Chlorinated solvents in urban areas

Which situation in France?

2011

This project has received European Regional Development Funding through INTERREG IV B.
INTERREG IVB
Investing in Opportunities

Tackling urban soiland ground water contaminations caused bychlorinated solvents

CityChlor aims an integrated approach for urban sites polluted by chlorinated solvents. Not only will we bring together technical knowledge, but we will also elaborate directives on how should be coped with organizational and socio-economicaspects and community involvement. This has to lead to a more efficientand faster tackling of this often-occurring type of pollution.To put this vision into practice a number of pilot projects will be executed.

The project starts with a review of the existing knowledge, present innovative approaches and technologies as well as different national approaches and their bottlenecks. Starting from this inventory - including needs for practical implementation strategies or research- further study and demonstration sites will be set-up on the following 4 topics:

- Technological innovation and transfer of know-how towards implementation on site characterization and remediation of soil and groundwater pollution. Integration of innovations in routine procedures will be facilitated by demonstration sites, technology verification, uptake in codes of best practice and workshops.

- Integrated groundwater risk management approaches and their implementation at urban level. Such approaches, recently developed and applied at pilot scale in Germany and the Netherlands will be further developed, described and demonstrated as best practice.

- Cost-benefit of integrated approaches and alternative financing mechanisms. Abatement of pollution has a strong economic dimension. Besides the political consensus on the “polluter pays principle”, public driven and pre-financed integral approaches considering larger areas and pollution clusters appear to be more appropriate solutions from a technical and administrative perspective. A thorough analysis of the pros and cons will help to optimize the methodologiesto be applied.

- Risk communication and community involvement. Long-term remediation or natural attenuation approaches in densely populated areas require public acceptance. Conceptsto create a realistic perception of risks and to establish risk communication with stakeholders are developed

The total research budget amounts to 5,2 M€ of which 50% is financed by the INTERREG IVB program for Northwest Europe. The project started end 2009 and will run for 3,5 years.

The realization of the project is in the hands of a partnership between authorities, research institutes and cities. In total, 9 partners spread over Flanders, the Netherlands, France and Germany are involved:

- OVAM (lead partner), cities of Ghent and Mortsel (Flanders/Belgium)
- ADEME and INERIS (France)
- ITVA and municipality of Stuttgart (Germany)
- Bodem+ and municipality of Utrecht (The Netherlands)

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EXECUTIVE SUMMARY

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Which situation in France?

Within the framework of CityChlor, current French situation is detailed in this report which is an overview of French practices in France concerning the management of urban sites polluted by chlorinated solvents. Through several phone interviews, meetings, written contributions dealing with concrete cases and the two workshops organized in Paris on June the 24th and November the 16th, several actors, with different backgrounds (Environmental Experts, Urban Planners, Institutions& Policy Makers, Associations and Industrials using chlorinated solvents) gave their input, their own point of view in order to drawn French situationand this as much relevant as possible. These elements are compiled and analysed in this report mixing real cases reviews and statements from different actors.

Some issues which can be extended to global field of polluted sites in France

Communication, problems of access, interactions between actors, legal framework, responsibility, redevelopment… all these issues don't look specific to Chlorinated Solvents but also to all others kinds of pollution (metallic pollutions, hydrocarbons, asbestos…).

However, when we talk about "chlorinated solvents" and "urban environment" we actually work with the worst case scenario. Indeed, chlorinated solvents, with their huge mobility in soils and groundwater, their volatility and their degradation characteristics make their characterization and treatment "delicate". The Urban Environment brings its amount of additional constrains with its upside-down hydrogeological context (embankments, excavated soil, underground pipes, underground water pumping…), its high concentration of human users (activities, inhabitants…) and the "cocktail" made by the other pollutions(interactions with chlorinated solvents…)

In a way, most of the issues, strengths, weaknesses, needs would fit well with other kinds of pollutions (without regarding intrinsic specificities of each compound. All of that makes CityChlor a precursory European approach dealing with polluted sites in general.

We decided in this report to focus our mind on two main input keys which are the panel of actors and the different phases of a polluted site's "lifetime".

French situation can be described in three main ideas: « Technique& Comprehension », « Legal Framework » and « Communication »

Even if we could be led to believe that such aspects as technical aspects and social economic aspects must be treated separately, the whole French situation is turning around three main and transverse points which are "Techniques& Comprehension", "Legal Framework" and, above all "Communication".

If we take a step back in order to have a global view of this situation, we can see that, these three issues can be used to explain many problems in French situation. Moreover, these topics concern every actor involved in a chlorinated pollution management and this, at anytime in the site's "lifetime".

1) **Technique & Comprehension : Few gaps bus solutions already exist**

Many weaknesses are linked to technical gaps. Indeed, chlorinated solvents' behaviour in urban environment still is unclearly known. Therefore it is difficult to model their future in soils and groundwater, and consequently to assess risks different users of urban areas are exposed to (Inhabitants for example).Thus, studies have to been work out in order to complete current knowledge. CityChlor has been created for this goal too.

However, innovative techniques already exist for diagnostic, modelling, treatment and monitoring and would allow tackling more efficiently chlorinated solvents in urban areas. Unfortunately, policy makers and experts often use sturdy and well-known techniques. These techniques, as they are used currently, solve partially the pollution

or not anymore. Hence, it becomes necessary to promote and give credits to these techniques, by setting-up demonstration platforms in order to convince involved actors.

2) **Legal Framework : some existing elements which nevertheless have to be improved**

In France, we have legal tools concerning the chlorinated solvents issue at our disposal. The methodology of 2007, dealing with polluted sites has brought many improvements to prior methods and approaches (iterative method, extra-sites investigations, Interpretation for the status of sites…). Law for activities classified for Environment Protection (ICPE) allow a quicker tacking in charge of certain sites impacted by chlorinated solvents. The Urban Code and the Environmental Code allow actors to create bridges between the two matters which are Environment and Urban Development.

However, in spite of these tools already existing, legal frameworks still are too little adapted to chlorinated solvents in urban areas. In fact, law for ICPE only concerns few kinds of activities and sites using chlorinated solvents.The iterative approach advocated by the current French methodology sometimes does not fit well to urgency of the situation (e.g.sanitary crisis) and does not forecast juridical consequences potentially implied by sampling, measurements…

Most of the actors agreed on the fact that there is no legal framework, no specific law for polluted sites management at the cross-section of different matters as Environment, Urban Development, and Health… More over, treatment is often hidden by real-estate operations. However, one common law, commonly designed for every actor (Environmental experts, Institutions, Urban Developers…) is needed to secure site mutations in context of pollution.

3) **Communication: Need to organize everyone's job in the panel of actors**

The third and most important source of weaknesses in France is "communication". This issue is concerned at every time in the chlorinated polluted urban site's lifetime and every actor is concerned by this issue.
Communication concerns the two previous issues too. In fact, communication ways must be developed to promote innovative techniques and to prove their efficiency.

We can notice in this report that durability of the information has to be improved. That is to say that information about the status of the site, limitation of the uses on this site because of the pollution…must be communicate to any actor involved in the further redevelopment of the site.

Legal texts legitimate participation by associations of inhabitants in the mutation process. Unfortunately, those are not fully applied. Nevertheless, we have to keep in mind that inhabitants are themselves actors of the management process of a polluted site because they are main users of the urban land. They must be involved at every phase in the project (from the discovery of pollution to the site mutation). This would set-up a confident relationship between inhabitants and other actors, which would make access to houses for Environmental Experts possible because neighbours would simply open their door as soon as they know they work for the same goals.

Communication does not only consist of the simple information of the neighbours about risks or the nature of characterization or treatment works. In fact, communication must involve every kind of actors. For example a bad communication between actors could cause problems concerning transmission of the alert, the taking in charge of the site, compatibility of further uses…

The first thing to do to grant a good communication is to organize the panels of different actors. In fact, it is very important to define clearly what is every one's job in the global process which has to be a participative one and not only informative. It is extremely important to make every actor involved in each phase of the site's "Lifetime" (since discovery of the pollution to redevelopment of the site.

Another point is that there are a lot of actors with different interests (political ones, economical…) which are likely to cause conflicts. Therefore, it is necessary to professionalize this communication thanks to an independent ombudsperson specialized in polluted-sites issues. This person or group of persons shouldn't belong to the actors initially involved in the management of chlorinated pollution in order to be the more objective as possible.

INTRODUCTION:

Chlorinated Solvents issue in urban environment

Within the framework of CityChlor, current French situation is detailed in this report which is an overview of French practices in France concerning the management of urban sites polluted by chlorinated solvents. Through several phone interviews, meetings, written contributions dealing with concrete cases and the two workshops organized in Paris on June the 24th and November the 16th, several actors, with different backgrounds (Environmental Experts, Urban Planners, Institutions& Policy Makers, Associations and Industrials using chlorinated solvents) gave their input, their own point of view in order to drawn French situation and this as much relevant as possible. These elements are compiled and analysed in this report mixing real cases reviews and statements from different actors.

A specific kind of pollution but regularly found in urban areas

Chlorinated solvents according are amongst the most common soil and groundwater contaminants due to their widespread use as dry-cleaning solvents and degreasing agents (annex 2 of the Groundwater Directive (GWD)). Due to their physicochemical properties they produce large scale plumes of pollution in the groundwater. Pollution by chlorinated solvents is in many cases caused by small-scale activities as dry-cleaners, garages and metal-using industry, which generated multiple contaminant sources for widespread groundwater pollution in urban areas. In the densely populated Northwestern-Europe, these pollution plumes are situated under residential and urban development areas and therefore difficultly accessible. Vapors can migrate through building slabs and affect the quality of indoor air.

Urban environment causes additional difficulties: adapted processes are compulsory to tackle the problem in strongly built areas

Remediation of this type of pollution is a slow and difficult process, which is cost-intensive and exceeds in many cases the financial capacities of the polluter.

Cities offer to little space to set up easily diagnoses and remediation operations. Access to “source zones”, containing “pure phase” of product, is complex due to urban environment although it is necessary to ensure efficiency of remediation.

Contrary to extra-urban industrial brownfields, huge soil heterogeneity (backfills, foundations, buried webs and pipes), and strong solicitation of groundwater (pumping well to product drinkable water) in addition of multiple pollutions in urban areas are hard parameters remediation must deal with. In such an environment, remediation is a very “delicate” issue. French methodology for polluted sites management, published in 2007, ask to list reasonable objectives for this remediation (e.g. in the frame of an urban redevelopment project).

Some operations, as investigations and treatment of the pollution, are quiet “intrusive” in urban zones with high activity (housing, commercial…). Each intervention in urban area must be dimensioned and organized depending of constrains of the redevelopment project.

Research can bring some elements in order to face such an issue. However, implementation of innovative technologies on the field is relatively complicated because they are quiet unknown and they contain amounts of uncertainties concerning their forecast results. These techniques are hardly financeable. “Who can pay for the risk?” Consequently, decision-makers often basic well-known techniques, as excavation and “pump & treat” which can be none adapted to chlorinated solvents.

Uncertainties for responsibility and financialissues: obstacles for urban economical redevelopment

Define pollution by chlorinated solvents in soils and groundwater usually is a “delicate” operation (in particular, find the “source zone(s)”. In fact, pollution usually spreads over cadastral site’s limits. However, extra-site

investigations make risk of litigation increase. Chlorinated solvents can migrate easily in groundwater and they are very volatile. In urban areas, houses are usually surrounding polluted site and can suffer from vapour intrusions to indoor air. Neighboursare consequently able to set trial cases against industrials or polluted sites owners. Moreover, in many cases the polluters are not traceable or cannot be held liable due to the overlap of pollution plumes.

Urban brownfields are “high-stake lands” and bear a huge pressure from real estate. This kind of pollution, very specific, adds additional constrains to the urban development project (building preventive measures, remediation…). These are hardly financeable by urban developers and by industrial/owners of the site.

A specific management which necessary needs all actors to be involved

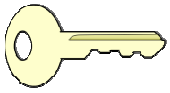
Pollution does not only pose a direct risk by exposure to contaminants, it also indirectly restrains economic development and harms the quality of life due to the slow processes of investigation and remediation and the resulting long period of uncertainty.

Urban environment is shared between many different actors. Chlorinated solvents can be found below commercial sites (e.g. offices, shops…) but also below houses. Therefore, intrusive operations are lead in individuals’ homes (sampling, remediation…). Sometimes, use restrictions are set up. As a consequence, communication should be well dimensioned and implemented.

But, inhabitants are not the only actors. Industrials or polluted site owners, Institutions, Urban developers, decision-makers, environmental experts (as lawyers, researchers, remediation operators…) are also involved in the whole process. They have many different points of view, interest and they use different languages. Some speak in terms of livable square meters, others in terms of concentrations, many in euros…

Two input keys for an integrated approach

French approaches dealing with « integrated approach » (United Nations' program for Environment, Integrated Water resource management, National strategy for sustainable development…) put into relief the numerous links between different actors and time-space dimensions of the systems. These two keys for analysis ("panel of actors" and "steps of a redevelopment project") will be used in this report to describe French situation concerning urban sites contaminated by chlorinated solvents.



Input key #1: Panel of actors

Management of urban sites contaminated by chlorinated solvents make several actors act. Their interests are bothcompletely differentand complementary. These actors have been gathered in five categories in this report in function of their interests, their roles…etc.

- **Associations:**Neighbours or/and environmental associations, these organisms' members are sensitive to environmental issues. Associations can be a real leading force in management of urban polluted sites, and they can even make proposals (see. Technical guide for Developers by the ADEME).
- **Industrials/owners of urban sites contaminated by chlorinated solvents:** Thiscategory gathers both little companies (e.g.: dry cleaners, garages…) and bigger industries using chlorinated solvents (e.g.: metals treatment plants…). The exploiters can be the site owners themselves or only users of the site. Polluted sites owners who are not exploiters/industrials are also considered in this category.
- **Actors of urban development:**this category gathers all actors involved in the whole « urban developing chain » (Municipalities, Urban experts, city planners, builders and real estate promoters...),
- **Institutions:** This category gathers all decision-makers (Government, Administration...) involved in public decisions concerning polluted sites management.
- **Environmental experts:** Design offices, remediation operators, researchers, but also lawyers and other experts of environmental issues who make consultancy or field work (characterization, treatment...) in polluted sites management.

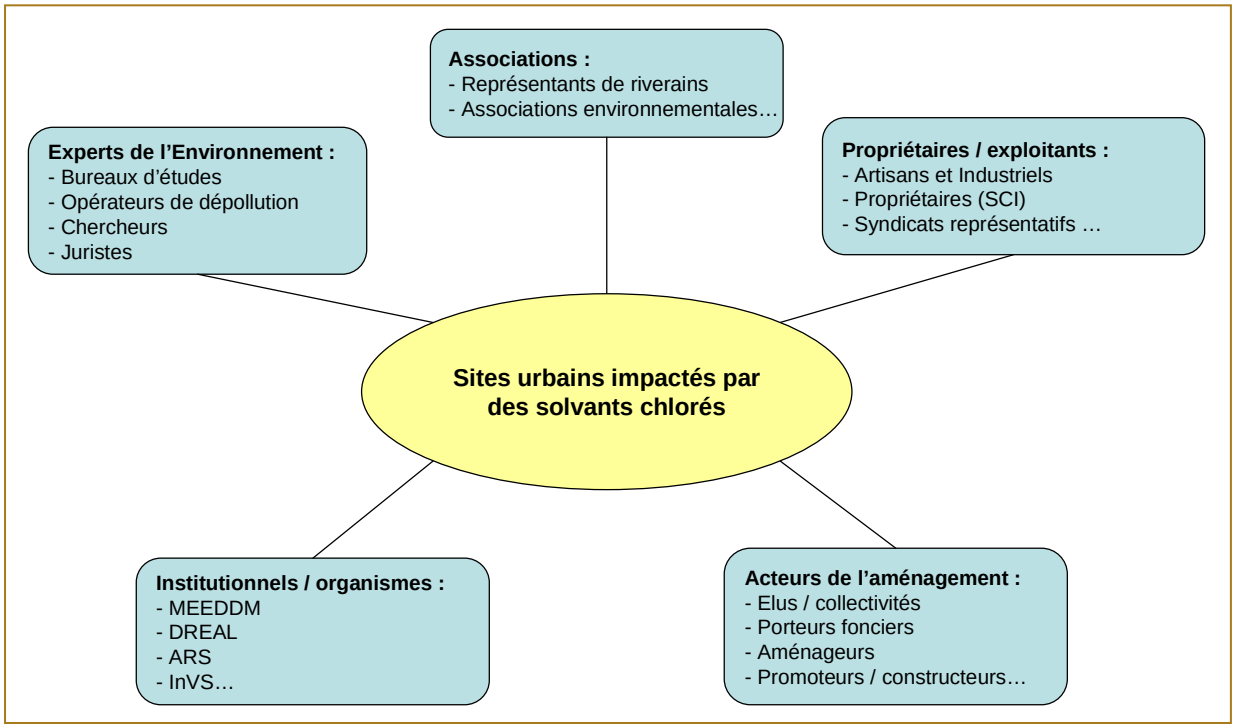


Figure 1 : Involved actors in management of urban sites contaminated by chlorinated solvents.

