

FRANCE



Source: esri

General

France - officially the French Republic - is a country whose territory consists of metropolitan France in Western Europe and several overseas territories. The metropolitan area extends from the Mediterranean Sea to the Channel and the North Sea, and from the Rhine to the Atlantic Ocean. It is bordered by Belgium, Luxembourg and Germany in the Northeast, Switzerland and Italy in the East, and Andorra and Spain in the South. The overseas territories include French Guiana and several islands in the Atlantic, Pacific and Indian oceans. The country has an area of 55.2 Mha (million hectares) with, in 2022, a population of 64.6 million, or 1.17 persons per ha (Wikipedia and United Nations, 2022).

Climate and geography

As the French territory is relatively large, the climate is not uniform, with the following climate variations (source: Wikipedia):

- the west of France has an oceanic climate – it extends from Flanders to the Basque Country in a coastal strip several tens of kilometres wide, narrower to the North and South but wider in Brittany, which is almost entirely in this climate zone;
- the climate of the Southwest is also oceanic but warmer;
- the climate of the Northwest is oceanic but cooler and windier;
- away from the coast, the climate is oceanic but its characteristics change somewhat. The Paris region, and the regions protected by mountain chains show a stronger seasonal temperature variability and less rainfall during autumn and winter. Therefore, most of the territory has a semi-oceanic climate and forms a transition zone between the oceanic climate near the coasts and other climate zones;
- the semi-continental climate of the North and Centre-east (Alsace, plains of the Saône, the middle section of the Rhône, Dauphiné, Auvergne and Savoy);
- the Mediterranean and the lower Rhône valley have a Mediterranean climate due to the effect of mountain chains separating them from the rest of the country and the having Mistral and Tramontane winds.

Most of the low-lying areas of France are located in the oceanic climate zone. Precipitation exceeds 1,000 mm per year in the most exposed areas of Brittany and Normandy, and also at the foot of the mountains in the Centre-south, while it drops below 700 mm per year in the interior of the Centre-north, in the plain in the east of the Vosges and in the area around the Gulf of Lyon. In the mountains, on the other hand, it can exceed 2,000 mm per year. The average temperatures in January range from 2 °C in the North-east to 9 °C in the French Riviera. The daily averages in July and August range from 17/18 °C along the English Channel coast to 24/25 °C along the Mediterranean coasts. The amount of sunshine also varies widely: the sun shines for less than 1,600 hours a year in Brittany and the far North, for about 2,000 hours in the Centre-south, and for more than 2,500 hours along the Mediterranean coast (source: Wikipedia).

France has a wide variety of topography and natural landscapes. Large parts of France were raised during several tectonic episodes during which the Armorican Massif, the Massif Central, the Morvan, the Vosges and Ardennes ranges and the island of Corsica were formed. These massifs delineate several basins such as the Aquitaine Basin in the Southwest and the Paris basin in the North, the latter including several areas with fertile soil such as the silt beds of Beauce and Brie. The coastlines offer different landscapes: mountain ranges along the French Riviera, coastal cliffs, such as the Côte d'Albâtre, and wide sandy plains in the Languedoc. France has an extensive river system consisting of four major rivers Seine, Loire, Garonne, Rhône and their tributaries. The Rhône divides the Massif Central from the Alps and flows into the Mediterranean Sea at the Camargue. Other water courses discharge towards the Meuse and Rhine along the north-eastern borders (source: Wikipedia).

Le Comte de Dienne (1891) gives a detailed description of the types of swamps and lakes in France that have been reclaimed before 1789, as well as for the reasons of the reclamation, which, among others, was the prevention of diseases, enabling agriculture and military defence.

Arnand (1898) describes that King Henry IV and his prime minister Sully initiated the reclamation of the swamps in France by a Royal Decree.

Toussaint (2005) describes the role of Dutch and Flemish engineers and financiers in the reclamation of swamps, lakes and coastal areas in France. In his paper there is also a detailed overview of the reclaimed areas.

Beukers (2018) describes that around 1700 a real cultivation rage broke out in the Médoc, north of the city of Bordeaux on the left bank of the Gironde River. This rage was made possible by the fact that in the past century a lot of marshy land along the Gironde had been reclaimed. Dutch engineers and entrepreneurs had played a major role in that reclamation. This involvement was based on a request of 1596 by the French King Henry IV. Following this request King Henry commissioned in 1599 Humphrey Bradley with two others to inspect the marshes north of the city of Bordeaux. A short time later Bradley was appointed *grandmaître des digues du royaume*, which he would remain until his death (Le Comte de Dienne, 1891 and Toussaint, 2005).

In Wikipedia it is described that the Hoeufft family invested over a million livres in reclamation of lakes and wetlands in Picardie, Poitou and other parts of France. For the most part this work was carried out between 1642 and 1653 by Dutch engineers, such as Jan van Ens. In 1650, Hoeufft was the director of the operation to drain the Poitou Marsh in western France. From the 1640s, one of his associates was David de la Croix, who married Hoeufft's niece, Marguerite Hoeufft. When Hoeufft died, de la Croix was among his beneficiaries and took over the Poitou marsh operation. Frédéric Otto Fabrice de Gressenich, Councillor and Maître d'hotel du Roi, the son of Hoeufft's sister Anne, inherited the Sacy marshes along with his Hœufft cousins. As the only cousin living in France, Fabrice administered the lands on their behalf.

Existing polders

Clout (1977) describes that in the Marais de Dol reclamation started in 1024, in the first half of the 11th century in the marshes of Poitou, and in 1150 around Arles.

Pin *et al.* (2007) describe that *Les wateringues du Nord-Pas-de-Calais* is a polder territory, built since the twelfth century, which covers about 90,000 ha in the North Department (District of Dunkirk) and that of Pas-de-Calais (districts of Calais and Saint-Omer) (Figure 1). This territory which coincides with the delta of the Aa is located near mean sea level, sometimes below this level; always at below the high water level. The dune strip, which runs along the coast, provides partial protection against the intrusion of the sea. They also describe that drainage by gravity gradually had to be replaced by drainage by pumping. They describe in detail all, technical, institutional and financial arrangements within the area. At present the water management systems consist of:

- thousands of kilometres of private drains along the fields;
- 1,600 km of community collector and main drains;
- 100 intermediate pumping stations discharging into the main drains (capacity from 0.1 to 1.6 m³/s), in the Aa and in the shipping canals;
- 12 main pumping stations (capacity from 2.5 to 25 m³/s) for discharge to the sea a total of up to 120 m³/s.

