D.4.2.1. Efficiency of the storage tank

Document Control Sheet

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INTRODUCTION

Monitoring of the efficiency of the pilot site are useful to verify the positive impact of tank infrastructure in environmental terms and it will be possible to measure the number of pollutants released into the environment and not properly treated in the purification plant.
All information obtained by the sensors and in-situ analysis are necessary for the management of the spill water in the sea. In case the water quality does not meet the requirements concerning the health status of urban wastewaters, the pumping system loops back these waters to the purification plant to reduce the microbial load.
During the extreme rainfalls events that could cause an overflow from the tank and an increase of the microbial contamination, the system generates an automatic alert and consequently the collected data are used as input into the forecast operating model in order to identify the critical areas (offshore or along cost) affected by spillage in order to prohibit the bathing.

1. Microbial load control after the tank

We have analysed the faecal bacteria after the tank. The specific function of the tank is to retain the first rainwater during a rain event that involves mixing of runoff water and the wastewater running through the sewerage system. The two water masses are usually characterized by a very high load of microbiological pollutants derived from the drainage runoff at the beginning of the rain event.

The involved area to the tank water collect is to covering ~ 7 hectares, lies near the Arzilla River and belongs to the Municipality of Fano, a seaside town in Marches (Fig. 1). The area is strongly urbanized and a popular summer resort.

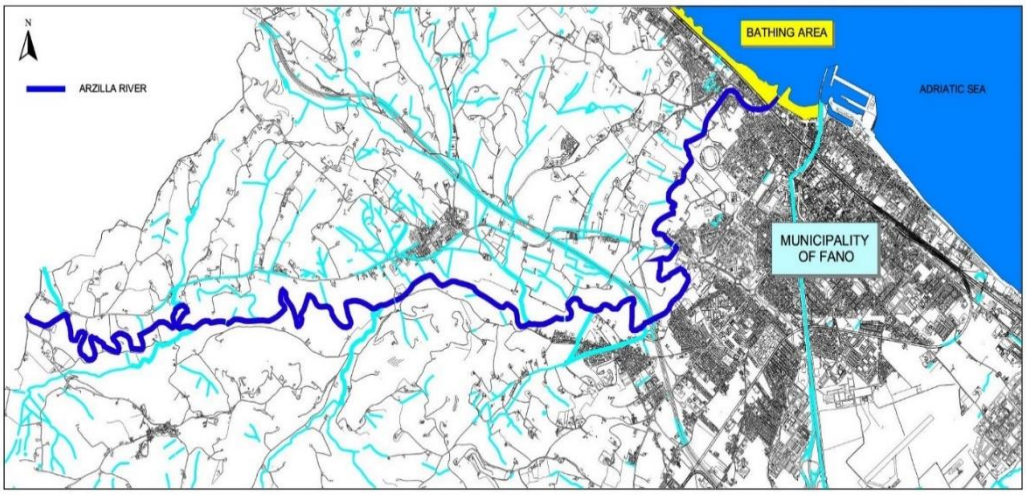

Figure 1. Study area with the course of the Arzilla River (blue) and the recreational beach (yellow).

As shown in Figure 2, there are two sewer catchments, one in via del Moletto (basin A; 3. 40 hectares) and the other in via 1° Maggio (basin B; 3.80 hectares), whose drainage systems are not connected to one another.
After the tank is put into operation the wastewater from the two basins is delivered through two com-bined pipes, one from each basin, discharge the wastewater into the reservoir; the wastewater is subsequently pumped to the nearby lift station.

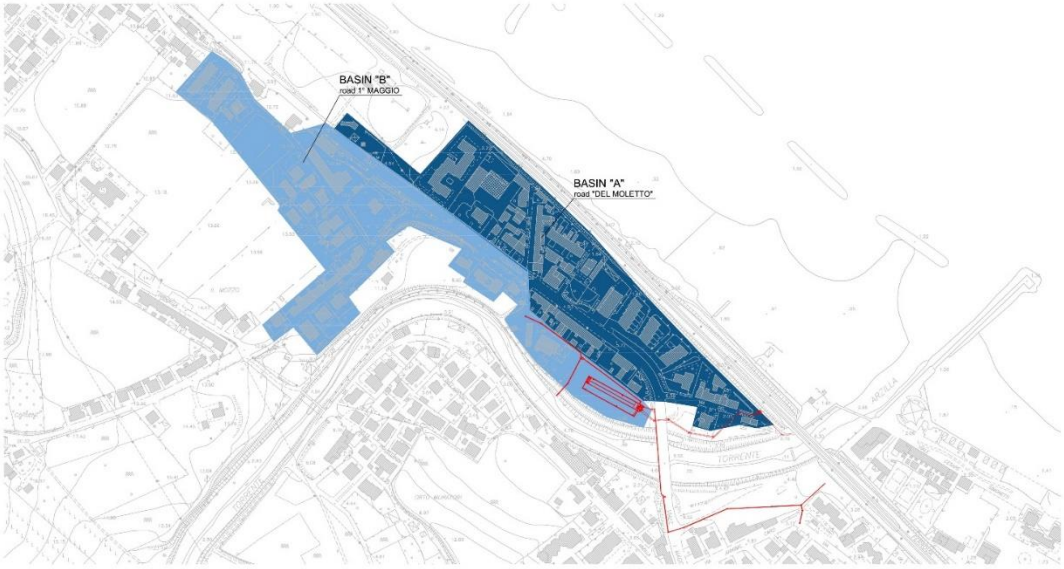

Figure 2. The two-sewer catchment.

