2-FUN

***F**ull-chain and **UN**certainty Approaches for Assessing Health Risks in*

***FU**ture **EN**vironmental Scenarios*

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– SPECIFICATIONS FOR THE DEVELOPMENT OF METHODOLOGIES /DATABASES/SOFTWARE RELEVANT FOR THE RESPECTIVE CASE STUDIES –

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Contents

INTRODUCTION

In Deliverable 4.2: "Critical analysis of previous studies related to the case studies and internal collection of datasets for further use in the case studies", data characterizing case studies were described.

During the Case Study Meeting, based on data prepared by CS3 were discussed and concluded that the raw data are more appropriate than general data concerning case studies. Consequently new databases containing raw data were prepared and have been completed.

An other conclusion from the CS Meeting was recommendation that is better to have lower number of examined sites but detailed characterized instead of greater but with only general environmental description. It allows better ranking/comparing risk factors (WP1).

1. METHODOLOGIES RELEVANT FOR THE RESPECTIVE CASE STUDIES

In case study 1, present and future health impacts from ambient pollutants and thermal stress will be assessed. Health risks for children and adults in Lisbon associated with chronic exposure to benzene as well as metals (Pb, Cd, As) will be estimated using the 2-FUN tool box. Health impacts from acute exposures to thermal stress, PM10, PM2.5, and ozone will be assessed using concentration-response functions from epidemiology studies in Lisbon. Future climate generated from WP1 will be integrated into the air pollution dispersion model TAPM V4 to assess future ambient air pollutant concentrations.

One of the project objectives is to developing a conceptual model for each of the following environmental sub-systems: freshwater, outdoor atmosphere, indoor air, soil and groundwater, plants, animals and humans. 'Freshwater' was chosen as the first investigated sub-system to demonstrate the feasibility of the process of model construction.

2. DATABASES RELEVANT FOR THE RESPECTIVE CASE STUDIES

2.1 Case study 1

In deliverable D4.2 we discussed in detail and presented graphically the datasets required to conduct this case study. The datasets were daily mortality (2000-2004), PM10 (2000-2004), PM2.5 (2002-2004), hourly ozone (2000-2004) and benzene (2003-2005). We now also have data for 2005 and 2006 for these datasets.

2.2 Case study 2: management of a river watershed in france

2.2.1 Introduction and background

The objective of the European 2FUN project (Full-chain and uncertainty approaches for assessing health risks in future environmental scenarios) is to provide methods and tools for analysing environment-related health risks. The aim is to build a "toolbox" complementary to other projects

(HEIMSTA, INTARESE, ENVIRISK, NOMIRACLE) to contribute to implementation of an integrated approach.

2FUN is structured around the following 4 aspects:

- building long-term environmental and socio-economic scenarios;
- evaluating the toxic effects of product mixtures;
- integrating children in health risk assessments;
- establishing margins of uncertainty and performing sensitivity assessments.

This will essentially involve the development and then the implementation of mechanistic models of pollutant transfers in the environment and in the human body in order to draw some conclusions in terms of pathology risks.

The tools developed will be tested on three case studies, one of which focuses on a watershed in a multi-use, multi-pollution environment.

These case studies, which must be based on data available in various existing research programs, will serve prior to and following actual development of the tools for building scenarios and modelling.

- Prior use: inventory and analysis of available data as well as of any previous health risk studies in order to determine the development constraints in terms of types of pollutants to investigate, exposure pathways to examine, type of available input data;
- Subsequent use: to test the tools developed on the scale of a complete study.

The catchment area chosen had to meet the following criteria:
1. possibility of assessing combined exposures;
2. availability of previous health risk assessments;
3. access to data from existing research or monitoring programs;
4. scalability from a local spatial scale (one site) to a regional scale (watershed);
5. possibility of studying a “medium-term” time scale (30 years).

Given the characteristics of the Seine catchment area, it would appear that the first condition is easy to satisfy: a succession from up- to downstream of agricultural zones and dense urban and/or industrialized zones, giving rise both to different types of releases into rivers and to varied water uses. The availability of data to enable assessment of exposure doses with a multi-media model was less certain, however. As it happens, this river basin is the subject of research programs being carried out by GIS PIREN SEINE and GIP SEINE AVAL, as well as a monitoring program for the purpose of implementing the European Water Framework Directive, coordinated by the Seine Normandy Water Agency (AESN). All three bodies responded favourably to the requests of the 2FUN working group. It is true that no previous assessment of health risks is available for this river basin (condition n°2). Despite this reservation, the Seine catchment area was chosen as a case study for the 2-FUN project due to the clear interest expressed by the stakeholders, the availability of monitoring data and the multi-pollution context.

The purpose of this report is to present the characteristics of the sources and data on the Seine basin, together with the needs identified for a multi-media tool to assess the health risks associated with the basin. It is primarily based on feedback from the three bodies mentioned above, which are also described.

2.2.2 Presentation of the Seine catchment area

The catchment area of the Seine and Normandy coastal waterways covers approximately 100,000 km^2. It is primarily composed of a large sedimentary basin with aureoles. The relief is relatively flat, with a mean altitude of 160 m and less than 1% of the territory above 500 m (highest point at 902 m at the source of the Yonne).

Upstream and in the west of the basin beyond the Ile de France region and the major valleys, the countryside is essentially rural. It tends to become relatively uniform (farming, urban areas) the closer one get to the centre of the basin, while the constraints and uses increase correspondingly.

The Seine-Normandy catchment area includes 55,000 km of waterways. Most of this network converges toward the Seine, which drains a 78,000-km^2 watershed between its source on the Langres plateau and the estuary.

Figure 1: Boundaries of the Seine and coastal waterways of the Normandy basin.

Seine basin hydrology

The Seine is a plains river with an oceanic pluvial regime that receives on average 720 mm of water per year, ranging from 550 mm/year in the Beauce to 1200 on the fringes of the basin. The 65,000-km^2 watershed does not have a great runoff capacity due to the limited slope. The many convergences facilitate the combining of flood waves, particularly in the Paris region (Marne, Oise, Yonne, Seine). Generally speaking, runoff is considerably impeded by riverbed management facilities, by surface sealing in urban areas, water uptake and restitution, and by dams on the upper reaches.

The mean annual discharge in the Seine in Paris is 310 m^3/s. It reaches 481 m^3/s at the entrance to the estuary, or 6.1 l /s/km^2, which is low. The Marne, Yonne and Oise add an average of 100 m^3/s. Fluctuations between the driest and the wettest year observed in 75 years, however, can be considerable: on the order of 1 to 5. These variations are due not only to the volume of precipitation over the year but also to its distribution through the year, and finally, to groundwater levels, which reflect precipitation from preceding years.

Flooding on the Seine is neither sudden nor strong. It is feared, however, due to the overflow caused in the Paris region.

Water uses

The Seine basin is quite highly anthropized, as reflected in the low density of forests, considerable urbanization around the Paris region and the major waterways, and the sustained agricultural activity in the Paris basin.

A study conducted by AESN in 2004 gives the following picture of the major water uses in the area.

Domestic uses

Significant urban density concentrated around the major waterways

The river basin has a population of 17.25 million distributed over 97,000 km^2. 55% of the population is in fact concentrated in only 2% of the territory: the Paris agglomeration, which composes a continuous urban fabric covering 2000 km^2. Some other cities such as Rouen, Caen, Le Havre, Reims and Troyes have more than 150,000 inhabitants. Yet 90% of the 8,720 communes in the Seine basin have fewer than 2,000 inhabitants. This contrast is reflected in the strong variability of population density, which ranges from 35 to more than 20,000 inhabitants/km^2, with the highest values being found along the rivers.

