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Pilot Action: Milan Functional Urban Area

1. Pilot Action Milan FUA

Milan FUA is one of the most densely populated areas in Lombardy (northern Italy). In particular, in the FUA of Milan about 2.254.263 inhabitants live within 521 km^2. The northern area of FUA is characterised by a dense agglomeration of companies, and especially near the Milano City historically (from '50) are located many industries such as automotive, refineries, chemical plants, still and tires production. Because of the high hydraulic conductivity and the high groundwater withdrawal rate (public withdrawal is within 8000 l/s), Milan represents a drainage area of groundwater and many pollutants flows into municipality.

Especially the north-west area of Milan has since '70 a direct effect on water quality near water supply wells at pumping station in Milan. Thus, the area is hit by several plumes, which deteriorate groundwater quality over decades. It is very important to evaluate the extension of the plumes and distinguish areas within the FUA where concentration values exceed the national threshold values.
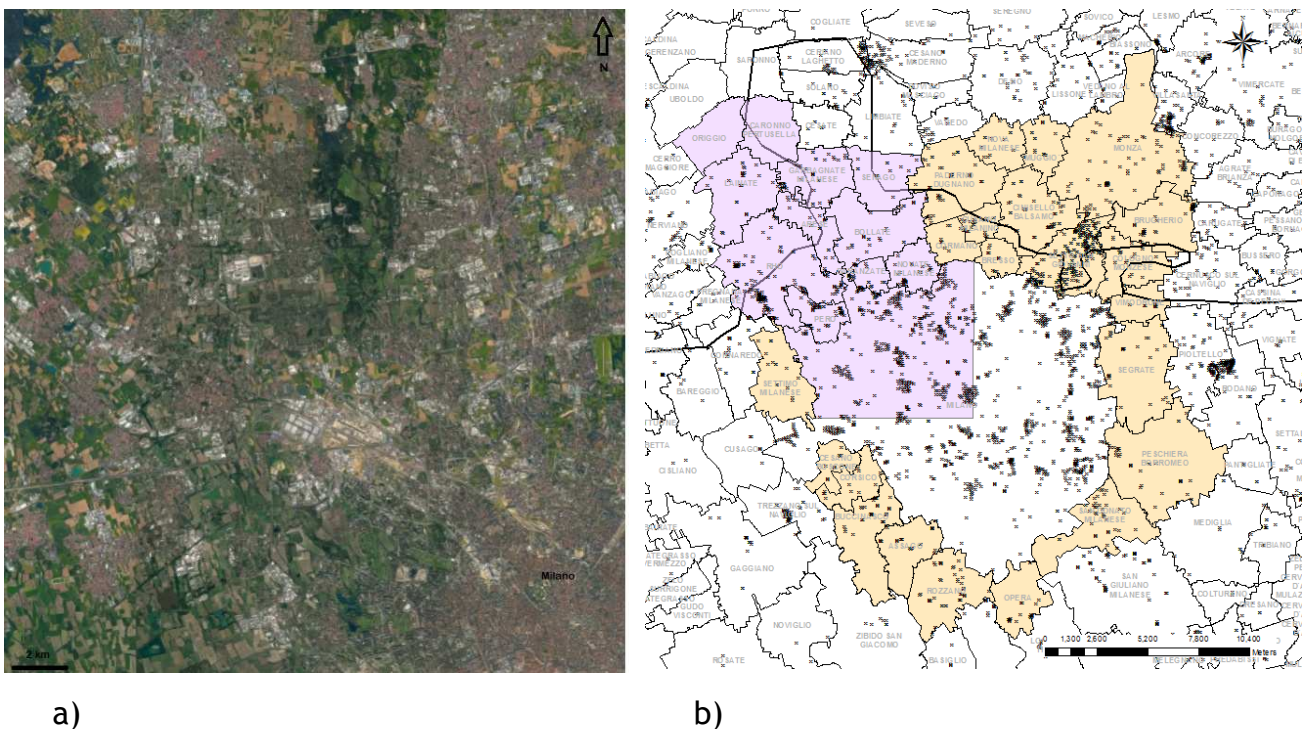

a)   b)

Figure 1 - a) satellite view of the area of pilot action, b) GIS representation of the area of interst: pilot action in violet and in yellow the FUA of Milan.

In Figure 1 are represented respectively a satellite view of the pilot area (a) and a GIS schematization of the pilot area and the Milan FUA. As it is showed in figure 1 a) the area is very densely anthropized and, consequently, populated.

Nowadays, the pilot action (about 12 municipalities within the violet coloured area with 617.773 inhabitants) is densely populated, and especially near the northern border of Milan it is heavily industrialised. More than 34 contaminated sites are located in this

zone. Of these about 10 are known or suspected to discharge chlorinated solvents in the groundwater. Many plumes involve/affect/include both shallow and deep aquifer. It became important to distinguish in this area the contribution of these plumes and the diffuse contamination that afflicts the groundwater bodies.