Actors involved in the management of urban sites which are polluted by chlorinated compounds are numerous and their interests are sensitively different. Thus, their own perception of pollution will be different in function of their skills and education.

"Actor sheets" are available at the end of this report with detailed information about the roles, needs of each actor during the management of sites contaminated by chlorinated solvents.

Input key #2: Four phases in a polluted site life

According to feedback from all the actors involved, the life cycle of one (or many) site(s) polluted by chlorinated solvents in urban areas can be characterized according to four management steps, from its discovery to final use of the site(s).

- <u>« Discovery » of the pollution :</u>

This phase extends from the discovery of the pollution (early warning) to the moment it is taken into account (following phases of characterization and treatment).

- <u>« Characterization » of this pollution :</u>

This phase includes all the conducted investigations in order to characterize the pollution (definition of pollutants involved and the impacted area) and to assess impacts and risks induced for populations and the environment.

- <u>« Treatment » of the pollution :</u>

This phase includes as well safety measures as real treatment of the pollution. The treatment of the pollution can be "active" (ex: in-situ oxidation) than "passive" (ex: natural attenuation)

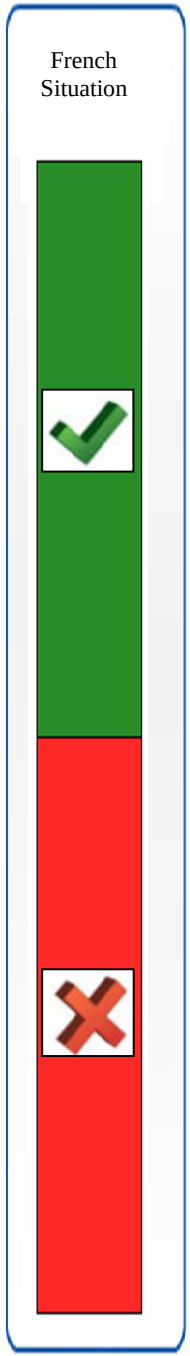
- <u>The last phase concerning the « use » of the polluted sites :</u>

When pollution has been treated or simply secured, urban areas can emerge as very important territorial issues (included in development plans). Therefore, this phase includes the future uses of the site(s), formerly or currently polluted. Monitoring might be implemented on site and their use might be regulated by tools as public "easements" and use restrictions.

All actors should be involved in each of these four major steps. Indeed, communication, for example, can be implemented in different phases. Therefore, there is a set of actors identified in eachphase.

Summary of French situation

The following tab sums up briefly main strengths and weaknesses of French situation, as described by different actors which are described in following chapters.



Discovery	Characterization	Remediation	Use
• National tools for management of polluted sites. • Generally, setting-up of communication ways with inhabitants. • Inhabitants know more and more about chlorinated solvents. • Few existing financial sources for the implementation of safety measures.	• A Research & Development trend to know better and characterize chlorinated solvents in soils and groundwater. • Tools and initiatives in order to structure communication with inhabitants during investigations.	• Remediation objectives are defined functions of the future use of the site. • "Routine" remediation techniques as venting are globally satisfying. • Some innovative remediation techniques are currently developed in order to treat chlorinated solvents in urban areas. • Some tools exist in order to help decision-makers (choice of the remediation techniques).	• French policy is currently evolving, mixing Environment and Urbanism. • Consciousness of potential risks when sites polluted by chlorinated solvents are not well included into urban development projects. • Some initiatives in order to structure the integration of polluted sites in urban development operations.
• Insufficient monitoring and alert systems. • Some situation which don't fit with juridical frames. • A real will for communication… But alerts often are badly transmitted. • Implementation of public involvement is a delicate issue. • Numbers of actors with different interests.	• Some lacks in terms of modeling, thresholds and risk assessment. • Investigation phases are not adapted to urban environment. • A lot of juridical questions are brought by investigations and badly defined responsibilities. • Methodological tools and databases must be improved. • Different social perceptions of the "risk" notion.	• Operations remain delicate in urban areas. • Innovative techniques need trust by decision-makers. • Different perceptions of remediation processes (time, efficiency).	• Pollution by chlorinated solvents make mutation more constraining in urban development. • Juridical responsibilities are insufficiently defined concerning residual pollution. • Nowadays, public easements and use restrictions are not handy tools.

PHASE 1: DISCOVERY OF THE POLLUTION

1-Discovery 2-Characterization 3-Remediation 4-Use

The discovery of pollution can be done at different levels. Indeed, the alarm can be triggered by an inhabitant affected by a very strong smell of chlorinated compounds into his house, during the design phase of a development project, during an environmental study on a Classified Installation for the Protection of the Environment (French ICPE legislation), or by a city planner who discovers that his site, bound to become one site of a development project, is impacted by chlorinated solvents at the first shot of the mechanical digger… This step leads to the effective taken into account of the site, that is to say investigations, eventually treatment and finally, its use. If there was something wrong at this step, the whole process would be compromised. All actors, without exception, are concerned here.

1.*Strengths of French situation*

✔ *National tools in terms of management of polluted sites*

Several national tools are available such as the « polluted sites and soils » methodology, written in 2007 by French Ministry in charge of Ecology. Some inventories and databases are also available. These tools enable to apprehend urban pollutions by chlorinated solvents.

« A French methodology for contaminated sites and soils that has been proved »

France acquired a methodology for polluted sites which has been well tested since it was created. This approach developed for polluted sites by French Ministry in charge of Ecology, today the MEDDTL, (cf. Circular of February 8th, 2007), proposes at first, to give priority to the management of the impact. This allows the implementation of « management plans » in case of non-identifiable sources. Moreover, this methodology encourages « extra-site »investigations consisting in making samples directly into the exposure middles (using of the IEM tool). Finally, decision of the best management plan and its implementation are based on the future use of the site in order to avoid incompatibilities between its statusand planned uses.

« National databases »

Several databases and national inventories, listing all polluted sites and former industrial that can be found exist in France (e.g.BASOL and BASIAS). They enable to maintain information on the sites impacted by chlorinated solvents (among others). Halogenated solvents are a search criterion in the BASOL database. These databases are more particularly used by the actor of urban planning to learn more about sites which could be integrated into a development project. The existence of these databases appears to be known by majority of actors, making those toolsmore than precious.

« Certification for environmental jobs »

A certification of disciplines in the sector of polluted sites and soils is currently built by the French Minister in charge of Ecology is underway. New environmental professions are created such as « Certifiers of the State of sites' pollution». These certifiers would have the right to deliver building permits after assessing the sites' status as it is written in the French Grenelle II law.

✔ *Communication ways with inhabitants generally implemented on the field*

French landscape contains more and more examples where a communication strategy is initiated, as soon as the pollution by chlorinated solvents is discovered. Therefore, numerous vectors of communication are used in order to cope with residents' interests.

« Special organisms in order to inform about risks »

Organisations as Regional Health Agencies Health (ARS) inform populations about the risks, more particularly risks in relation with the consummation of groundwater from private wells.

« Information structured by Town Hall services »

Keeping inhabitants informed is usually done by the Town Hall in coordination with the responsible of the site using various methods as: distribution of forms explaining the context of the operation, visits of an elected representative, press releases, installation of a free phone number, newsletters…Therefore, the Town Hall is often seen as the principal component of the communication system. In fact, it centralizes usually all exchanges from different actors.

« Participative approaches during investigations »

Public meetings in the Town Hall are sometimes realized, not only to inform populations, but also in order to choose, for example, houses which will be investigated. It allows involving residents (information about the approach, modelling of dispersion results, volunteering).

« A reel wish to integrate residents into monitoring site committees »

Inhabitants associations sometimes join monitoring site committees. They, deliver then the information to populations, using the right words in an adapted vocabulary.

« Some methodological tools exist »

COMRISK methodological tool, led by the IRSN, the INERIS and the ADEME has been created in order to organize interactions with populations for the assessment and management of polluted sites. This tool recommends various good practices, more particularly during investigation phase, such as organization of public meetings, forms and contents of the information designed for inhabitants, … This also provides communication models (for example: transparencies to be projected during public meetings…)

A cultural integration and an involvement from inhabitants

Resident populations are the most exposed actors to pollutions by chlorinated solvents because they are major users of densely populated urban areas. Inhabitants can be actually seen as real actors in pollution management mechanisms. Indeed, they shouldn't be considered only as "passive" receptors of the information.

« Mobilization from residents »

A large mobilization of residents worried about the environmental and especially about health issues, can be seen. Residents are able to create a Political Force (for municipal elections). This phenomenon is mostly due to the development of communication means and better access to information (via Internet for example). Thanks to thiscultural integration, some residents become a real "suggesting force".

« An Environment Charter in order to define rights and duties of and for the residents »

The Charter of the Environment, leaned back to the Constitution in 2005, recognizes, for everybody:

- the right to live in a well-balanced and health-respectful environment,
- the right to reach information held by public authorities and,
- the right to participate in the development of public decisions which have an impact in the environment.

But this charter also recognizes resident's duties in order to contribute to the preservation and the improvement of Environment. We can see that the application of this Charter is on the high road, especially concerning Environment in its broad sense: general information, awareness and participation in the development of public decision are taken in place gradually.

Some financing sources exist for safety measures.

Financing issues arrive very early in minds before treating of the polluted site. If this reflection often emerges as quite delicate, some solutions exist in France.

«Preventive financing sources (Water Agencies) »

Water agencies are able to fund:

- The evacuation of waste from industries such as dry cleaner's to appropriated treatment schemes (ex : Water Agency of Seine Haute-Normandie);
- Some water resource studies.

« Town Hall services: financing in case of emergency

Town Hall services often finance « emergency ». They can take in charge:

- water analyses at neighbour's houses,
- linking of houses to drinkable water network,
- individual installation for water treatment,
- distribution of bottled drinkable water…

« ADEME: a potential financial support »

The ADEME may, in some conditions, release financial support for:

- re development of urban brownfields (for example: in 2009, an exceptional 20 million euros financial help for remediation polluted urban brownfields was released);
- environmental diagnoses,
- safety measures on polluted sites with defaulting responsible.

2. Weaknesses of French situation

Insufficient monitoring and warning systems

Monitoring systems available in France, for chlorinated solvents, are rather limited. They are often inadequate to ring the alarm bell as soon as possible, in order to make easier quickly measures.

« Occasional monitoring, that is to say inadequate »

According to most of the actors (especially Environmental Experts), implementing punctual monitoring systems remains inadequate to revalue continuously the risk level for inhabitants. Moreover, it either doesn't allow giving an alert in case of gas transfers increasing towards residential buildings. It would be better to allow implementation of automatic alarm systems at strategic places in urban areas (more particularly thanks to boreholes)

«Vinyl chloride is not systematically monitored in drinkable water »

The Decree of January 11th 2007, relating to the limits and references of the quality for raw water and drinkable water, lays down a 0,5 µg/L limit value for Vinyl Chloride. However, some Environmental Experts said that this compound is not a systematically targeted parameter during analyses for drinkable groundwater in boreholes. But Vinyl Chloride is one of the most mobile and carcinogenic chlorinated solvents. « *We can expect surprises with that.* », experts said.

Some situations getting away from legal framework make pollution management difficult.

Management of pollutionsby chlorinated solvents is often hindered by a sites' high heterogeneity. Indeed, these sites' status can bedifferent intrinsically and legally. In some cases, French legal framework does not make easy management of these sites.

« French ICPE is limited »

Many human activities responsible for contamination by chlorinated solvents are ruled by French ICPE laws (Installation Classified for Environment Protection). Most of industrial sites are identified as Classified Installations (e.g. surface treatment plants). This regulation allows a systematic control of the site's state (periodic monitoring or during the step of suspension of activities/ handover/acquisition).

This ICPE regulation mainly remains a prevention tool and presents limits when we are talking about "chlorinated solvents" and "urban areas". Indeed, historical pollutions escape from these rules (activities suspended prior to the creation of the ICPE regulation (1976) and/or enjoying the thirty year's prescription).In this case, it is not possible to prosecute polluters.

In addition of those “temporal” aspects”, all sites contaminated by chlorinated solvents are not necessarily ruled by ICPE regulation. In urban areas, groundwater pollutions are often diffuse and large. Therefore, several sites (even non-ICPE sites) can be concerned. Finally, chlorinated solvents are used in many different activities with variables sizes and regulatory statues (ICPE or non-ICPE). All these aspects can interfere with speed of management measures.

Besides, when a private site is polluted by an ICPE ruled site, the first one is hardly taken into account by the authorities. Responsibilities are not clearly established and the “polluter-payer” principle cannot be applied, freezing any site management or re-development.

«For the moment, there is no general/transversal legislation for polluted sites in France»

Field of polluted site is located at the crossroads of various legislations and regulations: Code of the Environment, Code of Urbanism, Labour Code, Public Health Code… Most of the actors agree on the fact that there is no existing general legislation concerning polluted sites and soils. Such legislationcould build some bridges/links between different actors with different skills.

Failing general regulation about the management of polluted sites and soils, the Land Mayor, for example, can intervene only in the limit of his « traditional » skills (e.g.: urbanism, public safety and security…). This can lead to management projects which are not really adapted to polluted sites issues. Other urban planners and decision-makers on re-development projects donot always have the required skills to secure technically and legally the transformation of urban sites contaminated by chlorinated solvents. Two consequences can result of that:

- project is abandoned by the precaution principle, or
- project is maintained and some problems can appear (e.g. health risks).

« Difficult seek of responsibility because of the urban complexity »

In urban areas, pollutions are complex and impact various cadastral parcels.Most of the time, origin of the pollution is poorly define, not to say, not at all. Noticed impacts by chlorinated solvents can be caused by the existence of several source zones. So we can talk about “multi-sources”. Therefore, it is difficult to link a noticed impact to a specific source zone, and so to infer responsibilities.

Besides, even if pollution’s origins can be identified, question of the future responsibility for the owner, who is not responsible for pollution, is remained. “Why should I pay for something I have not caused?” However, a pollution brought about the existence of a source zone should be considered as a potential source?

Out site investigations are often required in order to determine the sources zones. Take for example the case of an owner asking this kind of investigation outside his site. If pollution is identified on his land, the owner of a downstream parcel might wish a right of review against the owner’s parcel adjoining his property whereas the source of the pollution should come from a further upstream land.

For all these reasons, impacts generated by various industrial activities lead to a particular situation where a Municipality cannot directly act on a juridical, legal or technical point of view.

A real will for communication…but alerts are often bad transmitted and loses in the chain.

During the discovery of pollution step, the setting up of communication vectors with the neighbours is often seen in France. Several innovative cases on a communicative point of view appeared in France, but improvement are needed.

