OUTPUT FACT SHEET

Pilot actions (including investment, if applicable)

Version 2

Project index number and acronym	CE32 AMIIGA
Lead partner	GIG, Glòwny Instytut Gòmictwa
Output number and title	O.T2.4.1 Assessment of Natural Attenuation potential as a remediation option in Parma FUA (IT)
Investment number and title (if applicable)	I3, Drilling of boreholes for Natural Attenuation potential assessment in Parma FUA
Responsible partner (PP name and number)	PP8, EMA, Municipality of Parma
Project website	https://www.interreg-central.eu/Content.Node/AMIIGA.html
Delivery date	05/2019

Summary description of the pilot action (including investment, if applicable) explaining its experimental nature and demonstration character

Max. 3.000 characters

Demonstrative pilot action on evaluating the NA (Natural Attenuation) processes and its applicability at the FUA scale as a perspective option for remediation of groundwater polluted by chlorinated hydrocarbons in the Parma territory. In the studied groundwater, AMIIGA partners decided to verify the NA potential through periodical chemical analyses and through Biological Molecular Tools (BMT) analyses carried out by Technical University of Liberech (TUL - PP5). In particular the following items were investigated: total bacterial biomass (16S rDNA), organohaliderespiring bacteria, nitrifying and denitrifying bacteria, HCH degraders (lindanes), sulphate-reducing bacteria, iron oxidizing and reducing bacteria and BTEX (benzene, toluene, ethylbenzene and xylene) degraders. The results of the BMT analyses can be summarized as:

- denitrifying bacteria, sulfate-reducing bacteria and BTEX degraders were reliably detected
- only slightly active organohalide respiration was detected,

The results have showed that there is not an effective bio-degradation of CHCs (chlorynated hydrocarbon) , so the NA for CHC at the Parma pilot site is not applicable.

The pilot action consisted of 7 sampling campaigns carried out between September 2017 to March 2019 on a monitoring network (MN): the first campaign, n. 0, were carried in the existing MWs (Monitoring Well), before to drill the seven-AMIIGA piezometers. During the sampling campaigns, the chlorinated hydrocarbons and nitrates were investigated. Moreover, some samples, for evaluating the biodegradation of the chlorinated hydrocarbons, were collected. An analysis of the community bacteria that exists at the monitoring well and at the groundwater was carried out at TUL and at University of Parma to identify potential natural attenuation (NA) processes. During two monitoring campaigns some sample for isotope analysis were collected and then processed by Politecnico di Milano and by University of Parma.

Considering that the Municipality of Parma had few monitoring wells (MWs) on the investigated aquifer (the shallow one – up to about 25 m of depth), 7 new MWs were drilled in Autumn 2017 and Spring 2018 upstream and downstream (SW-NE direction) the study area. Now the monitoring network consisted in 12 MWs: seven drilled in the AMIIGA context and five already drilled (in this network, only one piezometer is not owned by the Municipality of Parma).

Finally all the collected data were used to elaborate at first a conceptual model of the aquifer and then a numerical one. The groundwater flow model allowed to estimate the mean groundwater flow direction and the hydraulic properties of the porous media. The backtracking, as FOKS tool, was applied to estimate the potential source area.

NUTS region(s) concerned by the pilot action (relevant NUTS level)

Max. 500 characters

Nuts0: IT, ITALY
Nuts1: ITH, Nord-Est
Nuts2: ITH5, Emilia-Romagna
Nuts3: ITH52, Parma

Investment costs (EUR), if applicable

Total investment costs: 29.879,43 EUR (24.491,34 + VAT 22% 5.388,09)
PP8 has realized 7 new monitoring wells (n. 6 were drilled up to 25 meters, n. 1 up to 30 m).
By and large, the cost items are (VAT 22% excluded):

- implementation works, supply and assembly material: 23.078,00 EUR
- elaboration Reports pursuant to Regional Regulation no. 41/01, art. 17: 700,00 EUR
- security charges not subject to discount (3% on works): 713,34 EUR

All detailed costs related to the Investment in the pilot action 4, can be found in: "INVESTMENT FACT SHEET: I3, Drilling of boreholes for Natural Attenuation potential assessment in Parma FUA".

Expected impact and benefits of the pilot action for the concerned territory and target groups and leverage of additional funds (if applicable)

Max. 2.000 characters

The application of the AMIIGA project has led us to identify a new situation of contamination of the shallow aquifer around the Arlecchino kindergarden. A logical, necessary and adopted consequence is to initiate a technical-bureaucratic process that will lead to manage the pollution phenomenon: a study will be elaborated, defined and codified by the current legislation as Risk Analysis, which will define whether the level of contamination present is acceptable, that is without any risk on the part of the public health (human targets), or if it will be necessary to carry out the appropriate remediation operations.
A second benefit of AMIIGA project was the development of the groundwater monitoring network within the urbanized area of Parma: no. 7 new piezometers were drilled, that allowed and will allow to control the quality of the groundwater environment in the area of the Oltretorrente. These infrastructures could also be used for general clean-up operations should the need arise.
Another positive aspect was to create and develop the awareness, the information and the knowledge on the existence and the real applicability of new investigation methodologies, to clean the aquifers, for the public authorities, stakeholders, professionals, researchers and Universities. In other words, an experimentation and dissemination of operational activities was carried out: activities that the actors of the territory do not (rarely) know and about what they hardly ever know the real potential in terms of results.
To sum up, the successful development of the AMIIGA project involved:
- the identification of a new contamination that will be managed in the best way in order to eliminate the state of potential danger;
- the transfer to the territorial actors of new investigation techniques and knowledge for the management and solution of groundwater contamination;
- the creation and implementation of tools/infrastructure to monitor the quality status of the environment (groundwater).