A lot of single site investigation and remediation took place in the area in the last decades. Additional field studies (hydrogeological and numerical model) were developed within PLUMES PROJECT (ARPA for Lombardy Region) in order to identify hotspots responsible of the plumes. Considering all monitoring wells hit by plumes, a geostatistical analysis was performed in order to have/define/calculate a preliminary value of diffuse contamination. In the pilot area many groundwater wells are built in different aquifers, see Figure 2.
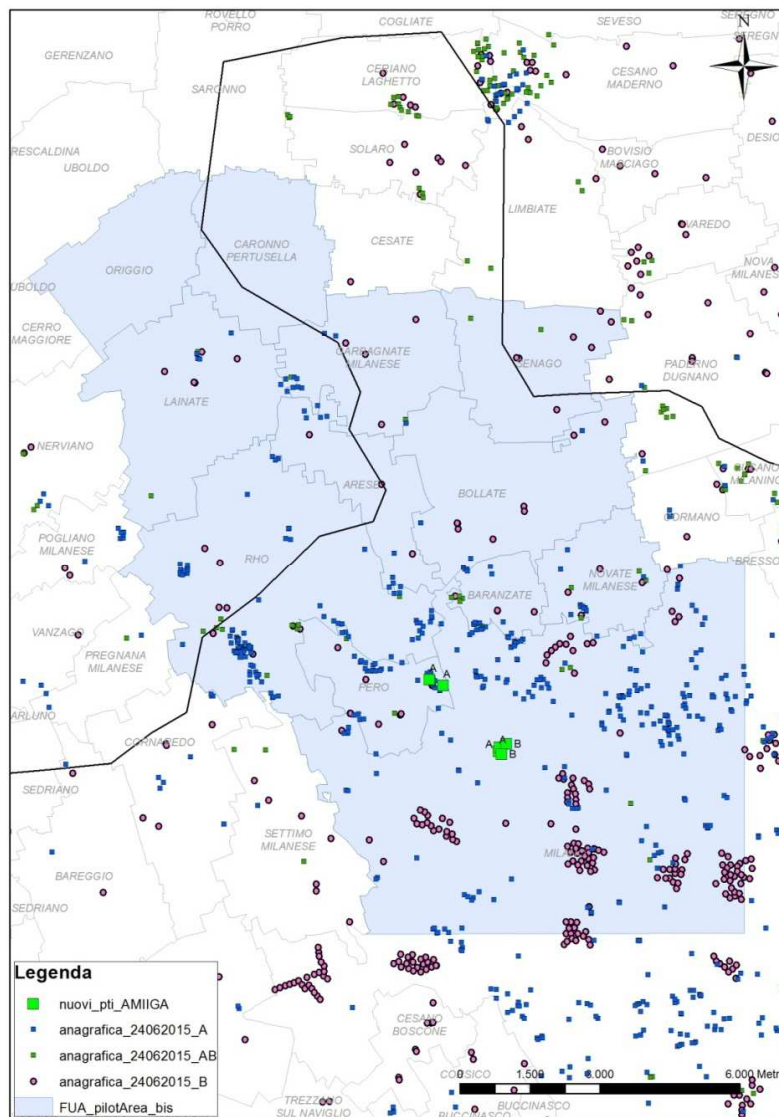

Figure 2 Representation of the groundwater monitoring wells in the pilot area: in violet the deep wells/piezometers, in blue the shallow wells/piezometers and in green the new piezometers that will be realized within AMIIGA project.

Figure 3 shows the geological build-up through the project area. An aquitard (thickness of 10 meters of low permeability) divides a shallow aquifer with a sand gravel material with a relative high hydraulic conductivity from a deep aquifer, which is constituted by fine sand. The separation of two aquifers becomes more and more discontinuous in the norther part of Milan.
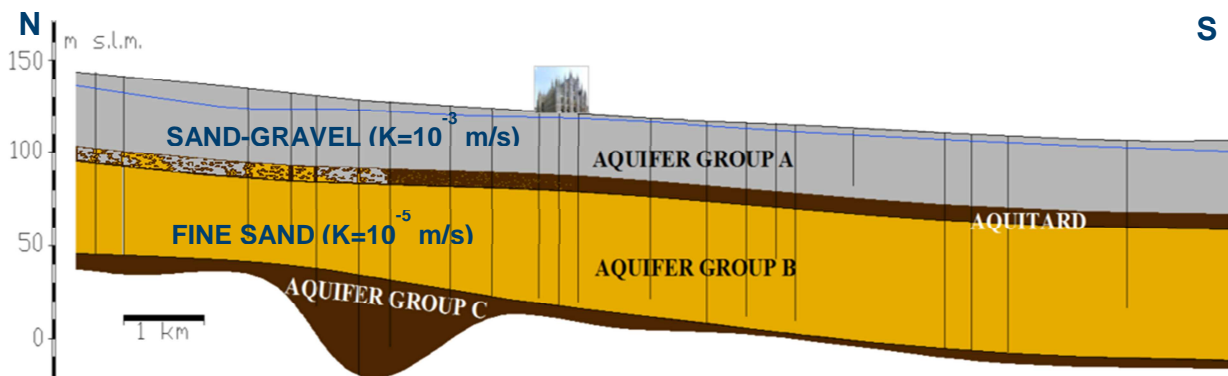

Figure 3 Geological build-up with the delineation of the FUA aquifers.

