



INITIATIVES POUR L'AVENIR
DES GRANDS FLEUVES
INITIATIVES FOR THE FUTURE
OF GREAT RIVERS

Synopsis sheets

Rivers of the World

THE PANAMA CANAL

The Panama Canal

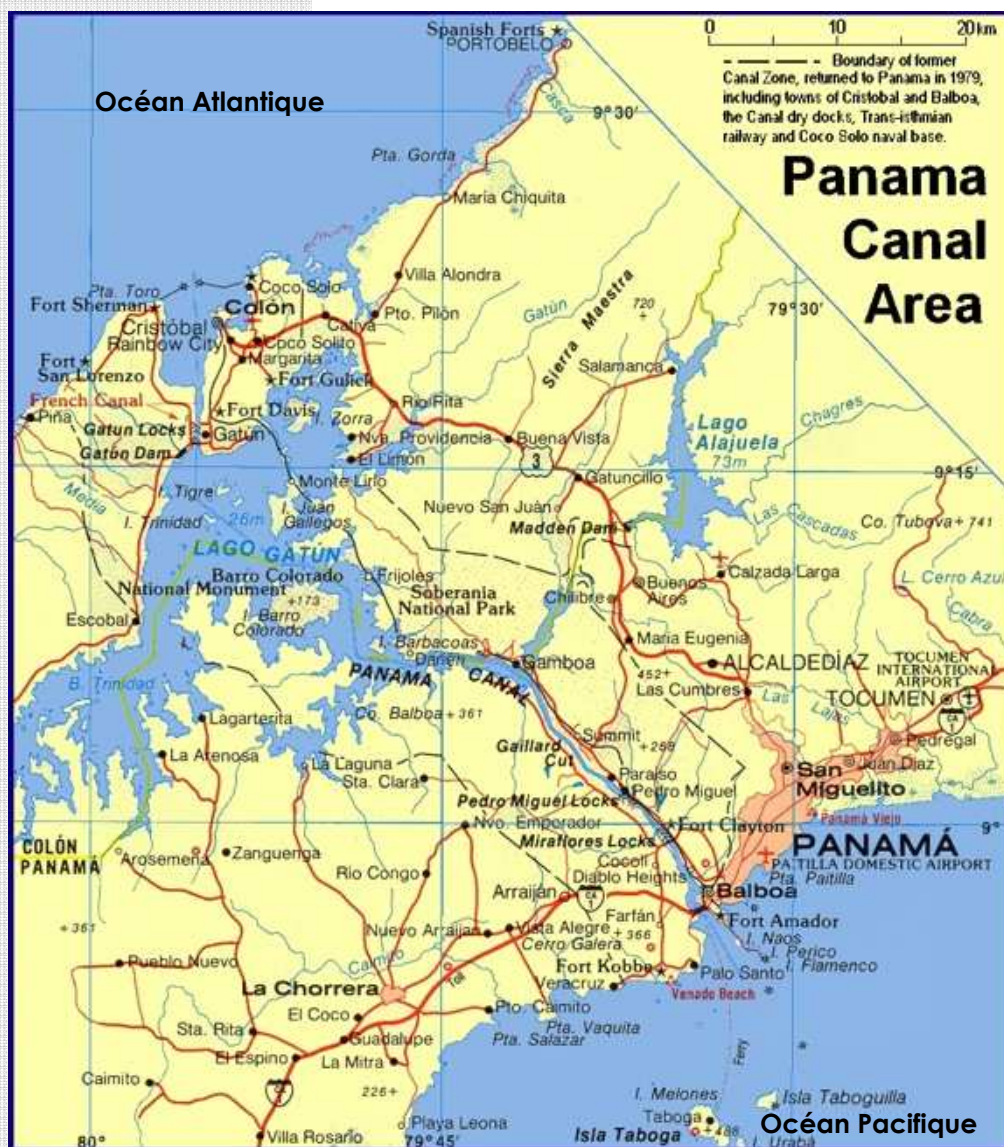
80 km long, the Panama Canal links the Pacific and Atlantic Oceans, forming a faster transoceanic route for merchant shipping than by passing via Cape Horn, at the southernmost tip of South America. A strategic hub for the world's maritime trade, 15,000 ships pass through it every year. In 2016, a huge project of Canal's enlargement was completed to double its capacity and accommodate the new generation ships, larger and longer, the Post Panamax. Now it has to face new challenges: competing projects are emerging and new shipping routes can be opened that would reduce the supremacy of the Panama Canal.