Clout (1977) describes that from 1258 till 1862 gradually various coastal reclamations, called Marquenterre, have been implemented at the Mouth of the Authie River (Figure 2).

Toussaint (2005) describes that in the Languedoc already in 1314 at the order of the Benedict monastery Psalmody near Aigues-Mortes a reclamation project was implemented, which comprised the excavation of a navigation canal, digging of ditches and the construction of dikes. In the 16th century a number of swamps was reclaimed. Toussaint also describes the reclamation of the swamps around Bordeaux in the first half of the 17th century: Marais de Bordeaux, Marais de Bruges, Marais de Blanquefort and Marais de Perempuyre, later called the Marais Flamand. He shows a map that was originally published by (Tutein Nolthenius, 1892) (Figure 3). Le Marais de Bruges covers 262 ha and is now a nature reserve (Figure 4).

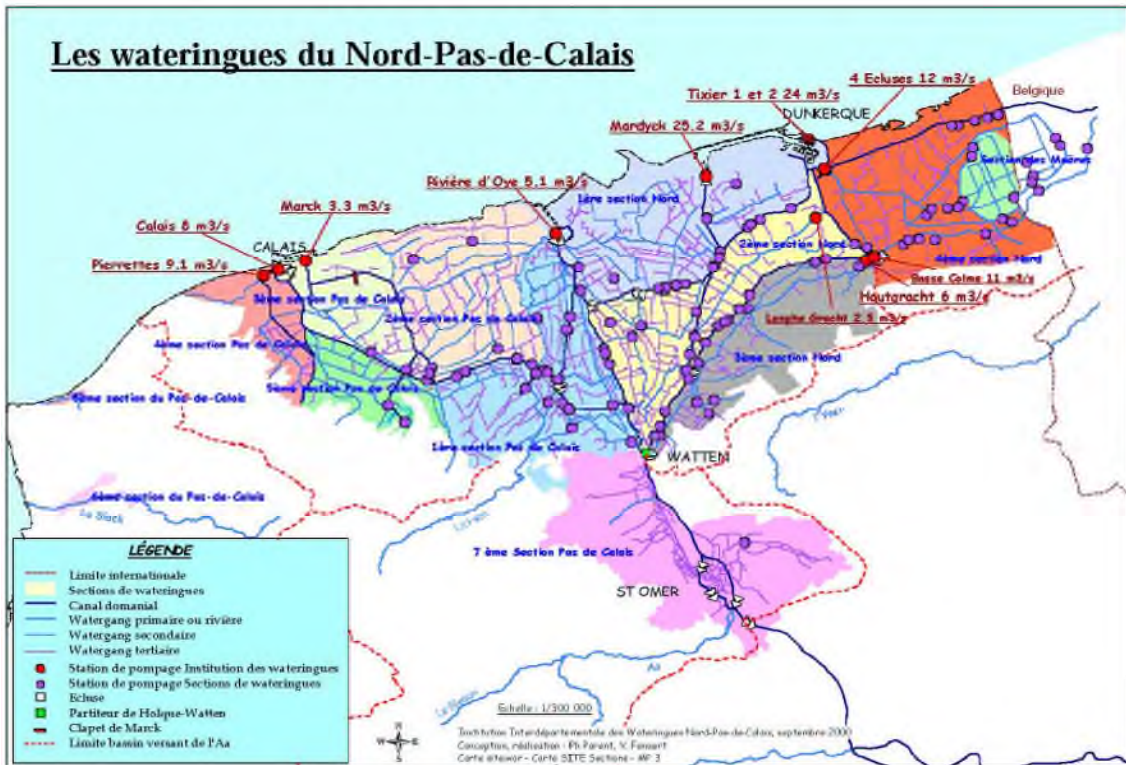


Figure 1. Les waterings du Nord-Pas-de-Calais (Pin et al., 2007)

