MONITORING REPORT PILOT blankaart

Content

1. INTRODUCTION

The pilot Blankaart is a major habitat restoration and habitat development project in Flanders (Belgium). The pilot area is approximately 950 ha large.

A short introductory video on the pilot Blankaart and its involvement in the project Carbon Connect can be viewed on the following link.

https://www.youtube.com/watch?v=FD1hG9ZrUTg

The pilot area is situated in the floodplain of the river IJzer. Location of the pilot is indicated in figure 1. Figure 8 shows an orthophotograph of the area, with the area involved as pilot area in Carbon Connects. This pilot area is 505 ha large. The river IJzer flows west of the pilot area. A digital hight model gives an indication of the level of altitude of the pilot area. The pilot area acts as a transit area of evacuated water from the higher agricultural land (arable land) to the east. This agricultural area has elevations up to 25 tot 30 m higher than the pilot area. Water from an area of approximately 6000 ha is evacuated towards the pilot area, from where is pumped into the river IJzer. The location of the pumping station is indicated on figure 7 (annex). During periods of high rain fall (mainly in winter), the pilot area gets flooded. In 2021 the flooding lasted nearly one month, with water level exceding 4,25 m TAW during 2 weeks. During this period mean water depth was approximately 1,25 m. An area of more than 900 ha was flooded.

The pilot area is a peat area where from the Middle Ages onwards peat was extracted. The 50 ha large pond 'Blankaartvijver' is the result of the historical peat extraction. Nevertheless peat is still present in the soil over large parts of the area.

In the northern part of the pilot a large area consists mainly of peat extracted soils. Even in this zone locally peat is still present. The map in figure 5 is based on an intensive soil mapping carried out by VLM. Additional drillings give detailed soil profiles,with depths of the peat layer and in some drillings thickness of the peat layer. On figure 5 the depth under the surface of the peat is indicated for some parts of the pilot. Locally the peat is nearly surfacing, whereas in other parts the clay layer can have a thickness of 1 m or more. Peat layer thickness varies from 30 cm up to more than 1,5 m.

Historically the area mainly consisted of wet meadows, with reed marsh, primarily situated along the 50 ha large pond 'Blankaartvijver'. The area has been an important nature conservation area since the 1950's, when the 'Blankaartvijver' became a nature reserve. The protected area has expanded extensively since then. Now a total area of more than 600 ha is protected as a nature reserve, either by Natuurpunt or by the Agency for Nature and Forests. The remainder of the parcels are still privately owned and mainly used as agricultural land. On most of these parcels there are legal restrictions on the use of fertilizers or manure.

Since the 1970's, and particularly the 1980's, the area has experienced an excessive lowering of water level for the purpose of agricultural intensification. As a result habitats deteriorated rapidly.

In the 1970's a water drinkingwater production plant was installed, with a prominent waterbasin of 60 ha. On the orthophotograph this plant an basin is readily visible as the centrally lying polygon.

In 1988 the area was designated as a Special Protected Area Birds Directive. In order to meet the goals as part of the Natura 2000 network a habtitat restoration programme was initiated with the signing of a framework agreement in 2001 by all authorities involved, together with the farming organisations and the nature conservation organisation that has been managing a part of the pilot area as a nature reserve for some since the 1950's. In 2006 additionally a nature development project ('natuurinrichtingsproject') was installed by the Flemish Government. Habitats presents before restoration started are indicated on figure 9. Target habitats are presented on figure 10.

The most important measure taken for the habitat restoration is an area-wide rise of the surface water level. The rise of the water level is implemented gradually in different phases. In figure 12 the different phases of the rewetting are indicated. The first phase of the rewetting was initiated in 2012 in one part of the pilot area. In 2019 the second phase was established in the other part of the pilot area.

This means that the pilot area can be differentiated spatially in two zones:

- Zone phase 1: intermediate rewetting is established in 2012
- Zone phase 2: intermediate rewetting is established in 2019

Final rewetting level can, as defined in the framework agreement, only be initiated once most of the lower lying plots of land are acquired by the Flemisch authorities or the ngo Natuurpunt. At this stage still 115 ha of land need to be acquired in order to proceed to the final water level rise, which is optimal for habitat restoration.

Phase 2 was established as part of the project Carbon Connects in September 2019. The presence of peat in the soil and the lowering of the groundwater table over the last decades most probably gives excessive peat oxidation and thus carbon emission from the soil. Rewetting the area can mitigate this carbon emission.

2. Objective of the monitoring

The objective of the monitoring conducted in the pilot Blankaart is to verify the following:

a. ***Are the targeted surface water levels, as agreed in a agreement between all actors in the area reached***
b. ***What is the effect of the rise of the surface water level on the ground water level***
c. ***Do the rise of surface and groundwater level have any effect on the peat layer in the soil***

3. Hydrological situation before and after rewetting

On the map in figure 13 the hydrological situation before the rewetting in phase 2 is presented. The pumping station located at the river IJzer evacuates alle excess surface water into the river. The amount of evacuation is regulated by agreed fixed minimum and maximum surface water levels. Levels before and after rewetting phase 2 are depicted in table 1.

Water is evacuated towards the pumping station through the central waterway 'Stenensluisvaart'. This waterway forms the connection between the large pond 'Blankaartvijver' and the pumping station at the river IJzer. It evacuates the excess water that enters the pond through the several brooks that flow from the higher lying plateau east and south of the pilot area. Half way between the pond and the pumping station there is an automated weir on the Stenensluisvaart which regulates water levels in zone phase 1 after the implementation of the rewetting in 2012. The water from zone phase 2 is enters the Stenensluisvaart halfway between the weir and the pumping station. The area from which the water is evacuated through zone phase 2 is indicated on figure 13. Part of this area is located outside the project area of the pilot Blankaart. In order to implement a rise of water level in the zone phase 2 , the area needs to be hydrologically isolated from this upstream lying area. There an essential part of the rewetting phase 2 was the building of an new pumping station which evacuates the water from the upstream area outside the project area. The location is indicated on figure 14, which shows the hydrological situation after implementation of phase 2. To reach the water level in zone phase 2 pumping conditions in the pumping station were adjusted.

4. Surface water levels before and after rewetting

A time series of surfacewater levels was used to compare water levels before and after rewetting. The location of the sampling site is indicated on figure 15. This site is part of a network of several measurement points managed by the Flemish Environmental Agency. Table 1 gives the water levels before rewetting (October 2019) and the targets of water levels after rewetting for 3 differents periods. For the periode before rewetting a time series from 2009 untill October 2019 was used.

	Measured levels before rewetting (m TAW)	Target after rewetting (m TAW)
1/12-31/01	2,68	2,90
1/2-15/10	2,52	2,70
16/10-30/11	2,54	2,80

Table 1: Targeted levels after rewetting and mean levels of surface water before rewetting

There is a minimum level of surface water after implementation of phase 2 of 2,70 m TAW during the period February untill October 15th: 18 cm higher than mean level before rewetting in this period. During the period December – January minimum level is 2,90 m TAW: 32 cm higher than the mean level before rewetting. From October 16th untill November 30th there is an intermediate period with a targated minimum of 2,80 m TAW: 26 cm higher than measured levels before rewetting.

In table 2 monthly mean surfacewater level is depicted fort he periods before and after rewetting in October 2019. Overall there is a 15 cm higher mean annual water level after the rewetting.