A strategic route

The origins

The first attempt to build the canal dates back to 1880. France entrusted Ferdinand de Lesseps with the responsibility of its design and amassed considerable funds. However, the technical difficulties and above all a major financial scandal revealed in 1889 led to the bankruptcy of the Compagnie Universelle du Canal Inter-océanique du Panamá. The new Panama Canal Company took over but met the same fate, and in 1903 the treaty of Hay-Bunau-Varilla officialised the transfer of the operating and building rights to the United States.

Built under the direction of G.W. Goethals, at the head of the U.S. Army Corps of Engineers, the canal opened in 1914 and was finally handed over to Panama in 1999 by virtue of the Torrijos-Carter Treaty. It then became the mainstay of the Panamanian economy.



Technical sheet

Construction	1904-1914	Number of ships/yr	15 000
Length	80 km	Tons transported	300 million tons/ yr

Characteristics

The canal comprises two artificial lakes, several canals, and three sets of locks. An additional artificial lake, Lake Alajuela, acts as a reservoir for the canal.

The Panama Canal

Uses

Merchant shipping

Before the canal's excavation, ships travelled 22,000 km between New York and San Francisco, passing via Cape Horn. This distance was cut to 9,000 km when the canal was opened in 1914.

5% of world maritime trade passes via the canal (excluding oil). It is now Panama's main source of income after banking, with an annual turnover of more than \$1 billion. The number of ships using the canal is about 40 per day.

Despite handing over sovereignty of the canal to Panama, it remains essential for the United States for their exports (cereals) and imports of raw materials (minerals, oil products). It is an unavoidable route for a large share of the trade done with its clients in Pacific Asia and for the eastern seaboard of Latin America and the Great Lakes. The Torrijos-Carter treaties also stipulated that ships flying the American flag should be given priority for using the canal. Japan and China are the two other important users.

In 1996, the Panamanian government privatised its ports, attracting strong growth in foreign investment in the development of terminals. The American terminal operator SST invested more than US\$300 million in **Manzanillo** to develop the port infrastructure. At the other end of the canal, Hutchison Port Holding, a company based in Hong Kong, invested US\$120 million at **Balboa** to set up infrastructures capable of accommodating post-Panamax ships. Hutchison also owns another terminal at **Cristobal**, on the Atlantic side. The maritime company Evergreen operates a fourth terminal at **Colon**. It has already invested US\$10 million in the site and plans expansion projects amounting to US\$80 million.

In total, the 4 main Panamanian ports did more than 6.5 billion TEU in 2017.

Key figures:

Port of Balboa : 1.88 billion TEU

Port of Colón : 2.9 billion TEU

Port of Cristobal : 1.3 billion TEU

Hydroelectricity production

The dam of Gatun, which allowed the creation of the lake bearing the same name, produces hydroelectricity intended in particular to operate the locks and other equipment of the canal.

Tourism

Panama is taking increasing advantage of its tourist potential, by profiting from the rights of way through the canal, an essential link for the seasonal cruise liners sailing between Alaska and the Caribbean. It also develops excursions on land and to the shopping districts. The canal region attracts more than a million tourists every year, some of whom pass through the canal on the cruise liners (more than 300 a year). Hutchison Port Holding manages a terminal for cruise liners at Cristobal.

A country now politically stable and not subject to hurricanes or earthquakes, Panama is attempting to attract foreign residents, especially retired pensioners. Property development projects are mushrooming in the bay of Panama and the airport is one of the busiest in Latin America. Most of the visitors and pensioners, as well as much of the investment, come from the United States.