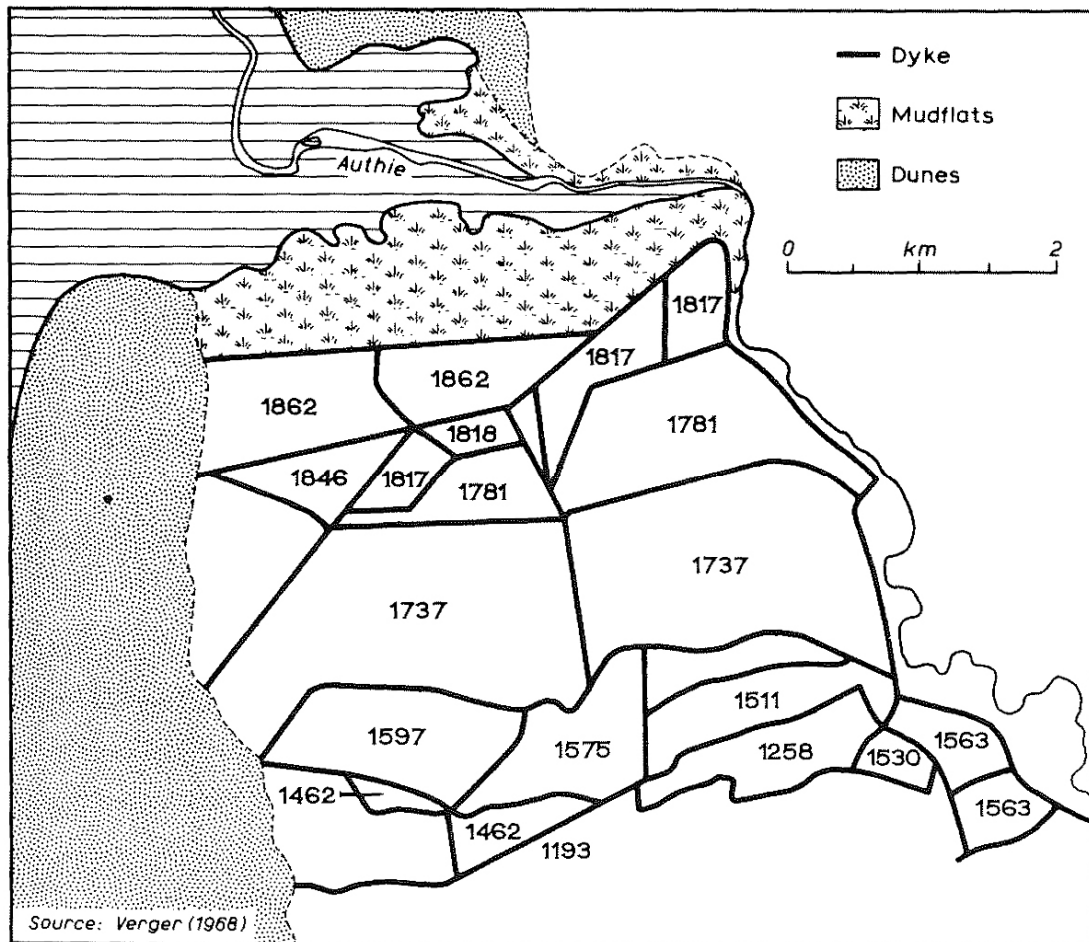


Figure 2. Coastal reclamations, called Marquenterre, at the Mouth of the Authie River (Clout, 1977)

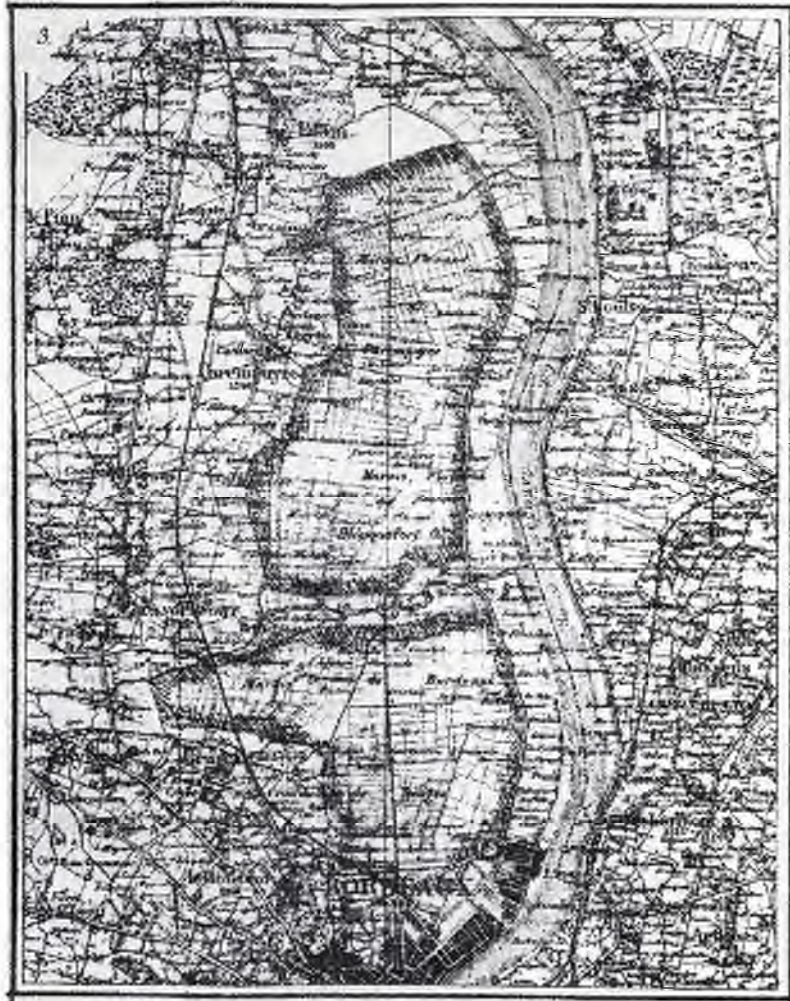


Figure 3. Reclamation of the swamps around Bordeaux in the first half of the 17th century: Marais de Bordeaux, Marais de Bruges, Marais de Blanquefort and Marais de Perempuyre, later called the Marais Flamand (Tutein Nolthenius, 1892 and Toussaint, 2005)



Figure 4. Le Marais de Bruges

In addition Toussaint describes the reclamation of the Marais de Saintonge and the Marais de Poitou. Here there have been very old reclamations during the Middle Ages by monasteries (Clout, 1977) (Figure 5).

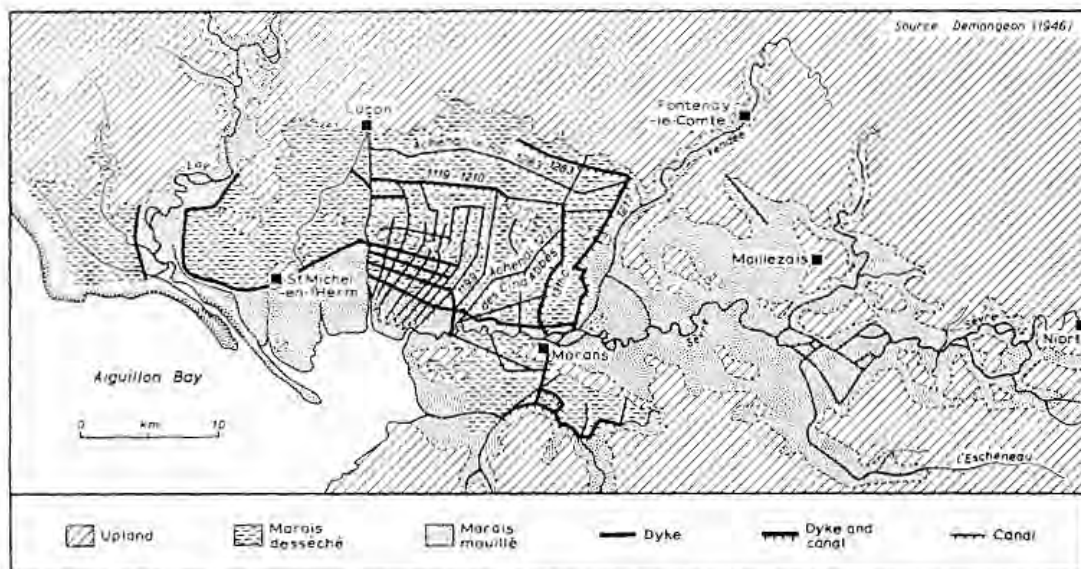


Figure 5. Reclamation of the swamps at the mouth of Sèvre-Niortaise in the Middle Ages (Clout, 1977 and Toussaint, 2005)

Clout (1977) describes that since the Middle Ages coastal reclamations have been implemented at Saint-Michel-en-l'Herm (Figure 6).

