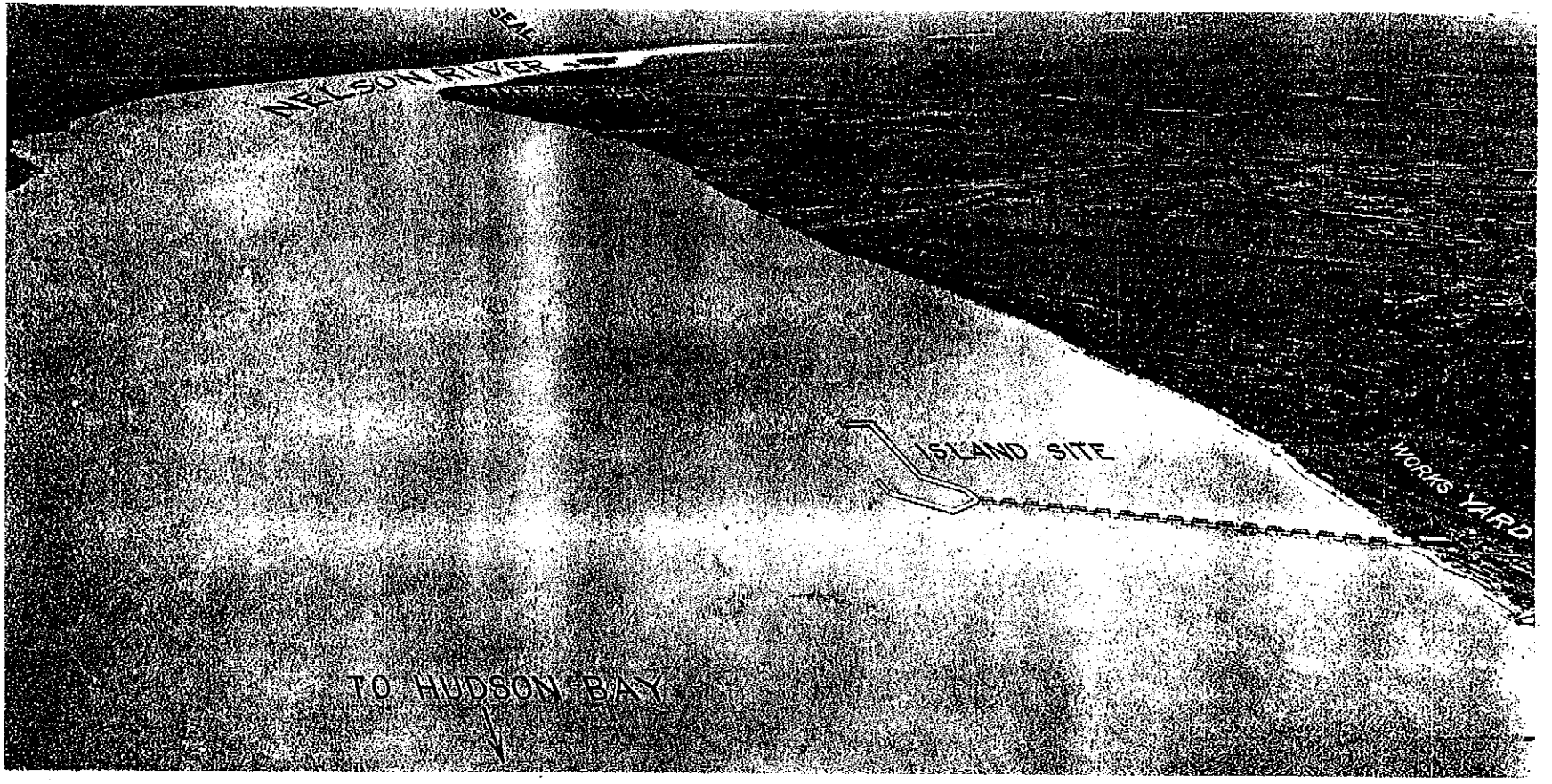

Figure 3: Aerial view of the estuary at Port Nelson showing the works constructed to the end of 1917. (from report by F. Palmer)