Water level in cm TAW: monthly mean	January	February	March	April	May	June	July	August	September	October	November	December	Mean	Difference
Surface water 2009-2019	274	268	262	259	257	256	244	245	246	250	257	272	258	
Surface water 2019 - 2022	309	274	286	278	263	263	258	252	255	269	276	290	273	15
Difference before / after (cm)	35	5	24	19	7	7	14	7	9	18	20	18	15	

Table 2 Monthly mean surface water levels in zone phase 2 before and after the rewetting in 2019.

It can be seen that differences are somewhat smaller during the period May - September (7 – 14 cm in), whereas differences are much higher in the winter months (January 35 cm higher). Initially it was estimated that the annual mean difference between before and after would be 13 cm. Results are thus in agreement with these predictions. These results are also depicted in figure 1. In this figure the targets of minimum water levels are added. It can be seen that in the period May – September the minimum level of 2,70 m TAW is not attained. It is because of the higher than foreseen levels in the period December – April that a mean water level rise of 15 cm is achieved.

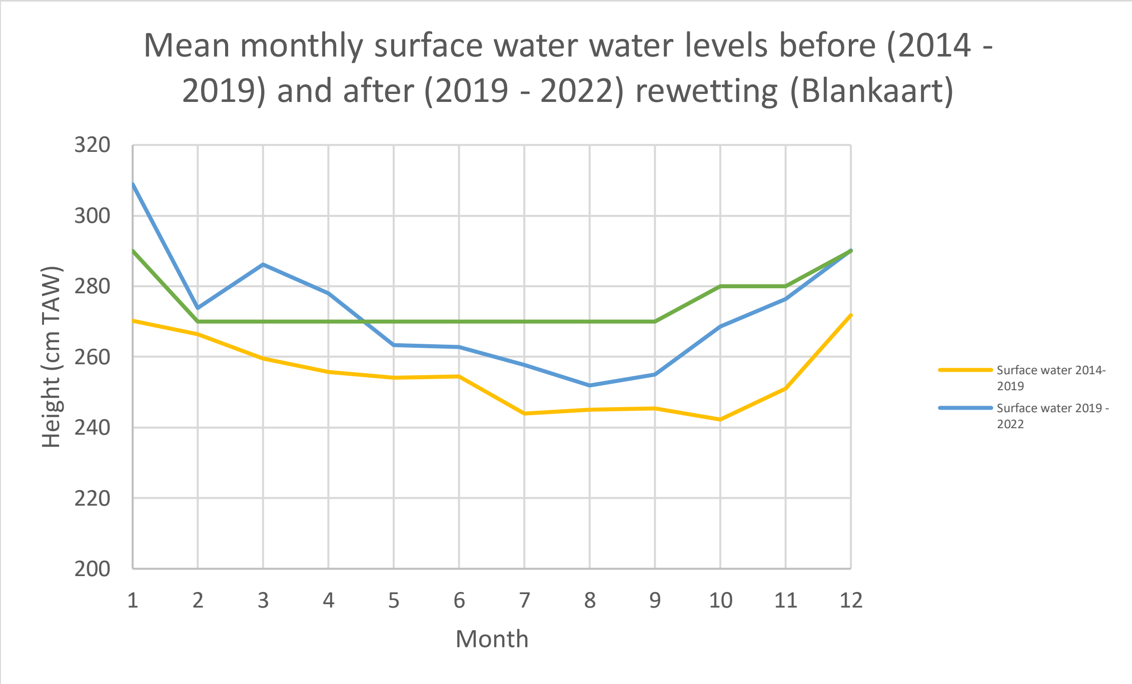

Figure 1 Mean monthly surface water levels before and after rewetting

5. GROUNDWATER LEVELS BEFORE AND AFTER REWETTING

A network of piezometers managed by VLM is operational since 2006, both in zone phase 1 (rewetted since 2012) and zone phase 2 (rewetted since 2019). These data generate continuous time series of ground water levels. Two time series from two piezometers are available for zone phase 2 from 2009 onwards (PBL28, PBL17). These times serie are however not complete, but data are complementary. Surface water levels are continuously measured on several locations. One of these locations is used in the analysis. Locations of the sampling sites are indicated on the map of figure 15.

In table 3 monthly mean level in PBL 28 is presented for the period before and after the rewetting. The annual mean rise of the groundwater level at this location is 33 cm. In contrast with the surfacewater, it is during the period May – September that the largest differences between before and after occur (32 – 64 cm). The rise of groundwater levels is caused by the higher surface water levels. So despite the rather small rise of surface water in the period May – September (7 – 14 cm), a rise of groundwater of 32 to 64 cm is generated.

The surface of the soil at this location is 2,75 m TAW. The mean groundwater level is 2,77 m TAW. This means that only from mid April untill the beginning of October groundwater level is under de soil surface, dropping to 22 cm (average) under soil surface during summer. Before rewetting annual mean groundwater level was 30 cm under soil surface, with averag levels of 80 cm under soil surface during summer.

The mean monthly groundwater levels before and after are presented in figure 2.

Water level in cm TAW: monthly mean	January	February	March	April	May	June	July	August	September	October	November	December	Mean	Difference
Groundwater 2009 - 2019 (PBL28)	293	282	274	252	229	198	195	199	210	233	257	302	244	
Groundwater 2019 - 2021 (PBL28)	315	307	298	268	260	253	259	253	253	274	287	296	277	33
Difference before / after (cm)	22	25	24	16	32	55	64	54	43	41	30	-5	33	

Table 3 Monthly mean groundwater levels before and after rewetting.

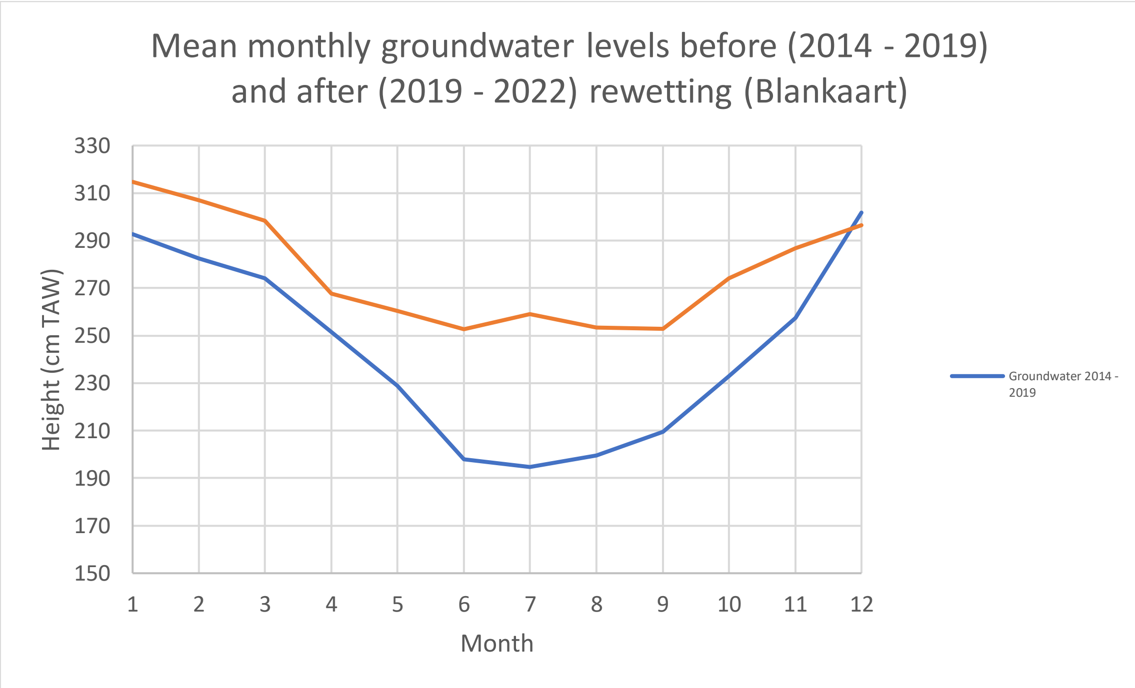

Figure 2 Mean monthly groundwater levels before and after rewetting

6. Correlation between surfacewater and groundwater

Figure 3 gives a time series of surfacewater and groundwater levels from 2009 – 2021. In this figure data for piezometer PBL17 are also presented as there is a period for which measurements in PBL28 are missing. It can be seen that in the 2009 – 2013 water levels in both piezometers are quite alike. So water levels of PBL 28 in this periode will be similar to those of PBL17.

