

CANADA



Source: esri

General

The ten provinces and three territories of Canada extend from the Atlantic to the Pacific and northward into the Arctic Ocean. Canada is the world's second-largest country by total area, its southern border with the United States is the world's longest bi-national land border. The country has an area of 998 Mha (million hectares) with in 2020 a population of 37.7 million, or 0.04 persons per ha. Canada is highly urbanized with 82% of the people concentrated in large and medium-sized cities, many near the southern border (Wikipedia and United Nations, 2019).

Climate and geography

The majority of the country has a cold or very cold winter climate, but most areas are warm in summer. The majority of the land territory is dominated by forest, tundra, the Rocky Mountains, and the relatively flat Canadian Prairies in the southwest with mostly agriculture. The Great Lakes feed the St. Lawrence River (in the southeast) where the lowlands host much of Canada's economic output. Canada has over 2,000,000 lakes containing much of the world's fresh water. There are also fresh water glaciers in the Canadian Rocky Mountains (source: Wikipedia).

Existing polders

Bay of Fundy

The earliest records of reclamation in the Bay of Fundy dates back to about 1633 at Port Royal by settlers from France (Desplanque, 1983). They started to apply the endiking and drainage techniques known to them. They transformed 36,000 ha of the salt marshes into polders (Figure 1). These polders are spread along the coast from the mouth of the Bay of Fundy, where the tidal range is 3.0 m and the spring tide range can be 4.2 m, to the head of the bay, where the tidal range can reach 16.3 m. The polder area consists of many small polders. Most of the endiked marshes are found in the head of the Cumberland Basin. Along this bay there are polders with a total area of 14,700 ha. The largest block of 7,200 ha is found along the Tantramar and Aulac rivers. At Prince Edward Island there is a polder of 20 ha (Figure 1) (Desplanque, 1983). The protection works include (Group Polder Development, 1982):

- some 400 km of dikes;
- 433 structures, e.g. sluices;
- 30 km of riverbank control installations;
- 3 major tidal dams, e.g. Annapolis River Dam. This dam provides protection against salt-water flooding to some 1,700 ha of marshland and eliminates the need for reconstruction of alternative protective works.

Part of the reclaimed area – the Grand Pré marshland in the Province of Nova Scotia - is a UNESCO Heritage Site (UNESCO World Heritage Centre, 2012). In the justification it is described that the Grand Pré marshland and archaeological sites constitute a cultural landscape bearing testimony to the development of agricultural farmland using dikes and the *aboiteau* wooden sluice system, started by the Acadians – immigrants from France - in the 17th century and further developed and maintained by the Planters and present-day inhabitants. Over 1,300 ha, the cultural landscape encompasses a large expanse of polder farmland and archaeological elements of the towns of Grand Pré and Hortonville, which were built by the Acadians and their successors. The landscape is an exceptional example of the adaptation of the first European settlers to the conditions of the North American Atlantic coast. The site – marked by one of the most extreme tidal ranges in the world – is also inscribed as a memorial to Acadian way of life and deportation, which started in 1755, known as the *Grand Dérangement*.