Sustainability of the pilot action results and transferability to other territories and stakeholders.

Max. 2.000 characters

The most qualifying and sustainable aspects and application activities, which are most suitable for use also in other territories and other subjects / operators are: BMT analysis (Biological Molecular Tools), CSIA (Compound Specific Isotope Analysis) and the processing of a numerical flow model of the aquifer.

In an environmental system characterized by pollution of groundwater from CHC, in consideration of the characteristics and behavior of these substances in the aquifer context, verification of the applicability of Natural Attenuation (NA) processes is extremely important in order to have a further - or complementary - remediation strategy available.

At the present state of knowledge of Parma Municipality, the practice of the potential of NA phenomena in reclamation procedures appears strongly underestimated and almost never taken into consideration. Moreover, the support that the management of the NA could offer to an area subject to the remediation procedure, especially in terms of savings on intervention costs, is evident; therefore, BMT analyzes on the bacterial families present on site constitute the indispensable approach.

Equally important are the CSIA analysis, especially for the purpose to identify the sources of contamination.

Another important instrument that emerged during the implementation of AMIIGA in Parma area is represented by the development of a numerical flow model of the groundwater dynamics (an application already experimented in FOKS project - Interreg CENTRAL EUROPE).

Considering the dynamic peculiarities of CHC, any approach concerning the characterization, remediation and monitoring of polluted groundwater cannot be separated from the knowledge of the groundwater dynamics. This instrument is still little used, at least in the territory of the Municipality of Parma: the consequence is an approach, sometimes approximate, to the drainage activities: this limit is even more marked in areas that present widespread pollution.

Lessons learned and added value of transnational cooperation of the pilot action implementation (including investment, if applicable)

Max. 1000 characters

For the experience gained by Parma staff during AMIIGA, the rewarding items of transnational cooperation in a technical-scientific activity are important. Evaluating the application of investigation, clean-up and monitoring techniques used in territorial contexts with different regulatory approaches, is stimulating and rewarding.
The collaboration has been applied for: BMT (TUL) analysis, CSIA analysis and the implementation of the WebGIS (PoliMi).
An evidence of the added value of transnationality is the awareness that an interdisciplinary and widest approach is the best strategy for a useful site characterization/remediation.
According to the acquired knowledge, in addition to the comparison or confirmation, on the use of new or not new operating techniques, it‘s the conviction to standardize as much as possible the regulations of the clean-up procedures in all EU member states.
We must‘n forget the rewarding value of using a common language between technicians from foreign countries.

Contribution to/ compliance with:

- **relevant regulatory requirements**
- **sustainable development – environmental effects. In case of risk of negative effects, mitigation measures introduced**
- **horizontal principles such as equal opportunities and non-descrimination**

Max. 2.000 characters

As part of the specific activities in progress in the Emilia Romagna Region (Associated Partners of the Municipality of Parma), the implementation of the Registry of contaminated sites (soil and groundwater matrices) is currently underway: the activities of AMIIGA will give a qualifying contribution for the definition of the best practices of characterization, remediation and monitoring of sites characterized by diffuse pollution. The inclusion of such approaches could be included in the developing regional regulations.

Furthermore, the comparison with a different Italian territorial reality, the Lombardy Region, underlined the need for the regions to standardize the various regulations in the field of study.

Regarding the environmental effects achieved in the Municipality of Parma thanks to the activities performed with AMIIGA, referring to what was illustrated in the previous, first box: "Expected impacts and benefits of the pilot action ...", we can summarize the following points:

- the identification of a new contamination site (Arlecchino kindergarden area);
- the transfer to the territorial actors new investigation techniques and knowledge for the groundwater management;
- the creation and implementation of tools/infrastructure to monitor the aquifer quality.

The application of AMIIGA did not have any negative effect on the territory concerned; a possibility that cannot be excluded, even if it is remote considering the attention with which the infrastructural works were carried out, is the conveyance of a pollutant from the surface to the groundwater through the new piezometers made, or their immediate surroundings.

References to relevant deliverables (e.g. pilot action report, studies), investment factsheet and web-links
If applicable, additional documentation, pictures or images to be provided as annex

Max. 1.000 characters

Deliverables D.T2.4.1, D.T2.4.6, D.T2.4.7 contain the site description, the data collected during the project and the groundwater numerical model at FUA scale and at pilot site scale.

Deliverables D.T2.4.2 and D.T2.4.3 explain the activities to design the monitoring network and to start to drill it.

Deliverables D.T2.4.4 reports the description of the investment: 7 new monitoring wells drilled to increase the monitoring network of the shallow aquifer and to monitor the potential Natural Attenuation.

Project products:

- Guidelines (D.T1.4.3): https://www.interreg-central.eu/Content.Node/D.T1.4.3-final-version-guidelines---ENG-1.pdf
- Final Brochure (D.C.5.2): https://www.interreg-central.eu/Content.Node/AMIIGA---final-brochure-LR.pdf