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SHORT-TERM COASTAL IMPACT OF LAKESHORE RECONSTRUCTION FOR NATURAL RESERVE PROTECTION

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ABSTRACT

The site of Grangettes, which is registered as a natural reserve of national and international importance for waterowl and migratory birds (i.e. OROEM site), is considered the last part of the Swiss lakeshore of Lake Geneva that remains natural. This area hosts a wide variety of coastal ecosystems, containing significant natural values located both in aquatic and in terrestrial areas of the reserve. Because of repetitive localized dredging activities of the lake bottom since the last century, a severe withdraw of the shoreline and its associated natural values has been observed between 1964 and 2001 close to the « Gros Brasset » dredge pit.

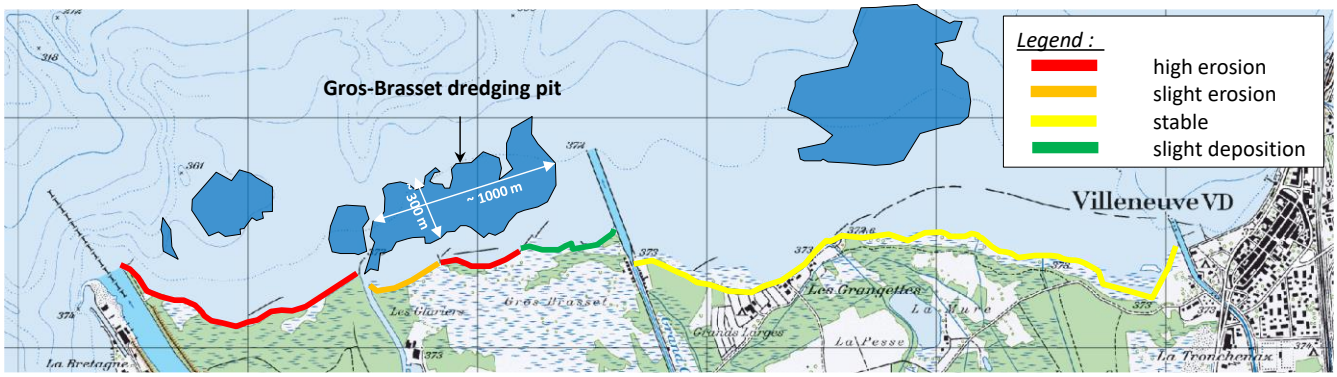

Figure 1. Localization of the "Gros-Brasset" dredging pit and shoreline evolution.

To prevent further erosion and reconstruct part of the shoreline, erosion mitigation measures have been numerically modelled and optimized and are applied at the site since several years. They are monitored by the cantonal authorities through an evolutive process. Numerical modelling highlights the negative impact of the dredging pit on the significant wave height reaching the shoreline. An additional 4 m of water depth created by massive dredging activities increased the significant wave height by 24% at a high lake level and by 44% at a low lake level (Fig. 2), thereby increasing the erosive power during progressive wave dissipation.

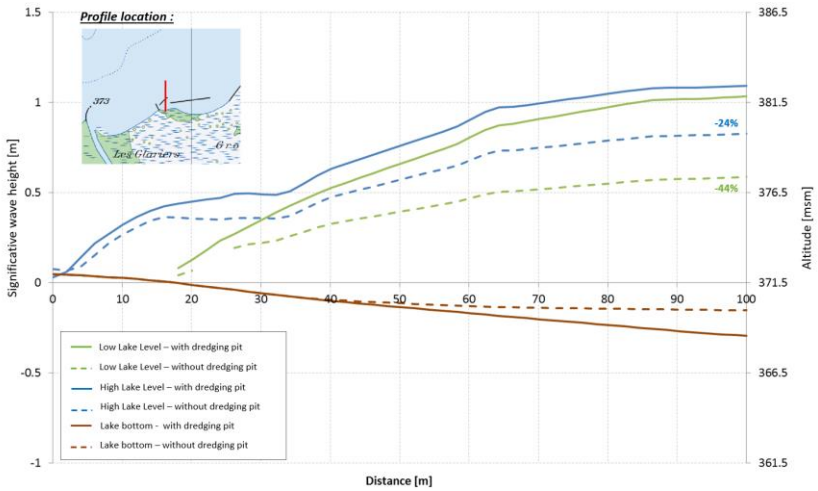

Figure 2. Influence of dredging pit on significative wave height.