« Alerts often are hardly heard and transmitted »

On many sites in France, locals populations are warned by authorities (e.g. Town Hall Services). This communication is often done on a single one direction. On the contrary, it is really difficult for inhabitants to be heard when they are suspecting a pollution. Neighbours’ complaints are not or not taken into account enough. *“Inhabitants, who thought that they had legitimate questions, had to fight for being heard by public authorities”.*

« A sanitary alert is differently anticipated than an environmental one »

Sanitary alerts are not treated such as environment ones. In the case of a sanitary alert, safety measures have to be taken and anticipation becomes impossible.
In the case of an environmental alert, pollution is detected with an iterative approach. Actors have time in order to weigh the pros and cons of the different management scenarios that could be applied. All the aspects are anticipated, including the rehabilitation in a mutation using / urban planning process

The organisation of communication is different for the two kinds of alerts. With the sensitive dimension taken in the case of a sanitary alert, communication is consequently more difficult than in an environmental case.

« Medias can help in order to be heard, but also to be misunderstood»

The lack of communication or an uncontrolled communication can instantaneously be magnified and poisoned a situation. Medias potentially are a huge communication means. You cannot avoid the Media for a good communication, so you have to work with and to anticipate this work (preparation of messages and transmission of information). The major risk you can meet when you have no communication strategy is to spread damaged information or rumours…and to cause a "trust-crisis".

Integration of inhabitants can be difficult to apply

Beyond the simple information, the Charter of the Environment plan neighbours integration. However, if this integration is legitimate, it is difficult to apply in France.

« Neighbour's associations feel they are not fully integrated to the monitoring committees»

Sometimes, some discussions and decisions about cases are not brought to knowledge of the associations. The lack of listening, empathy and difficulties for acknowledgement are often noticed by associations. Their role is not always officially defined, and therefore, their comments, remarks … are not often taken to account.

« Progresses still are needed for the Charter of the Environment application»

Application of the Charter of the Environment becomes delicate when concrete problems appearbecause of actors' interactions and urgency.

«Actors are not trained enough in order to manage an emotional charge»

It is really difficult, even impossible, to separate the emotional part during the management of a sanitary crisis. A gap appears between experts and non-experts people, using representations attached to the used-term. Words remain technical for experts. For example, in densely urban areas, the theoretical term "target" really designates human population, children…
For non-expert people, vocabulary seems "frightening" (risk, carcinogenic…) and stressful. Some actors are not ready or not trained enough to manage emotional pressures made by these situations beyond their interlocutors.

A multitude of actors with various interests

Management of sites impacted by chlorinated solvents concerns a multitude of actors, with different interests, sensitiveness and vocabulary. This large panel of actors consequently involves complex interactions. These interactionsare not completely established in France.

« Interlocutors are always different»

The change of institutional interlocutors (Mayor, Prefect, General Direction for the Health (DGS), Ministers, Chairman of the monitoring committee, Director of the Regional Agency for Health (ARS)…) are frequently noticed. These changes involve consequences, more particularly in term of management rapidity and needed measures. Some gaps of communication between the different institutional actors survive again and increase the demarche's inertia.

«Communication during a sanitary alert doesn't bring into play the same actors than an environmental alert»

The two kinds of alert (sanitary and environmental) are not manage by the same actors. In the case of an environmental alert (e.g.: existence of a pollution on an urban brownfield far from houses), the preferential interlocutor is the DREAL institution.
In the case of a sanitary alert (e.g.: impact of a chlorinated solvent pollution in indoor air of the neighbour's houses) the Regional Agency for the Health is in charge of the case.

In an urban context, a sanitary alert is identical to an environmental alert. This situation is often a source of confusion in the responsibilities of the different concerned stakeholders.

3. Needs and expectances of French actors

To strengthen alerts and preventive measures

Technical experts, but also the other actors involved in the management of pollution by chlorinated solvents in urban areas insist on the fact that preventive measures and alert systems are not developed enough in France.

« Preventive and constructive measures»

The preventive measures in buildings should be seen as a complementary action for soils treatment. In the management of potentially polluted sites, constructive measures are preventive actions to prevent from sanitary risks (setting up of crawl spaces, ventilation devices, building tanking…). Many research projects are actually led in this sense by the CSTB. These devices have to be compatible with the BBC's objectives for buildings for example (BBC: Low Energy Consuming Buildings). Indeed, the over-ventilation is contrary to the requirements of BBC label. These measures must match whit the regulation (e.g. designed floor assembly are impossible to ventilate).

« A better monitoring of water quality »

A better monitoring of groundwater's quality is necessary on a large scale (alert sensors…). Moreover, the automatically research of chlorinated solvents and halogenated compounds in samples from groundwater could be made.

It is absolutely necessary to include the Vinyl Chloride into the systematically measured parameters at the pumping well for drinkable water.

Taking into account of a site is made easier for all the impacted sites (ICPE or not) by chlorinated solvents in urban areas.

Tackling of the pollution by chlorinated solvents is easier when the concerned polluted site is ruled by French ICPE law. On the contrary, if it is not the case, the site's status could be an obstacle against a good sequence of events. Regulations should consequently be adapted or at least, a methodology should be created to tackle pollution whatever the site's status.

Conciliate "sanitary" and "environmental" alerts

Sanitary and environmental alerts often are merged in urban areas. It is consequently necessary to conciliate both even if these two approaches seem extremely different.

« Make possible a better management of sanitary alerts »

In this approach, it is necessary to anticipate all aspects linked to this kind of situation despites emergency.

«Avoid any loss caused by complex interactions between actors »

Actors involved in management of sanitary crisis should be the same as for environmental crisis.

Designate a single interlocutor for both kinds of alerts.

New funding means

The question of the payer is often delicate. Funding actors are not clearly defined, especially when responsibility notion is not established. New funding means are therefore necessary.

« Public authorities can fund in case of emergency? »

The question of funding can significantly slow down the management of pollution. French actors agree on the fact that Public Authorities had to fund studies and emergency measures (even containment methods). with a possible power on polluting industry.

« Special sectorial funds for chlorinated solvents? »

The creation of a special fund for VOCies or sectorial funds at a national level, in order to intercede with professionals using chlorinated solvents who are not able to tackle pollutions, are proposals that must be studied.

« Allowing all urban sites remediation, even the least attractive sites »

Taking pollution into account is possible when the concerned site(s) is/are included into a whole development project (strategic sites with profitable rehabilitation). But it is not the case for all sites. How is that possible to remediate a polluted site which does not take advantage of this attractiveness (financial issues, pressure for land…)?

⚠ *Anticipate in order to secure development's choices on technical, financial and legal point of view*

The « polluted sites and soils » dimension has to be taken into account early upstream, during the « discovery of the pollution » phase. This anticipation is necessary, especially for development actors, in order to secure urban development projects.

« An earlier recognition of the issue in order to have it integrated into urban development documents and approaches »

Anticipating « polluted sites and soils » issues as "upstream" as possible is very important during political decisions. The announcement of a site'redevelopment should go in the sense of a better consideration of sanitary, legal and financial risks. Applied to chlorinated solvents issue, the new Article L.125-6 of the Code of the Environment could allow the government to inform local collectivities about specific environmental risks in relation to the presence of chlorinated solvents in the soil. Then, communes could adapt their urbanism documents including building constraints linked to this specificity.

« Secure legally land handovers »

It is necessary tosecure legally land handovers to builders and public spaces designing on old polluted sites. A systematic study of acquisition conditions, legal context and juridical right of action and opportunities against the land seller or the former operator would bring solutions.

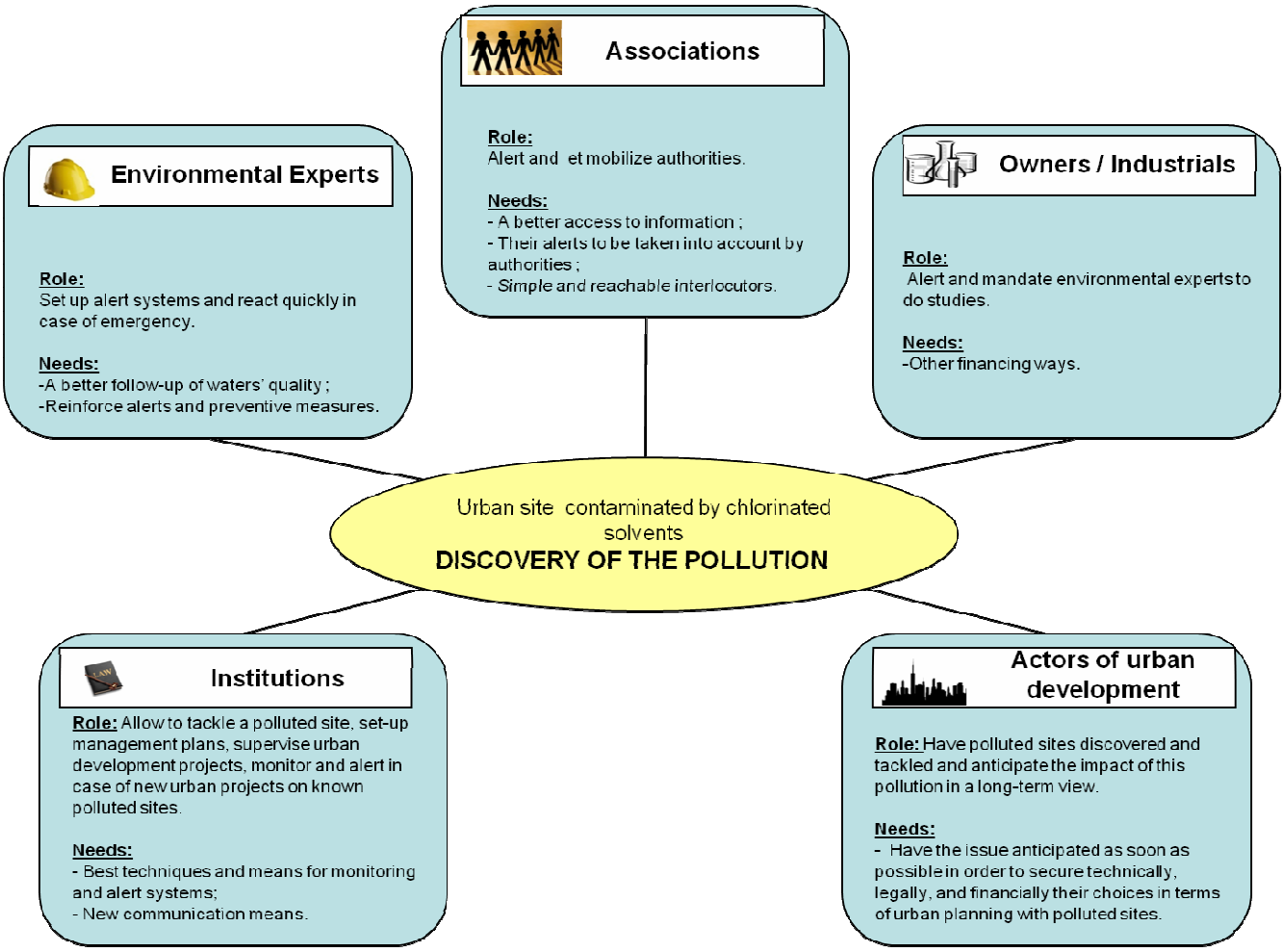
« Return on experience in order to anticipate better»

Experts underlined the need of treatment references of a polluted groundwater by VOCies used in urban areas for sensitive uses (e.g. AEP): methodology, even solutions in order to treat large area pollution when sources cannot be treated. The realization of such a database would allow actors of urban development and decision-makers to anticipate these aspects at the beginning redevelopment projects.

«Resort to a technical assistance during redevelopment projects. »

In order to secure a redevelopment project involving sites impacted by chlorinated solvents, actors of urban development more and more ask for technical skills of Project management assistance (AMO). It becomes possible for redevelopment actors to design project safely. However if it is easy to ask for an AMO for very important projects (with important stakes), it should also be similar for small projects. Unfortunately, it is not the case and AMO are often not an option for decision-maker and urban developers in such a context.

4. Summary of the phase "DISCOVERY OF THE SITE"



Proposals from actors:

- To develop complementary preventive measures in buildings to prevent from sanitary risk (setting-up of crawling spaces, ventilation systems...).
- Systematic seeking of chlorinated compounds (especially Vinyl Chloride) during groundwater sampling.
- Adapt rules or create a new methodology in order to tackle polluted sites whatever are their legal status (e.g. private sites as well as sites which are classified for environment).
- Create a global approach allowing to recognize the issue as soon as possible and to anticipate all different aspects and to integrate them since their discovery to the whole project (e.g. integration in documents for urban planning).
- Interlocutors must be the same in an "environmental alert"or in a "sanitary alert". Both alerts are often mixed in urban areas.
- Studies and measures of emergency should be paid by public authorities.
- Create special funds for "chlorinated compounds" or sectorial funds at national level in order to intervene with professionals using chlorinated solvents and who cannot pay for remediation.
- Organize a huge feedback to make every actor able to anticipate all aspects linked to this issue.
- Make easier resorting to consultancy/assistance for project owners even for modest projects.

PHASE 2: CHARACTERIZATION

1-Discovery | *2-Characterization* | 3-Remediation | 4-Use

Characterization phase is aimed to define borders of pollution (definition of the impacted zones, location of « source » zones, of plume…) and if there is a real risk for potential targets (people living or working in urban contaminated zones). This phase should lead to the decision to remediate or no and on the best management plan. Although characterization is a complex phase, it is one of the most important ones because it allows dimensioning remediation techniques and defining future use of the site(s).

1. Strengths of French situation

✔ *Some R&D projects in order to know better chlorinated solvents' behaviour and to characterize the pollution*

Many Research and Development projects have been or are currently realized in order to improve knowledge on chlorinated solvents and to adapt better techniques for their characterization. Some methodological guides, from French consequent R&D program are available nowadays.

« New tools to diagnose chlorinated solvents in urban environment »

New tools are developed in France in order to better know, quantify and use biodegradation of chlorinated solvents in soils and groundwater. For example, molecular biology can be used in order to monitor and understand better biodegradation mechanisms (using quantitative Polymerase Chain Reaction (qPCR)).

VOCies' behaviours are studied in other R&D projects which essentially deal with urban environment.

Some new non-destructive innovative tools for investigations, cheaper and more adapted to urban environment are currently developed as phytoscreening and dendrochemistry. They respectively used to realize a first diagnosis of the pollution and its dating. These techniques could be very interesting because they would make Environmental Experts able to find who is responsible for certain pollution, obviously, if there are trees available in concerned urban area.

Other optimized tools are also developed to assess transfers of organic compounds from soils to atmospheric and indoor air.

« Many expectations from different R&D projects – focus on some of them »

PIT project: Use of such innovative tools as phytoscreening and dendrochemistry in order to locate the plume and quantify it. These two methods, ten times cheaper than conventional methods) could be coupled to a portative Gaseous Chromatography (GC) system in order to provide quickly in-situ results. Obviously, it is crucial to have trees available in the considered urban areas.

OPUSS project:This project is aimed to realize a database with different transport models for pollutants in urban environments and to assess their potential interest for a concrete use on the field.

CityChlor and FLUXOBAT projects:CityChlor should allow a better understanding and the modelling of groundwater to soil-gases transfers. FLUXOBAT, a complementary project, should allow understanding better soil-gases to indoor-air transfers.

Degradation Kinetics project:This project, included into CityChlor project, should allowdeveloping a methodology in order to characterize kinetics of degradation of VOCies in groundwater. This would made by the analysis of bacterial genes which are present below the water table. This tool could be used for forecasting measurements.

« Some existing methodological guides, from a consequent French R&D program: MACAOH »

Some methodological guides designed for technical experts and also for decision-makers have been created. Among them, MACAOH guides deal with good practices to follow during "characterization" of halogenated compounds, "modelling" of their behaviours and becoming and their "natural attenuation" in aquifers. These three guides have been validated and recognized by French Ministry in charge of Ecology, for management of sites impacted by chlorinated organic compounds.