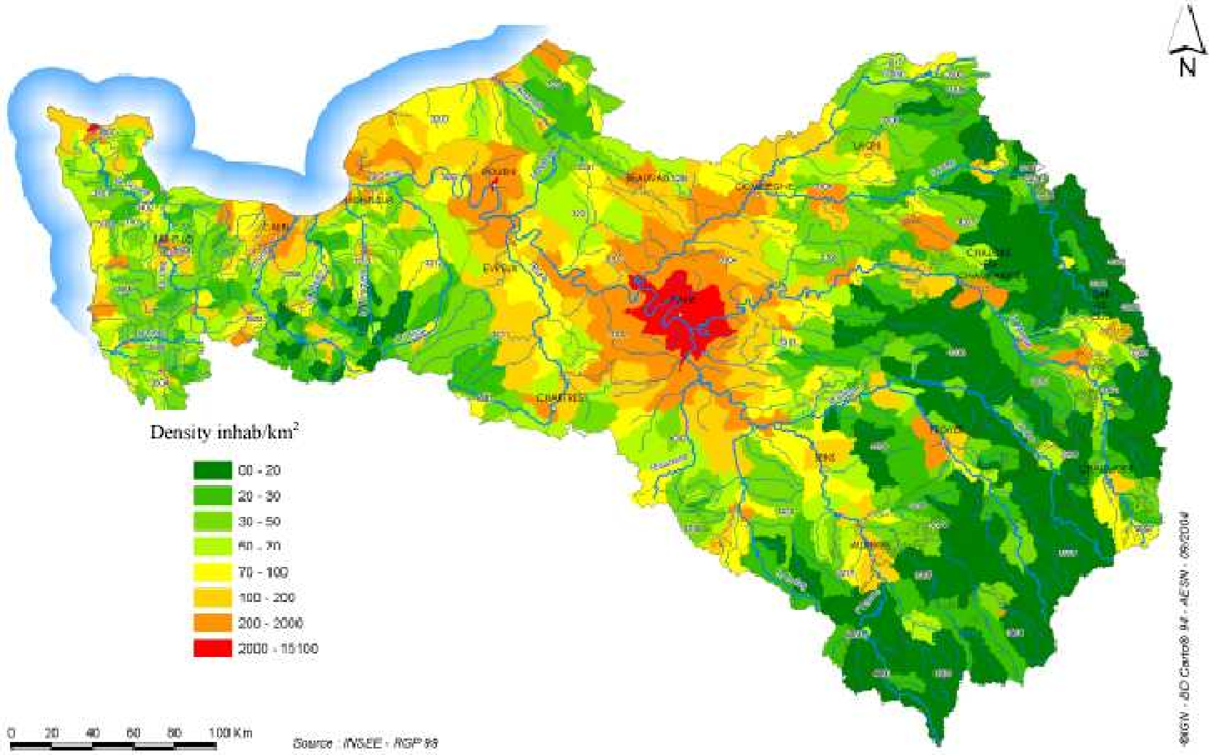


Figure 2: Population density by river basin zone

40% of drinking water comes from surface water

The densely populated areas account for the most significant water uptake. 40% of drinking water is drawn from surface water, essentially to supply the Paris region, and in the bedrock zone (Lower Normandy and Morvan). It should be noted that the high number of industries, services, small business and artisans connected to the mains network generates a higher than average per-inhabitant ratio of drinking water consumption.

84% of the population connected to public sewerage systems

More than two million people in the basin (5,200 municipalities) have individual sanitation systems. In the eastern part of the basin, dwellings are grouped into "semi-collective" sewerage systems, while to the west, dwellings are scattered and will certainly continue to use individual systems. All the municipalities in the basin with more than 2,000 inhabitants have waste water treatment plants for at least part of the population. In all, 14.7 million inhabitants (84% of the population) are connected to public sewerage systems. In urban areas, these sewerage systems pose the problem of concentration of wastes, particularly downstream of Paris, as well of mixing of domestic wastes with those from services and businesses, and management of rainwater runoff. Despite the facilities in place, the share of overall pollution of the environment attributable to public sewerage remains high.

Industrial uses

The industrial economy of the Seine basin draws much of its vigour from significant growth in activities at the downstream end of the production cycle (specialty chemicals, automobiles, etc.). This does not mean that upstream activities (energy production, basic chemicals, steel, etc.) are not present. There is, for example, a dynamic basic chemical industry, especially in the Baie de Seine region.

Jobs in the tertiary sector are growing to the detriment of those in the secondary sector, even in industry, where a non-negligible number of jobs could be considered more related to the tertiary sector (head offices, research and development, marketing, etc.).

Industry accounts for a large part of the releases of organic matter (OM) and for some 90% of the toxic metals, or Metox[1]. Toxic releases come primarily from the electronics industries, from the steel-foundries sector, from waste treatment plants, assembly activities and printing.

The Seine downstream sub-basin stands out clearly from the other sub-basins in terms of the considerable water uptake and the metal emissions.

Agricultural uses

In 2000, an agricultural census showed that the basin was home to 104,000 farms, the major share of which are operated on a tenant farming basis. They occupy 6 million hectares, or 62% of the total surface of the basin. The mean size of farms is 57 hectares, but they vary widely, from 1 to more than 300 hectares. The smallest (< 20 hectares) tend to be found in the west, and the largest (> 100 hectares) in the east.

The characteristic features of farming in the basin are:

- Large farms with high productivity (large-scale grain farming, herbivores, etc.);
- Small labour- and capital-intensive operations generating high added value (vineyards, market gardens, horticulture, poultry);
- Labour-intensive farms with low productivity (livestock breeding).

There is significant regionalization of the different types of agricultural output, strongly correlated with the pedoclimatic characteristics of the basin.

Agriculture remains the main source of diffuse pollution by phytosanitary products and nitrates. In addition to diffuse pollution of groundwater, the high densities of livestock operations generate risks of pollution of surface water. Locally, the impact of concentrated breeding operations can be greater than of humans. AESN nonetheless points out the significant efforts being made in terms of water-treatment facilities (at end 2001, 41% of livestock were raised on compliant farms).

With regard to water use, irrigation within the basin, carried out by 3,033 of the farms (some 140,000 hectares, is primarily to improve crop yields and product quality, to regulate production, and to introduce crops inherently sensitive to water shortages. 92% of the water used for these purposes is thought to be drawn from groundwater.

Rivers and ports

The Seine basin includes 3 of the 6 principal river ports in France, the largest being the Autonomous Port of Paris.

[1] Metox: a fee parameter used by water boards to allow for the quantity and relative toxicity of metal emissions.

Commercial navigation in the basin, accounting for more than half of all river traffic in France, serves the Paris region and industrial sites on nearby waterways (Val d'Oise, Yvelines, major port platforms) and provides a link between the ports of Rouen and Le Havre.

It is also to be noted that as an inland estuary seaport, the Autonomous Port of Rouen has several terminals in the Seine valley (Rouen, Saint Wandrille Le Trait, Radicatel, Port Jérôme and Honfleur).

Lastly, the waterways are also used for recreational navigation, essentially on the Seine and involving "passenger" boats (excursion and cruise boats).

Fishing

Aquaculture along the coast essentially consists in shellfish farming, as well as fish breeding, the major share of which is continental trout farming. Recreational fishing accounts for close to half of all fish breeding output, primarily for the purposes of restocking.

Recreational fishing is a major activity in the departments around the upstream rim of the basin, but decreases in importance the closer one gets to the Ile-de-France region and the plains of Picardy. The coastal departments of Normandy also post low rates of freshwater fishing.

Freshwater fishing companies have become extremely rare: on the Seine, there remained only three between Poses and Paris in 2004.

Recreational uses

The basin has more than 500 water sports sites, 40% of which are located on waterways and 25% on the seacoast, with the rest distributed among former quarries, artificial reservoirs, canals, natural lakes and ponds. Most sites located on waterways are in Ile-de France, Burgundy and Normandy. Bathing sites are primarily found in Normandy along the coast.

The most widespread sports in addition to bathing are sailing and canoeing-kayaking.