From this figure it can be seen that generally there is a good correlation between groundwater levels and surfacewater levels in the periods with higher surfacewater levels. In the period before rewetting this does not count for the summer periods, where we see large drops of groundwater level, whereas surfacewater levels remain more or less constant. This is especially noticeable for the summers of 2013 and 2014, where surfacewater level remains around 2,50 m TAW, but groundwater drops to 1,60 m TAW. The summer of 2017 was very hot and dry. Surfacewater level dropped to 2,20 m TAW, but groundwater dropped under 1,50 m TAW (1,25 m under surface). It seems that after rewetting there is a better correlation between groundwater level and surfacewater level.

This correlation is shown in figures 4 and 5. The correlation before rewetting seems to be non-linear, whereby at low groundwater levels (under 2,50 m TAW), there is hardly any correlation. At higher groundwater levels (+ 2,80 m TAW) there is a more linear relationship. After rewetting both groundwater levels and surface water levels are higher and the relationship is linear. Higher surface water levels give better correlation (linear) with ground water levels. This means that rewetting by means of a substantial rise of the surface water level is a very effective measure for rising the ground water level in the pilot Blankaart

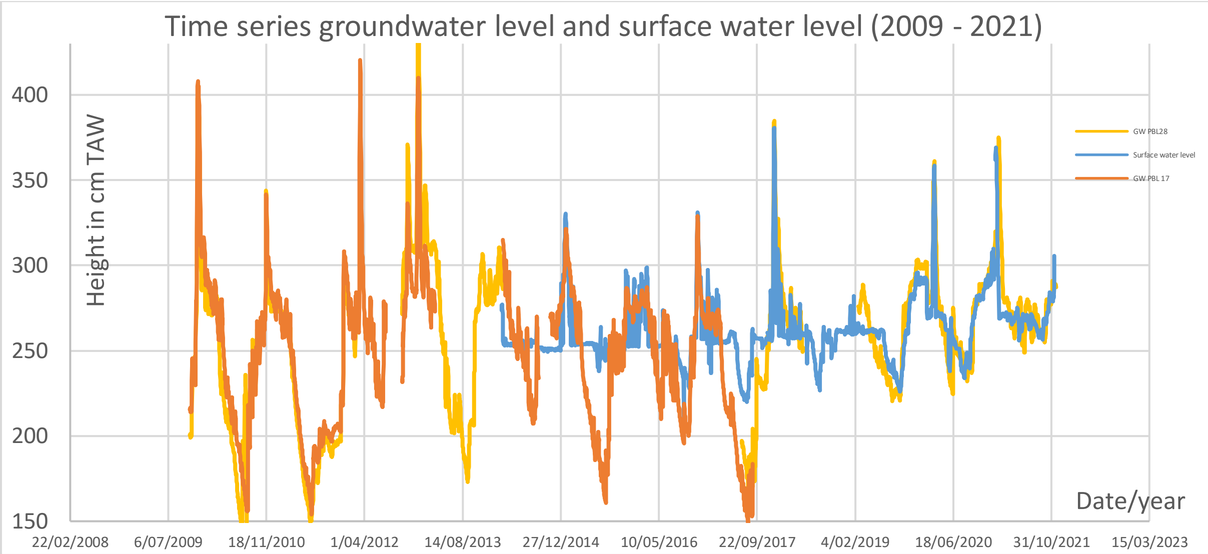

Figure 3 Time series for groundwater and surface water level before and after rewetting.

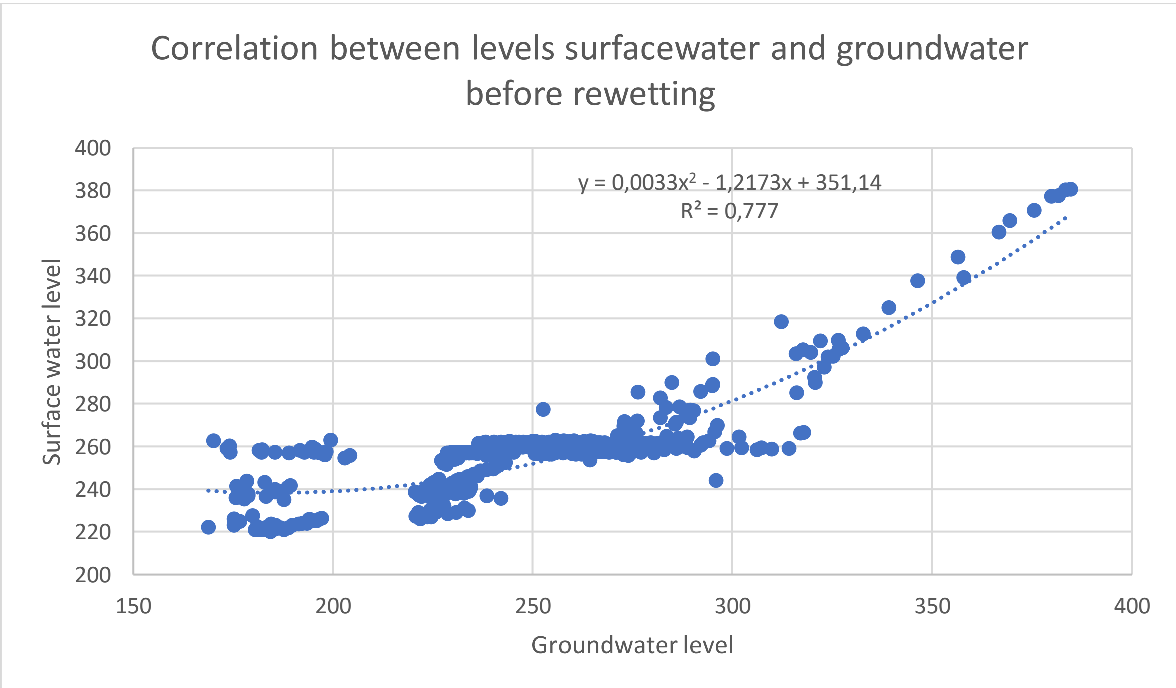

Figure 4 Correlation between levels of groundwater and surface before rewetting.