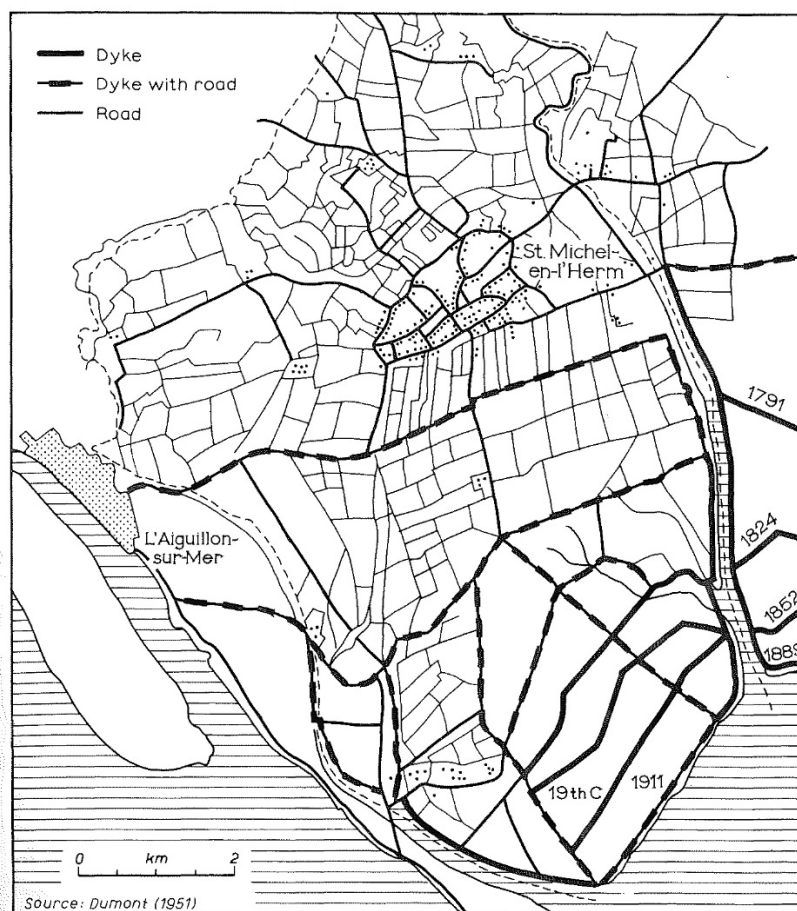


Figure 6. Coastal reclamations at Saint-Michel-en-l'Herm (Clout, 1977)

At the first half of the 17th century the renewed reclamations have been carried out. The parcellation of the Marais Poitou is shown in Figure 7.

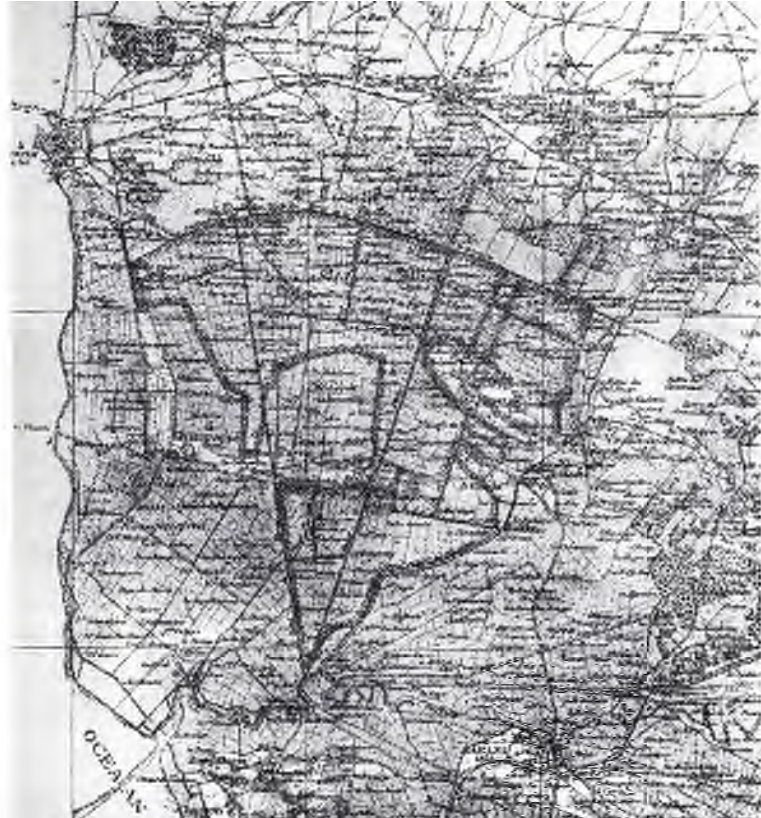


Figure 7. Parcelation of Marais de Poitou (Toussaint, 2005)

The Marais de Lesparre was reclaimed based on a design by the Dutch polder expert Jan Adriaansz. Leeghwater. In fact the reclamation consisted of three parts. The reclaimed lands were renamed Polders de Hollande (Toussaint, 2005; Aten *et al.*, 2009) (Figure 8).



Figure 8. Reclaimed Marais de Lesparre, later called Polders de Hollande (Toussaint, 2005)

Toussaint (2005) describes that between 1619 and 1627 the lakes, the Moères, were reclaimed (Figure 9) and between 1624 and 1627 the Marais Sacy (Figure 10).