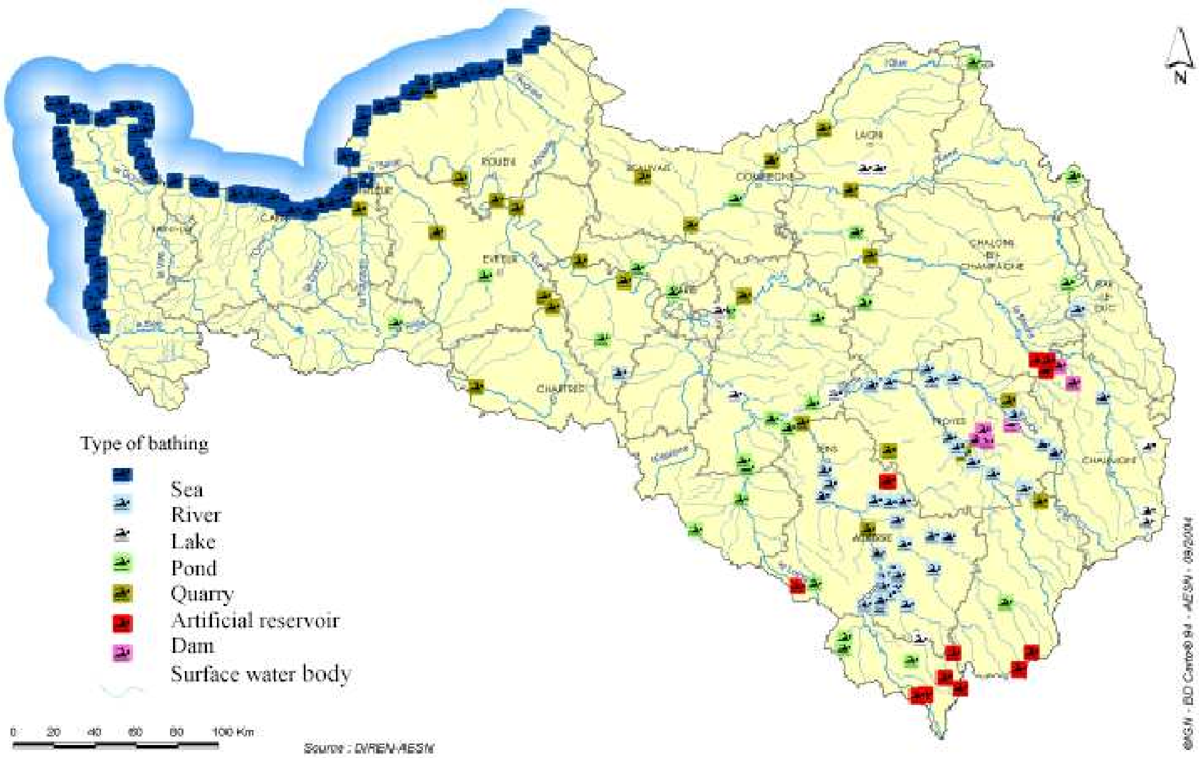


Figure 3: Location of swimming areas in the basin

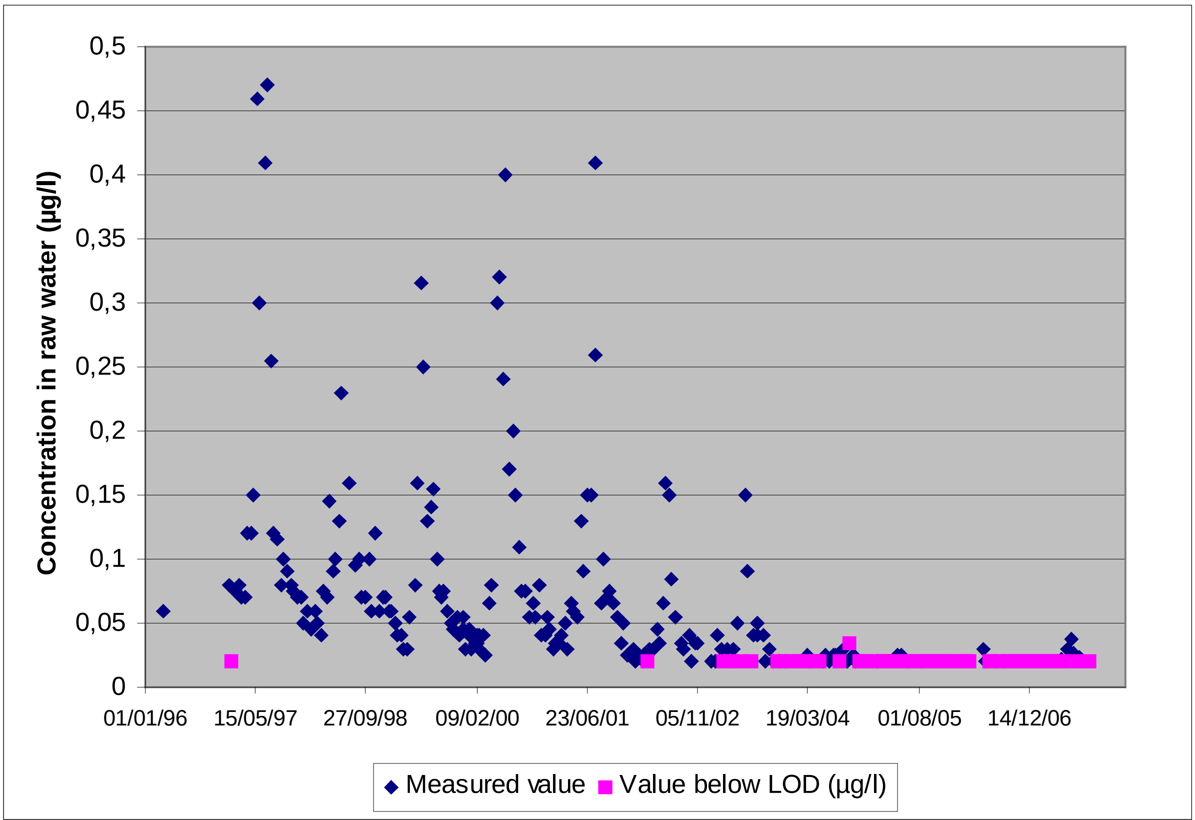
2.2.3 Choice of substances investigated

During the first year of the project, working groups responsible for the two types of tools developed (multi-media models bearing on transfers of pollutants between different environmental compartments to evaluate doses to humans, and pharmacokinetic models which assess dose – exposure – response interactions) agreed on the objective of chaining the tools. Given the state of advancement of their work, it is possible now to define certain pollutants for which this coupling would be possible in the next three years:

- Lead;
- Benzo(a)pyrene (BaP), Benzo(a)anthracene (BaA), and Dibenzo(a,h)anthracene (DahA);
- Atrazine;
- Arsenic.

Furthermore, discussions are continuing in the working groups on the benefits and feasibility of adding cadmium and a pharmaceutical substance (ionized) to this list.

As indicated above, contacts have been made on a national level with French experts familiar with the Seine basin and likely to be interested in the study and to be sources of input data. The list of substances given here was shown to them to get their opinion on its pertinence in relation to the challenges in the basin. They regretted that PCBs are not on the list. Because the prohibition on the use of atrazine was clearly visible in the monitoring results (see following graph), the experts understandably removed it from the list.



Graph 1: Concentration of atrazine in raw water (recording station furthest downstream in the basin: Amfreville-sous-les-Monts, known as " Poses")

Arsenic poses methodological problems due to consideration of its speciation both in the techniques used to measure it in the environment and when modelling it.

As for pharmaceutical substances (ionized), these have not, to date, been investigated regularly by the monitoring networks (in the past or at present).

In the end, for the first extraction phase, we decided on lead and the three HAP substances.

2.2.4 Data available for characterizing the presence of the target substances in the aquatic environment

Data sources

Seine Normandy Water Agency

The Seine Normandy Water Agency (AESN, *Agence de l'Eau Seine Normandie*) is a government agency whose mission is to preserve water resources, fight pollution, and restore aquatic environments. The agency receives usage fees from all users (private individuals, farmers, industry, etc.) which it redistributes to finance its activities and projects. The work of the agency is an integral part of a long-term program developed in concert with the various stakeholders: consumers, elected officials, professionals, and government are all represented in the Seine basin "water parliament" committee and on the agency's Board of Directors.

One of the responsibilities of the Seine Normandy Water Agency is to run monitoring and testing programs on the basin's waterways. The resulting database will be our principal data source.

Finally, the agency contributes financially to 3 research programs (it sponsors more than 30% of each of the programs):

- Piren-Seine, an interdisciplinary program of environmental research;
- Europol'Agro, a program for the development of bio-based industries in the Champagne-Ardennes region;
- Seine-Aval, an end-oriented research project on the Seine estuary.

GIS Piren Seine

Launched almost 20 years ago, PIREN-Seine is a research group whose objective is to use field measurements and modelling to develop a global view of the dynamics of the system formed by the Seine catchment area, its watershed and the humans who occupy it. To do this, the ecological functioning of the entire fluvial system and its modelling from bacteria to fish have been based on an in-depth study of the physical, chemical and biological processes at play in the environment. The models developed by PIREN-Seine simulate ecological and biochemical variations in the hydrosystem, from small streams to the estuary entrance.

PIREN-Seine groups teams from *CNRS*, *ENSMP*, *INRA*, *CEMAGREF*, *CEREVE* and a number of universities and professional schools. Its work is carried out with the support of most public and private stakeholders involved in water resource management in the Seine-Normandy basin (AESN, SIAPP, IIBRBS, DIREN, SEDIF, VNF, SAGEP, Eaux et Force, etc.).

GIP Seine Aval

Seine-Aval is a program of end-oriented research and decision support which, from the beginning, has aimed at using the results of research carried out by the scientific community to benefit decision-makers and planners in the estuary and bay of the Seine. Begun in 1995, it is now in its 4th phase, which is structured around 3 themes: "observation system", "reclaim and restore", and "environmental and health risks"; and 3 questions: 1) "How is the estuary doing and how is it changing?" 2) "What kind of estuary do we really want?" 3) "What are the health and environmental risks to which estuary populations are exposed?"