The Panama Canal

Uses

Evolution of traffic on the main routes (in thousands):

Vessel Trade Route	Fiscal Year 2014		Fiscal Year 2013		Percent Increase or (Decrease)	
	PC/UMS Net Tons ⁽²⁾	Long Tons Cargo	PC/UMS Net Tons ⁽²⁾	Long Tons Cargo	PC/UMS Net Tons ⁽²⁾	Long Tons of Cargo
East Coast U.S. - Asia	116,797	86,202	112,722	77,027	3.6%	11.9%
East Coast U.S. - W.C. South America	33,485	33,376	29,950	28,156	11.8%	18.5%
Europe - West Coast South America	23,252	12,557	22,885	14,209	1.6%	(11.6%)
East Coast U.S. - W.C. Central America	17,670	11,973	11,617	9,560	52.1%	25.2%
South America Intercoastal	14,600	10,893	16,668	11,556	(12.4%)	(5.7%)
Europe - West Coast U.S./Canada	11,857	9,992	11,598	10,281	2.2%	(2.8%)
U.S. Intercoastal including Alaska and Hawaii	10,284	5,010	10,991	5,065	(6.4%)	(1.1%)
East Coast U.S./Canada - Oceania	6,293	2,483	4,821	2,203	30.5%	12.7%
Around the World	5,913	3,164	3,535	1,700	67.3%	86.1%
West Indies - W.C. Central America	2,597	1,151	3,061	1,777	(15.1%)	(35.2%)
E.C. South America - West Coast U.S./Canada	2,516	2,686	4,018	3,362	(37.4%)	(20.1%)
Europe - Asia	686	605	929	857	(26.2%)	(29.4%)
Sub-Total	245,949	180,093	232,794	165,752	5.7%	8.7%
All Others Routes	79,933	44,791	86,752	44,132	(7.9%)	1.5%
Total	325,882	224,884	319,545	209,884	2.0%	7.1%



The Panama Canal

Governance and international cooperation

Under American administration until 1999, the canal zone was handed over to Panama by virtue of the Torrijos-Carter Treaty.

The canal's management was entrusted to a public entity, the **Authority of Canal de Panama (ACP)** by the Organic Law of the ACP adopted on 11 June 1997. It is responsible for operating, administering, managing, preserving, maintaining and upgrading the canal. It is financially independent. The ACP has a Administrator appointed for seven years, a deputy Administrator and a board of eleven directors.