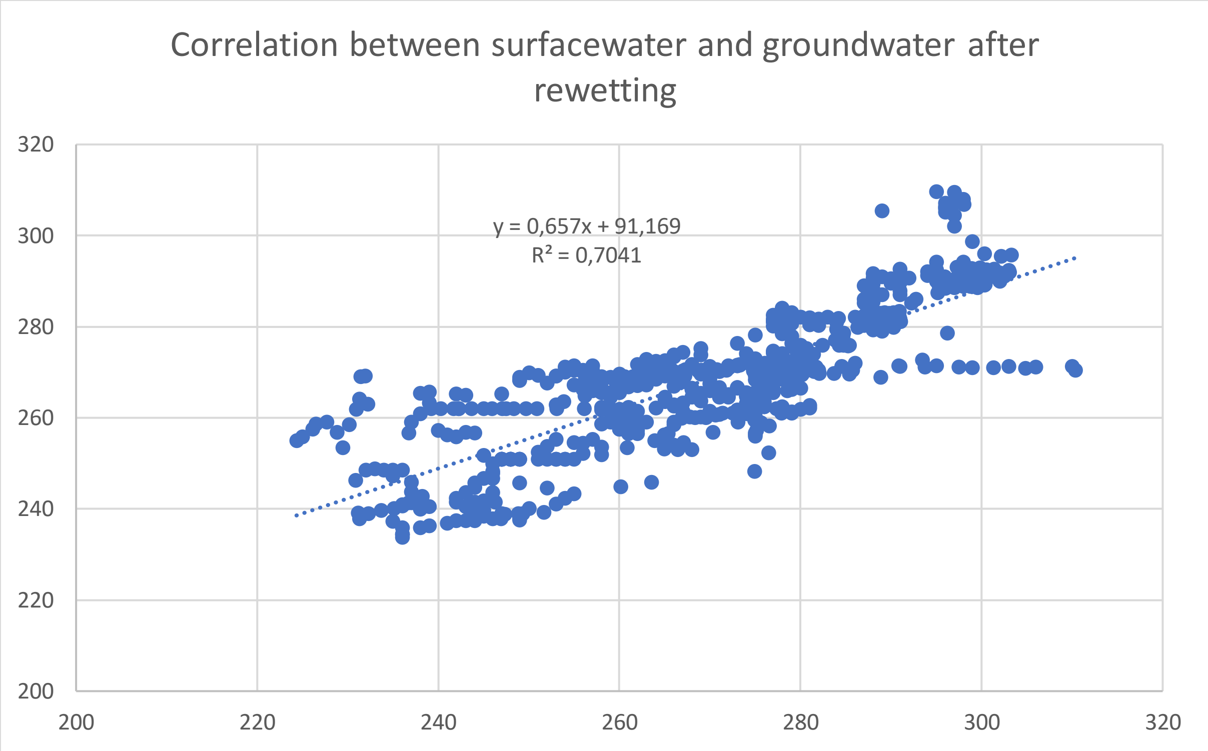

Figure 5 Correlation between levels of groundwater and surface after rewetting.

7. Groundwater levels and peat conservation

At the location of the piezometer PBL028 a peat layer of approximately 1 m thick is present at approximately 40 to 45 cm under soil surface. It is covered by a clay layer. The top of this peat layer sits at approximately 2,30 m TAW. Soil surface is at 2,75 m TAW.

In figure 6 the impact of the fluctuating groundwater level on the peat layer is presented. Before the rewetting, and especially visible in the years 2009 up to 2013, there were prolonged periods (up to six months) during which the groundwater level was substantially under the top of the peat layer. Consequently during these periods the peat layer was prone to oxidation, generating a substantial carbon-emission from the soil.

After the rewetting groundwater doesn't drop under the top of the peat layer anymore, which means that because of the rewetting the peat layer remains saturated with water, preventing oxidation of the peat and thus lowering carbon emission from the soil.

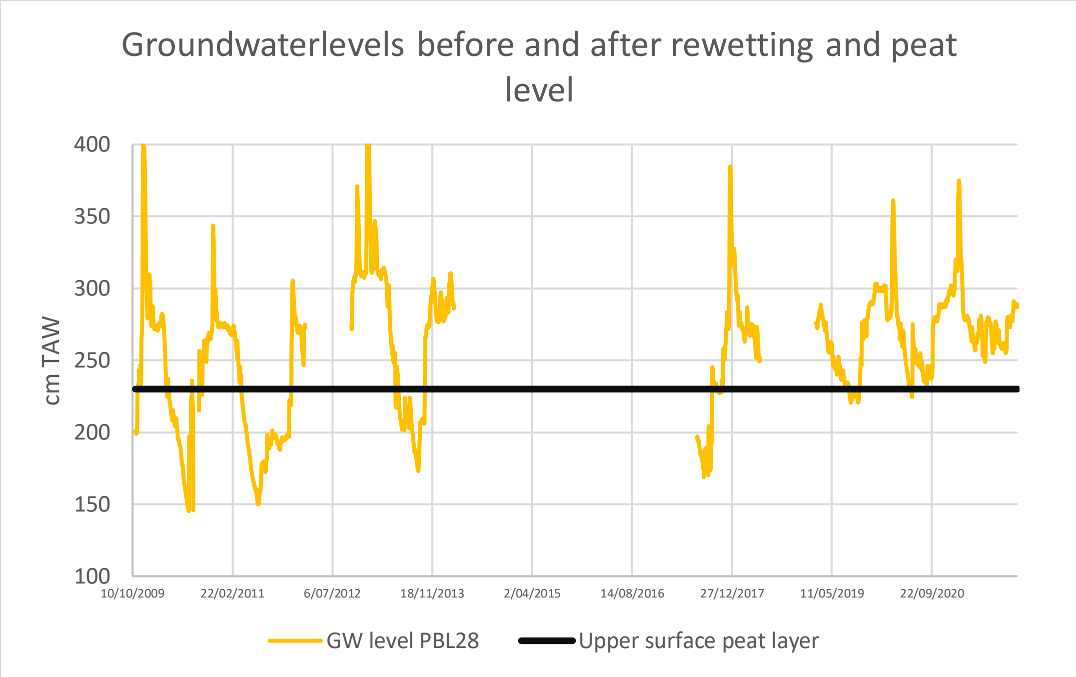

Figure 6 groundwater level and peat layer before and after rewetting

8. Conclusions

A. The water level rise implemented in 2019 has reached its targets, with a mean rise of the surface water level of 15 cm on a yearly basis

B. Groundwater levels have reacted positively on the rise of the surface water level: at the lower lying areas (under 2,80 m TAW) groundwater has risen with 33 cm on a yearly basis. Difference in groundwater level between before and after rewetting is highest in summer. Rising the surface water level is thus an very effective measure for increasing groundwater levels.