It evolved gradually from a purely scientific program oriented essentially toward disciplinary research on the environmental dynamics of the Seine estuary to its present global focus on end-oriented research and decision-support for improved understanding and environmental management of the estuary.

The Seine-Aval program is now structured around two themes:

an **operational platform**, to capitalize on and transfer scientific and technical information, together with expertise specifically adapted to the estuary environment. It is coordinated by the GIP technical team, which groups a number of specialized technical bodies.

a **scientific platform** carrying out end-oriented research projects to improve understanding of the estuary ecosystem and providing regular feedback on results. It is coordinated by the GIP Director and Scientific Committee and groups a community of 160 scientists (researchers, engineers, students) who have been working on the Seine estuary for more than 10 years.

The overall program is structured as an environment public interest group, GIP Seine-Aval.

The geographical limits of its investigations are defined as follows:

- Upstream: Poses dam
- Downstream: **the eastern third of the Baie de** Seine, covering a zone south of the meridian passing through Antifer, and east of a parallel passing through Ouistreham.
- Lateral scope: all land around the internal watersheds of the estuary system and the habitats associated with the convex slopes: mud flats, wetlands, zones of confluence of the affluents from the inner estuary (with the possibility of extending the field of investigation upstream of these affluents if called for to treat specific issues). Some measures requiring significant extension of these geographical limits may be considered if clear justification is provided.

Primary data source: the Seine-Normandy Water Agency "Water Quality" database

The Seine-Normandy Water Agency "Water Quality" database has the results of analyses of water sampled from rivers and groundwater in the basin.

The data collection networks, which are the national basin network (RNB) and the groundwater network (RES), are considered to be "legacy" networks: they monitor changes in the national aquatic "capital", homogeneously in space and time. For the most part, they are co-financed by the Seine-Normandy Water Agency and the Ministry for Ecology and its public establishments, as well as the Ministry of Health and Consumer Affairs (SNS).

Data are available beginning in 1971 for surface water and 1997 for groundwater. In the case of surface water, they have been collected by RNB Seine Normandie (AESN/Diren/SNS data) and for groundwater, by RES Seine Normandie (AESN/Ddass data).

Numerous parameters are measured which serve in evaluating the quality of and changes in aquatic ecosystems. In addition to the classic physico-chemical parameters (dissolved oxygen, nitrates, phosphates, etc.), measurements are taken of pesticides, toxic substances, metals and hydrobiological indexes. All of these data are public and accessible over the AESN website.

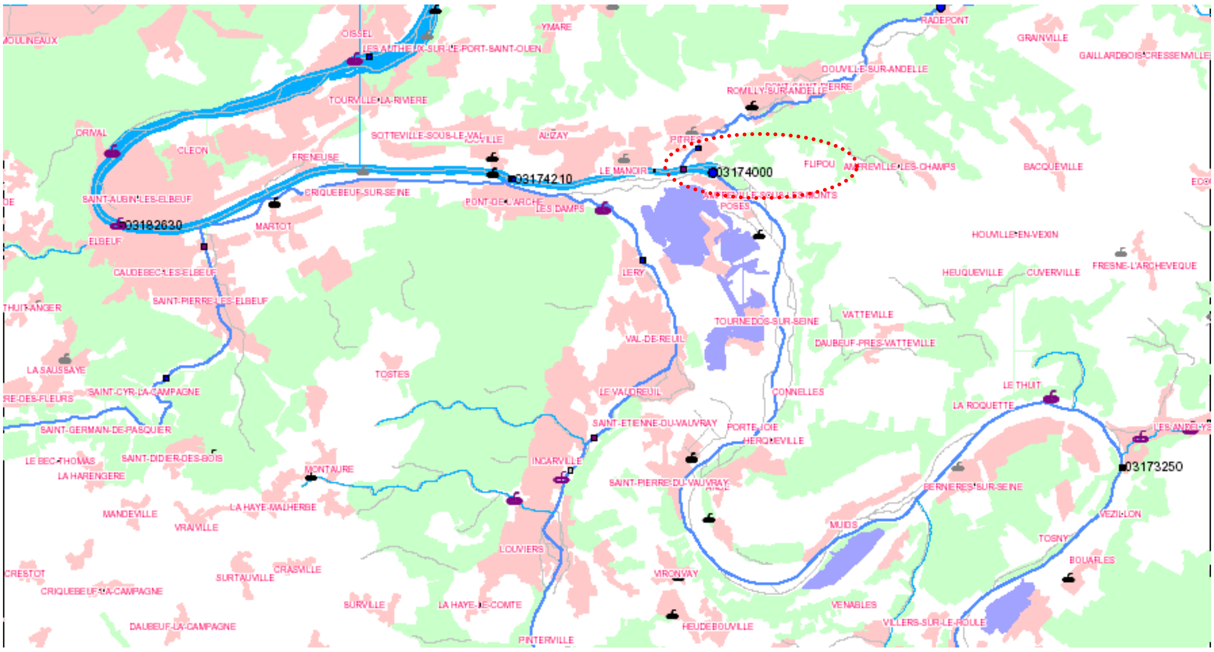
However, these networks do not entirely meet the objectives and selection criteria for implementation of the European Water Framework Directive ("DCE"); as a result, a new "DCE" network has been constituted the RCS. It should be noted that some sites included in the traditional networks have been incorporated into this new network as well, when they meet the new criteria. This has the advantage of enabling continued data acquisition over long time series.

Choice of study site

As the overall scope of the study has not yet been definitively determined, we chose to extract data from the RCS at Amfreville-sous-les-Monts (called "Poses") for the following reasons:

- a study site in the downstream part of the basin subject to definite urban and industrial impacts;
- the site in the basin with the most available data (in terms of monitored parameters and length of the time series);
- a site interesting for the work of both GIP Seine Aval and GIS Piren Seine.

The <u>Amfreville-sous-les-Monts</u> site is upstream of Poses dam, which marks the entrance into the zone of transition to the Seine estuary. It is downstream of the urban conglomeration of Rouen and is therefore subject to strong urban and industrial influences.



The site chosen is part of the new monitoring network and will therefore continue to be monitored in years to come. It is also the site of earlier monitoring in previous programmes, as we shall see in the tables of results.

Sampling methods and principles for the "DCE" monitoring network

In order to be able to better define the characteristics of data available for our tools "in the future" using the RCS, we must note the following.

There is one sampling point per site:

- For raw water, in the central line of the main channel;
- For sediments, in the surface layer (first few centimetres) of the deposits.

The most pertinent type of sample for the analyses was defined on the basis of the following criteria:

- "Water": log Kow < 3 (Kow: octanol/water partition coefficient)
- "Water and sediment": $3 \leq$ log Kow < 5
- "Sediment": log Kow ≥ 5

“Water” analyses are performed on the total sample (including total suspended matter). For non-volatile organic substances and samples with high TSPM concentrations (≥ 250 mg/l), the analysis is performed on both the dissolved phase and the particulate phase.

For metals, the analysis in water corresponds to a dissolved concentration after filtering at 0.45 μ, and in sediment, it is performed after mineralization with aqua regla (NF EN 13346).

Substance	Family	Chemical Abstract Services N°	SANDRE Code	Most pertinent type of sample	Percentage of sites concerned
Benzo(a)pyrene	HAP	50-32-8	1115	Sediment	100%
Benzo(a)anthracene	HAP	56-55-3	1082	Sediment	25%
Dibenzo(ah)anthracene	HAP	53-70-3	1621	Sediments	25%
Lead	Metals	7439-92-1	1382	Water - Sediment	100%
Arsenic and mineral compounds	Metals	7440-38-2	1369	Water - Sediment	25%
Atrazine	Pesticides	1912-24-9	1107	Water	100%
Cadmium	Metals	7440-43-9	1388	Water - Sediment	100%

In the following tables, the data available in the databases of the earlier networks are included when possible.