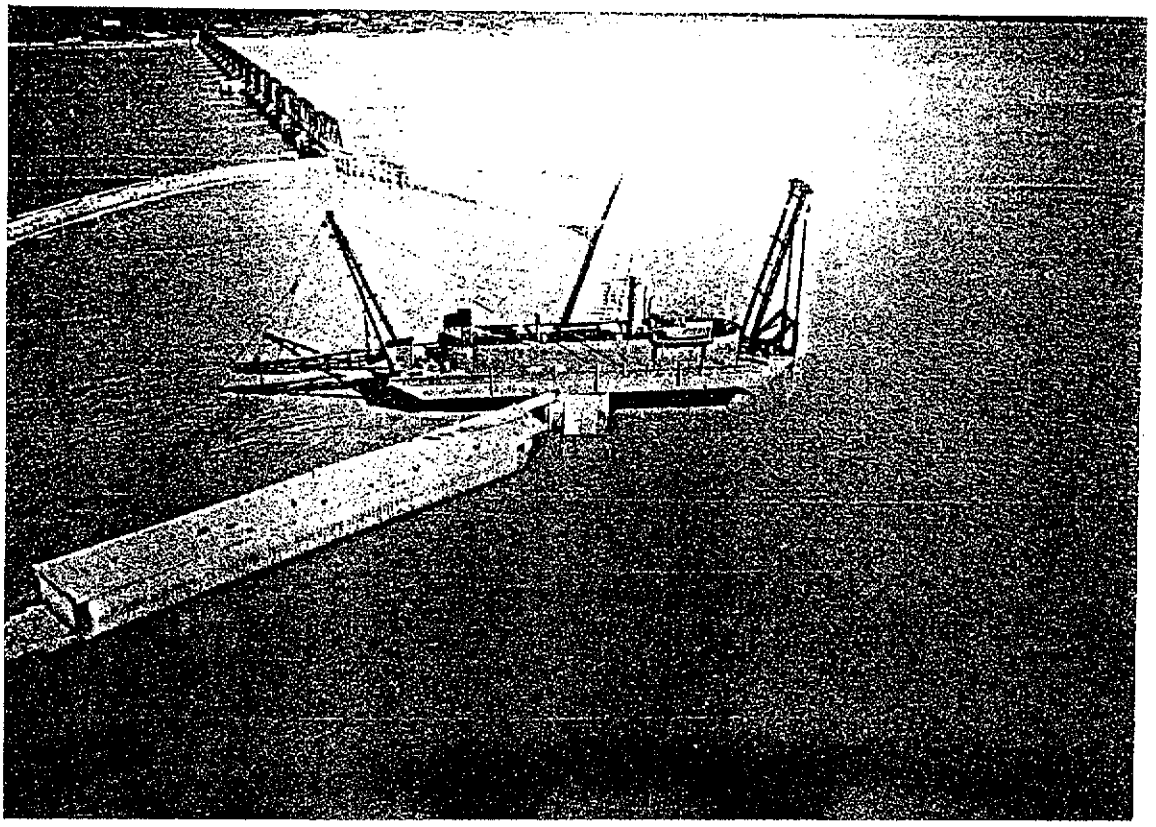

Figure 4: Aerial photograph showing Port Nelson dredge on south-east corner of island crib. (R.C.A.F. photograph, September 1924)