« An improved access to international R&D projects »

CityChlor project will make possible the synthesis of existing documents written in English. Moreover, the ADEME is currently working, in SNOWMAN network, on the identification of potentially useful documents (e.g.: KORA German project) and their translation in French for French actors.

✔ *Some tools and initiatives exist in order to structure communication with populations, and even their involvement during characterization phase*

Communication is a crucial parameter during investigations (especially when they are realized out of the site). Facing this statement, a project has been made to build a methodology. This one has been implemented in a few concrete examples in France.

« COMRISK: a tool which suggest good practices for communication »

COMRISK project, lead by the IRSN, INERIS, CIRE and the ADEME presents a state of the art of communication in France on polluted sites, especially during investigation phases. This tool, suggest also good practices, a whole methodology and operational tools for good communication strategy with populations.

« Some concrete examples of population involvement during investigations »

In more and more cases in France, neighbours and inhabitants (often by associations) take part more and more actively during investigations. In this case, they are not considered any more as passive receptors of information but as real actors in the whole process. For example, they can attend to public meetings and help during the sensitive choice of investigated houses (during indoor measurements). If some people do not want to hear about pollution at all, others wish to be really involved in the process (as association most of the time). This involvement often makes easier communication between different actors (neighbours, environmental experts…).

2. Weaknesses of French situation

✘ *Some lacks remain: Chlorinated solvents' behaviour are not known enough to allow their modelling, any definition of clear thresholds and a good risk assessment*

Chlorinated solvents have a specific behaviour in soils and groundwater. There still are a lot of questions about this topic. However, it is important to know them more in order to characterize them better and, by this way, to assess risk potentially incurred by populations in proximity.

« VOCies have a particular behaviour in urban soils with a huge part of unknown… »

According to environmental experts, it is necessary to take into account, the transport of pollutants via urban networks (e.g. pipes). It is also necessary to understand better fluxes from soil to indoor air in order to realize good models.

Besides, impacts of chlorinated solvents on the buildings' underpinning and possible corrosion on urban equipment are not taken into account in management plans although these phenomenons are very important in urban areas

« … and too few financial means for characterization studies»

Lacks of knowledge on VOCies in urban sites can be caused by a lack of finances invested in characterization studies. For certain environmental experts, this problem would cause more unknown than theoretical lacks themselves.

« Models still are too imprecise for an optimized management of sanitary risk »

The use of models seems to be impeded by some technical and financialbolts. Another brake could be design offices' skills.

- Technical bolts:

Major part of transfers of contaminated pollutants to soil-gases seems to be from soils. Could fluxes from groundwater be neglected? These assumptions must be confirmed.

Moreover, it is rather difficult to estimate most part of the exposure which is linked to transfers of pollutants to indoor air:

- Problem of representativeness for measurements : « domestic sources » as paint or common housing products can cause interferences during indoor air measurements;
- Flowing and transport mechanisms are complex through different compartments (soil/concrete slab/indoor air);
- Problems of realisms during the use of modelling tools (huge differences are often noticed between results of the model and concrete measurements on the field);
- Huge space-time variability of parameters.

Consequently, it is necessary to develop new tools or improve existing ones in order to break through these bottlenecks.

Sometimes, pollution can cause no sanitary problem on the site itself (e.g. industrial site) whereas there is actually a risk for surrounding houses. In fact, indoor air can be contaminated by groundwater and vapour intrusion and pollutants can go through canalizations, degrading drinkable water's quality.

- Budget bolts:

A reliable model (for example, a groundwater flow model) necessary is a model which has been fine-tuned thanks to several measurements on the field. Most of the time, it is difficult to realize many high-quality measurements in urban environment because it adds new constrains (sensitive interventions at privates' homes) and because it can be expensive.

As a consequence, a good modelling is often a very expensive one. However, prices of environmental studies are inevitably cheaper for a competitiveness issue. It becomes harder, for design offices, to propose well fine-tuned models implying several measurements on the site.
Finally, certain people think that models, which are meant to be predictive tools, seem to lose their added-value because it looks easier to proceed directly to in-situ statements by measurements!

- Skills bolts:

Few environmental experts blame models for being to overstate risks and to misevaluate concentrations in indoor-air. However, the considered assumptions (more or less overstating) are one part of the choices made by the modelling specialist. This choice must be taken after discussion between involved actors (Institutions, industrials…).

Other technical specialists told us their difficulties to reach some practical feedback on the relationship between the plume groundwater and contamination in soil gases. According to other specialist, there is some available existing data in literature. Some work should be done in order to improve their accessibility.

Besides, bolts such as the inappropriate use of well-known analytical solutions by some modelling specialists and their unawareness of "three phases" approaches should be treated in priority.

«Thresholds are not clearly defined. Which values should we use? »

In France, it seems that there is no single threshold defined. Although some values exist such as "Acceptable Maximum Concentrations" (CMA) and "Guide Values" from World Health Organization (WHO), some questions still are asked such as "Which values should we use?", "What is the legal threshold for concentrations in groundwater?", "Which value should we take when there is no legal value?"…

Environmental specialists noticed that there was some kind of "discrepancy" for Toxicological Reference Values (VTR). It is the case for the tetrachloroethylen. Many specialists ask if these values would evolve.

Core of the problem is a definition issue. It is actually necessary to take into account the "pollutants cocktail" (hydrocarbons, BTEX, PCB…). This exercise is usually use during the French Quantitative Assessment of Sanitary Risks (EQRS).

Finally, urban environment shows a vertical heterogeneity for geology and distribution of pollutants. Some tools such as multi-level samples, to characterize soils, water and gases can solve problems due to this issue. However, these tools, commonly used in UK-US countries, are quiet unrecognized in France.

«Pollution with weak concentrations »

We focus too often on consequent concentrations. In fact, it is easy to draw a line between huge concentrations of chlorinated solvents and a potential sanitary risk. But, how about weak concentrations which are generally detected in urban environments? Could sanitary and environmental impacts be neglected in such little concentrations, or should they be taken into account anyway?

During the two CityChlor workshops in France, many environmental experts criticized the fact that in France, we only speak in terms of concentrations. In fact, chlorinated solvents, even in weak concentrations, can constitute nevertheless a consequent global quantity of pollutants, as a whole. In fact, impacted water resource can be solicited out in the future. That is why one of the suggested proposals was to speak in terms of mass and fluxes instead of concentrations only.

✖ *Diagnoses are not well adapted yet to a complex urban environment*

A modified hydrogeology (back fillings, pumping and wells, urban networks…) and a high number of different uses of the urban middle (buildings, underground networks…) are representative of the complex environment we deal with. Specific behaviours of chlorinated solvents in soils and groundwater must be added to the board of difficulties. Although some methodological tools and "routine" techniques are used in France, they are actually limited during investigations of chlorinated solvents in urban areas.

« No clear definition for a "source" zone »

Sources of pollution in urban environments often are diffuse and pollution is everywhere (at a wide scale). This "odd" source zone can be seen actually as a "plume". Therefore, there is a problem of definition here. So, it is important to have a clear definition of a "source zone". Should plumes and soils impacted by weak concentrations and diffusing VOCies in soil gases and groundwater be seen as "source zones"? French national Workshop put in relief the fact that a common vocabulary should be defined for everybody. Main aim should be to answer to the following question: "What exactly is a "source zone"? Sometimes, presence of organic phase defines this "source zone", but we already deal with interpretation here (More than a single measurement is needed to define it).

« Diffuse source zone very difficult to find. Towards notion of "urban chemical background noise" »

Locate the source zones often is the more delicate step of the characterization phase. This one is crucial in order to define the whole management plan. The ideal case is the following: we locate the source zone, remove it and we treat residual concentrations if necessary. However, reality is much different because it is not practically easy to find these source zones, often diffuse. Intervention on diffuse source zones is more difficult than treating more conventional "punctual" source zones (on small sites). Some French experts start thinking about the concept of "urban chemical background noise".

Moreover, the massive use of chlorinated solvents and VOCies in general by an impressive quantity of industries can cause interferences during the diagnosis. Looking the source zone is more complicated because interpretation of the results becomes more complex due to the multiple contaminations in urban areas. It becomes more difficult to establish a clear link between a stated contamination (concentrations) and a precise activity.

« Historical data often does not exist and databases are incomplete»

Historical data often are incomplete even non-existent. However, this kind of information can help to adapt characterization phase (targeted compounds). There often is no administrative monitoring of sites and installations which are not ruled by the ICPE French legislation (installations classified for environment protection). The historical and documentary study, realized by Environment experts and sometimes by Institutions and Urban developers, is often blocked.

«Some methodological bolts still exist »

Heterogeneity of urban environment, space and time variations for measurements, soil/indoor air transfers… are some of the many parameters which should be taken into account during characterization. Unfortunately, they often are not during thinking.

« Protocols for sampling still need to be adapted »

Indoor-air and soil gases sampling are not always representative. In fact, some experts noticed a 1 to 3 time during a 24 h period for active sampling and during 7 days for passive sampling. In addition, it was said, during French regional workshop, that there was a lack of harmonization for in-situ methods used to define kinetics of degradation of chlorinated compounds in soils.

« French IEM tool can be incompatible with emergency »

French methodology for polluted sites advocate the iterative use of the Media Quality Assessment tool (IEM) and can lead to extra-site investigations. These different steps can consist in realizing many sampling, analysis and interpretation campaigns around the site. This could take a lot of time. Unfortunately, time is missing for actors in case of emergency, especially when human exposure is concerned.

✘ *Many juridical problems linked to investigations and responsibility is hardly defined*

Juridical issues can be raised during the investigation phase. Pollution is not contained by the property perimeters and extra-site measurements often are needed. This can cause some litigation and can bring to legal cases.

« Litigation can be spread during extra-site investigations »

French methodology explains clearly the legitimacy of extra-site measurements. However, they can bring to litigation. For example, there can be some conflict when pollution is discovered at neighbour's house, or when another new pollution is discovered.As a consequence, some decision-makers or industrials can be reluctant to proceed to extra-site investigation because it looks too "risky". However, extra-site investigations often are necessary for a good characterization of the pollution.

« No legal tool in order to legitimate investigations at neighbours' home »

There is no juridical tool in France in order to legitimate access at individual's home to do measurements. These measurements can be water samples in private wells, indoor-air samples…). It occurs that technicians stay in front of a closed door. Maybe the only culprit is a deficient communication (as seen earlier in this report). In certain case, it could be useful to have juridical tools available to improve access to investigation points. But, how far can we go not to encroach upon privacy and individual liberties and rights (as property)?

« Responsibility is often bad defined »

When contamination by chlorinated solvents is discovered, studies are mandated by Institutionsor Industrials in order to define who is responsible for pollution of soils and groundwater. However, chlorinated solvents are massively used in urban areas, and even by individuals at home. Associate a stated pollution with a certain activities. Moreover, chlorinated solvents are mixed with other substances (such as hydrocarbon, BTEX…). It is consequently difficult to define factually real responsibilities and to apply the « polluter-payer » concept. This can block the whole remediation project.

✘ *Available methodological tools and databases can be improved*

If some tools are available, they are not well adapted to urban contamination by chlorinated solvents.

« Des mises à jour méthodologiques nécessaires »

Written in 2006, MACAOH guidelines do not integrate tools suggested by French methodology for polluted sites (IEM, Management plan, advantages/costs balance…). The constant evolution of characterization (for soils, water, soil gases) necessitate an updating of recommendation for "screening" phases, identification and quantification of organic phase and associated mechanisms.
During French workshop, it was said that, if assessment criteria change, it will be necessary to monitor polluted sites managed by older methodology (former French methodology before 2007).

« Methodological tools and guidelines are not well known »

Methodological and technical guidelines proposed in MACAOH guidelines are relatively bad known by experts. Too few contractors use or refer to these guidelines during their studies (except when it is clearly asked by decision-makers (some municipalities and the ADEME who concretely ask for it in the tender).

«A new way to proceed? »

Most of the Environmental experts work in terms of concentrations. Necessity to work in terms of mass and fluxes was raised by experts during French CityChlor regional workshop. This change of methodology would make able the take into account the total sum of pollutants in soils and groundwater that could be solicited in the future.

❌ *Different perceptions of characterization and « risk » notion*

While communicating during investigations, risk notion is necessary tackled. This topic is definitively sensitive because a bad communication can lead to fear.

« A complex interactions between stakeholders during characterization »

Needs during characterization are not the same for every actor. For municipalities, main issues are finances, responsibility and legislation. For environmental experts, increasing diagnoses' quality is more important. Objectives seem to be quiet different from an actor to another.

« Different cultures: a vocabulary which can be frightening »

Communicate on pollution to a large public is not a real easy thing to do. In fact, it is technical and complex to understand for people who are not aware of environment, risk and techniques. How to talk about "residual risks", "exposure calculations"…? The use of these strange terms or calculation tables beyond understanding (like sometimes shown in public studies) can cause anxiety.

«Technical experts are not always trained for communication »

When Institutions and urban developers are skilled enough too communicate on polluted sites, other actors, such as technical experts (e.g. design offices) are not at ease to communicate to population on these sensitive subjects. However, these actors often are first ones, populations talk to (during investigation phases).

« Nowadays, context does not make easy the implementation of communication on the field »

Prices of studies are lower and lower, which reduces means that could be deployed on the field for communication (by design offices for example). For example, the performance of an ombudsperson can be always planned.

3. French actors' needs

⚠ *Better tools to assess risk and explain it*

Many fine tuning sessions are needed in order to assess better risk potentially caused by chlorinated solvents in urban areas.

« Define clear thresholds »

It is necessary to define clear thresholds in order to make good risk assessments and to dimension remediation processes. For example, two different values exist for exposure during work and at home (in houses). However, these two uses are mixed in urban environments.

« Couple remediation operations with a medical check follow-up »

Health experts recommend that a medical follow-up is integrated in the toxicological and risk management approach. In addition, development of some techniques such as monitoring of the real exposure by following bio-indicators and the widening of epidemiologic studies should be considered.

« Some new databases in order to act better »

Many actors raised the issue that urban maps of soils, groundwater and soil gases pollutions are needed in order to react as early as possible. This would make such actors as decision-makers and urban planners to put action into hierarchy: risk assessment, monitoring, remediation…

« Create and use a common vocabulary reachable by everybody »

Certain actors think that technical vocabulary is quiet "terrifying". In fact, when environmental experts show risk indicators (e.g.10^{-5}) during some public meetings, main information people remember is the fact that there is a risk. It is consequently necessary to present which stakes are really concerned, the approach and the results

through understandable words, designed for targeted groups (e.g. urban planners, populations, decision-makers…)

It is necessary to build up a common vocabulary for chlorinated solvents which should be designed for every kind of actor.

Which representative protocols to characterize pollutions construe them?

Representativeness of soil, groundwater, soil gases samples and indoor-air often is a problem. Technical experts wish some new protocols more adapted to chlorinated solvents in urban areas.

« Which good practices for indoor air measurements? »

How far are indoor-air samples representative? How is it possible to construe regarding much interference there could be in houses?

« Which good practices for soil gases measurements? »

Soil gases sampling can be considered in two approaches: location of "sources zones" OR definition of transfers. Strategy is radically different from an objective to another. Nevertheless, it is necessary to make measurements directly in exposure middles. Moreover, these objectives are not final aims themselves and should be used in order to define the best management plan as possible.

But, what is real representativeness of soil gases measurements in function of meteorological conditions and other kinds of pollution of urban soils and groundwater?
Would it be possible to homogenise sampling methods for soil gases in European countries? Some experts suggest that gases are systematically measured in soils.

Finally, this approach has been evaluated in MACAOH guidelines. Studies show that the assessment of concentrations in soil gases is not relevant in many cases because diffusion mechanisms homogenise concentrations too quickly. This phenomenon is much less important for water sampling.