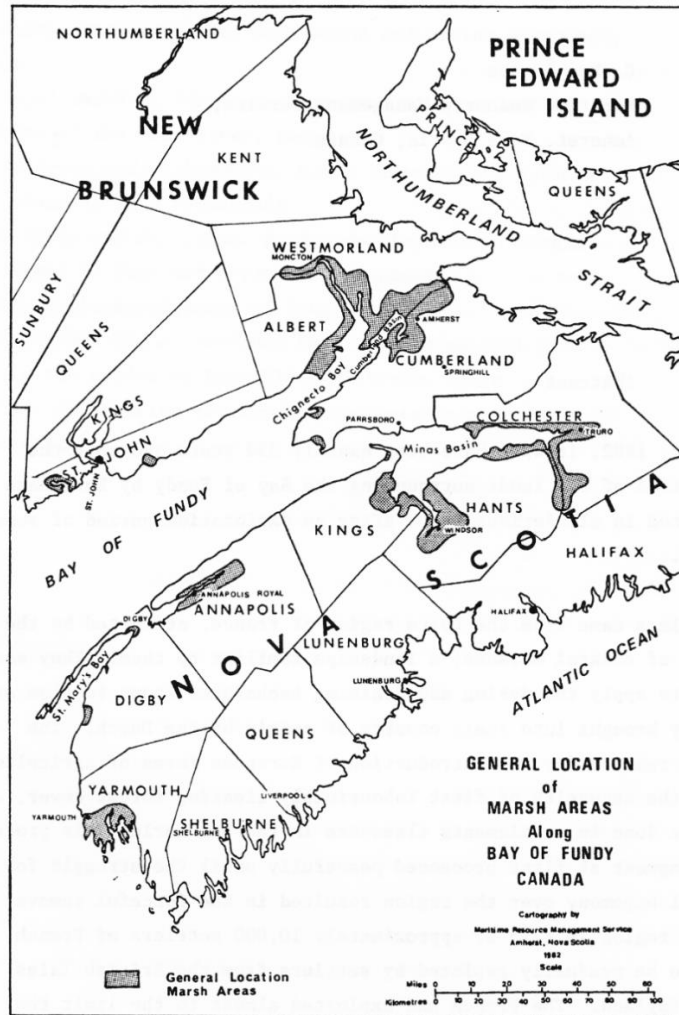


Figure 1. General location of the polder areas along the Bay of Fundy, not their exact outline (Desplanque, 1983)

The Lower Fraser Valley is subject to periodic flooding from spring freshets as well as high tides in the lower reaches. The valley has been partly endiked (Figure 2), this includes the Pitt Polder and Allouette Polder on the Pitt River (Figure 3) (Group Polder Development, 1982). The area was first developed in 1911, but the dikes were too low. Waite (2008) describes that Dutch dike builders, under the supervision of Biezefeld, a civil engineer, repaired the older dikes in 1951 and built them up up just over 5 m+MSL (mean sea level). He also describes that in the period from 1949 to 1961 the dikes were gradually further strengthened and that new dikes and flood protection provisions were added.



Aerial view of the Pritt Polder (Waite, 2008)

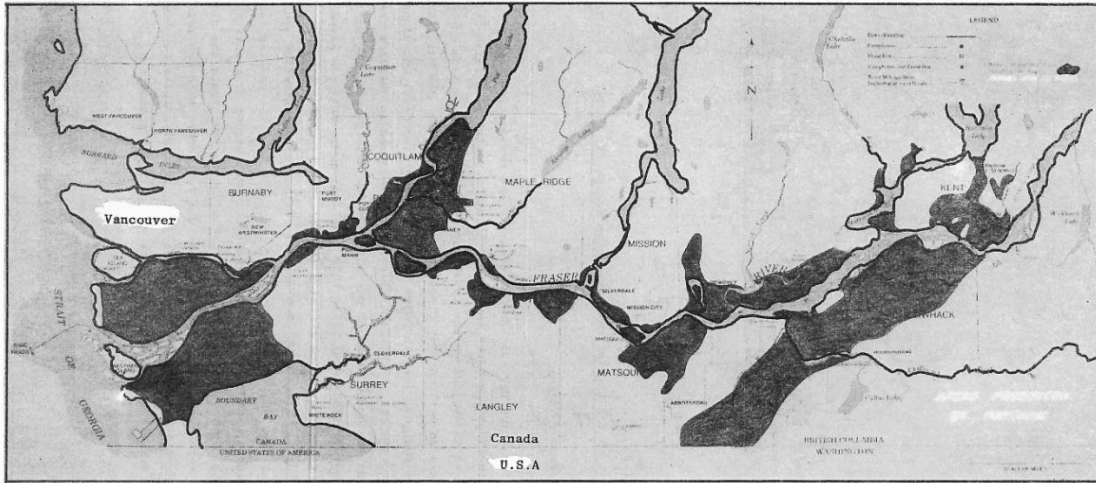


Figure 2. Polder areas in the Lower Fraser Valley (Group Polder Development, 1982)