C. The rise of the groundwater level is enough to keep the peat layer in the soil saturated with water yearround.

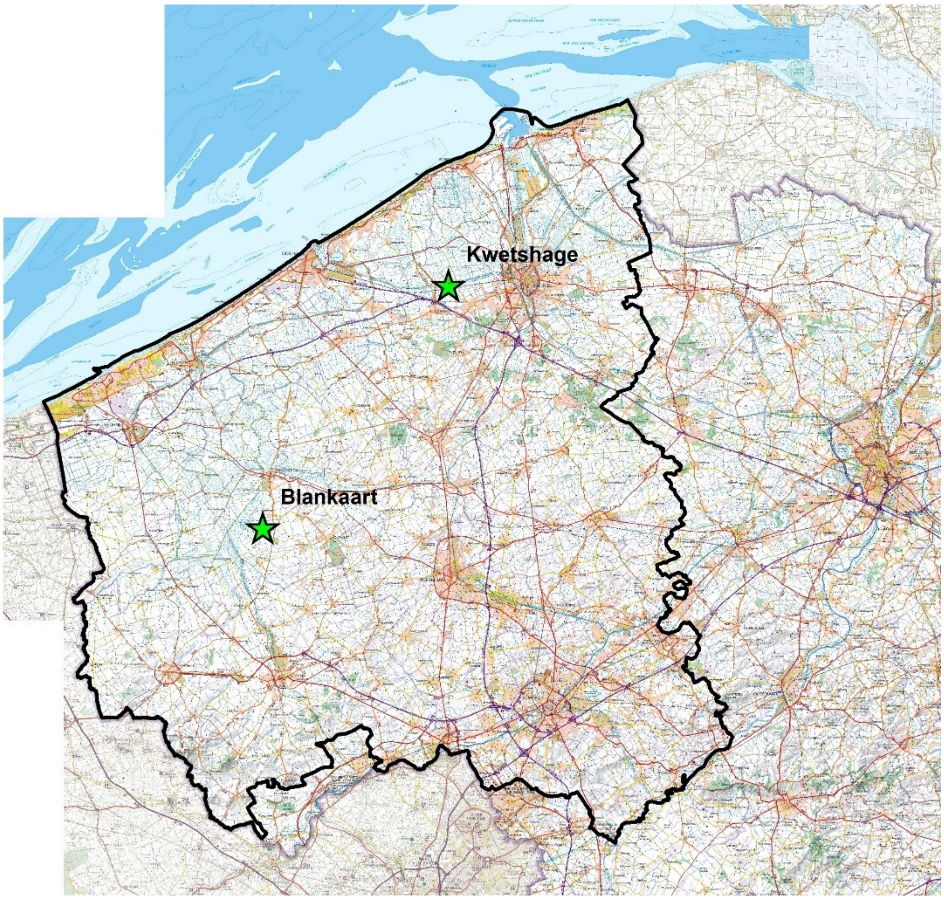

Figure 7 Location of the pilot Blankaart

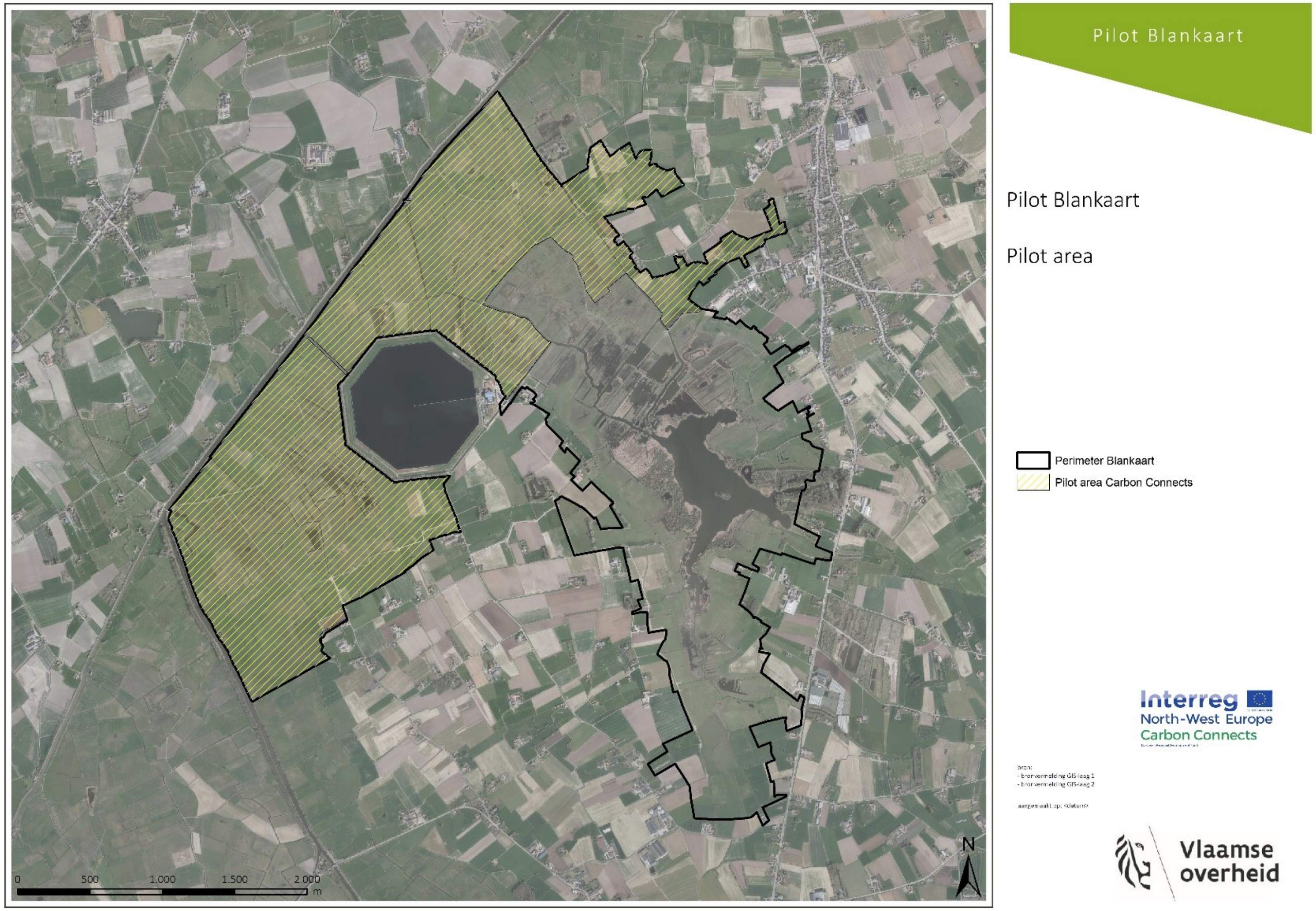

Figure 8 Orthophotograph of the pilot area with the area involved in Carbon Connects