« Promote good practices to measure chlorinated compounds in soils and groundwater? »

Bad practices during samplings, packaging and conservation of samples are first origin of characterization mistakes according environmental experts. Similarly, there are some problems with measurements of in-situ degradation kinetics which need appropriate techniques and methodology.

Good practices, in particular for sampling, results analysis and interpretation in terms of saturation and volume of pure phase (NAPL) from concentrations in samples, are presented in MACAOH guidelines developed by the ADEME with different partners. However, too few experts use them.

It would be necessary to promote MACAOH guides to experts but also to decision-makers in order to include these guidelines in their tenders/contracts/specifications.

Environmental experts agreed on the fact that reliable « indirect characterization methods » (non destructive) would be useful to quantify impacts of a polluted site. For example, integrative pumping methods" (which consist in pumping huge volumes of groundwater could be a solution to locate "source zones". The only remaining problem could be disposal of pumped water…

Finally, phytoscreening could potentially is a good mean for characterization of chlorinated compounds in urban areas.

«New portative tools»

Environmental experts wish new portative tools in order to progress easily in urban environment where access is a really thorny issue.

Characterization by phytoscreening can be done thanks to a portative gaseous chromatograph which makes operations easier and quicker.

«Think in terms of mass and not only with concentrations »

Source zones often are quantified in terms of mass of pure product. Pollutions by chlorinated solvents in groundwater are estimated in terms of concentrations. However, weak concentrations in huge volumes of groundwater could be used in the future.

It seems necessary to couple measures of concentrations with precise mass balances.

Develop a better knowledge on chlorinated compounds in urban areas

Some characteristics of chlorinated solvents remain unknown in urban areas. As a consequence, it is important to know more about them in order to characterize better pollution and to assess concerned risks.

« Concerning transfers via buried canalizations »

Environmental experts need solutions in order to know more about transfers of chlorinated compounds via urban canalizations and specific interventions for this way of transport. However, some experts said that some coefficients already exist in the literature to quantify common chlorinated compounds through common materials in literature.

« Better know impact of chlorinated solvents on buildings and their foundations»

During French regional workshop, many experts underlined the importance of geotechnical impacts on foundations by chlorinated solvents. These effects should be considered in management plans. Some R&D work could be envisaged in this way.

Some inventories/state of urban equipment should be done in order to state on different impact from VOCies on foundations and urban equipment.

« Know better behaviours of chlorinated solvents in soils and groundwater»

It is necessary to realize an inventory of knowledge on metabolites (toxicity, stability, degradation, physical and chemical properties…). These kinds of information could be incorporated to models in order to make them more reliable.

Some training sessions could envisaged in order to aware experts on these aspects (especially for modelling) and to make them able to increase their skills on these topics.

« Know better soil to indoor air fluxes »

It appears necessary to develop some tools in order to know better about transfers at the soil/building interface and to take them into account during risk assessment for indoor exposure.

« FLUXOBAT » project could bring some solutions to this topic developing new tools for the assessment of volatile compounds transferred from soil to indoor air.

Develop other techniques which are not integrated in current R&D projects

Other investigation methods are not in current French orientations for research and development. However, some experts seem to use these techniques as « routine » techniques.

Isotopic methods to characterize chlorinated solvents could be more than interesting and should be developed more.

A more adapted characterization approach to chlorinated solvents

Even if current methodology used in France suggests bases in order to lead characterization, it is necessary to adapt it to "chlorinated solvents in urban areas" issue.

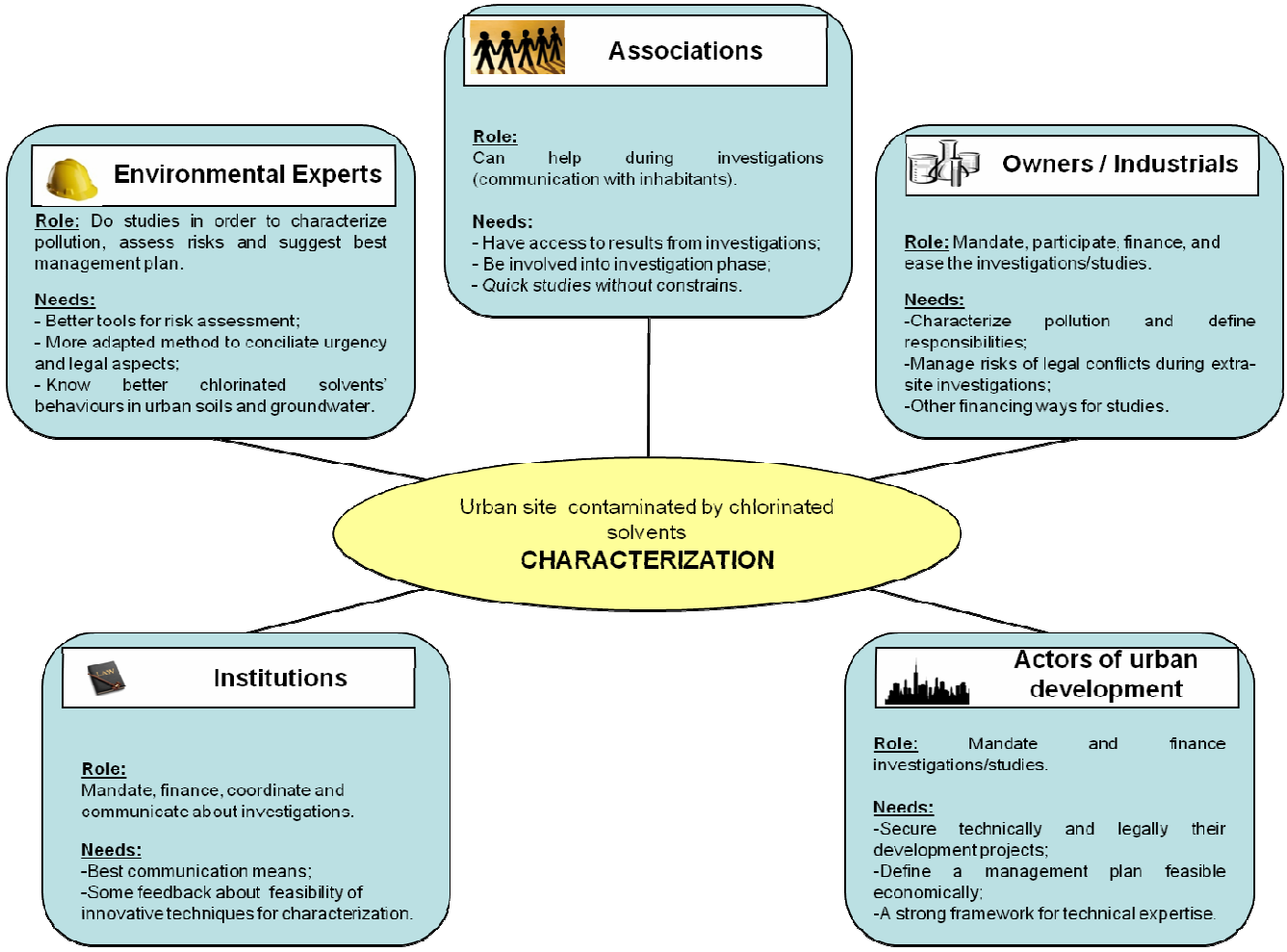
«An investigation approach more adapted to emergency »

The iterative IEM approach allows a good comprension of the pollution. However, this methodology should be compatilbe with emergency (especially during sanitary crisis).

« Anticipate juridical aspects and litigation risks during extra-site investigations »

Extra-site investigations should be secured juridically. Decision makers and industrial have to control risk of litigation in order to proceed to most adapted investigation safely and to choose best managment plan. Finally, during investigations, it occurs that some samples are not admissible (e.g. indoor air samples). Therefore it is necessary to ensure legitimitiy of samples and measurements.

4. Summary of the phase: « CHARACTERIZATION»



Proposals from different actors:

- Work in terms "of mass and fluxes" in complement of concentrations (couple concentrations with accurate mass balances).
- Define clear thresholds for risk assessment.
- When necessary, couple remediation operations with sanitary monitoring.
- Create some urban cadastres for pollutions in soils, soil gases, groundwater in order to put action in hierarchy: risk assessment, monitoring, remediation...
- Establish and use a common vocabulary understood by everybody (populations, urban planners...).
- Create guides of good practices for measurements for indoor-air, soil-gases, soils and groundwater.
- Do studies to know more about fluxes by urban webs and pipes, impact of chlorinated solvents on foundations and urban equipment, their behaviour in urban groundwater and soil/indoor air fluxes.
- Use isotopic analysis in order to characterize pollutions by chlorinated solvents.

PHASE 3: REMEDIATION

1-Discovery

2-Characterization

3-Remediation

4- Use

Once the pollution is characterized and the risks assessed, remediation or safety measures can start. This phase's main aim is to cut any potential impact of this pollution to target people (e.g. inhabitants). This can be done by treating contaminated soils and groundwater and also by setting-up building preventive measures (e.g. tanking for buildings) and/or containment (hydraulic barriers).

1. Strengths of French situation

✔ *Remediation objectives are defined in function of the future use of the site*

French methodology requires that objectives for remediation must be defined in function of the future use of the site. This use must be compatible with soil and groundwater's quality. When it is not the case, remediation or safety measures must be proceeded to maintain current use of the site.

Thresholds that should be reached after remediation can be clearly defined if the future site's use is already fixed. One of the advantages of this methodology is that it makes decision-makers able to anticipate and to control, as soon as possible, the site's becoming, especially during new development projects.

✔ *« "Routine" methods are rather satisfying »*

"Urban middle" is a criterion itself and it is taken into account when technical experts choose the most adapted technique. When certain ones currently are in development, others have been well tested on the field and can solve the problem for certain conditions.

« Hydraulic barriers are frequently used »

Containment measures are quasi-systematically used in urban areas in order to prevent from a spread of the pollution via the groundwater flow (plume). This containment can be used to protect wells, in down-stream,which pump groundwater designated to human consumption from this pollution. Exposure levels are reduced in down-stream areas. However, hydrogeology can be complex in urban environment making its comprehension delicate. This can make difficult the implementation of hydraulic barriers on the field.

Containment is not a real remediation technique itself but often a temporary management measure complementary to remediation operations. Obviously, its installation, the process and its maintenance cost money.
Technically speaking, it consists in pumping. Generally, groundwater, considered as a waste once pumped, is treated. In this case, this process can be considered clearly as a remediation technique which iscalled "*Pump&Treat*". Unfortunately, this technique, often used, can be inadequate and will be treated after in this report.

« Used as a "routine" technique, the "venting" seems to be well adapted to urban environment »

Venting is frequently used by remediation operators in France. It consists in extracting the vapours of chlorinated compounds in soils (in the unsaturated zone) using "needles" or gas-wells. Soil's surface is often covered by a depressurized tent, and a gas-treatment unit (charcoal) treats soil gases before their atmospheric discharge is systematically implemented. This technique can be implemented easily, can turn out cheap (depending on deployment time) and allow cartography of the pollution (depending of density of measure points). Therefore it is possible monitor pollution in soils in real-time. Results of this technique often are quiet good.

✔ *Many innovative remediation techniquesand safety measures adapted to chlorinated solvents in urban areas are currently developed*

Several innovative techniques are in development and/or have already been tested on the field. Some of these are studied by R&D projects (e.g.ETVsol) in order to acquire some credit with decision-makers

« Preventive building measures currently in development »

New systems are currently developed in order to reduce or cut transfers of VOC from polluted soils to indoor-air. Other are aimed to increase indoor-air's quality. These techniques are developed by the French Centre of Technical Sciences of Building(CSTB):

- Use of ventilation systems in buildings are studied (crawl spaces, Controlled Mechanical Ventilation...);
- Installation of tanking in order to increase buildings' tightness (setting-up of thick concrete slabs).

The CSTB sometimes intervenes as an expert and proceeds to technical diagnostics of buildings and can help to realize dimensioning of buildings preventives systems (ventilation systems, tanking...).

«Innovative processes which are more and more adapted to urban environment »

In-situ remediation techniques, as the In-Situ Chemical Oxidation (ISCO), the In-Situ Chemical Reduction (ISCR), and the in-situ reduction by soil mixing and in-situ ventilation by soil mixing are more and more frequently used. Chemical reagents can be injected thanks to conventional drilling tools, even under buildings with people and activities in them.In function of used reagent, the suspension can infiltrate and spread around the injection points or react locally when source zone is well defined.

« Some approaches in order to give some credit to new innovative techniques »

Environmental Technology Verification Systems are currently implemented. These systems are aimed to verify the provider's assertions about new technologies' performances. This would provide additional elements in order to convince the first buyers of these techniques. One ETV project deals with thermal desorption techniques to treat hydrocarbons).

«Natural Attenuation: Implemented soon in France as a management plan? »

Concrete field tools are also developed in order to implement Monitored Natural Attenuation (MNA) as a real management plan, especially for sites contaminated by halogenated compounds. French R&D project called ATTENA goes in this direction. These tools will have to integrate French methodology for polluted sites, implemented in 2007 and including such tools as costs/advantages balance, management plan...).

✔ *Some tools for decision-makers to choose he best remediation technique*

Help decision-makers to choose the most adapted technique for remediation is one of ADEME's priorities. Main aim is to create new tools in order to help French actors to improve their skills on polluted sites management so that they will be able to adapt better their actions to these quiet complex issues.

« Some tools exist already, others are currently developed »

The ADEME alreadydeveloped a guide for decision-makers to make them able to do a pre-selection of remediation techniques *("Guide for Soils Treatability*"). Main aim of this guide is, on the one hand, to exclude remediation techniques which are clearly inadequate with such parameters as "the site", "pollutants" and "soils" and, on the other hand, to identify which parameters can limit techniques' feasibility and performances. Another available reference document, *"Which techniques for what remediation? Costs/advantages balance",* developed by the BRGM, is a guide which presents all available remediation techniques to concerned actors (as decision-makers).

2. Weaknesses of French situation

✘ *Delicate operations due to urban environment*

Some techniques, used by French operators, are well adapted to urban environment. However, their implementation can remain delicate.

« Proximity of houses and activities »

Proximity of houses from the zone to remediate is an additional constrain source. In fact, people who live and work near or on the operation zone can be exposed to an atmospheric discharge from polluted soils for example. In urban middle, it is compulsory to:

- protect workers (who operate the remediation) from vapour emissions of chlorinated compounds (made compulsory by the French "Code of Work");
- reduce dust and gas emissions from the remediation process in order to protect the neighbours (inhabitants);
- realize systematically inventories and inspection of the state of the site;

- optimize traffic of work vehicles (used for remediation) and well schedule work time of remediation devices.

When urban configuration allows it, remediation can be made under depressurized tents. Several actors noticed than operations were quiet different between sanitary alerts and only environmental alerts. As remediation is complex in urban areas, this lead certain actors to think that priority is often given to the least urbanized zones (which would be totally remediated) when only monitoring will be made on “more urban” areas (whereremediation is more delicate). These actors suspect the existence of a “”differentiated management” between sanitary and environmental alerts.

«Remediation techniques can upset the urban soils’ equilibrium »

Certain types of remediation techniques can have a strong influence on geotechnical equilibrium of urban soils. Indeed, such soils’ geotechnical properties as “stability” can be modified by these operations (for example drawdown the water table by pumping groundwater. Few things are know about chemical and geotechnical consequences of in-situ techniques (modification of redox potential (during oxidation or reduction, pH, water-table drawdown....). Effects of these techniques on buildings (concrete, foundations...) are also unknown.

When it is not well controlled, remediation (especially in-situ remediation) can result to accumulation of metabolites, more dangerous than the former compounds, as the Vinyl Chloride. There are many publications on this topic.

« Access to pollution is often difficult »

Spatial spread of the work zone is often quiet limited in urban areas. Soils’ permeability, depth of pollution, but also, configuration of urban equipment (buildings, pipes...) can make difficult, even impossible, access to the polluted zone to treat. This can make costs increase and unreachable by decision-makers economically. In this case, pollution remains in soils or is partially (and inefficiently) treated.