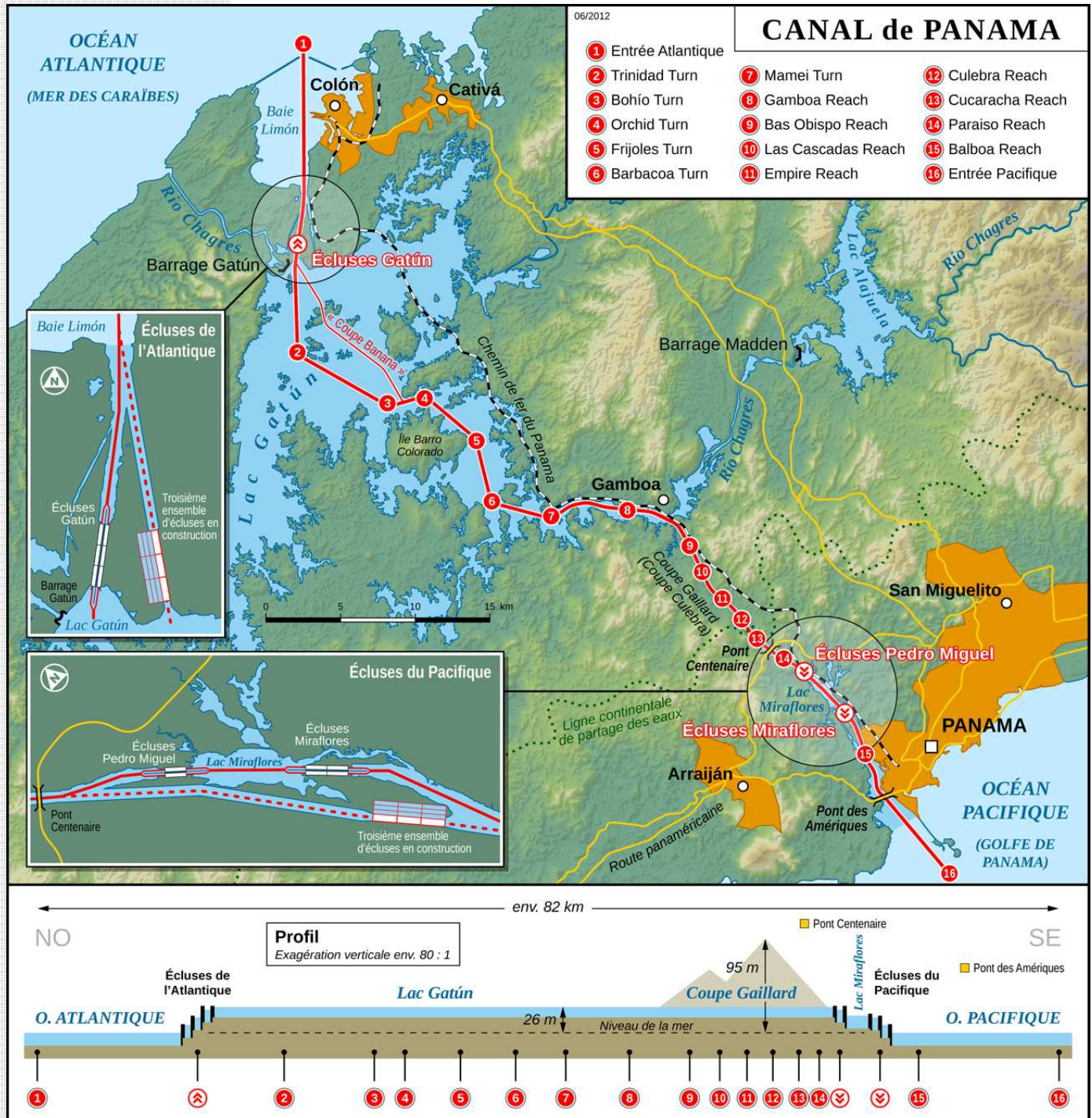
Structures

A ship sailing between the Pacific Ocean to the Atlantic Ocean follows the route below:

From the entry into the Gulf of Panama to the locks of Miraflores.	13.2 km on the canal, passage under the Bridge of the Americas
Miraflores lock system	1.7 km long (including the approach walls)
Artificial lake of Miraflores	1.7 km 16.5 m above sea level
Pedro Miguel lock	1.4 km long
Coupe Gaillard	2.6 km long 26 m above sea level Passage under Centenaire Bridge
Chagres river	Natural river enhanced by a dam on Lake Gatun 8.5 km westwards, entrance into Lake Gatun
Gatun locks	Three steps for a total length of 1.9 km to bring the ships down to sea level.
Canal of 3.2 km	Approach to the locks on the Atlantic side.
Bahía Limón	A huge natural port, anchorage for ships awaiting transit. 8.7 km up to the external dike.

The Panama Canal

Structures



The Panama Canal

Widening the canal

The project

The locks became bottlenecks. The dimensions of the current locks and the depth of the canal dictated the maximum size of the ships that pass, the *Panamax*. But an increasing number of ships exceed the limits of the *Panamax* gauge and are called post-*Panamax*. These ships are supertankers and most modern container ships. The latter have developed since the 1980s to make up almost half of world sea traffic. They can transport 3 times more goods, with 12,000 containers per ship!

In order to ensure the canal remains competitive in the face of world demand, and optimise passage time, improve efficiency and increase the financial contribution of the structure to the Panamanian public accounts, ACP launched a major development plan (2007-2025) to double the canal's capacity.

In 2006, an enlargement project was approved by a referendum in which 78% of the votes were in favour. The solution chosen consisted in adding a third line to the existing locks, by building a set of three locks in series at the Atlantic and Pacific ends of the canal, i.e. a total of 6 locks, to the east of the Gatun locks already in place, and to the southwest of the Miraflores locks. The project also included the deepening of the canal.

The original locks are 33.53 m wide, 305 metres long and 12 metres deep. The new locks are 427 metres long and 55 metres wide; as the maximum width ("main beam") of the post *Panamax* container ships is 43 metres. The new locks allow the passage of a container ship carrying 12,000 TEU – versus 4,600 at present, and should permit doubling tonnage (with an objective of 600 million tons in 2025).

Launched in 2007, the project lasted 9 years and cost \$ 5.2 billion. This cost is paid by the users of the canal by an annual toll increase of 3.5% and by a loan of US\$2 billion to be paid back in eight years.

The new locks were inaugurated in June, 2016. As of 2017, the Panama Canal Authority recorded a 22% increase in tonnage transported.