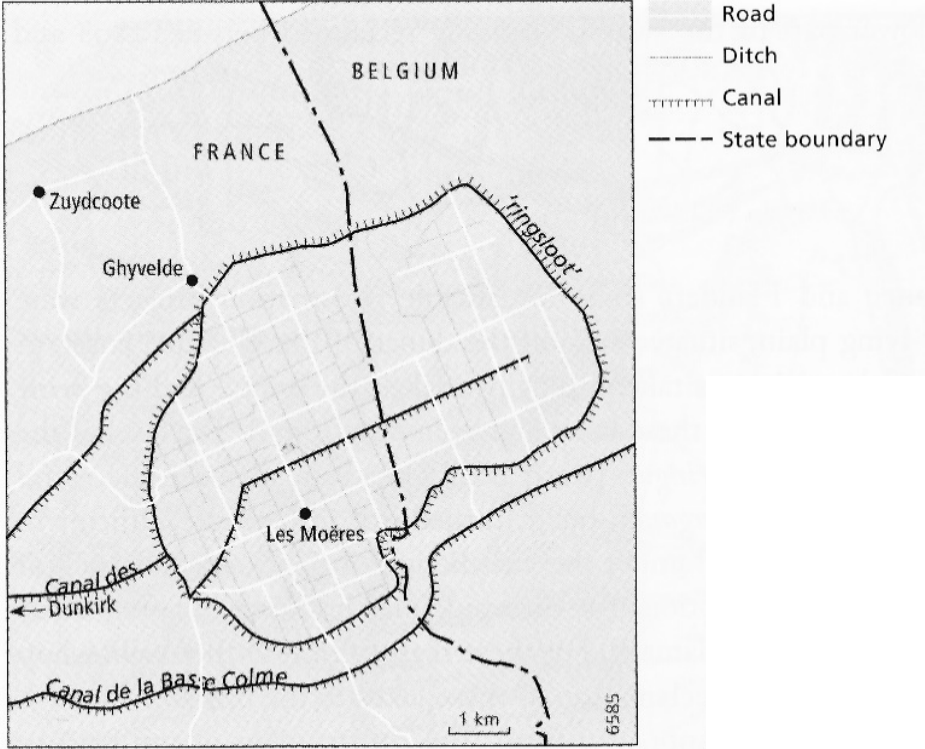


Figure 9. Parcellation of the Moères in the 17th century (Toussaint, 2005)

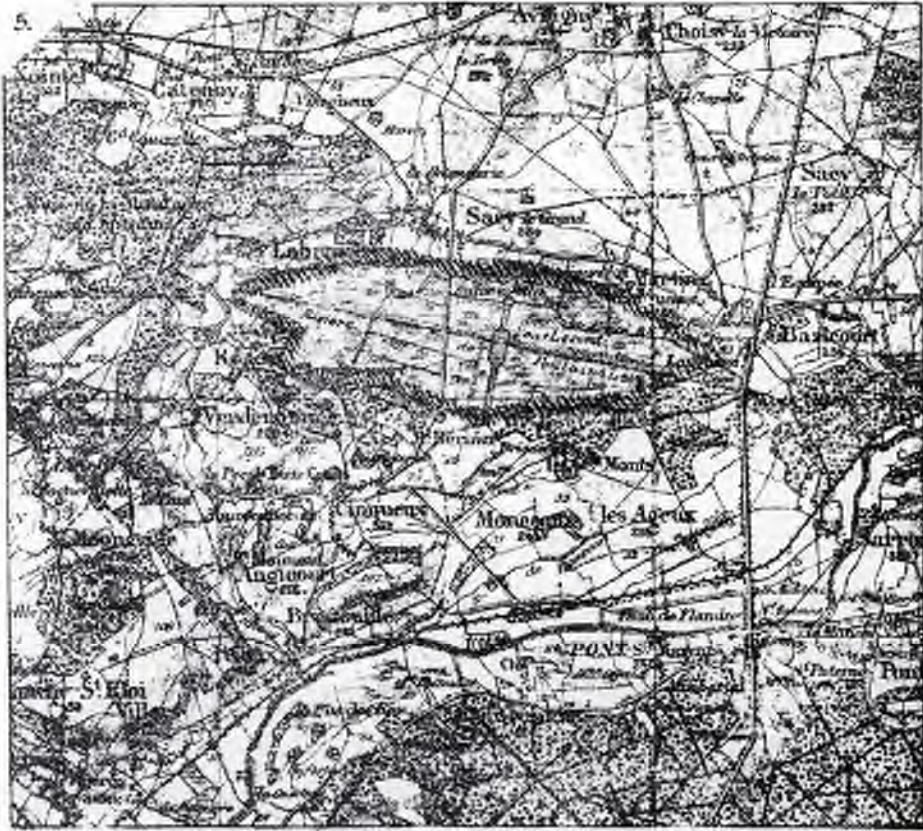


Figure 10. Parcellation of Marais Sacy (Toussaint, 2005)

In 1633 the Marais Vernier was reclaimed (Toussaint, 2005). Here the seadike is called Digue des Hollandes (Figure 11).

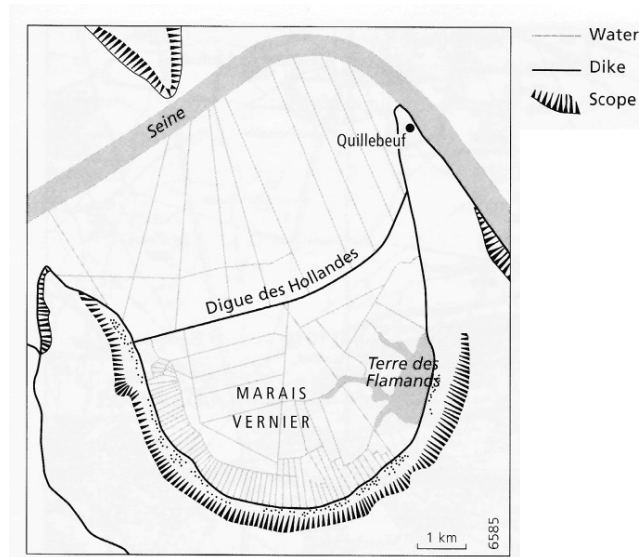


Figure 11. Parcelling of the Marais Vernier with the Digue des Hollandes (Clout, 1977 and Toussaint, 2005)

In the Marais d'Arles already in the 13th century a few reclamation projects had been carried out by Benedict monasteries (Toussaint, 2005). Toussaint (2005) also mentions that at request of Jean d'Antonelle Jan van Ens made a reclamation plan and that in 1645 the swamps had been reclaimed (Figure 12).