Difficulties can also be encountered when intervention take place in protection parameters around pumping well for drinkable water. For example, some in-situ remediation techniques consist in the injection of reagents in groundwater (ISCO, ISCR, nutrients for Bioremediation...). This is properly forbidden in these perimeters. Such operations sometimes are authorized by the Administration (Institutions). Legal documents which are linked to these perimeters are documents for public easements. But, legally, everything which is not written in this text is considered as forbidden. Moreover, conditions and modalities for treatment’s end must be studied in order to guarantee a durable absence of impact to the drinkable water pumping well.

« Treatments are quiet long. There are many uncertainties and a few inadequate techniques »

Remediation can take a very long time and, therefore, be very expensive. For most of French actors, “remediation of site contaminated by chlorinated solvents is a very expensive and complex issue”.

Excavation and venting are the most used techniques in France*(Ernst & Young - 2006)* for remediation of vadose zone. However, when pollution is not well defined enough, excavation can take a long time before reaching acceptable remediation rates.

For French actors, still Pump & Treat technique is too often used to remediate chlorinated solvents which are in groundwater (saturated zone). However, this technique often is too inefficient to treat these compounds. Also at a pinch, the only way Pump & Treat can be useful is when source zone is entirely well defined and/or as a hydraulic barrier system but not as a real remediation technique.

When there are uncertainties on techniques’ performances and remediation rates for soils and/or groundwater, it becomes hard to schedule a fixed operational planning. This can cause huge overcosts.

« Some results which can be criticized »

Nevertheless, Venting, which is the most used remediation technique in France to tackle chlorinated solvents in the vadose zone can leave small residual concentrations of chlorinated compounds in soils and soil gases. Can these “weak” concentrations be considered as a real “source zone” and how to treat them? These questions often came to experts’ mind.

Moreover, in some cases, no improvement of indoor-air quality after the implementation of building measures as ventilation or tanking systems in houses for example.

«Ventilation, crawl spaces… Some recommendations which can "hit" legislation »

The use of ventilation systems, crawl spaces... described in certain management plans can hit Low Energy Consumption objectives for new buildings (*BBC – Low Consuming Buildings)* and legislation (in fact, ventilation of certain technical floor is prohibited.

Some innovative techniques which are looking for some credits

New techniques suffer from a lack of feedback about their implementation and their success rate. However, decision-makers need these kinds of information in order to take a decision as less "risky" as possible.

«Bad picture for innovative *in-situ* treatments… »

In spite of many obvious advantages of in-situ techniques in terms of implementation, durable development (no excavation, low energy consuming, reduced space, these suffer from a blurred picture. In fact, as results cannot be seen visually, we cannot be 100 % sure that remediation objectives have been reached. On the contrary, when there is excavation, people see that pollution is "gone". It is also a matter of "communication". These innovative techniques seem to be risky, but who can support/pay this risk and how do it?

« … In particular, Natural Attenuation »

Monitored Natural Attenuation suffers from a lack of confidence too. In several people's minds, MNA is equivalent to "we do nothing and let things doing".

«Consequently, decision-makers prefer safe-looking techniques which can fit bad to chlorinated solvents in urban areas»

Excavation and Pump & Treat still are massively used because they look safer for decision-makers than innovative techniques. In fact, these techniques are mostly unknown for decision-makers, which is why the administration hesitates to use these innovative techniques.Besides, excavation and Pump and Treat techniques look simpleand reassuring for decision-makers. Consequently, they are massively ordered in order to limit risk-takings. To conclude with, France seems to run late behind US-UK and Nordic countries in terms of using innovative remediation techniques.

« Access to foreign results and technologies is quiet difficult »

Many French actors agree on the fact that too many publications and synthesis from R&D projects are in not in French. This can make difficult access to these sources of knowledge. CityChlor project should allow partner countries (at least) to create an English synthesis of relevant documents written in different languages. Moreover, the ADEME, with the SNOWMAN project, work currently on the identification of interesting documents (cf. German KORA project).

Different visions for a remediation process which can take a long-time

Remediation process looks different from an actor to another. Professional background, scientific skills, personal sensibilities... can influence people's vision. Time and remediation objectives are appreciated differently by different actors, which can lead to several misunderstandings.

« Different "time" perceptions »

Remediation can be a very long time process for some people, and not enough for others. Everyone has their own way of seeing things. Time is not the same for everybody. Even this non-scientific criterion cannot testify the efficiency of a remediation process, time is an indicator for everybody.

«Different views of "remediation" »

Excavation is a strongly visible operation. An in-situ remediation is, on the contrary, invisible. Natural Attenuation often has negative image ("Do nothing and let it go"). There is still some work to do with communication at this level.

Moreover, thresholds and remediation rates and objectives are not easy things to explain (especially to inhabitants. The fact that remediation is dimensioned in function of future uses of the site can look insufficient for people who live on or around this site.

For example, if one remediation level is sufficient for a “square” use but inadequate to a “housing” use, will potential users of this park feel safe? Generally, a residual pollution, whatever it is, is a hard to explain and to understand. Such questions as “why don’t you remediated all the pollution?” can be asked. Thus, it is compulsory to explain what “risk management” is. But, when you are talking about “risk management”, you also use the word “risk”, which is another “hot potato”.

3. French actors’ needs

Know better impact of remediation on urban environment

Certain in-situ remediation processes can lead to an increase of some metabolites, which sometimes are more dangerous than the initial compounds (e.g.Vinyl Chloride). Other techniques upset hydrogeological (e.g. drawdown of the water table) and geochemical (variation of oxido-reduction potential or pH in soils...) equilibriums. These modifications of soils’ characteristics can trigger some variation of the geotechnical behaviour of soils (e.g. drying ofswelling clays) and threaten buildings around.

Therefore, it is necessary to find answers for the two following questions:

- What are geotechnical impacts of remediation operation on surrounding buildings (e.g. on foundations)?
- What are the potential risks for populations due to anaerobic in-situ treatment of chlorinated solvents (e.g. potential increasing of metabolites in case of unachieved degradation)?

Some studies and general feedback sessions could give answers to these questions.

Some technical tools in order to intervene better on these pollutions

Environmental experts put into relief the fact that they need new technical tools which would allow them to intervene more efficiently in urban areas with a reduced access to pollution and where exposure of the population is possible.

« Allow the access to polluted zones »

It is compulsory to manage better access, authorization (e.g. to intervene in a private site) and communication problems. Which techniques to develop or improve in order to solve these problems?

Some drilling techniques, as “directed drills” could be adapted and used to reach unattainable contaminated zones?

It is important to be able to intervene in limited access zones such as protection perimeters for pumping wells (used for drinkable water). Modalities for intervention should be written in legal texts for public easements.

Modalities for treatment’s end should also be studied in order to guarantee a durable absence of any impact for the pumping well.

«New remediation techniques are needed to manage contaminations by chlorinated solvents in urban areas »

These new techniques should allow the optimization of traffic of work vehicles, the reduction of noise, dust and (obviously) volatile compounds emissions. A more efficient and a durable management of soils pollution is necessary because sanitary regulations are more and more restrictive for indoor-air quality. It is also necessary to reduce quantity of excavated earth and earths which are treated outside of the site.

Some techniques which are less used in France (as in-situ thermal treatment, injection of zero-valent iron particles...) are tested on the CityChlor pilot sites.

Some experts have also mentioned potentialities to do some studies on building preventive measures to protect people from vapour transfers from soils to indoor-air.

Which objectives for remediation of chlorinated solvents?

Environmental experts often face unattainable remediation objectives. That is why they ask for relevant and clear objectives for this remediation.

«What objectives for soils and groundwater treatment? »

Until when should we continue remediation operations in soils and groundwater for VOCies? Until acceptable risk or beyond? Remediation objectives aren't always clearly defined, especially for sites where uses are likely to change in the future. In this case, it becomes impossible to remediate, as French methodology for polluted sites advises it, in function of future uses of the site.

« Real objectives for management plans »

It is very important to clearly define objectives for a management plan in function of the site's configuration and its environment. Not only with calculations and models.

Samplings in exposures middles allow reducing uncertainties during Quantitative Sanitary Risk Assessments (EQRS). These samplings also permit to dimension more pragmatical management measures. That's why they must be done as soon as possible.

« Well characterize to better remediate »

One of the main raised issues in France is the following question: *"In France, are characterization studies detailed enough (high density resolution for screening and wells…) in order to dimension the best remediation operation and to avoid inefficient and over-estimated operations?".* During French CityChlor workshops, the answer was mostly *"No"*. However, all the actors agreed on this point: it is necessary not to hesitate to make as many efforts as possible to characterize pollution, in order to find the most adapted remediation treatment and, finally to save money.

Enforce sharing of tools and experiences while supporting innovative techniques and approaches

Development of sharing networks seems to be unavoidable in order to give innovative techniques and approaches some credits. This would also allow answering to current and future questions/issues.

« So some feasibility studies »

Some feasibility studies are necessary to give some credits to innovative techniques decision-makers do not know anything about. These studies would also help Environmental experts to well dimension remediation techniques.

For example, feasibility studies are currently made in ATTENA French R&D project for implementation of Monitored Natural Attenuation (MNA).

« Organise sharing and feedback sessions »

Some feedback on good and concrete practices on characterization and remediation techniques should be organized. Moreover, a quasi-systematic inventory of the state of the site should be made on the site before and after remediation (population's claims…). This could be probably useful to define impacts of remediation techniques on geotechnical and chemical properties of urban soils.

These feedback sessions could also deal with « real ecological footprints' of remediation techniques. Some Life Cycle analyses could be done on remediation processes. Finally, limits of each technique could be found out.

However, it is necessary that every actor plays fair the « game » because these points can also considered as crucial for competitiveness.

Such initiatives could be launched by professional syndicates (e.g. French "Remediation Professionals Union" (UPDS) in collaboration with Institutions (e.g. ADEME).

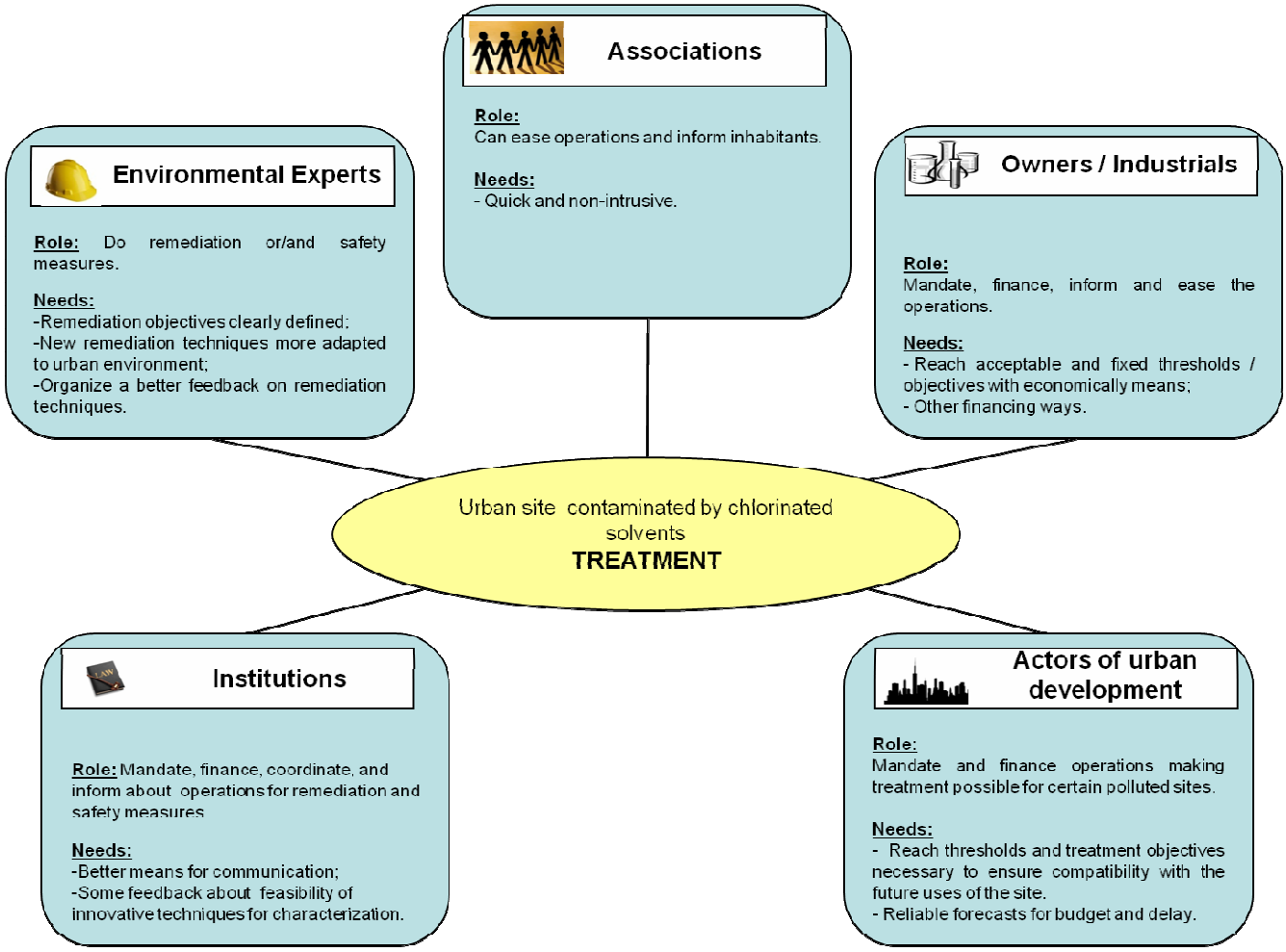
« Creation of an « Urban Soils Database »

The creation of a database for urban soils' quality, identifying which soils are contaminated by chlorinated solvents is often mentioned by environmental experts, decision-makers and actors of urban development. In France, there are many referential for soils' quality (especially for rural soils) as the RMQS… For urban soils, some local initiatives have been done to make this kind of inventory, as the City of Lyon.

« An international work of bibliography »

Many technical guides and R&D projects exist in Europe and at world level. A common work of synthesis to gather all technical information and to improve its access should be realized. Operational documents should be translated in national languages and be available in each country. Currently, discussions are lead by decision-makers on these topics. CityChlor and SNOWMAN projects and networks also go in this direction.

4. *Summary of the phase « REMEDIATION»*



Proposals from different actors:

- Some research studies on remediation techniques' impact on urban environment (geotechnical aspects, increasing of sub-products and metabolites...).
- Use "Directed Wells" in order to make easier the access to polluted zone.
- Define management measures in function of field measurements (e.g. Concentrations).
- Organise a common feedback on remediation operations in urban areas polluted by chlorinated solvents and on choosing criteria such as "ecological footprint.

PHASE 4: USE

1-Discovery | 2-Characterization | 3-Remediation | *4-* **Use**

Once the pollution is treated or safety measures set-up, the site can be used. In fact, urban areas often are strategic areas with strong stakes. They can be used for housing, service, cultural and recreational activities. If they are not included in urban plans yet, it is just matter of time. However the (former) presence of pollution by chlorinated compounds in soils and groundwater make compulsory a reasonable and compatible use of this site. Although this fourth part is presented at the end of this report, aspect it deals with must be anticipated as soon as possible since discovery of the pollution and even when this one is suspected.