Because of this hydrogeological conformation, many plumes in the northern municipalities can flow from shallow to deeper aquifers causing pollution in deeper wells. In Figure 4, the Tetrachloroethylene concentrations monitored from 2003 to 2014 are represented. While the higher values (red colour-brown colour) could be representative of hotspot contamination and associated to possible plumes extension, the values within 10 μg/l could be linked to diffuse contamination. In the next step, strategies and methodologies to handle the diffuse contamination and the contamination plumes will be developed within the AMIIGA project.
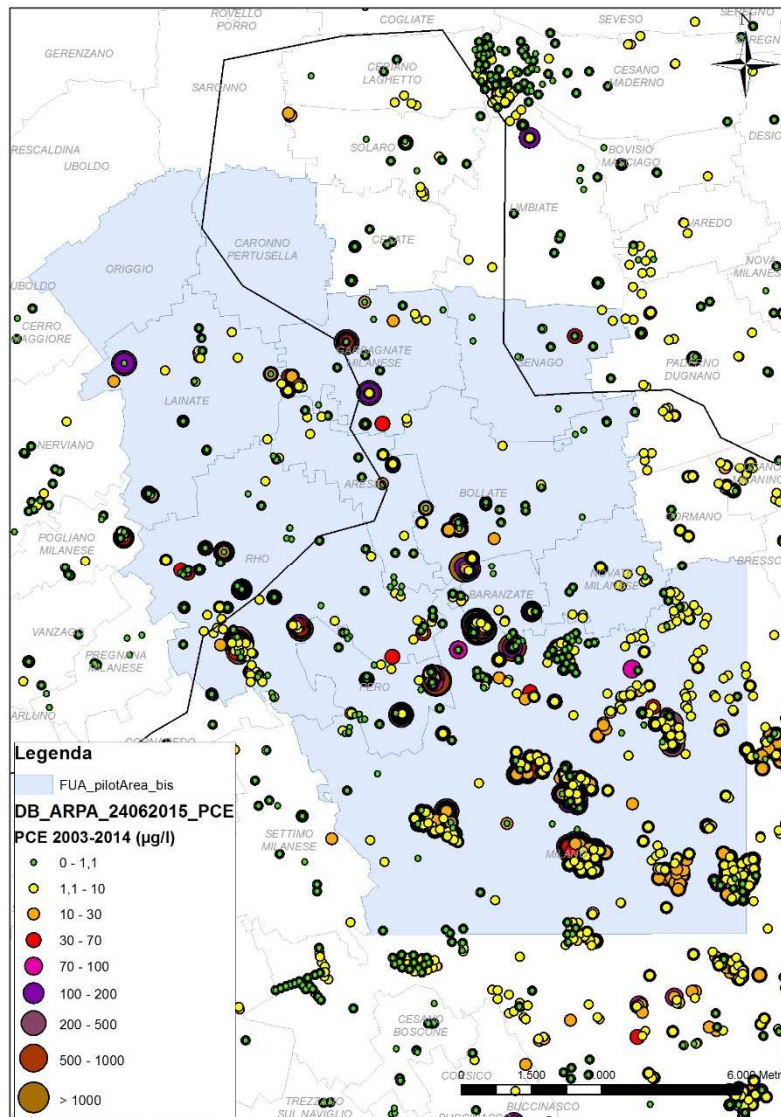
Figure 4 Tetrachloroethylene monitoring wells/piezometers – from 2003 to 2014.

The following activities are planned in FUA Milan:

- Hydrogeological and groundwater monitoring data collection (hydraulic and contaminant characterization for shallow and deep aquifer available until 2016) is being updated.

- Hydro-geological and numerical models will be updated in order to improve the results of plume extension in pilot area.

- Six monitoring wells in the deep aquifer will be drilled to optimize the existing groundwater monitoring network in order to distinguish plumes and diffuse contamination area (Four groundwater monitoring wells in the shallow aquifers and two groundwater, see Figure 2).

- The Regional Implementation Group, that will be involved in the preparation of the Groundwater Management plan for the FUA, will officially meet for the first time the 19 of April.

- Three sampling campaigns will be done in order to survey the extension of plumes (PCE, TCE, TCM, cis-DCE, vinyl chloride, methane, sulphates, iron cations, manganese, nitrates, dissolved oxygen) and support their numerical transport modelling. The CSIA analyses will be useful to distinguish plumes from a diffuse contamination in the pilot area.