Presentation of data

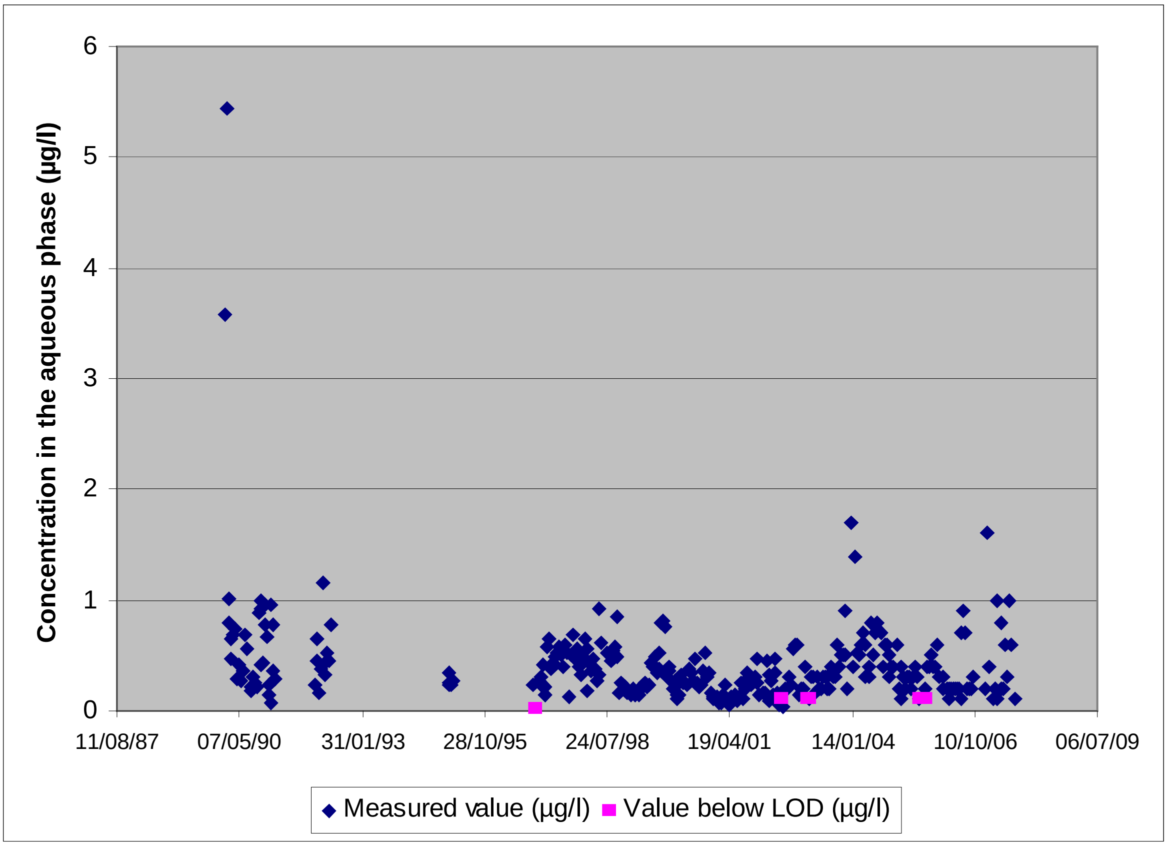
For the purposes of this study, the Seine Normandy Water Agency extracted data for the 4 substances identified in the first study phase for the Amfreville-sous-les-Monts site. This ACCESS format database was converted into EXCEL files.

To illustrate the characteristics of the data, we give below the example of lead and benzo(a)pyrene.

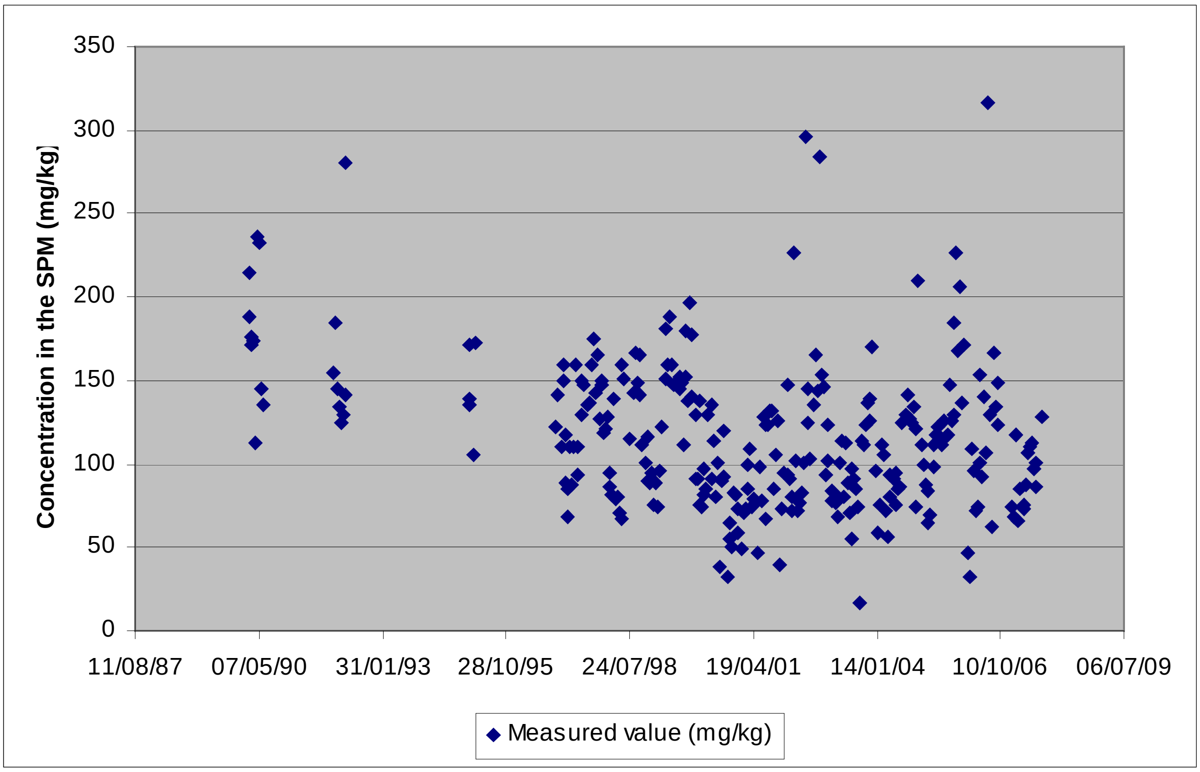
The tables of raw data are given in the annexes.

Lead at Amfreville-sous-les-Monts ("Poses")

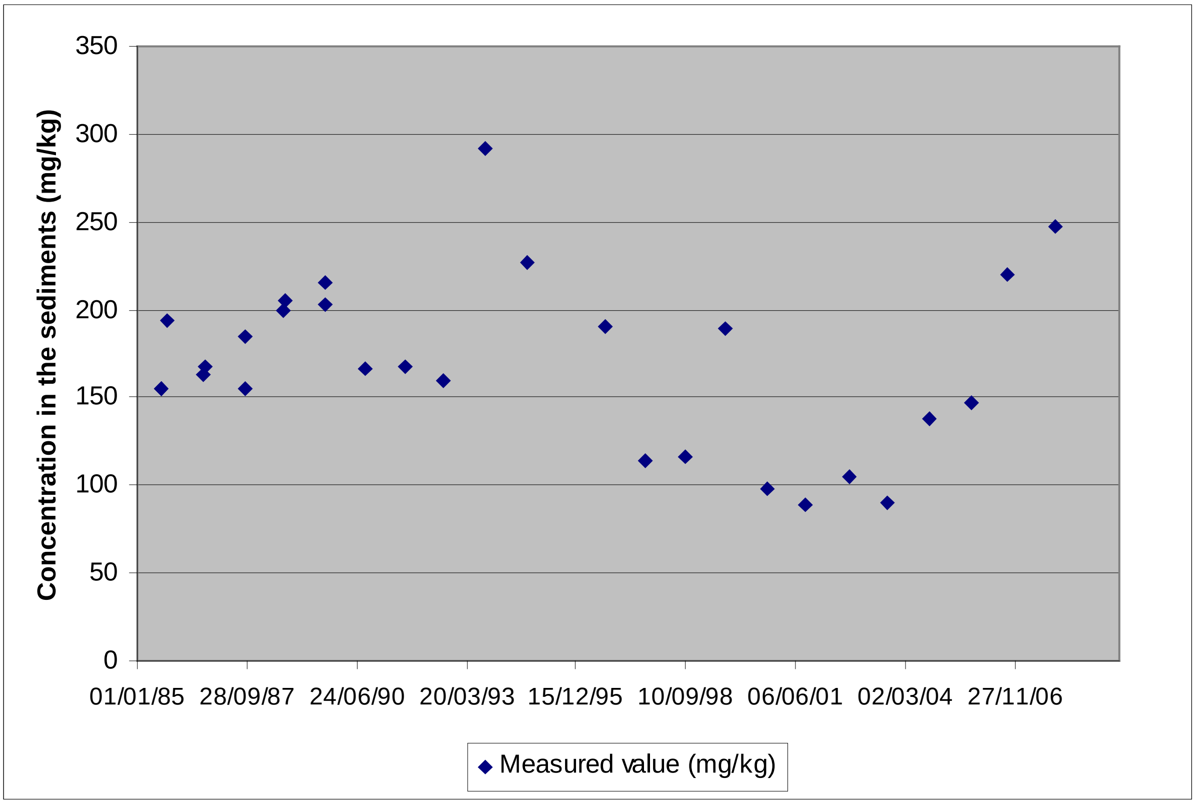
	Unit	Period	Number of values over the period	Number of values considered "< detection threshold"	Years with no values
Concentration in the aqueous phase of the water	µg/l	1990-2007	298	7	1993-1994
Concentration in SPM	mg/kg	1990-2007	279	0	1991 1993-1994
Concentration in sediments	mg/kg	1985-2007	28	0	1995