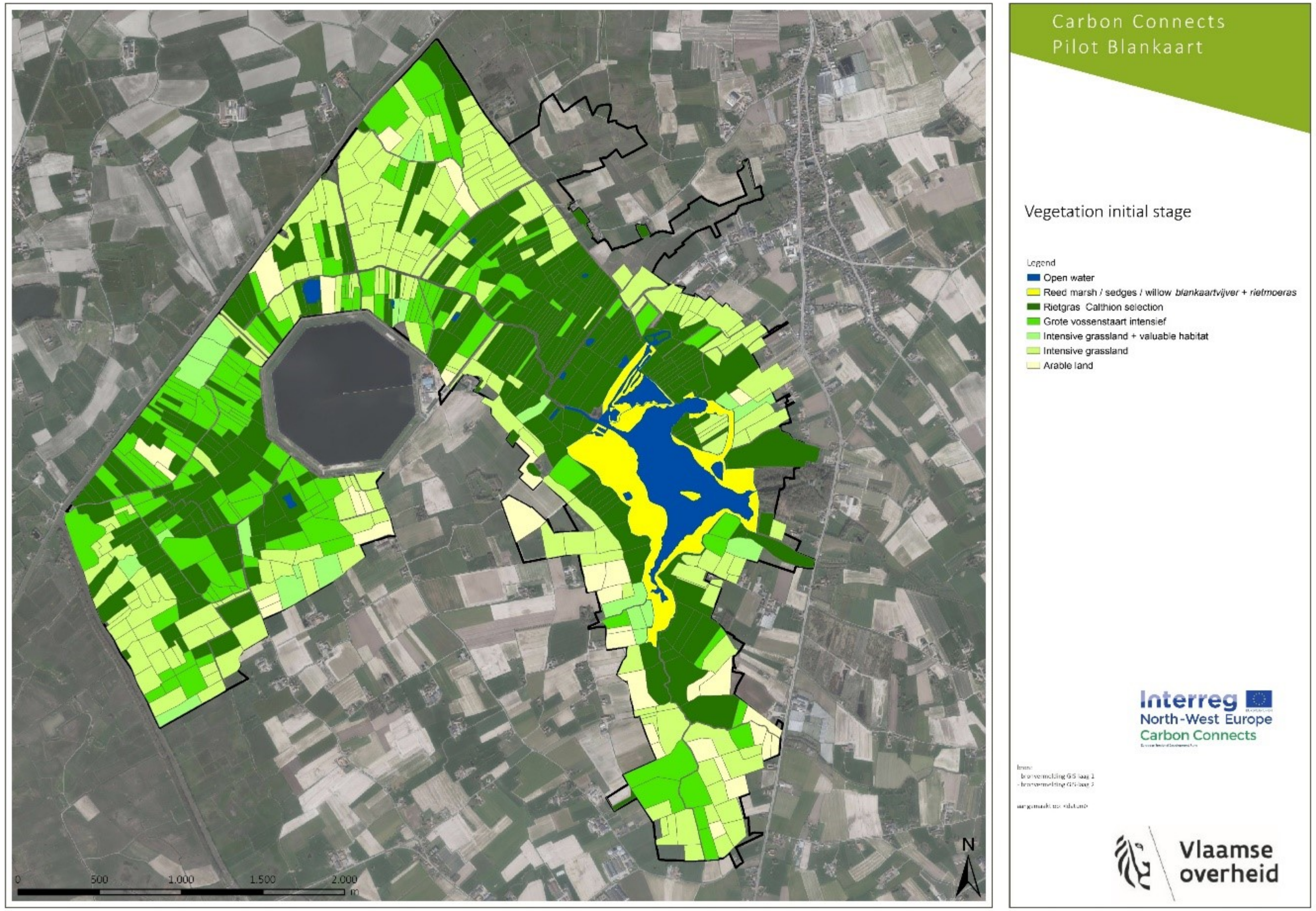

Figure 9 Habitats in the project area present before habitat restoration started

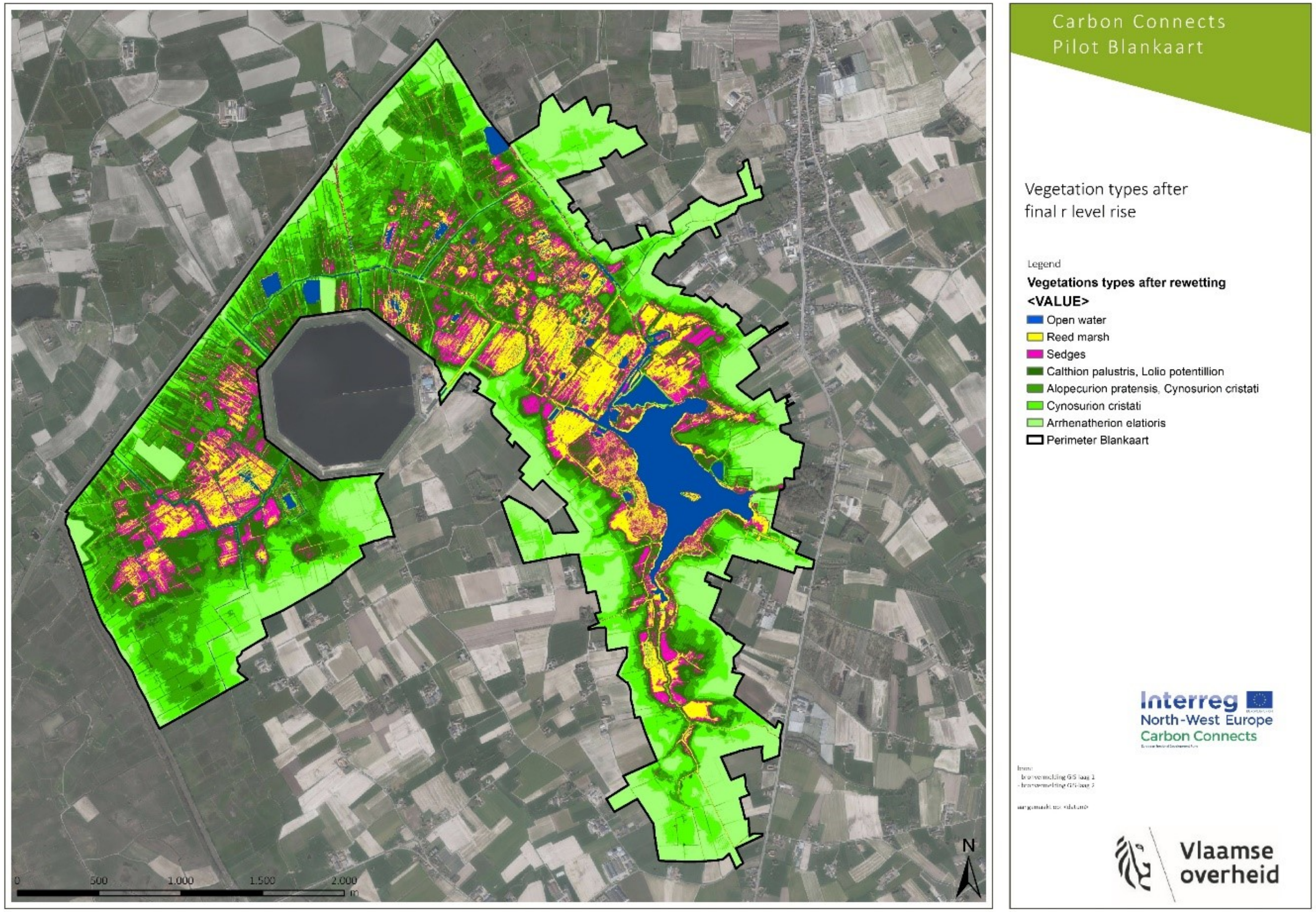

Figure 10 Target habitats of the habitat