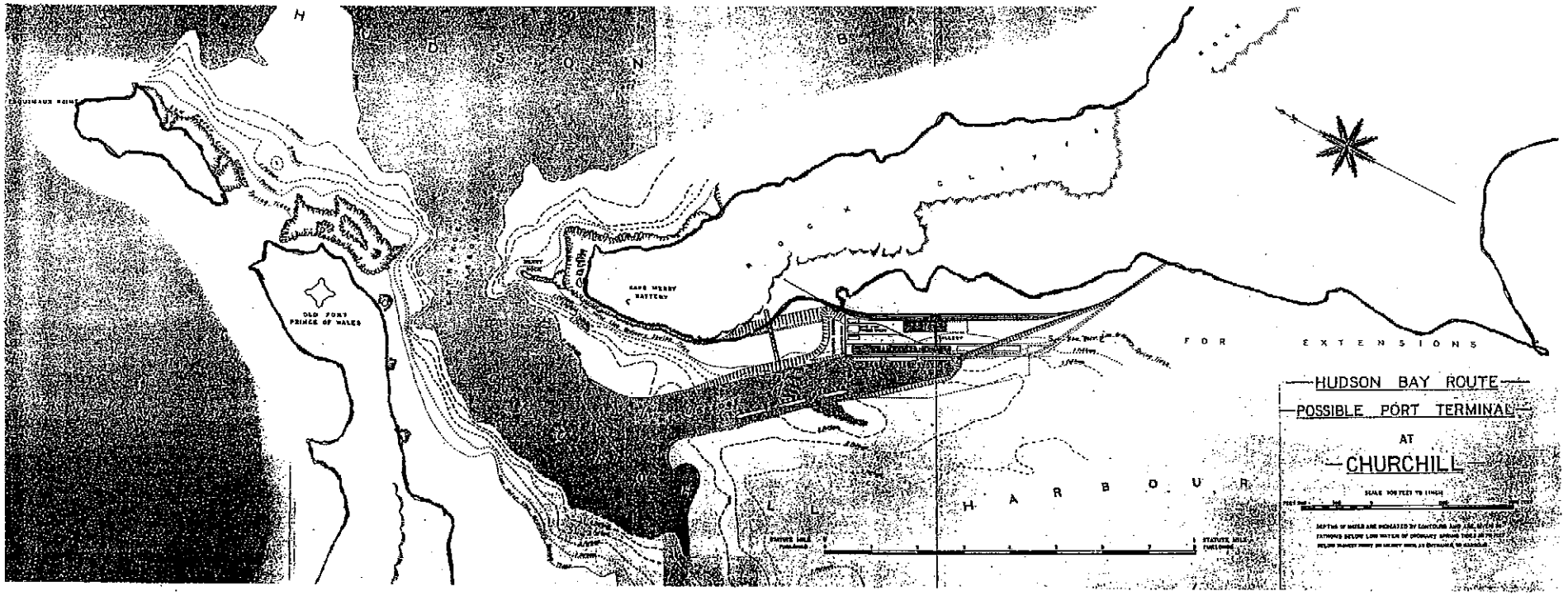

Figure 5: Palmer's plan for a port terminal at Churchill. Shaded area indicates water depth in excess of 5 fathoms at low water, ordinary spring tide. (from report by F. Palmer)

Figure 6: Condition of bridge in 1990, showing the settlement of the truss due to decay of bearing pad.
(McLeod report, 1990, Manitoba Culture, Heritage and Recreation)

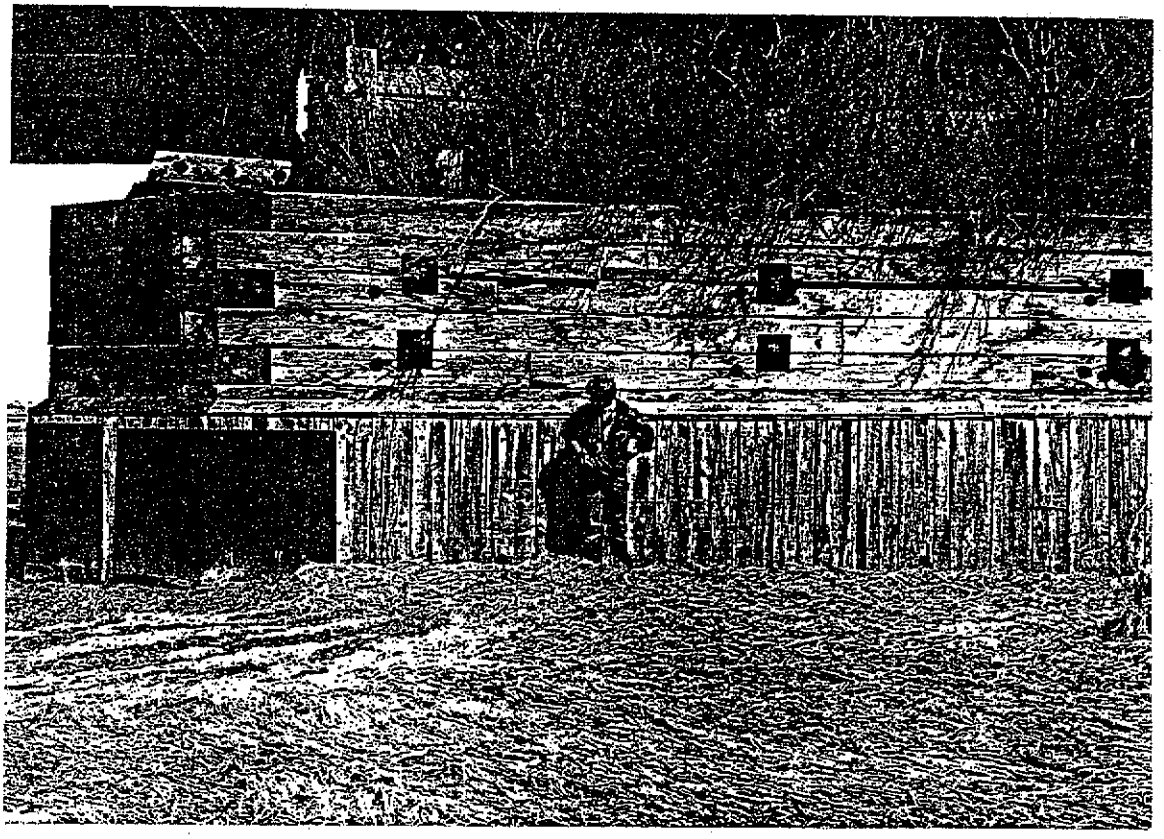

Figure 7: Upstream face of Pier 2 of railway bridge, 1990.
(McLeod report, 1990, Manitoba Culture, Heritage and Recreation)