Graph 2: Lead concentration in the aqueous phase



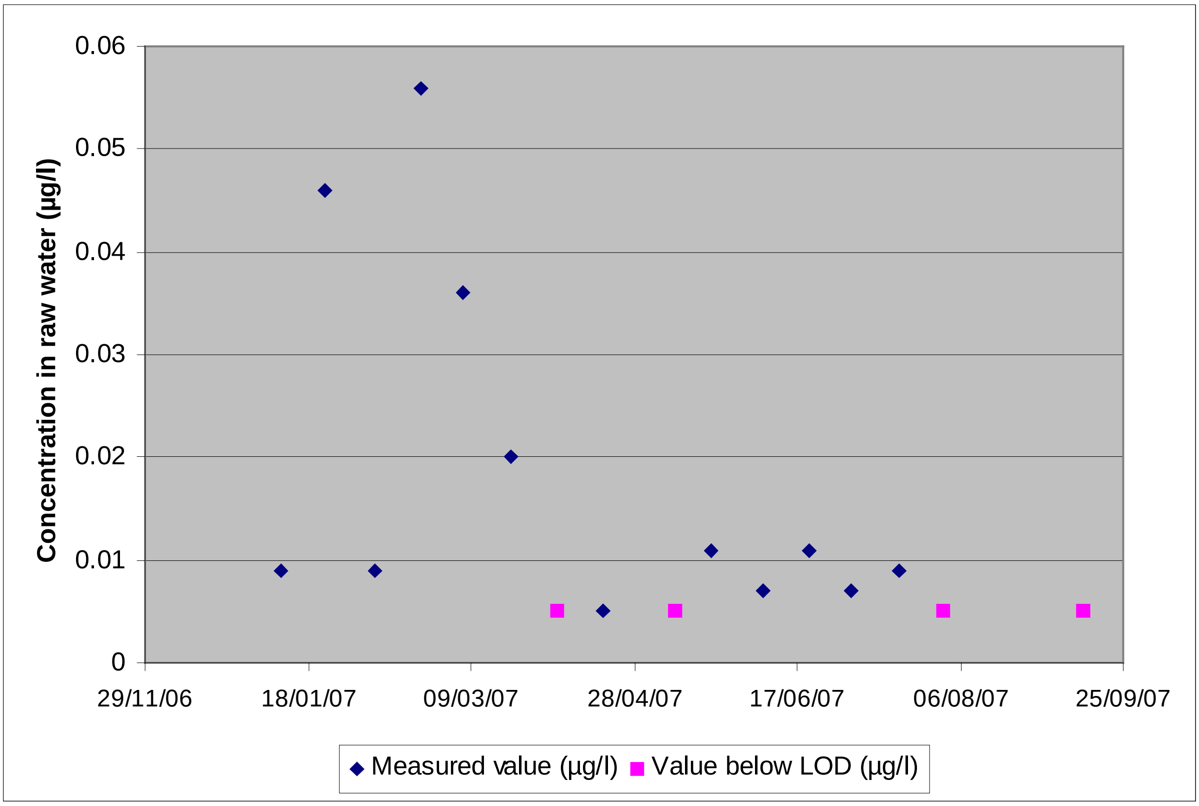
Graph 3: Lead concentration in SPM



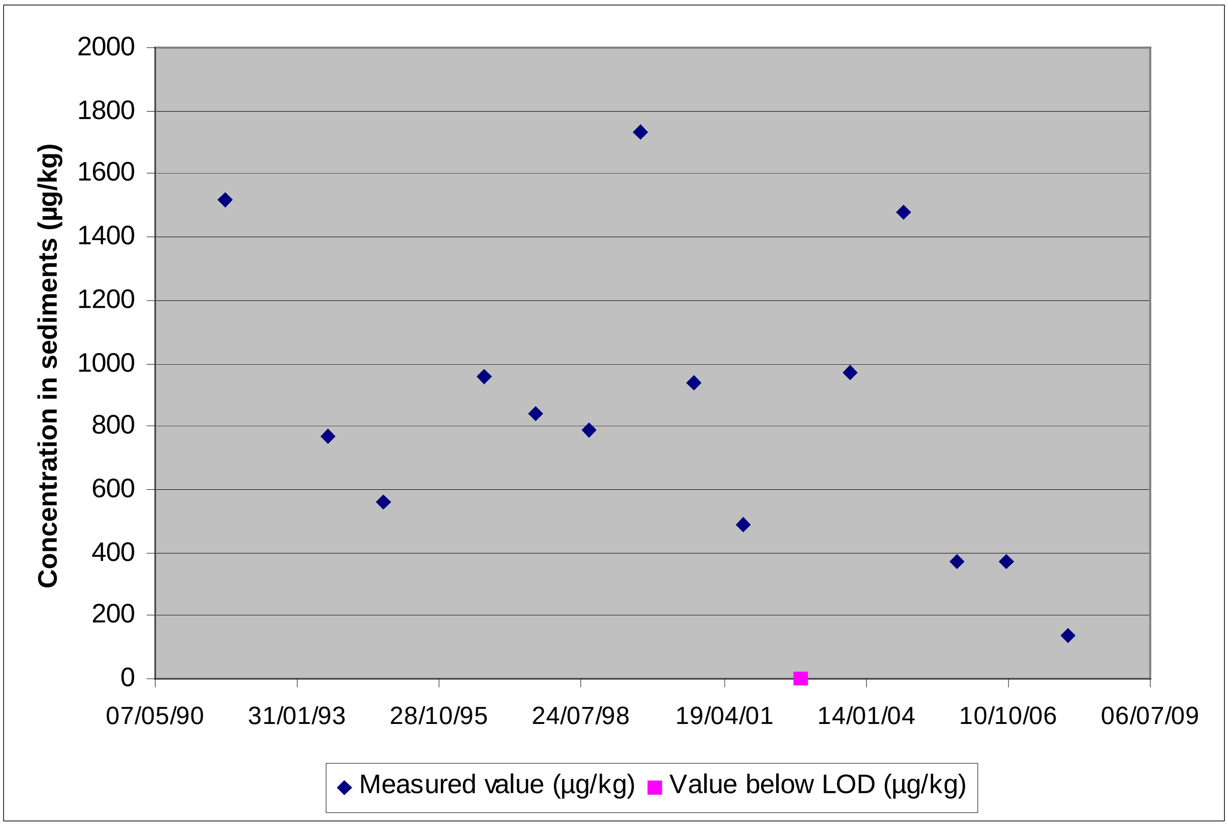
Graph 4: Lead concentration in sediments

Benzo(a)pyrene at Amfreville-sous-les-Monts ("Poses")

	Unit	Period	Number of values over the period	Number of values considered "< detection threshold"	Years with no values
Concentration in raw water	µg/l	2007	12	4	/
Concentration in sediments	µg/kg	1991-2007	14	1	1992 1995



Graph 5: Benzo(a)pyrene concentration in raw water



Graph 6: Benzo(a)pyrene concentration in sediments

2.2.5 Study requirements for a 2FUN multi-media tool

Needs related to the nature of the input data

Incompleteness of time series

As we have seen in the case of lead for example, the series are neither perfectly continuous nor uniform in the frequency of measurement.

In the course of the first phase in the risk assessment, during definition of the characteristics of the pollution investigated, it will be helpful to integrate work done in WP1 on optimum exploitation of these series.

Integration of values considered "at the detection threshold"

Given the precision of the measurement techniques used in the framework of the monitoring networks, a certain number of results are expressed in values termed "at the detection threshold". Similarly, work done in WP1 to propose a formalized method for exploiting these values may be helpful.

Concentration in sediments

Some of the measurements allowing for characterization of pollution are taken in the sediments. However, the first elements relating to design of the 2FUN multi-media model point to a preference for input data such as total concentration in the water column.