restoration in the pilot Blankaart

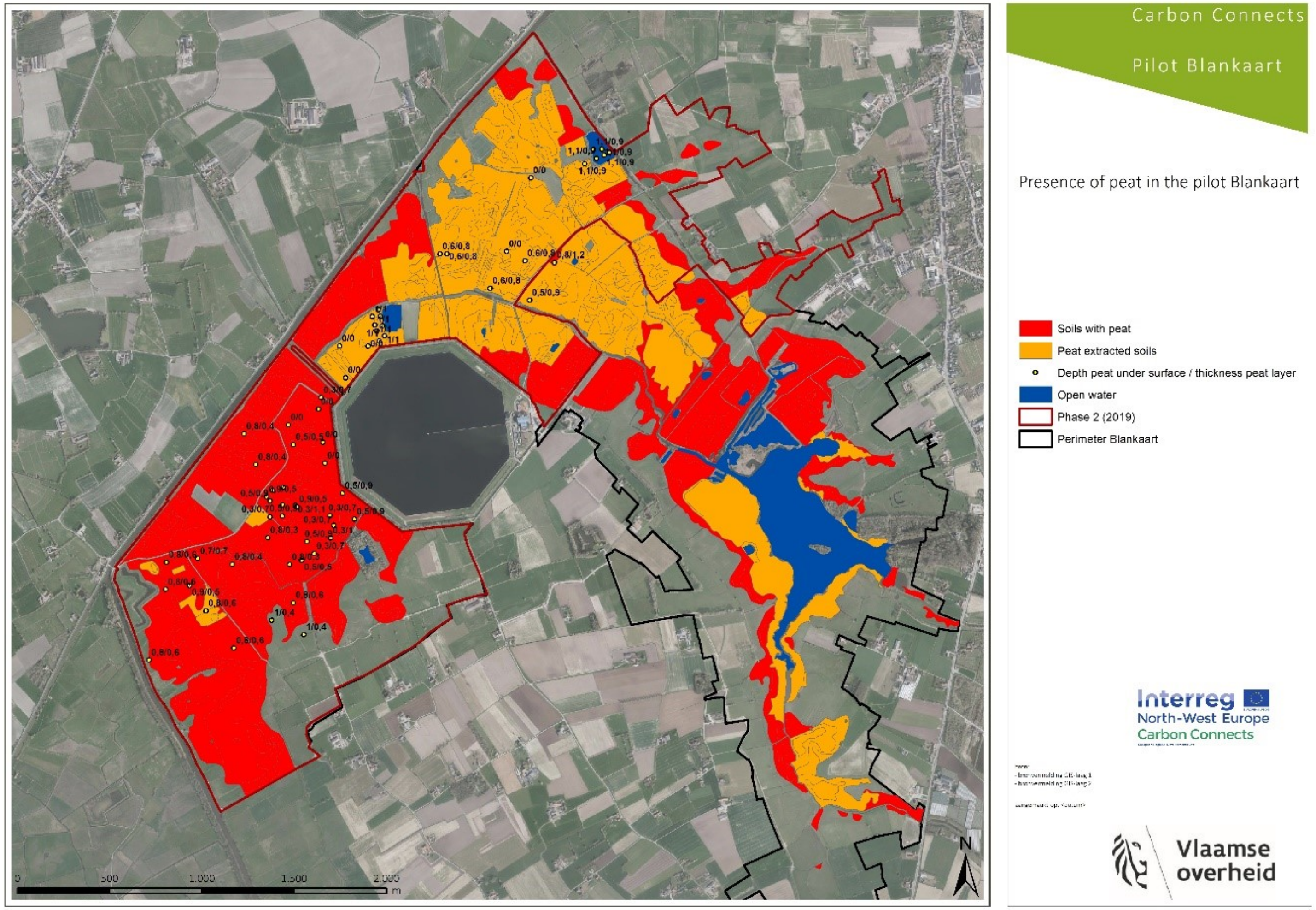

Figure 11 Map showing areas in the pilot Blankaart with peat present in the soil. Thikness and depth of the peat layer is indicated.