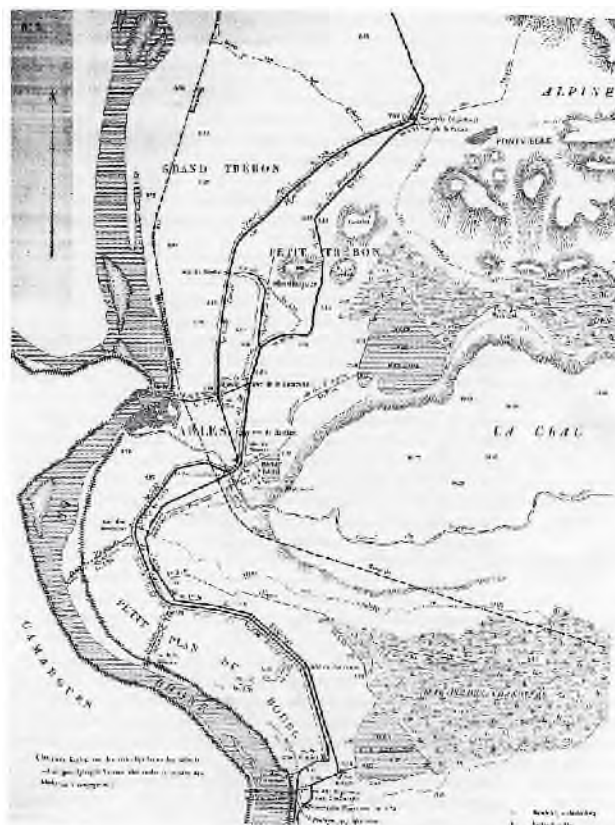


Figure 12. Works constructed under management of Jan van Ens in the Marais d'Arles (Toussaint, 2005)

In 1808 Mrs. Lawless managed to reclaim the Etang de Marseillette of 2000 ha in order to develop agriculture. However, the land remained saline, any culture was doomed to failure. It was necessary to clean up and leach this land. In 1850 a tunnel was dug over 2.2 km, connecting the river Aude to the pond, passing under the Canal du Midi near Marseillette. Starting from this arrival of water, a whole network of canals carried the fresh water in each parcel by gravity, allowing at the same time surface irrigation and to reduce the salt content in the soil. This could only be achieved thanks to numerous drains put in place before each planting and the importance of the network of drains (Figure 13) (Toussaint, 2005).

Clout (1977) shows polders along Mont Saint-Michel Bay (Figure 14).

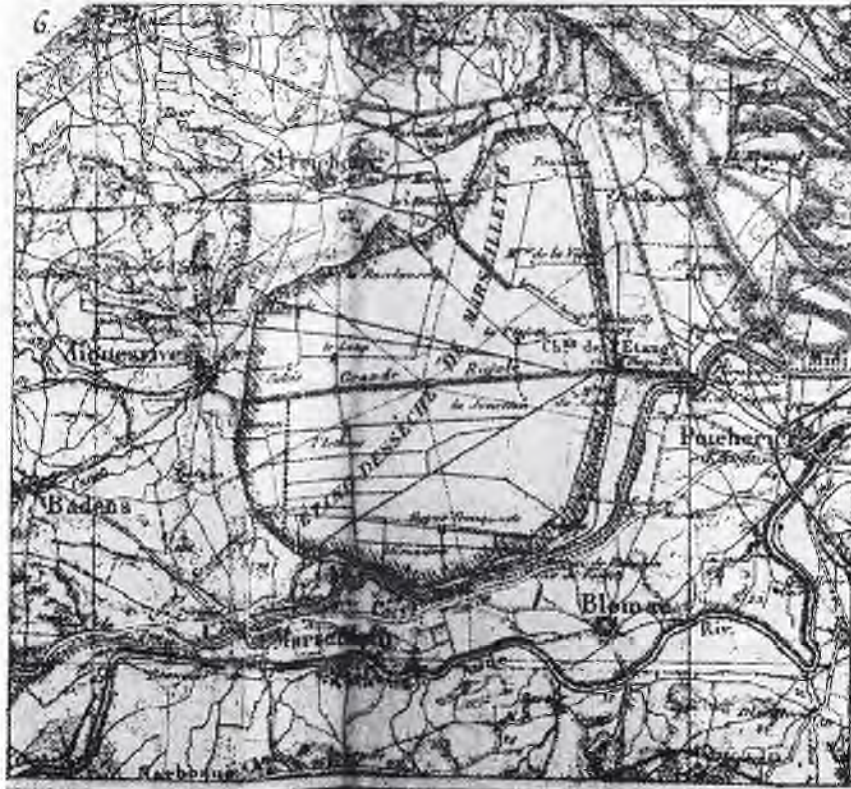


Figure 13. Reclaimed étang de Marseillette (Toussaint, 2005)

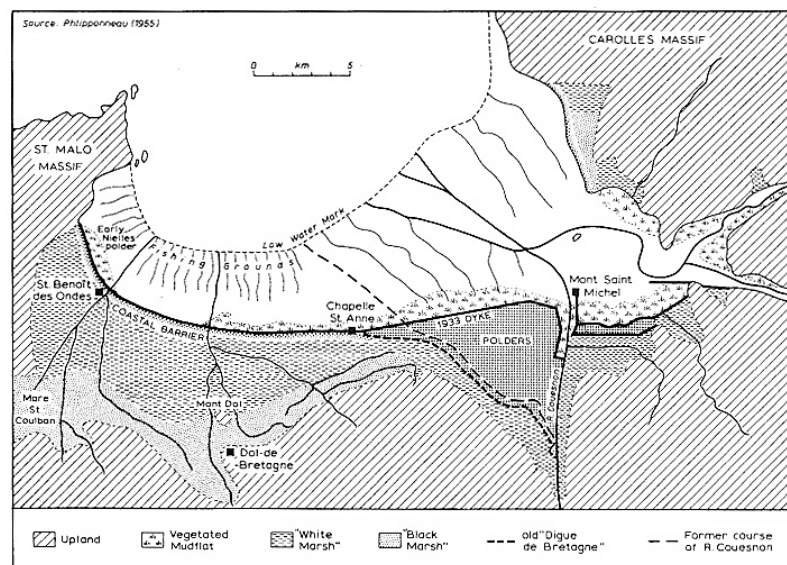


Figure 14. Polders along Saint-Michel Bay (Clout, 1977)

Clout (1977) shows maps with the Departments in France around the middle of the 19th century with the lakes and on-going reclamation activities (Figure 15).