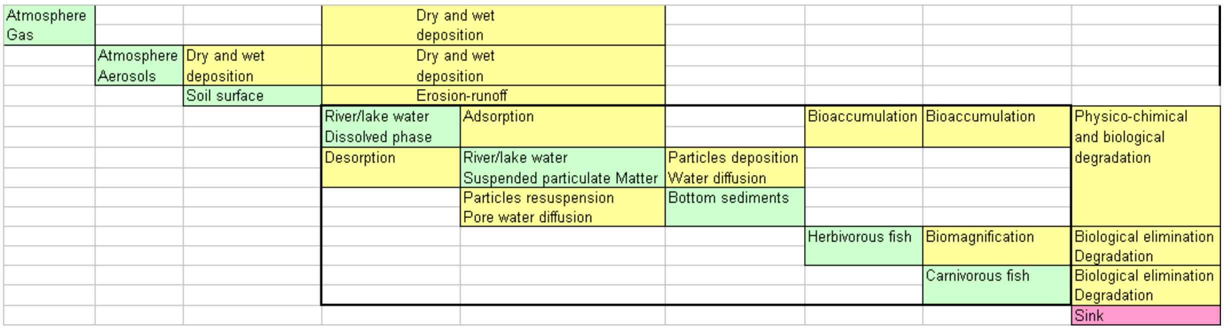
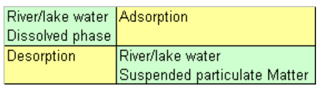


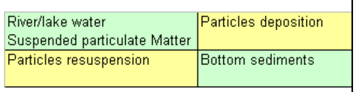
Figure 4 - The 2-FUN Interaction Matrix for the surface freshwater sub-system

The main principles of this conceptual model are summarized below:

- The water column was subdivided into two sub-compartments (respectively, dissolved and particulate phases). An equilibrium was assumed between these two phases through the use of a partition (or distribution) coefficient.



- Physical exchanges (deposition/resuspension of particles) of contaminants between the water column and the bottom sediment were simulated. A dynamic model incorporating the effect of flow rates on deposition and resuspension processes was preferred, to realistically describe the dynamics of the sediments and avoid the use of 'burial' processes.



• Diffusive transfer at the water-sediment interface was included in the 2-FUN conceptual model. However, only a generic approach (similar to those included in other multimedia models) was used as a screening method.	River/lake water Suspended particulate Matter — Water diffusion Pore water diffusion — Bottom sediments

The use of data acquired in the sediment compartment implies a certain reversibility in this calculation phase. In other words, the tool must enable deducing, from a concentration in the sediment, the corresponding concentration in the water column.

Allowing for speciation

Depending on the speciation[2] of a compound, its toxicity for man will be different. In the case of Arsenic, for example, whose inorganic form may be present in the aquatic environment in two degrees of oxidation, As (III) such as arsenites and As(V) such as arsenates, there is far greater toxicity associated with valence state III and inorganic forms than with valence state V and with complex organic forms.

Furthermore, the technique for measuring the compound in the environment can only partially describe its different possible forms.

Consequently, it will be necessary to define very precisely the degree to which the 2FUN model treats the "speciation" of the pollutant being studied and subsequently, what the constraints are in terms of type of input data to be integrated in the model.

Needs generated by the type of water uses

Characterization of groundwater/waterway relationships

As we indicated above, water is supplied both from groundwater resources and from surface waters in the basin, particularly in this study zone. To analyze the "drinking water" exposure pathway, therefore, we must:

- be able to distinguish the two sources of supply;
- characterize the relationships between groundwater / waterway in terms of pollutant "exchanges".

Production of drinking water (level of treatment)

In what can be considered a conservative calculation, we assume that the methods for treating surface water to produce drinking water do not lower the pollutant concentration: the concentration in drinking water is most often considered to be equal to the concentration in the dissolved phase of the river water.

This hypothesis is all the less realistic here in that, in our study zone, the purification level in drinking water production plants is high. We therefore propose to introduce a coefficient to express the proportion by which pollution is reduced in the typical water treatment processes employed for the principal pollutants.

Agricultural practices

The transfer matrix of the 2FUN multi-media model incorporates irrigation from surface waters in the agriculture compartments. In the Seine basin, however, surface spreading of water treatment plant sludge and/or compost is frequent. It would therefore be helpful to examine the feasibility of modelling these transfer pathways as well as irrigation.

[2] We refer here to speciation in the broad sense of the term : valence, organic or inorganic form, etc.

2.2.6 Prospects

Having completed the first phase of our study, we have been able to define for our WP1 and WP2 colleagues our needs in terms of method and tool to be developed.

Parallel to this development, we shall pursue our efforts to assess the risks associated with lead and HAP pollution in the Seine basin by defining the study scenarios. The choice of these substances served a twofold purpose: first, their benefits for the development of 2FUN tools, particularly with the perspective of coupling multi-media and PBPK models, and secondly identification of a characterized pollution in the basin in question. We must, however, note that in the Seine basin, no epidemiological data would seem to indicate that these substances pose a health risk. For this reason, we will very probably orient building of the scenarios toward risks of generic human exposure (rather than focusing on a precisely identified population group).

References

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Meybeck M., Lestel L., Bonté P., Moilleron R., Colin J-L., Rousselot O., Hervé D., de Pontevès C., Grosbois C., Thévenot DR., 1 April 2007. Historical perspective of heavy metals contamination (Cd, Cr, Cu, Hg, Pb, Zn) in the Seine river basin (France) following a DPSIR approach (1950-2005). *Science of The Total Environment, Volume 375, Issues 1-3, Pages 204-231*

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Seine Normandy Water Agency, Guide pratique des substances toxiques dans les eaux douces et littorales du bassin Seine-Normandie (February 2008)

2.3 Case study 3: Land Management in a Heavy Industry Region

The present database contains only raw concentration of heavy metals and polycyclic aromatic hydrocarbons in different kind of soil (still not completed) and edible plants. A data from biomonitoring of lead and cadmium will be added as well. All raw result in database are originated from:

- ✓ IETU's resources,
- ✓ IETU + Center for Environmental Research and Monitoring (OBiKŚ)*,
- ✓ Regional Inspectorate for Environmental Protection in Katowice.

Environmental database is under quality assessment. Institute has developed maps of cadmium and lead in topsoil based on this database with application of kriging methods of interpolation.

New database of modeled cadmium and lead contents in topsoil with kriging standard deviation is available.

It is still under discussion what is better:

- ✓ to use data after kriging, instead of raw data (because it is free from thick errors that are frequent in source database),
- ✓ to use raw data?

Another question, which is still under discussion with WP1 team is the number of priority diseases.

All result of health outcomes are originated from databases listed below:

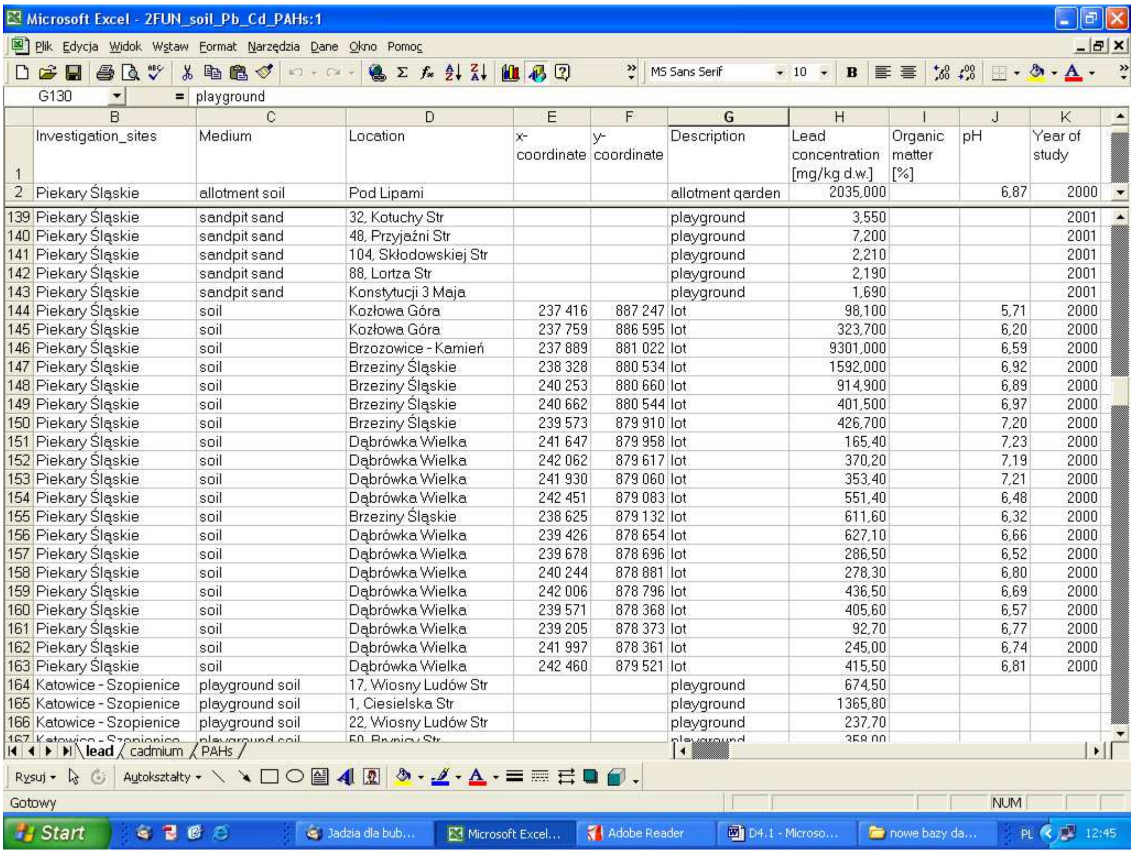
- ✓ National Cancer Registry,
- ✓ Silesian Center of Public Health.