Figure 12 Phases of rewetting in Blankaart

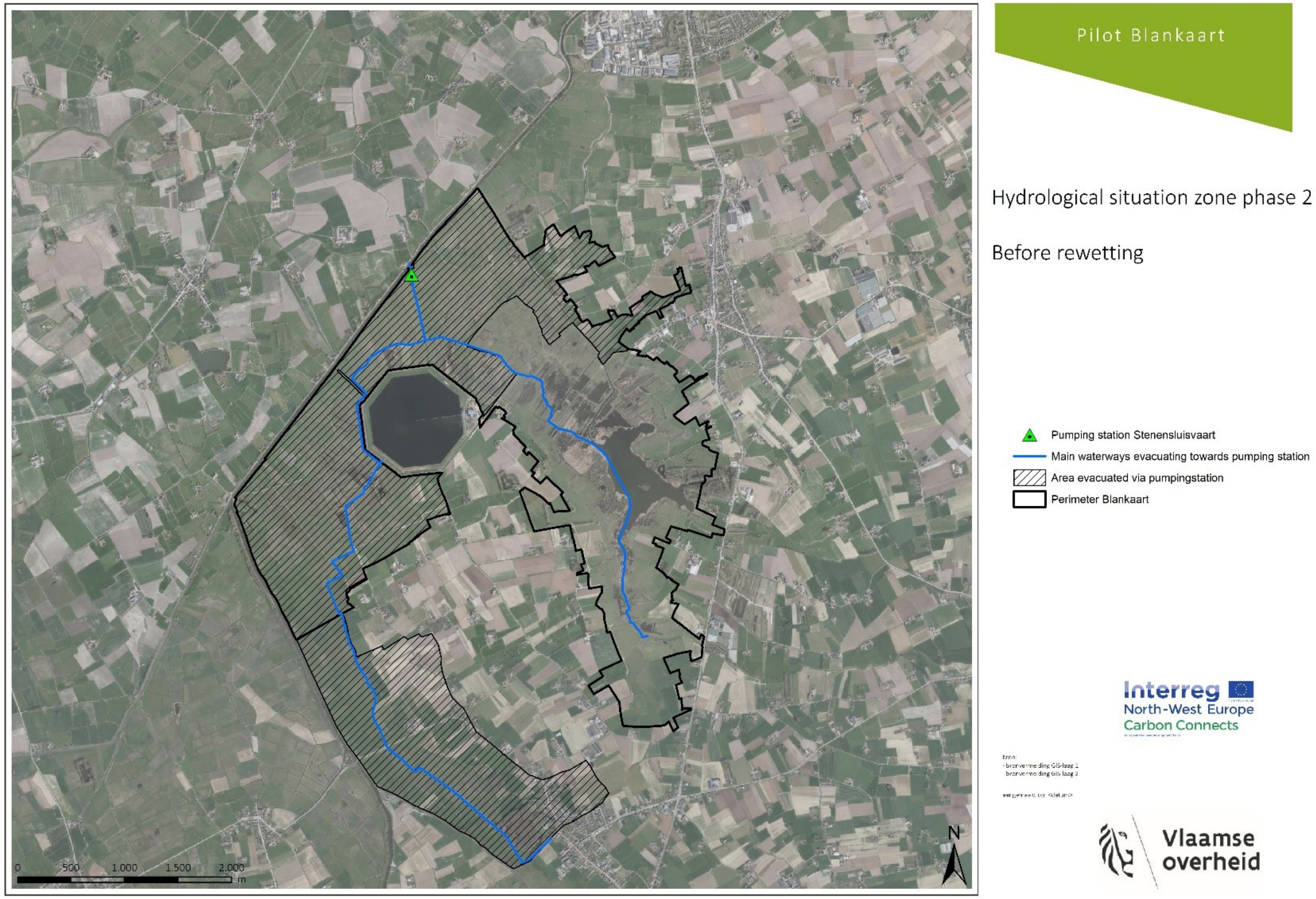

Figure 13 Hydrological situation before rewetting phase 2

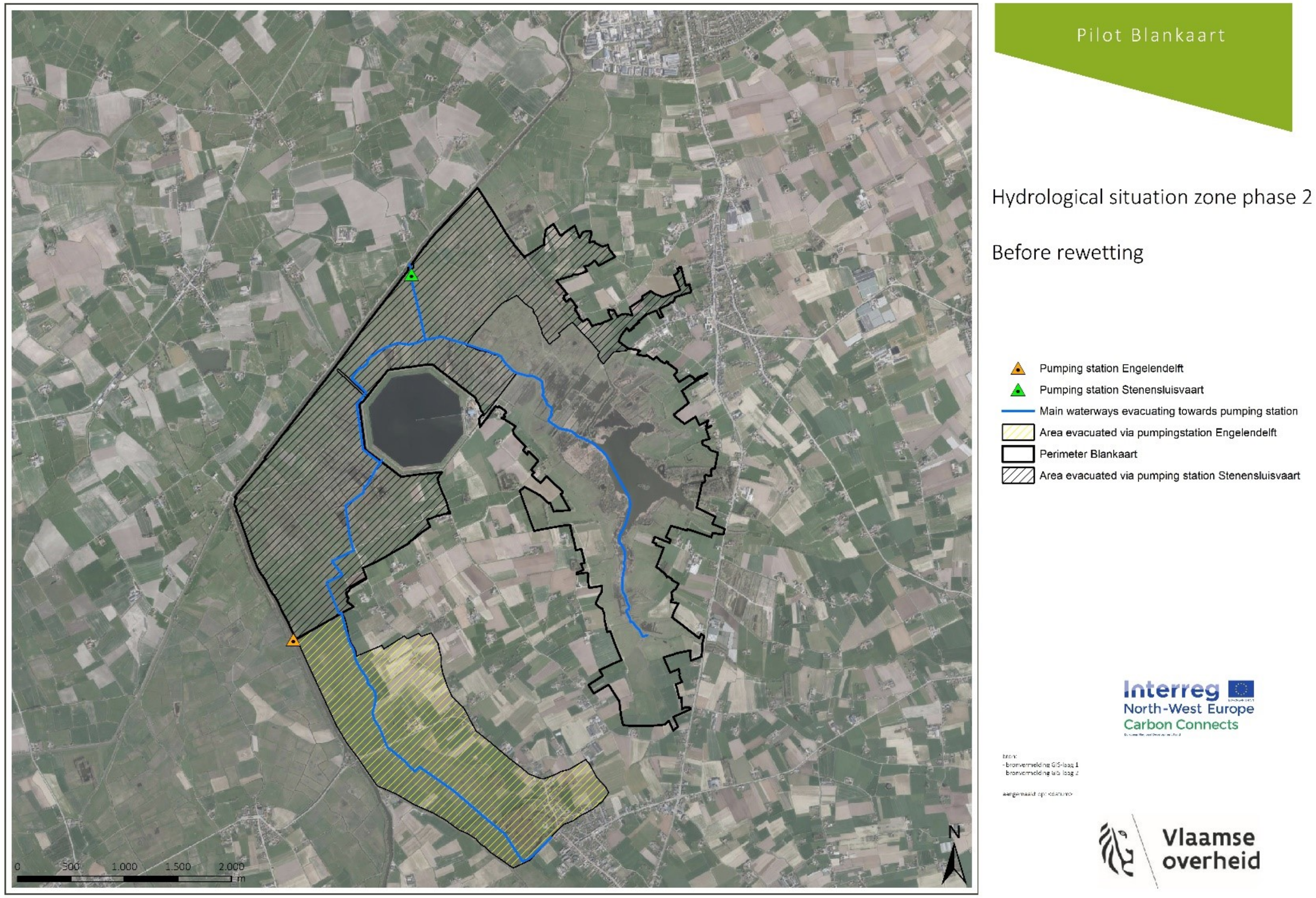

Figure 14 Hydrological situation after rewetting phase 2

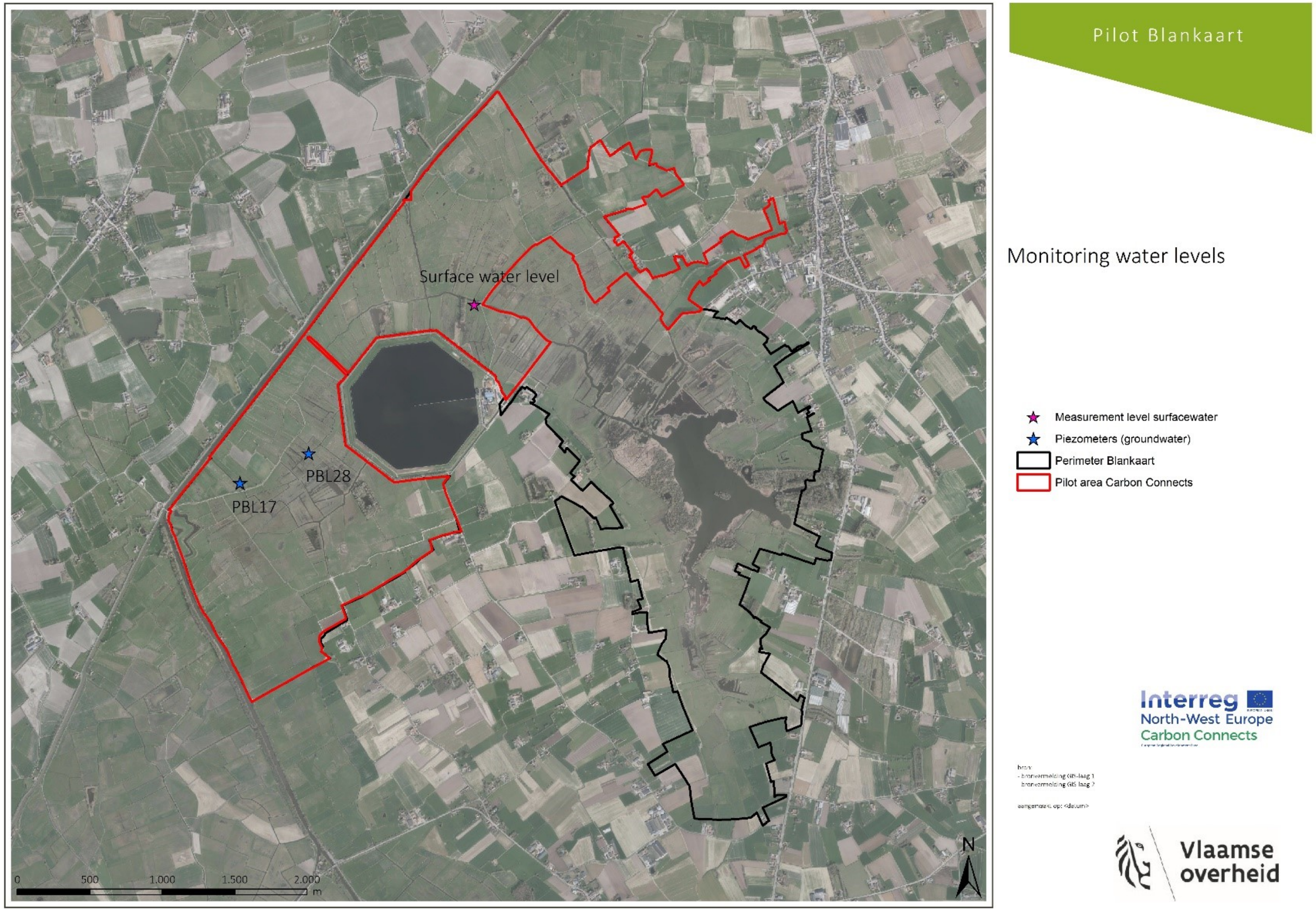

Figure 15 Location of sampling sites for groundwater and surface water