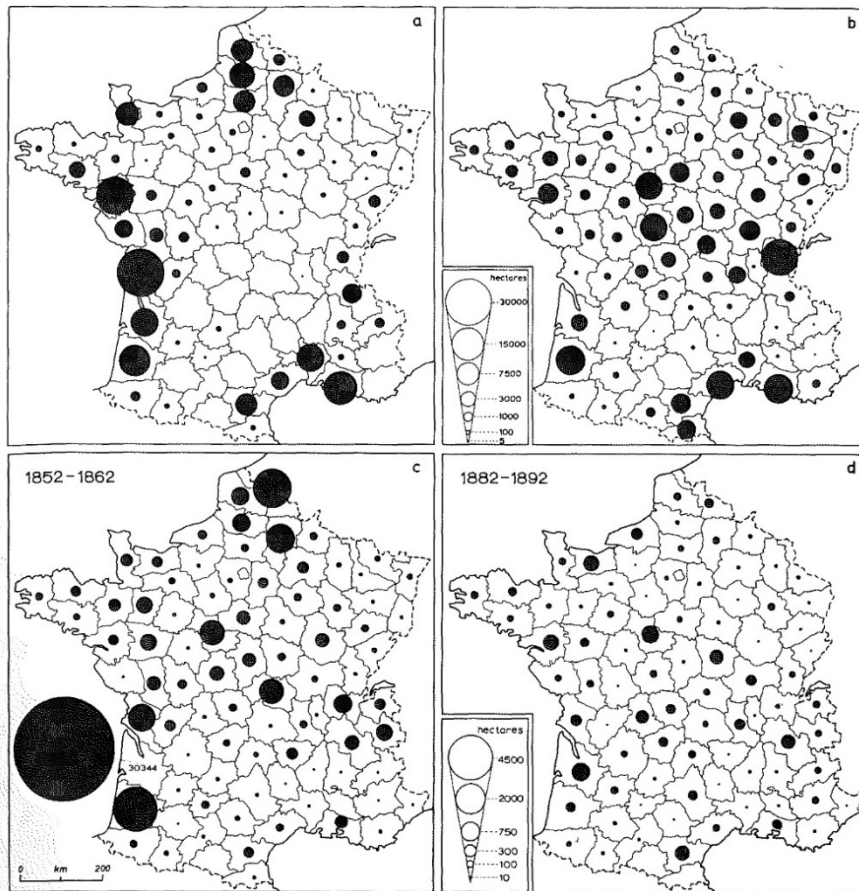


Figure 15. Marshland in the nineteenth century, (a) Estimated distribution of lakes and (b) of marshland in 1839; (c) Marshland drained 1852-1862 and (d) 1882-1892 (Clout, 1977)

The Group Polder Development (1982) identified several polders. These are listed in Table I. They also present the schemes of Polder de Bouin (Figure 16) and of the polders in the Bay of Aiguillon (Figure 17).

General characteristics of the polders in France are shown in Table I.

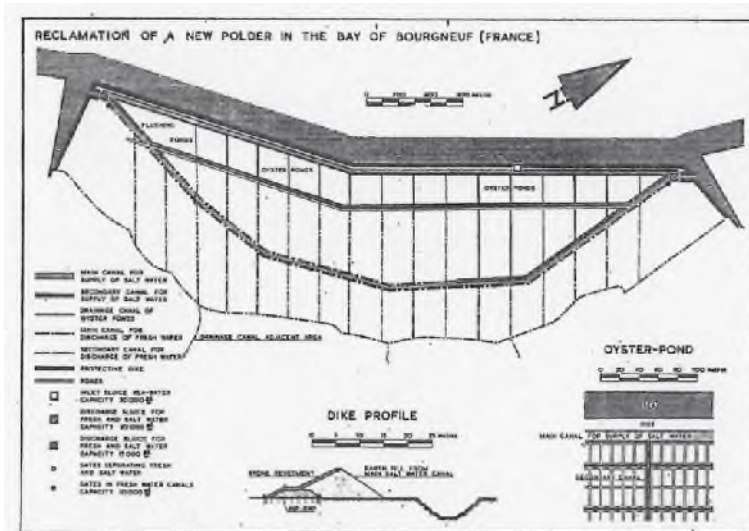


Figure 16. Polder de Bouin in the Bay of Bourgneuf (Group Polder Development, 1982)

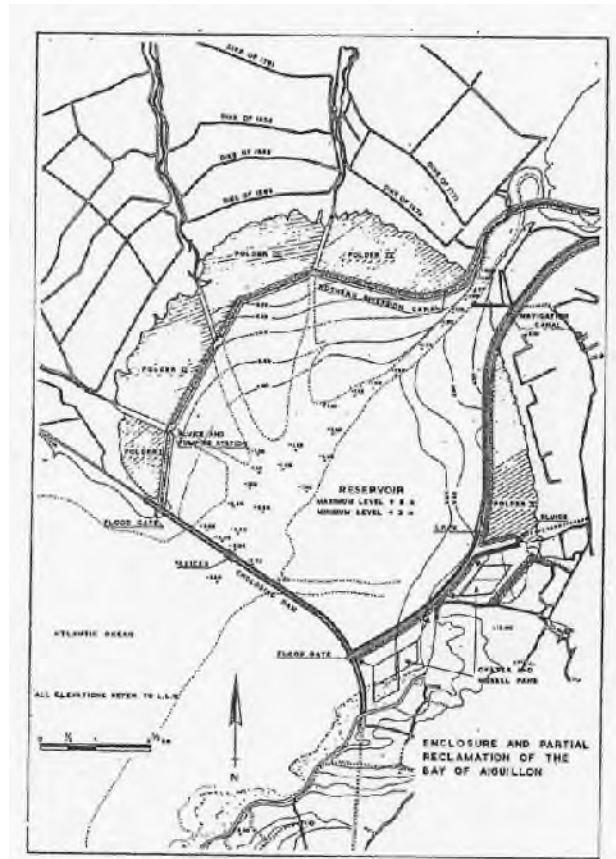


Figure 17. Polders in the Bay of Aiguillon (Group Polder Development, 1982)

Proposed polders

No proposed polders have been identified.