The French engineering of CNR at the service of this project

CNR was involved in the conception and design (with physical and numeric models) of the third set of locks for the Pacific side, before their construction. CNR Engineering assisted ACP from 2002 to 2011:

First period:

Hydraulic study and physical model of the 3rd set of locks for the Panama Canal (2002-2008). The model was built by the Compagnie Nationale du Rhône in Lyon in its hydraulic and measurement laboratory.

Second period:

Physical model for the final construction of the 3rd set of locks of the Panama Canal (2009-11). The enlargement works were officially launched on 3 September 2007. The Groupe Uni pour le Canal (GUPC) is the consortium responsible for the works. A second physical model was ordered from CNR by GUPC (2010-2011) for around US\$1.5 million.

General design studies of the new locks in Panama have contributed significantly to the success of the project and to its innovative dimension: the new locks use 8% less water and filling times do not exceed 10 minutes.

The Panama Canal

Perspectives

A central component of America's security and trade strategy on the American continent for nearly a century, the Panama Canal has acquired the status of global importance and the interests of the United States must now make way for the desire for independence of Panama, and with the emerging economies of South America and Chinese ambitions in the region. The canal is now the pillar of the Panamanian economy and a strategic hub for the world economy, but must now confront new challenges.

An international logistic hub

The enlargement works should generate major economic benefits for Panama, which takes advantage of increasing trade between Latin America and Asia. In addition to the canal, it has six ports, a railway, a highway and the largest free trade area in the world after Hong-Kong, at Colon in the Caribbean Sea. The PCA forecasts that the enlargement should increase the toll to reach US\$1 million per ship, in comparison to US\$350,000 today.

The works will also provide the United States the means to export oil from the Gulf of Mexico to Asia. Many ports on the American side are already seeking to adapt to the post-Panamax, gauge, in particular Charleston (South Carolina), New York and New Jersey.

Competing projects

The increases in the canal tolls have strengthened interest for competing routes that either exist already or are under consideration.

- The historic competitor, the Suez Canal, provides a passage of 193 km without any lock. The only limitation is its draught.
- Melting ice due to climate change, has made using the northwest passage a viable alternative, although this passage should not represent a genuine threat for the next two decades due to technical problems and major environmental risks. Cargo boats sailed via this route to Europe in 2013. The distance between Hamburg and Vancouver via the north would be 2,300 km shorter than the Panamanian route. A ship sailing from Rotterdam to Tokyo would sail 15,700 km via the north in comparison to 23,300 km via the Panama Canal.
- In 2011, Salvador, Honduras and Costa Rica raised the possibility of canals passing through their territories. At the beginning of 2012, Guatemala set up the Guatemala Inter-Oceanic Corridor (GIC), an organisation intended to link two ports by conveying goods by road and rail. Likewise in Colombia, the idea of a project was raised at the end of the 2000s, aimed at densifying the transport network with a "dry" canal and at reducing the cost of transferring loads for maritime shipping companies.
- The Nicaragua project plans for the excavation of a canal 300 km long. In June 2013, the government awarded a permit for 50 years to Hong Kong Nicaragua Development (HNKD). Its CEO, the Chinese businessman Wang Jing, announced he would commit up to US\$40 billion for this project which would allow the passage of post-Panamax container ships of 250,000 tons and more than 14,000 TEU. But this project hasn't gone further, due to financial difficulties and the diplomatic interest renewed by Beijing for Panama.

The competing projects demonstrate the ambitions of the Chinese in the region: the projects of the dry canal in Colombia, Guatemala and Salvador are all financed by China. Besides the limits in the capacities of the Panama Canal, notably for transporting oil products, it has the disadvantage for China of being too closely bound to the United States.