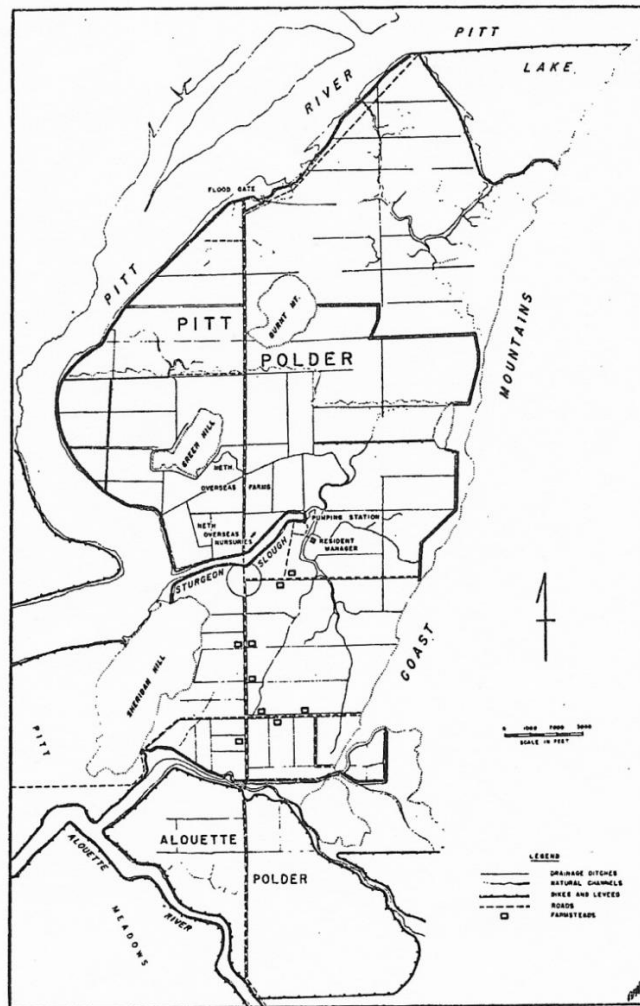


Figure 3. Pitt Polder and Alouette Polder in the Lower Fraser Valley (Group Polder Development, 1982)

The Holland Marsh (7,400 ha) is a mixed land use lowland (Classens, 2018). The cultivated land (3,000 ha) supports 125 farms.

The Squamish River Delta is an estuary, at the head of a fjord-like inlet, endiked to protect the seaport town of Squamish and surrounding industrial, residential area from periodic flooding due to spring freshet and winter rainstorms (Group Polder Development, 1982).

The Kootenay River - Creston Valley is a hinterland river valley, located at the head of Kootenay Lake near the town of Creston. The area is subject to a reduced threat of periodic flooding due to partial regulation from hydropower development and endikements (Group Polder Development, 1982).

Since the beginning of the 20th Century reclamation has added at least 800 ha to the city of Toronto (Group Polder Development, 1982).

Characteristics of the polders in Canada are shown in Table I.

Proposed polders

No proposed polders have been identified.

Design, construction, operation and maintenance

Desplanque (1983) describes that for the polders in the Bay of Fundy pumped drainage is uneconomical and that the discharge of the polders is provided by tidal sluices. The sluices range from 3 * 3 m boxes to multiples of 1.2 * 1.5 m boxes, set side by side, and made from chemically treated lumber and of with asphalt-coated steel pipes. The flap gates are made of bronze, or steel and are hung by hinges or steel chains. Provisions are made to protect them from ice pressure. He also mentions that for operation and maintenance there are *marsh bodies*, elected by the landowners, and assisted by provincial officers of the Departments of Agriculture of Nova Scotia – 86 *marsh bodies* - and New Brunswick - 39 *marsh bodies*.

Pictures of polders

In Table II the pictures by Prof. Adriaan Volker are shown.

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Lelystad, February 2021

Table I. General characteristics of existing polders in Canada

Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Polders along the Bay of Fundy:	1633						
• polder at Prince Edward Island		20	LGS	46° 39' N	63° 57' W	9	Agriculture
• polders in Nova Scotia		18,000	LGS	45° 07' N	64° 18' W	6	Agriculture
• polders in New Brunswick		18,000	LGS	45° 54' N	64° 19' W	4	Agriculture
Pitt Polder	1911/1951	2833	RLL	49° 18' N	122° 37' W	9	Agriculture
Alouette Polder	1911/1953	440	RLL	49° 15' N	122° 38' W	9	Agriculture
Holland Marsh	1954	3000	RLL	44° 03' N	79° 35' W	215	
Squamish River Delta			RLL	49° 42' N	123° 10' W	6	
Kootenay River-Creston Valley			RLL	49° 06' N	116° 34' W	535	
Polder in Toronto		800	RLL	43° 52' N	78° 46' W	70	Urban
Total		43,093					

*) RLL = reclaimed low-lying land; LGS = land gained on the sea; DL = drained lake

Table II. Pictures on polders in Canada by Prof. Adriaan Volker

		
<p>A2 001/II.2.1 Drainage machine in Canada</p>	<p>A2 002/II.2.2 Drainage machine in Canada</p>	<p>A2 003/II.2.3 Drainage machine in Canada</p>
		
<p>A2 004/II.2.4 Series of Shiplocks, presumably in Ottawa</p>	<p>A2 005/II.2.5 Prof. Volker on a ferry at John Diefenbaker Lake</p>	<p>A2 006/II.2.6 Prof. Volker on a ferry at John Diefenbaker Lake</p>