Location of the polders in France as shown on the World polder map

The location of the polders in France is shown in Figure 18.



Figure 18. Location of the polders in France (source: esri – Batavialand)

The pictures by Prof. Adriaan Volker are shown in Table II and the pictures by Prof. Bart Schultz in Table III.

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Bart Schultz

Lelystad, December 2023

Table I. General characteristics of existing polders in France

Name	Reclamation	Area in ha	Type *)	Latitudes	Longitudes	Elevation in m+MSL	Land use
Marais de Dol	1024	2,500	RLL	48° 36' N	1° 44' W	4	Agriculture
Marais de Poitou	First half 11 th century		RLL	46° 22' N	0° 48' W	1	Agriculture and nature
Marais d' Arles	Since 1150/ 1642-1660		RLL	43° 32' N	4° 46' E	1	Agriculture and nature
Les wateringues du Nord-Pas-de-Calais	Since 12 th century	90,000	RLL	50° 56' N	2° 10' E	2	Rural area
Reclaimed swamps at the mouth of Sèvre-Niortaise	1217		RLL	46° 20' N	1° 06' E	1	Agriculture
Marquenterre	1258-1862		LGS	50° 16' N	1° 36' E	5	Agriculture and nature
Reclamation near Aigues-Mortes	1314		RLL	43° 33' N	4° 12' E	0	Rural area
Reclamations near Saint-Michel-en-l'Herm	Since Middle Ages		LGS	46° 19' N	1° 15' E	4	Agriculture
Reclaimed swamps near Fréjus	16 th century		RLL	43° 26' N	6° 43' E	2	Rural area
Baie d'Authie	16 th century	119	RLL	50° 21' N	1° 37' E	4	Agriculture
Marais de la Souteyranne	1607		RLL	43° 36' N	4° 20' E	1	Agriculture
The Moères	1619-1627	2,250	DL	51° 01' N	2° 33' E	-1	Agriculture
Marais de Sacy	1624-1627		RLL	49° 19' N	2° 35' E	32	Agriculture
Marais Vernier (Digue des Hollandes)	1633	2,530	RLL	49° 26' N	0° 29' E	3	Agriculture
Marais de Lesparre, later called Polders de Hollande	1628- about 1640	2,250	RLL	45° 21' N	0° 58' W	0	Agriculture
Marais des Baux	1642-1645		RLL	43° 42' N	4° 48' E	0	Agriculture
Lac du Sarlièves	1612-1649		DL	45° 44' N	3° 10' E	346	Agriculture
Marais de Bordeaux	First half 17 th century		RLL	44° 54' N	0° 36' W	1	Agriculture and nature
Marais de Bruges	First half 17 th century	262	RLL	44° 54' N	0° 36' W	1	Agriculture and nature
Marais de Blanquefort	First half 17 th century		RLL	44° 54' N	0° 38' W	2	Agriculture and nature
Marais Perempuyre, later called Marais Flamand	First half 17 th century		RLL	44° 58' N	0° 34' W	0	Agriculture
Marais de Saintonge, later called Marais de la Petite-Flandre	-1639		RLL	45° 58' N	0° 55' W	1	Agriculture
Marais du Dauphiné	1675- about 1690		RLL	45° 22' N	5° 15' E	340	Agriculture
Marais de Carentan	18 th century		RLL	49° 19' N	1° 15' W	1	Agriculture
Etang de Marseillette	1808	2,000	DL	43° 14' N	2° 33' E	52	Agriculture
Polders in Saint-Michel Bay	1880 - 1933	4,500	LGS	48° 36' N	1° 33' W	6	Agriculture
Polderland of Audomarois	1890	3,730	RLL	50° 47' N	2° 14' E	2	Agriculture and nature
Basse Vallee de la Dives		5,000	RLL	49° 15' N	6° 30' W	2	Agriculture

Table II. Pictures on polders and lowlands in France by Prof. Adriaan Volker

			
B2 3 001/B.2.3.1*) Sluice complex	B2 3 002/B.2.3.2 Sluice complex	B2 3 003/B.2.3.3 Sluice complex	B2 3 004/B.2.3.4 Sluice complex
			
B2 3 005/B.2.3.5 Sluice complex	B2 3 006/B.2.3.6 Sluice complex	B2 3 007/B.2.3.7 Sluice complex	B2 3 008/B.2.3.8 Sluice complex
			
B2 3 009/B.2.3.9 Sluice complex	B2 3 010/B.2.3.10 Sluice complex	B2 3 011/B.2.3.11 Sluice complex	B2 3 012/B.2.3.12 Sluice complex

*) Batavialand/original

Table II. Pictures on polders and lowlands in France by Prof. Adriaan Volker (continued)











			
<p>B2 3 013/B.2.3.13 Pont d'Avignon</p>	<p>B2 4 041/B.2.4.41 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 042/B.2.4.42 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 043/B.2.4.43 Lowland area with main drain, discharge sluice and sea dike</p>
			
<p>B2 4 044/B.2.4.44 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 045/B.2.4.45 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 046/B.2.4.46 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 047/B.2.4.47 Lowland area with main drain, discharge sluice and sea dike</p>
			
<p>B2 4 048/B.2.4.48 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 049/B.2.4.49 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 050/B.2.4.50 Lowland area with main drain, discharge sluice and sea dike</p>	<p>B2 4 051/B.2.4.51 Lowland area with main drain, discharge sluice and sea dike</p>

Table II. Pictures on polders and lowlands in France by Prof. Adriaan Volker (continued)




			
B2 4 052/B.2.4.52 Sea dike	B2 4 053/B.2.4.53 Sea dike	B2 4 054/B.2.4.54 Sea dike	

Table III. Pictures on polders and lowlands in France by Prof. Bart Schultz
















			
<p>ING_3245 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_32465 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3247 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3249 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>
			
<p>ING_3252 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3253 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3254 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3255 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>

Table III. Pictures on polders and lowlands in France by Prof. Bart Schultz (continued)

			
<p>ING_3256 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3257 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3258 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3259 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>
			
<p>ING_3261 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3262 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	<p>ING_3263 Remaining of the Benedictine monastery in Maillezais, from where monks in the 12th century have reclaimed parts of the Poitou swamps, 23 June 2016</p>	