The Panama Canal

Perspectives

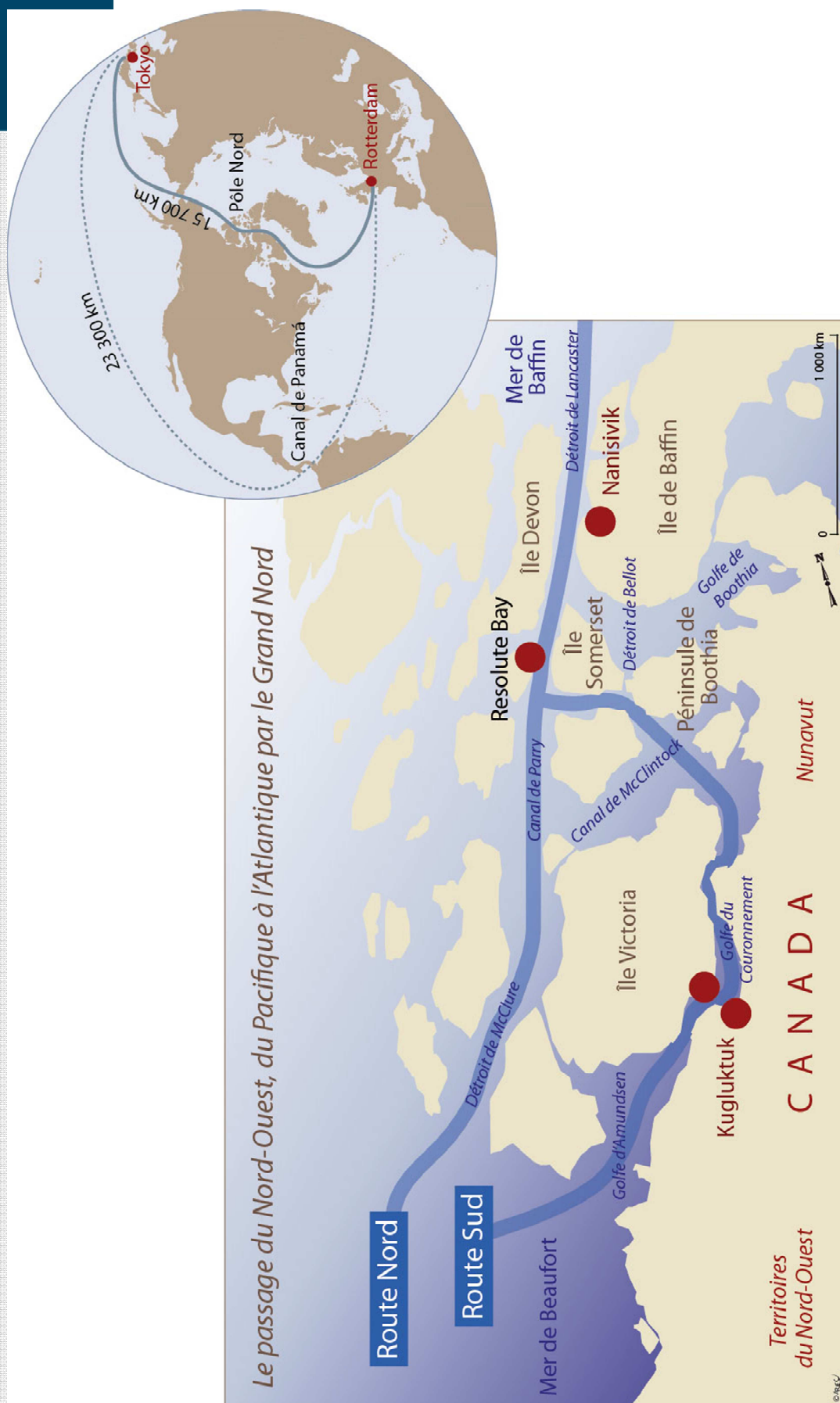
Environmental challenges

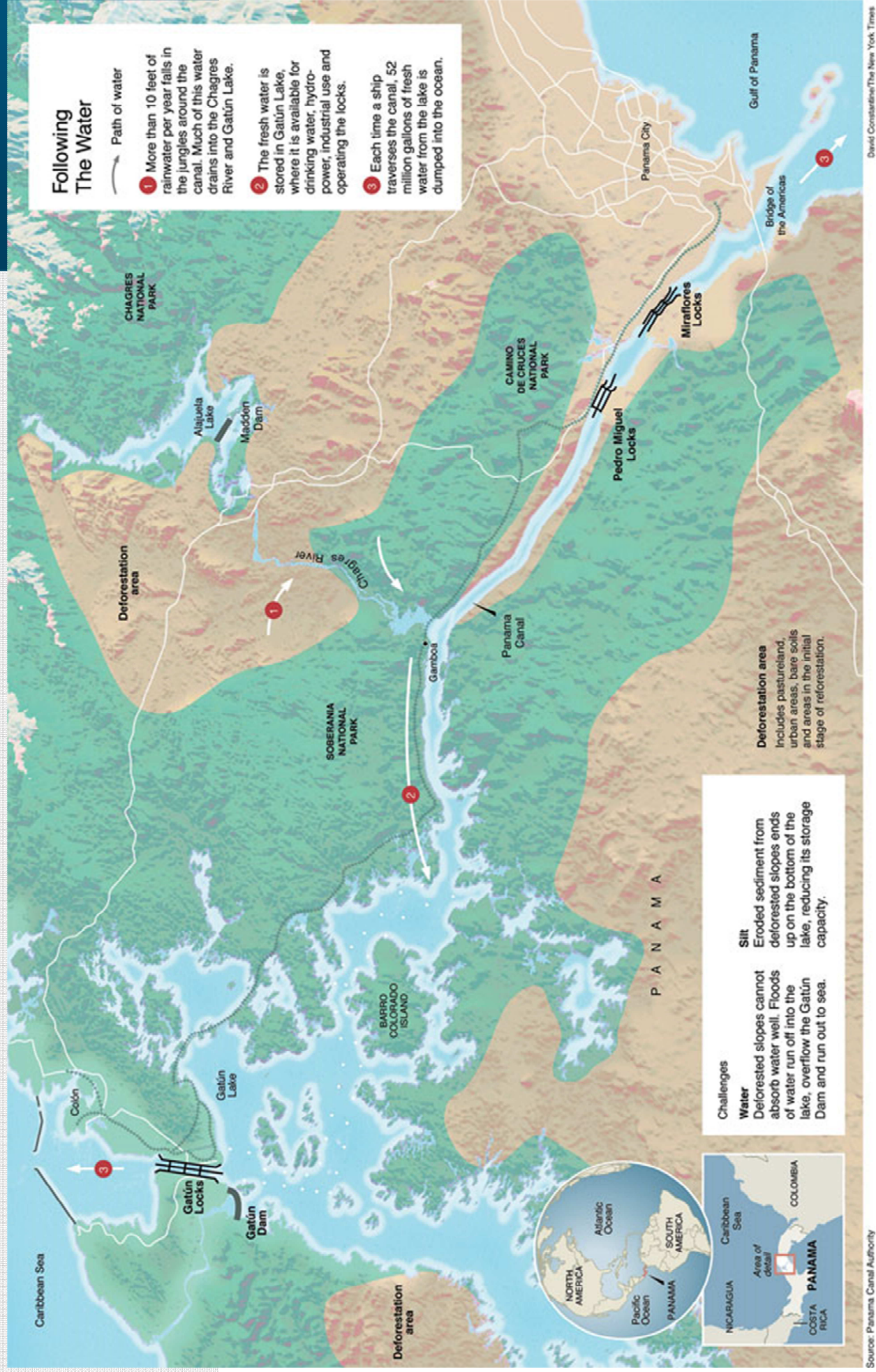
The canal is consuming increasing quantities of water due to the number of ships passing through it. Each lock passage requires 166 million litres of water, most of which comes from the reservoirs of Lakes Gatun and Madden. However, these reservoirs also supply the domestic needs of the populations of Panama City and Colon.

This situation has led the Panamanian government to increase the perimeter of a watershed already affected by major deforestation. 80% of the watershed was covered by forest in 1952, whereas nearly the entire forest had disappeared by 1978. This deforestation has led to the silting up of the canal.

The problems of water shortage in the canal have already had an impact, particularly following the meagre rainfall recorded during the El Nino episodes (a warm current from the Pacific), in 1983 and 1998. The costs of remedying these climatic changes are high, amounting to US\$12 million, and have led to considerable losses in income linked to ships having to reduce their loads.

The Panama Canal





The Panama Canal has also had severe impacts on the environment: it has led to the influx of invasive species, and problems of pollution and sediment transport worsened by the deforestation of the surrounding land. The isolation of the two continents has also led to ecological fragmentation and a considerable loss of biodiversity. Lastly, the supply of water to the canal can be difficult during the dry season.