Furthermore, as an alternative to a complete backfilling of the historic dredging pits, numerical modelling showed that fine sediment deposition in a well-chosen offshore area between 100 m and 250 m from the shoreline was also very effective in reducing the wave heights, saving millions of m^3 of sediments.

Sediments have been deposited by use of appropriate vessels allowing to release significant volumes through one single operation, by opening the hull of the vessel. Once the deepest part of the pit had been backfilled, it turned out that the remaining volumes to fill were technically difficult to perform. In fact, as the water depth decreased during the filling process, two problems arose: firstly, the fact that only small vessels with shallow draught could be used and, secondly, the difficulty of manoeuvring between the sediment deposits. Also, because of the high natural value of the site, onshore nourishment was not feasible. Therefore, it was decided to not fill the last metres of the nearshore trench, but to keep on backfilling offshore trenches and to count onstorm waves to transport the sediment to the shoreline.

The monitoring of this backfilling campaign is carried out by bathymetric echosounding, twice a year, of the areas with water depths larger than 3 m, and by key profile measurements by a maritime drone, once a year, in the same areas. Furthermore,a detailed aerial photography is made once a year based on an UAV flight. These measurements are used to monitor the evolution of fine sediment deposits in critical areas, to compare key profiles and to visualise the evolution of the shoreline.

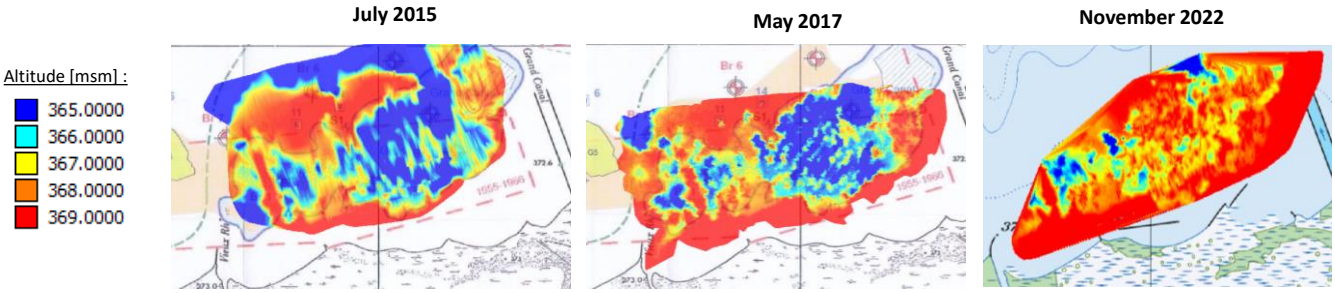

Figure 3. Bathymetric evolution from July 2015 (before bottom reconstruction) and November 2022 (latest measurement)

During the 7 years of filling, nearly 500,000 m^3 of fine sediment has been deposited, increasing the volume of the shoreline by about 200,000 m^3 and the offshore part by about 250,000 m^3. The follow-up campaigns showed that, depending on the deposited volumes, the natural littoral transport and the frequency and intensity of storm events, some years tended towards deposition and some years towards erosion, but the overall balance of the shoreline is quasi neutral. The offshore deposition did not significantly increase the shoreline in the first 100 metres, but the trend based on the profile measurement is either a stabilisation of the shoreline or deposition, which also means that no further erosion has been recorded. Numerical evaluation of the influence of this filling campaign is still in progress, and the results will be presented in the article.