1. Strengths of French situation

✔ *A regulation mixing Environment and Urbanism in constant evolution*

In France, two legal texts illustrate this necessary link between Environment and Urbanism: Code of Environment and Code of Urbanism

➢ **« Code of Environment (2005) »**

More important parts of this legal text are:

- Book V, Title IV which stand in for the law of 1977 related to Classified Installations for Environmental Protection:

  Most of the professionals using chlorinated solvents are ruled by the regulation related to **"Installations Classified for Environmental Protection (ICPE)"** which implies:
  - Rules to respect during the exploitation (machines, storage and waste);
  - Compulsory environmental diagnosis when the activity begins and/or ends;
  - Possibility or obligation to set up a management plan even during exploitation on the site;
  - Compulsory diagnosis during the purchasing or the sale of the site (related to the article L. 514-20 of the Code).
  - The Law on the risks of July 2003 force the salesman of the site to inform on the known risk of soil pollution;

- The L. 515-12 article of the Code of Environment makes compulsory the implementation of a simplified procedure for the setting up of a public easement (as use restrictions) when there are few owners concerned.

- Book dealing with the issue of urban planning and impact studies.

- The new L.125-6 article of the Code of Environment from the Grenelle II says that the Government make public all the information it owns concerning pollution risks. This information must be taken into account in documents for urbanism during their creation and upgrading.

➢ **« Code of Urbanism (1994) »**

- The R 123-11- b article from the Code for Urbanism says that graphical documents of the Local Plan for Urbanism (PLU) must make appear, if necessary, areas where buildings, installations, wells, storages... are forbidden or ruled to specific conditions due to natural resources or pollution.

➢ **« *Grenellell* law (2010) »**

- The Grenelle II law implemented since July the 12th of 2010 makes compulsory the notification of environmental elements on urban schemes and plans (PLU). This information should make urban planners able to anticipate the polluted sites and soils dimension as soon as possible. Moreover, the Grenelle II law force the polluted sites owners who want to sell to inform the potential buyer on the risk due to pollution in their site.

A rising awareness of risks due to the inclusion of polluted sites in urban planning operations

Vapours of chlorinated solvents can contaminate indoor air in buildings which have been built on polluted soils and groundwater. However, there are many different possible uses of urban areas: housing, services, schools, hospitals...Polluted urban areas' becoming often is ruled by a huge pressure from real estate. They can be included into different urban planning projects. These projects must take into account the pollution in soils and groundwater and the risks due to this pollution in order to avoid any problem of compatibility between quality of the site and the way it will be used. Nowadays, these aspects are more and more taken into account in France.

«Inclusion of the "polluted soils" dimension in the thinking about urban planning »

A certain interdisciplinary is emerging in France. This can be explained by:

- The will to secure choices in terms of urban planning from sanitary, legal and financial risks;
- Important stakes for strategic territories;
- Some urban organization schemes which are currently more and more realized from technical, juridical and economical studies, including the tracing of the pollution's history.

Moreover, environmental studies are systematically done during soils sale or purchasing.

« Realization of Urban Historical Inventories»

In certain huge cities as Lyon and Toulouse soon, some long-scaled Urban Historical Inventories (IHU) are realized in order to know better quality of their lands. Results from these campaigns, summarized in recapitulative sheets, even in Geographical Information Systems (GIS), make the municipality who wants to buy a site able to be aware of a potential pollution. Therefore, they can anticipate this issue as soon as possible, that is to say, at the early beginning the planning operations. These inventories are often realized thanks to the consultation of department archives, from the DREAL and/ or the Prefecture.

« French Institutions in stand by to pull the alarm-bell »

The French DREAL watch projects which include (former) polluted sites. They can warn the project owner on the different criteria and rules he must respect (e.g. build crawl spaces, ventilation systems...). They often are the first actors who pull the alarm-bell, especially, when some projects include sites classified for environmental protection (ICPE).

« A real awareness for sensitive choices in terms of urban planning »

Nowadays, most of the French authorities and decision-makers are aware on the fact that many polluted sites have been redeveloped for sensitive uses. A national campaign of diagnosis has been recently launched by the French Ministry in charge of Ecology. This program, called ***"Sensitive Activities",*** is based on the comparison of the national database for polluted activities (BASIAS) and the inventory of schools or other institutions which receive children.

However, the precaution principle is often used by decision-makers when sensitive uses are concerned. That is to say that a project on a former polluted site will not be approved, even if, investigations show that concentrations are compatible with the planned use (below the acceptable thresholds). This is, in acertain way, a very drastic mean to make the risk disappear.

Some initiatives in order to structure the integration of the urban sites polluted by contaminated solvents in operations for urban re-development.

As seen earlier in this report, many links already exist in France between regulations for Environment and Urbanism. Concerned actors have already understood all the stakes and some concrete initiatives have been implemented in order to structure the integration of the "urban sites contaminated by chlorinated solvents" dimension to the urban re-development operations.

« Some guides have been designed for actors of urban development »

The *Technical Guide for urban developers* has been developed by the ADEME and the French Ministry in charge of Ecology. Its role is to give some guidance to the urban developers when they are in charge of re-development projects on brownfields. The ADEME has launched the realization of a frame of reference to assess the "urban brownfields' quality" and an economical study in order to help concerned actors. These two studies will keep an "Urbanism and Polluted sites" double vision.

« Some French actors of the urban development who already tackle environmental issues »

The excavated earths usually are a real sticky point during urban development operations; In France, those are considered as "waste" as soon as they leave the site and must be driven to the appropriate ways which can make the operation costs become *over-budget*. Some French actors of urban development, as the Public Land Institutions, can handle this torn issue.

« Some exemplary innovative projects for a responsible mutation and a durable information »

Some innovative plans have been implemented in order to check if the mutations are compatible with quality of the soils. These plans include:

- Protection of populations who live or work on the site;
- A soil remediation and a groundwater protection in function of the future use(s) of the site;
- Clear and detailed information in order to give a sense of responsibility to all actors and to secure the operations technically and legally.

Such an initiative is mostly lead in order to make the information ("site's history") and building measures durable to avoid any problems of compatibility between soil quality andland uses. This can be tendered in the purchasing/sale acts.

Some building measures often are made compulsory for the project owner (systematic setting-up of 30 to 50 cm vegetable topsoil, ventilated basements...). These measures can be remembered by the watch and the control of building permits. In these initiatives, the "costs approach" intervenes at different levels, since the historical acknowledgement to the management plan.

The urban developer is responsible for the technical choices made. The building constrains are inserted in the contractual acts or, more durable, in the decrees for public easements (such as use restriction). In the city of Massy, an *"Environmental Note"* must be realized by the project owner while he asks for authorizations for soil occupation (e.g. building permits). The City of Massy can check the project's compatibility with the environmental situation and the respect of global prescriptions. This *"Environmental Note"* is therefore aimed to sum-up the project owner's commitments and to link environmental constrains to accepted technical solutions.

To conclude with, more and more actors of urban development in France (especially in big cities) systematically join an environmental clause to every act.

« Remediation costs are often shared »

The "Who does pay?" question often is a hot potato during negotiations for example between a land owner who wants to sale his good and an urban developer. In certain cases, remediation costs can be shared.
Sometimes, a *"return to better fortune"* clause (over 15 to 20 years) isnegotiated. Such a juridical clause implies that if a site remediated by the seller brought a substantial capital gain to the purchaser, this one would pay one part of this gain back.

The economical study on urban brownfields, currently realised by the ADEME, will bring additional answers on this topic.

2. Weaknesses of French situation

Strong constrains during redevelopment projects

Redevelopment of polluted urban sites contaminated by chlorinated solvents often is not an easy thing to do. In fact, the possible uses of these sites in the future are limited by this specific kind of pollution, also reducing profits from development projects. As a consequence, several projects have been abandoned.

« "Precaution principle" and limited uses of the site »

Most of the time, it is difficult to design a re-development project on urban sites hardly polluted by CAH because of strong constrains. In fact, chlorinated solvents can intrude the indoor-air as vapours when buildings have been set-up on polluted sites. Actors of the urban development often prefer to abandon the project, even in the case of weak residual concentrations after treatment, because of the "precaution principle".

The problem is that, in urban areas, buildings are often designated for housing or for other sensitive kind of uses (as schools, hospitals...). When it is the case, decision-makers, are, most of the time, reluctant to give their agreement, even if the project is feasible (concentration compatible with these uses).

«A lot of non profitable projects »

Projects for housing can be profitable enough to balance remediation costs. However, sites contaminated by chlorinated solvents are not chosen as sites where houses can be built on (because of the "precaution principle").

« Pollution not taken into account in estimation of the sites' value »

Polluted lands and sites often are estimated by the State (the *French "Domains"*). The sale prices must be based on this estimation. However, this one does not take into account soils and groundwater pollution and, as a consequence, additional costs due to remediation are not anticipated. Unfortunately, these costs are necessary to make the site usable. Hence, urban developers cannot use these sites for any project because remediation cost will not be balanced by the sale costs. Urban developers see their economical balances disrupted.

Remediation of chlorinated solvents, a difficult ingredient of the redevelopment project: a matter of budget and responsibility

Do remediation for a polluted site contaminated by chlorinated solvents thanks to the capital-gain brought by a profitable redevelopment project seems to be a good solution. However, the "remediation" component can be really hard to control and can brake the whole project.

« French approach often is too much linear and badly adapted to redevelopment projects' dynamics »

French methodology make compulsory to design a management plan in function of the future use of the site. However, these can evolve during the thinking of the project. French methodology has been created as if the scheduling was frozen but this one can change during the maturation of the project which can take a long time (for huge redevelopment projects).

« Delays and budget are difficult to estimate »

Sometimes, define how long remediation would take is a very hard thing to do. Therefore, remediation costs can increase too. Such an uncertainty can throw a spanner in urban planners' work because it is not possible to fix a budget.

« However, some actors still under-estimate this issue facing pure real estate operations »

Some private and public actors still under-estimate consequences of a pollution by chlorinated solvents. Builders, and real-estate developers/promoters, seems to be less aware of this issue because they mainly think in terms of real estate. In fact, their objective could be to sell a good when urban planners have a wider field of vision.

Public easements and use restrictions still are unhandy tools

Public easements are the most used legal tools in France. These are very useful, for example, when pollution cannot be treated or when residual concentrations (after treatment) still are significant. However, use them can be a hard thing to do.

« Les servitudes d'utilité publiques diminuent la valeur foncière des terrains »

A site known as polluted is not attractive. Purchasers of polluted sites ruled by public easements do not have as much liberty as someone who bought a "normal site". Value of the land can decrease severely. Thus, when we talk about "public easement", it can lead to "financial compensation" of the site owner. However, French experts do not have so much feedback on this.

«There is no legal tool to control respect of good practices »

In France, there is no legal tool existing in order to control the respect of good practices in the whole chain of actors of the development (e.g. promoters, builders...), but neither for the individual (e.g. control of the good use of the ventilation system installed in the buildings, use of the water...). Nevertheless, this should be considered carefully because, this must be compatible with individual liberty (e.g. privacy, property...).

« Modalities for the removal of use restriction and monitoring are not clear yet »

Use restrictions are often used in France. Unfortunately, question of their removal remains confusing. The problem is that their implementation can "freeze" definitively the site, even if the concentrations have reached acceptable thresholds. It is necessary to clear this point and to include it into documents of Urbanism as urban schemes not to paralyse wrongly a strategic site with huge stakes.

Question is the same for monitoring campaigns for remediated sites. The INERIS and the BRGM are writing a technical guide with the French Ministry in charge of the Ecology to point out different modalities for the end of monitoring campaigns.

3. French actors' needs

Need a more accurate legal framework and some prescriptions for a global approach

All the French actors agree on the fact that a clear regulation for the use of the (former) polluted sites is needed.

« A new global regulation specific to polluted sites »

French actors ask for a new global regulation specific to polluted soils and sites and a better administrative following of these sites (especially for these which are not **classified for Environmental Protection** (ICPE)). They suggest to create a kind of new "transverse law" at the cross of different disciplines and regulations (Code of Urbanism, Code of Environment, Code of Work, Public Health...) in order to guide actors who do not have necessarily all the required skills.

Some thinking should be lead at national level on the articulation between remediation and other issues (legal aspects, sanitary aspects, urban planning...).

« A framework to control if redevelopment are reasonable »

The innovative example of the City of Massy, presented during French National Workshop in Paris on June the 24th in 2010, seemed to have reached interest from French actors who attended the meeting. But, is this initiative likely to be generalized?

«A better legal frame for the setting and the removal of monitoring, public easement and use restrictions »

Without any clearly defined responsible for the pollution, only the sanitary risk can be controlled at the points of exposure. This is necessary done by use restrictions. But this tool must be better framed since its implementation to its removal (especially conditions for the close of restrictions) in order to prevent from any freezing of the lands.
Moreover, it is necessary to define how far authorities can go do set up these measures without upset individual liberty.

« New tools in order to manage excavated earth contaminated by chlorinated compounds»

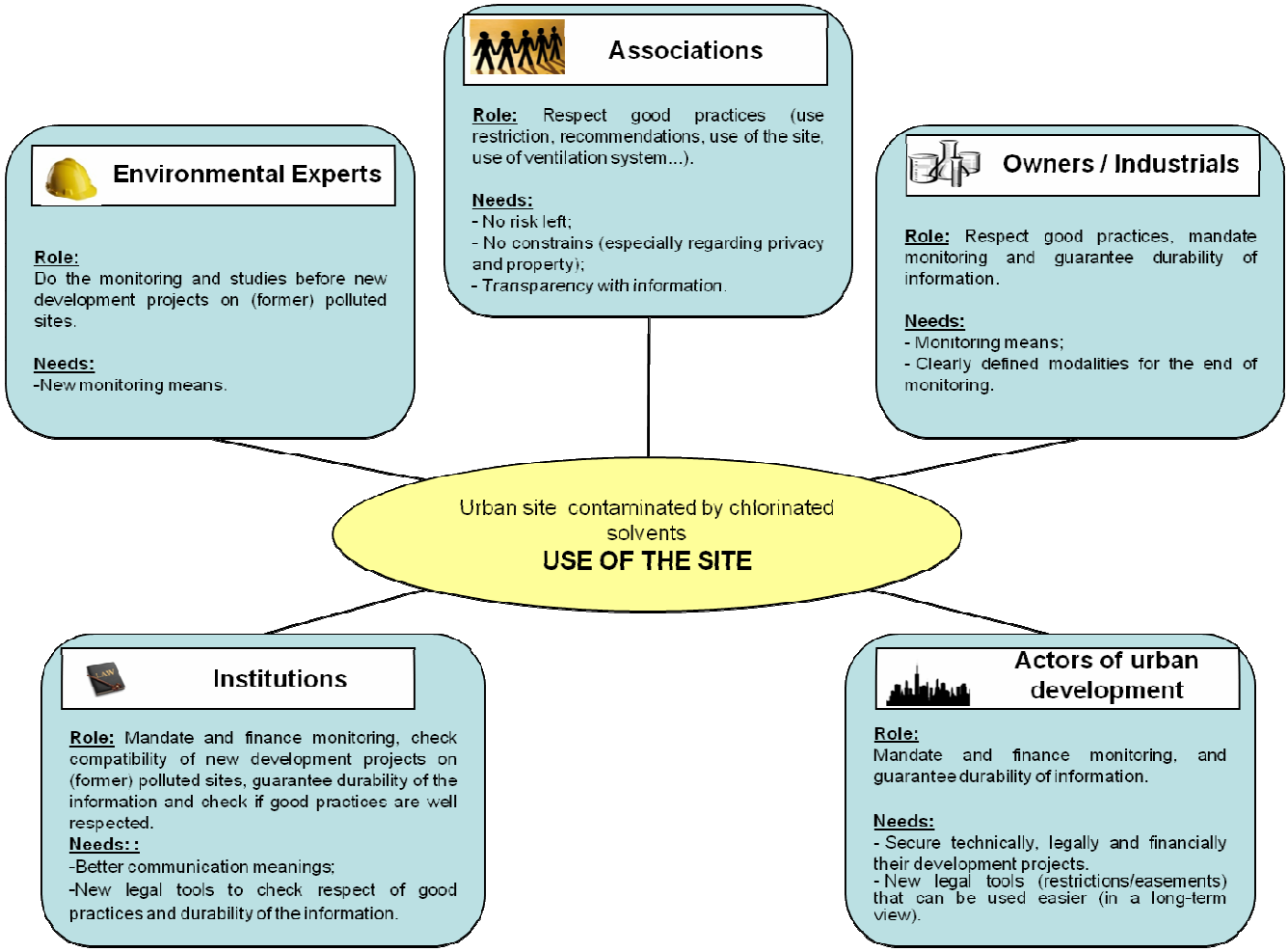
It is necessary to find other methods than excavation and waste disposal. New legal tools have to be created in order to optimize excavated materials management (costs optimization).