To assess the environmental effect of the reservoir, i.e. the reduction of microbial pollution of bathing water, and quantify its impact, we collected water samples both in the tank and at two sites (upstream and mouth) along the Arzilla River after a rain event during the 26 September 2021 (Table1).

During the monitoring, the water samples for microbiological analysis of faecal contamination with *Escherichia coli* and intestinal enterococci were collected manually in sterile bottles (final volume 1000 mL) from the detention tank and the Arzilla River, both upstream and at the river mouth. The bottles were immediately transported to the laboratory at in situ temperature in the dark and processed within a few hours of collection. *E. coli* and intestinal enterococci were analysed using culture-based methods as described previously (Penna et al., 2021).

The concentrations of *E. coli* and intestinal enterococci measured in the tank were one order of magnitude higher than those measured at the two sites along the river. Yet, despite the large amount of faecal coliforms collected in the tank water, which would have compounded the impact of the storm on the bathing site, concentrations at both river sampling sites still exceeded the limit set by Directive 2006/7/EC.

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However, it is highly likely that part of the *E.coli* and enterococci found at the mouth of the river came from other overflows upstream of the river that did not find their way to the tank. These results were published in Romei *et al.* (2021).

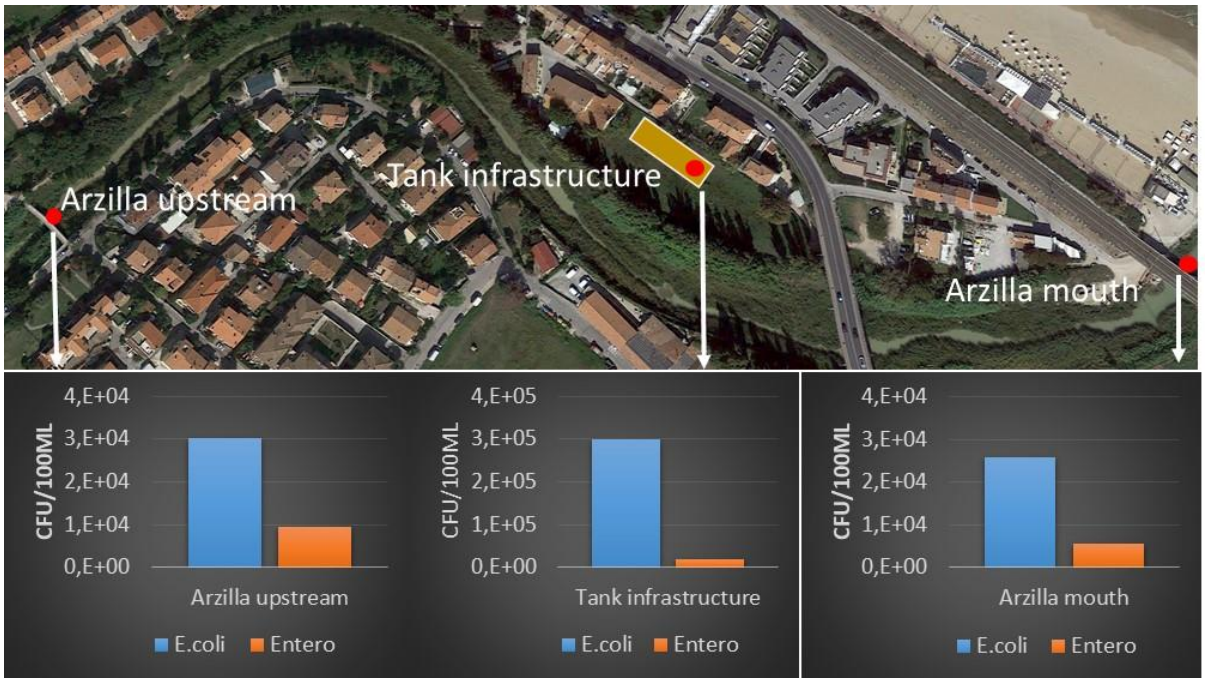

Figure 3. (From: Romei *et al.* 2021) shows the results of the *Escherichia coli* (E.coli) and intestinal enterococci (Entero) measured at the three sampling sites (Arzilla River, upstream; Tank; and Arzilla River, mouth) after an intense rainy event (27 mm 30 min^{-1}).

Table 1. Rainfall and wastewater storage in the tank in September 2021.

Date	Rain height	Rain intensity, max	Event duration	Volume stored in tank
	(mm)	(mm h^{-1})	(h-mm)	(m^3)
26/09/2021	30	340	15min	807

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List of References

Romei, M.; Lucertini, M.; Esposito Renzoni, E.; Baldrighi, E.; Grilli, F.; Manini, E.; Marini, M.; Iagnemma, L. 2021. A Detention Reservoir Reduced Combined Sewer Overflows and BathingWater Contamination due to Intense Rainfall. Water, 13, 3425. https://doi.org/10.3390/w13233425

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