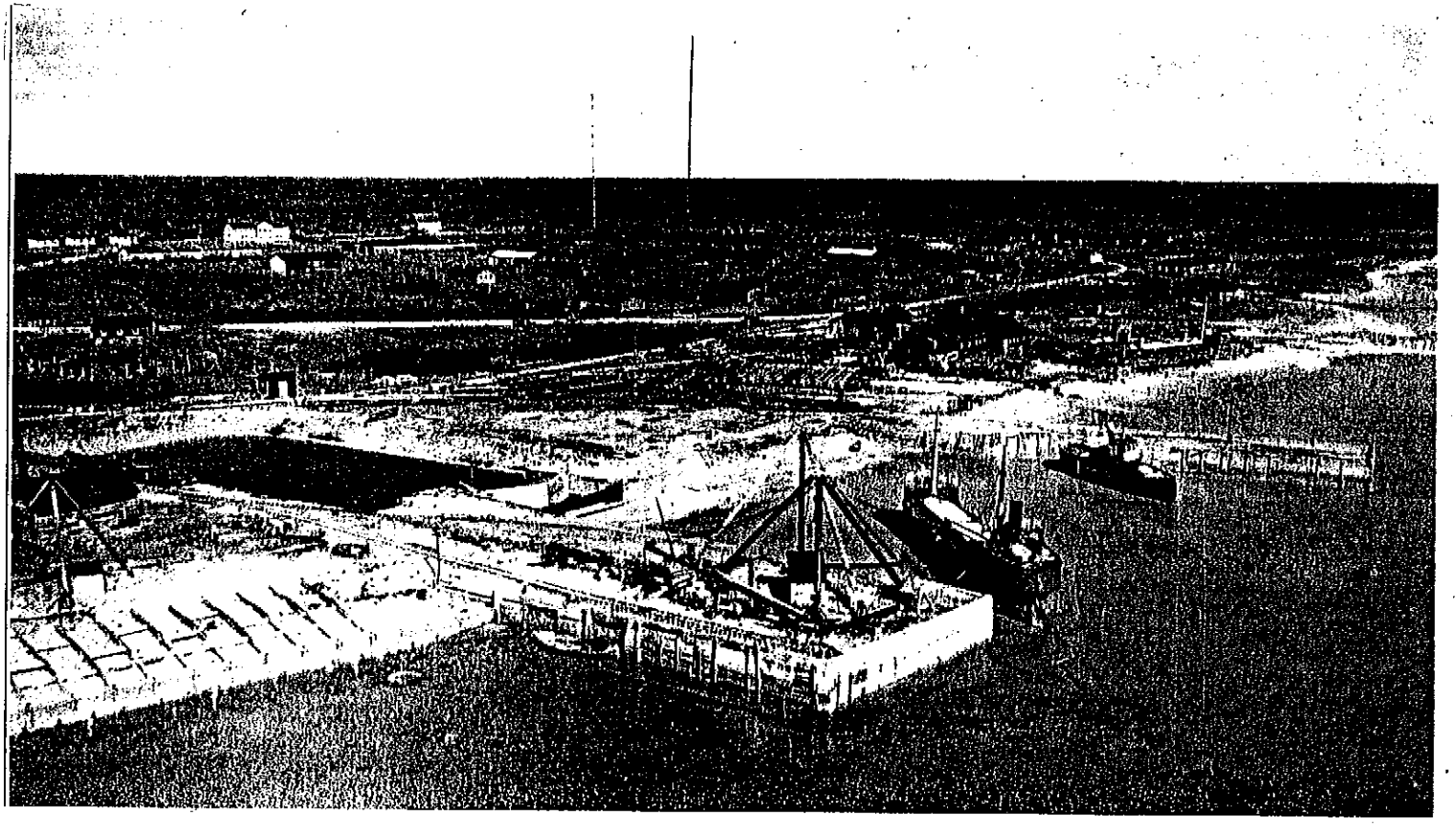

Figure 8: 1925 R.C.A.F. photograph of Port Nelson.
Shoreline cribs and piers remain in 1990