Moreover, when CAH-impacted excavated earth remain on the site, it is compulsory protect the workers on the field. The questions consequently are: "who is responsible for this?" and "how have this controlled and respected?"

« New tools in order to have good practices respected »

The "Use of the site" phase is the longest one in a long-term view. Good practices, indicated in the management plan, must be respected many years after safety measures. Experts noticed that, for example, in France, when ventilation systems are installed, the inhabitants do not use them at all. It seems obvious to make these measures respected too. The question remains the same: how far authorities can go in order to have these respected without upsetting individual liberty? For the moment, a "good communication" seems to be the key for this torn issue. In fact, inhabitants have to be aware of these measures' aims. So have the actors of the whole urban development chain (promoters, real-estate developers, builders...). But, who will pay to have these good practices controlled?

4. Summary of the phase "USE OF THE SITE"



Proposals from different actors:

- Create and set up a new legislation specific for polluted sites (at the cross of different legislations and rules) and have a better administrative following of polluted sites and their becoming.
- Start a thinking about articulation of remediation with other issues such as juridical aspects, sanitary aspects, urban planning...etc.
- Follow City of Massy's example during the setting-up of urban developing operations.
- Create a best framework for the implementation, the respect and the removal of public easements as use restrictions and monitoring.
- Create new tools for excavated earth contaminated by chlorinated solvents.
- Create new legal means in order to control the respect of good practices but also respecting individual liberties (as property).

ACTORS SHEETS

Actor n°1	Associations
	

Who are they?

This group gathers the following actors:

- **Associations of neighbours** (e.g.*Comité de Vigilance Franklin);*
- **Associations for protection of environment** (e.g.*Robins des Bois).*

What are their missions?

As representative of populations, the associations have to:
- Collect information about potential risks linked to pollution and about future using for the site if a redevelopment has been planned;
- Make populations aware of important issues and stick up for their interests and rights during public informative and participative meetings;
-Constitute the preferential connection between populations and the others actors (Environmental Experts, Institutions…).

What are their roles in management of urban sites impacted by chlorinated solvents?

- **Driving force:**

Associations often play a motivating role in projects. As representative of populations, they transmit the alarms and worries from them, in particular towards skilled authorities (administration, institutions, municipalities…).

- **Suggestions makers:**

Associations can make many suggestions, notably during the design of urban redevelopment projects. They can be asked for advice during definition of urban development projects. They can also give a critical view on the investigations' quality, and even on proposed management plans, including a social dimension in thinking. Therefore, Associations can naturally be included into workgroups.

- **A communication vector necessary for well going of operations:**

As main populations' interlocutors, they can make operations easier. It can be the case for investigations (e.g. during the choice of investigated houses in public meetings). They can also communicate with populations on rules they have to respect (Use restrictions for groundwater, good use of ventilation systems…)

What are their needs?

- The taking into account of alerts they trigger by the authorities;
- To be involved into investigation phases (choice of investigated houses);
- A better access to information about results from investigations and about remediation operations;
- A better management of sanitary alert with simple and reachable interlocutors;
- Quick operations without constrains (non-intrusive remediation processes);
- A better communication during remediation operations ("How well are operations?", "What are the results?", "When will treatment end?"…);
- No risk for housing;
- Very limited constrains in order to guarantee their right to land property (e.g. be able to use groundwater for kitchen gardens, no intrusion on their property…)
- Stability for price of their property (pollution strongly make land to go down in value).

Actor n°2

Owners and/or operators of urban sites contaminated by chlorinated solvents

Who are they?

This group gathers:

- **Ownersthat also are operators** of sites impacted by chlorinated solvents (under French policy about classified installations for protection of Environment or not);
- **Tenants who also are operators** (under French policy about classified installations for protection of Environment or not) (*e.g.: surface treatment companies, dry cleaners, chemical industrials, garages, syndicates…);*
- **Owners who are not operators***(e.g.: private owners).*

What are their missions?

Owners and/or operators of sites impacted by chlorinated solvents must:
• Prevent from pollution and progressively treat without waiting for end of the activities;
• Insure, directly or thanks to a representative (liquidator), civilian responsibility for their land concerning the impact on environment and damage to other people;
• Clean-up the site and make it available for a well-defined use.

What are their roles in management of urban sites impacted by chlorinated solvents?

- **An important actor at every level:**

These actors can warn authorities, mandate studies and participate to the setting of management plans and treatment operations. They respect good practices, mandate monitoring and guarantee durability of information.

- **An important role in communication on the site:**

The owners/operators have a very important role in communication processes on their site with neighbours and associations, about results from studies, remediation operations. They also have to guarantee durability of site's use memory and to inform about their land's quality in case of land transaction.
They can also initiate concerting processes in order to define future use of the site, in particularly with associations.

- **Initiation of changes of the polluted site's future :**

Polluted site's owners' main objective can be the sale of their land. For sites concerned by French policy about classified installations for protection of Environment, operations as activities' ending and sales are well controlled. Therefore, the site owners will have to respect prescriptions defined by the Administration. Therefore, they will have to mandate studies and which consist in mandate studies, and, in case of discovered pollution, to finance management plans and remediation operations.

What are their needs?

- Other ways to finance studies, remediation operations and the setting of a monitoring plan.
- Know characteristics of the pollution and check their potential responsibility;
- Control risks of litigation during extra-site investigations;
- A remediation which reaches compulsory thresholds;
- Efficient, quick, non-intrusive and cheap remediation techniques;
- Cheap monitoring systems;
- Clear modalities for the end of monitoring.

Actor n°3

Actors of urban development

Who are they?

This group gathers:
- The **land developers** *(e.g. Etablissements Publics Fonciers)*;
- The **public and private developers contractors***(e.g.municipalities)*;
- The **real estate developers***(e.g. Vinci, Bouygues…)*.

What are their missions?

The **land developers:**
- Make land studies;
- Make land "sale-and-leaseback" arrangements; ;
- Sometimes do the cleaning-up of some polluted sites;
- Help municipalities and other planners/developers (e.g. municipalities).

The **public and private developer's contractors:**
- make development project real;
- respect objectives and prescriptions defined in the management plan;
- check if remediation operations are well done;
- guarantee the setting of specific measures due to contaminations by chlorinated solvents (e.g. containment, vapour drainage…);
- Inform people (e.g. client).

The **real estate developers:**
- Set building measures defined in the management plan;
- Define use restrictions and inform the final users about these;
- Commercialize the development project.

What are their roles in management of urban sites impacted by chlorinated solvents?

- **Initiate mutation of urban sites contaminated by chlorinated solvents**

Urban development project often trigger the caring of abandoned polluted sites (e.g. in brownfields).

- **Allow financially characterization and remediation operations**

Studies and operations/treatment due to the presence of chlorinated solvents can be supported by the actors of development. Indeed, costs linked to pollution can be amortized by the project's earning power. Moreover, some schemes, as "operations with drawers" can allow remediation in a global project.

- **Guarantee durability of the information**

The actors of urban development are responsible for the transmission of site's memory and communicate on modalities for management and use restrictions (e.g. use of groundwater). Theses elements can be included into urban planning schemes.

What are their needs?

- Anticipate as much early as possible the specific issues in order to secure development choices in technical, financial and juridical view;
- Clearly establish missions technical advisors will be responsible for;
- Allow remediation of all urban sites, even the less attractive;
- Define a feasible and economically viable management plan;
- Reach defined remediation thresholds in order to make the land compatible with its future use;
- Well defined delays and budget;
- More adapted juridical tools and more "handy" (especially, time dimension)

Actor n°4	Institutions

Who are they?

This group gathers:
- Administration / State Institutions *(e.g.: MEEDLT, DREAL…)*
- Organisms for Health*(e.g.: ARS, InVS…)*
- National agencies *(e.g. ADEME, INERIS, BRGM…)*

What are their missions?

Institutions can:
• Be assigned to regulatory (circulars, control), juridical, and methodological missions;
• Give financial help (e.g.ADEME, Agencies for Water...);
• Initiate management processes as contracting owner or advise contracting owners (ADEME…).

What are their roles in management of urban sites impacted by chlorinated solvents?

- **Enforce French policy concerning classified installation for Environment protection:**

Authorities as classified installations inspectors (DREAL) control defined sites. There can be on-going activities on these sites or control can be made during the ending of activities.

- **Make the alert concrete:**

Once they are aware of the alert, authorities can launch the effective caring of the site.

- **Financent et coordonnent certains projets :**

Institutionscan, under certain conditions, help financiallysomeremediationprojectsLes Institutionnels peuvent, sous certaines conditions, soutenir financièrement des projets de réhabilitation. As they have a central role in the project management (as contracting owner), they often have to coordinate the different actors working in the project (e.g. communication tasks).

- **Guarantee a responsible mutation of contaminated sites and durability of information:**

When an urban redevelopment project includes at least one polluted site, Institutions can put the “polluted site dimension” in relief and underline precautions for use. The authorities can also check if measures defined in the management plan are well applied and they can communicate too.

What are their needs?

- Better ways for monitoring and alert (e.g. sensors);
- Better ways to communicate;
- Some feedback in order to validate easily the choice of innovative techniques;
- Juridical tools in order to guarantee durable information and to check if good practices are well followed (e.g. use restrictions);
- Clear modalities for the end of monitoring and easement on areas.

Actor n°5	Environmental Experts

Who are they?

This group gathers:
- Design offices/Advisors for contracting owners;
- Remediation operators;
- Researchers;
- Legal advisors specialized in environmental cases.

What are their missions?

Design offices/Advisors for contracting owners:

- Make studies and diagnosis investigations;
- Apply polluted sites methodology: definition of conceptual schemes, management plans and analysis of residual risks.
- Provide a technical expertise;
- Advise urban planners during urban development projects;
- Define objectives for remediation operations;
- Coordinate remediation operators as a project manager.

Remediation operators:

- Operate remediation work as defined in the management plan;
- Set specific measures for polluted site management as containment, vapours drainage…

Researchers:

- Develop new tools/techniques for characterize, treat and monitor pollution by chlorinated solvents.

Legal advisors specialized in environmental cases:

- Anticipate juridical aspects linked to investigations phases (extra-site investigations in particular).

What are their roles in management of urban sites impacted by chlorinated solvents?

- **Are in charge of technical issues:**

Environmental experts set alert and monitoring systems. They should be able to intervene quickly in case of urgency. They proceed to characterization, modelling, interpretation of the results and make suggestion on the most adapted management plan. They also secure the site and treat the pollution in order to reach remediation objectives defined in the management plan.

- **Have also a very important role in mechanisms for communication:**

Environmental experts often are the first interlocutors populations speak with because they are on the field. They consequently must have communication skills (about results, stakes…).

What are their needs?

- A better monitoring of groundwater's quality and more preventive measures and alert systems;
- Better tools for risk assessments and clearly defined thresholds;
- A more adapted methodology anticipating legal aspects and which would fit well with urgency;
- New protocols for representative sampling;
- More knowledge about behaviours, transfers, and consequences of chlorinated solvents in urban environment;
- More complete databases;
- Couple remediation operation to health monitoring;
- Clearly defined remediation objectives;
- New remediation techniques/methods more adapted to chlorinated solvents in urban areas (e.g. space-saving techniques, more efficient, less hazardous for urban environment…);
- Know and control potential effects of remediation techniques on urban environment (e.g. geotechnics, upset of soils' chemical equilibrium, increasing of metabolites…);
- Organize a better technical feedback.

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To follow CityChlor project

Do not hesitate to follow the news of CityChlor project on the official website:

http://www.citychlor.eu

Register to the free CityChlor newsletter and follow the project in real time!

Glossary

ADEME	Agence De l'Environnement et de la Maîtrise de l'Energie	Agency for Environment and Energy
AEP	Alimentation en Eau Potable	Drinkable Water Supply
AMO	Assistance (Technique) à Maître d'Ouvrage	Project Management (Technical) Assistance
ARS	Agence Régionale de Santé	Regional Health Agency (France)
BASIAS	Base de données des Anciens Sites Industriels et Activités de Service	Database of Former Industrial sites and Service Activities
BASOL	Base des Sols pollués	Database of Polluted Sites
BBC	Bâtiments Basse Consommation (Energétique)	Low (Energy) Consuming Buildings
BRGM	Bureau de Recherches Géologiques et Minières	Bureau of Geological and Mining Research
BSS	Banque de données du Sous-Sol	SoilsDatabase
BTEX	Benzène, Toluène, Ethylbenzène, Xylènes	Benzene, Toluene, Ethylbenzene, Xylenes

CAV	Composés aromatiques volatils	Volatile Aromatic Compounds
CV	Chlorure de Vinyle	VinyleChloride
DNAPL	Dense Non AquousLiquid Phase	
DREAL	Direction Régionale de l'Ecologie, de l'Aménagement et du Logement	Regional Direction of Ecology, Land Development and Housing (France)
DGS	Direction Générale de la Santé	General Health Supervision (France)
EPA	Environmental Protection Agency (USA)	
EQRS	Evaluation Quantitative des Risques Sanitaires	Quantitative Assessment of Sanitary Risks
FID	Flame Ionisation Detector	
HC	Hydrocarbure	Hydrocarbons
ICPE	Installations Classées pour la Protection de l'Environnement	Installations Classified for Environmental Protection
IEM	Interprétation de l'Etat des Milieux	Media QualityAssessement
IGN	Institut Géographique National	National Geographical Institute (France)
INERIS	Institut National de l'Environnement Industriel et de Risques	National Institute For Industrial Environment and Risks (France)
INRS	Institut National de Recherche sur la Sécurité	National Institute For Research and Security (France)
IRIS	Integrated risk information system. US-EPA	
ISO	International Organisation for Standardisation	
LID / LD	Limite inférieure de détection	Detectionlimit
LIQ / LQ	Limite Inférieure de Quantification	Quantification limit
LNAPL	Light Non AquousLiquid Phase	
MEDAD	Ministère de l'Ecologie, du Développement et de l'Aménagement Durables	Ministry of Ecology and Sustainable Development (France)
MEEDDM	Ministère de l'Ecologie, de l'Energie et du Développement Durable et de la Mer	Ministry of Ecology, Energy, Sustainable Development and Sea (France)
MS	Matière sèche	Dry Matter
NAPL	Non AquousLiquid Phase	
OMS / WHO	Organisation Mondiale de la santé	World Health Organisation
PCE	Tétrachloroéthylène / Perchloroéthylène	Tétrachloroethylene / Perchloroethylene
PG	Plan de gestion	Management Plan
PID	Photo Ionisation Detector	
PNSE	Plan National Santé Environnement	National Plan for Health and Environment
POP	Persistant Organic Compound	
PPE/PPR	Périmètre de Protection	Far / Tight Protection Perimeter

	Eloignée / Périmètre de Protection Rapprochée	
RMQS	Réseau de Mesures de la Qualité des Sols	Network of Measurements of Soils' Quality
SAGE	Schéma d'Aménagement et de Gestion des Eaux	Development Scheme for Water Managment
SDAGE	Schéma Directeur d'Aménagement et de Gestion des eaux	Main (Director) Scheme for Water Management
SIG / GIS	Système d'Information Géographique	Geographic Information System
VOC	Volatil Organic Compounds	
TCE	Trichloroéthylène	Trichloroethylene
VTR	Valeur Toxicologique de Référence	Toxicological Reference Values
ZNS	Zone Non Saturée	Vadose Zone
ZS	Zone Saturée	Saturated zone