Based on data received from mentioned above institutions, case study 3 team suggests to focus on selected priority diseases as such:

- ✓ anemia for Pb,
- ✓ hypertension and diseases of urinary system for Cd,
- ✓ cancer for PAHs.

An example of the new database is provided below:

Some legal problems concerning the rights to the data between partners were solved and now we have a permission for using the data for 2-FUN project purposes.



	B	C	D	E	F	G	H	I	J	K
1	Investigation_sites	Medium	Location	x-coordinate	y-coordinate	Description	Lead concentration [mg/kg d.w.]	Organic matter [%]	pH	Year of study
2	Piekary Śląskie	allotment soil	Pod Lipami			allotment garden	2035,000		6,87	2000
139	Piekary Śląskie	sandpit sand	32, Kotuchy Str			playground	3,550			2001
140	Piekary Śląskie	sandpit sand	48, Przyjaźni Str			playground	7,200			2001
141	Piekary Śląskie	sandpit sand	104, Skłodowskiej Str			playground	2,210			2001
142	Piekary Śląskie	sandpit sand	88, Lortza Str			playground	2,190			2001
143	Piekary Śląskie	sandpit sand	Konstytucji 3 Maja			playground	1,690			2001
144	Piekary Śląskie	soil	Kozłowa Góra	237 416	887 247	lot	98,100		5,71	2000
145	Piekary Śląskie	soil	Kozłowa Góra	237 759	886 595	lot	323,700		6,20	2000
146	Piekary Śląskie	soil	Brzozowice - Kamień	237 889	881 022	lot	9301,000		6,59	2000
147	Piekary Śląskie	soil	Brzeziny Śląskie	238 328	880 534	lot	1592,000		6,92	2000
148	Piekary Śląskie	soil	Brzeziny Śląskie	240 253	880 660	lot	914,900		6,89	2000
149	Piekary Śląskie	soil	Brzeziny Śląskie	240 662	880 544	lot	401,500		6,97	2000
150	Piekary Śląskie	soil	Brzeziny Śląskie	239 573	879 910	lot	426,700		7,20	2000
151	Piekary Śląskie	soil	Dąbrówka Wielka	241 647	879 958	lot	165,40		7,23	2000
152	Piekary Śląskie	soil	Dąbrówka Wielka	242 062	879 617	lot	370,20		7,19	2000
153	Piekary Śląskie	soil	Dąbrówka Wielka	241 930	879 060	lot	353,40		7,21	2000
154	Piekary Śląskie	soil	Dąbrówka Wielka	242 451	879 083	lot	551,40		6,48	2000
155	Piekary Śląskie	soil	Brzeziny Śląskie	238 625	879 132	lot	611,60		6,32	2000
156	Piekary Śląskie	soil	Dąbrówka Wielka	239 426	878 654	lot	627,10		6,66	2000
157	Piekary Śląskie	soil	Dąbrówka Wielka	239 678	878 696	lot	286,50		6,52	2000
158	Piekary Śląskie	soil	Dąbrówka Wielka	240 244	878 881	lot	278,30		6,80	2000
159	Piekary Śląskie	soil	Dąbrówka Wielka	242 006	878 796	lot	436,50		6,69	2000
160	Piekary Śląskie	soil	Dąbrówka Wielka	239 571	878 368	lot	405,60		6,57	2000
161	Piekary Śląskie	soil	Dąbrówka Wielka	239 205	878 373	lot	92,70		6,77	2000
162	Piekary Śląskie	soil	Dąbrówka Wielka	241 997	878 361	lot	245,00		6,74	2000
163	Piekary Śląskie	soil	Dąbrówka Wielka	242 460	879 521	lot	415,50		6,81	2000
164	Katowice - Szopienice	playground soil	17, Wiosny Ludów Str			playground	674,50			
165	Katowice - Szopienice	playground soil	1, Ciesielska Str			playground	1365,80			
166	Katowice - Szopienice	playground soil	22, Wiosny Ludów Str			playground	237,70			

Microsoft Excel - 2FUN_soil_Pb_Cd_PAHs:1

C87 = building-surroundings soil

	B	C	D	E	F	G	H	I	J	K
1	Investigation_sites	Medium	Location	x-coordinate	y-coordinate	Description	Cadmium concentration [mg/kg d.w.]	Organic matter [%]	pH	Year of study
2	Piekary Śląskie	allotment soil	Pod Lipami			allotment garden	58,600		6,87	2000
3	Piekary Śląskie	allotment soil	Azalia			allotment garden	33,100		6,64	2000
83	Istebna-Kubalonka	playground soil	Sanatorium			playground	2,650			2003
84	Istebna-Kubalonka	playground soil	Sanatorium			playground	1,280			2003
85	Istebna-Kubalonka	playground soil	Sanatorium			playground	1,610			2003
86	Istebna-Kubalonka	building-surroundings :	Sanatorium			building-surroundi	0,450			2003
87	Istebna-Kubalonka	building-surroundings	Sanatorium			building-surroundi	0,470			2003
88	Istebna-Kubalonka	sandpit sand	Sanatorium			playground	0,300			2003
89	Istebna	playground soil	Kindergarten			playground	0,400			2003
90	Istebna	playground soil	Kindergarten			playground	0,300			2003
91	Istebna	playground soil	Kindergarten			playground	0,460			2003
92	Istebna	sandpit sand	Kindergarten			playground	0,300			2003
93	Istebna	sandpit sand	Kindergarten			playground	0,390			2003
94	Piekary Śląskie	playground soil	79, Bytomska Str			playground	22,660			2001
95	Piekary Śląskie	playground soil	38, Cicha Str			playground	2,000			2001
96	Piekary Śląskie	playground soil	17, Piłsudskiego Str			playground	48,490			2001
97	Piekary Śląskie	playground soil	13, Ofiar Katynia Str			playground	3,660			2001
98	Piekary Śląskie	playground soil	5, Alojzjanów Str			playground	7,780			2001
99	Piekary Śląskie	playground soil	1, Hallera Str			playground	1,300			2001
100	Piekary Śląskie	playground soil	5, Czempiela Str			playground	1,610			2001
101	Piekary Śląskie	playground soil	40, Tarnogórska Str			playground	21,990			2001
102	Piekary Śląskie	playground soil	65, Słodowskiej Str			playground	45,060			2001
103	Piekary Śląskie	playground soil	10, Makowskiego Str			playground	14,030			2001
104	Piekary Śląskie	playground soil	26, Bednorza Str			playground	21,160			2001
105	Piekary Śląskie	playground soil	32, Kotuchy Str			playground	12,720			2001
106	Piekary Śląskie	playground soil	48, Przyjaźni Str			playground	13,570			2001
107	Piekary Śląskie	playground soil	104, Skłodowskiej Str			playground	10,490			2001
108	Piekary Śląskie	playground soil	88, Lortza Str			playground	7,060			2001
109	Piekary Śląskie	playground soil	Konstytucji 3 Maja			playground	2,740			2001

lead | cadmium | PAHs

Microsoft Excel - 2FUN_soil_Pb_Cd_PAHs:1

E12 = playground

	B	C	D	E	M	Q	S	U	V
1	Investigation_sites	Medium	Location	Description	Benz(a)anthracene [mg/kg d.w.]	Benzo(a)pyrene [mg/kg d.w.]	Dibenzo(ah)anthracene [mg/kg d.w.]	pH	Year of study
2	Katowice	allotment soil	sample 1057	allotment garden	0,898	0,935	0,236	7,06	200[illegible]
3	Katowice	allotment soil	sample 1058	allotment garden	0,832	0,984	0,109	6,68	200[illegible]
4	Katowice	allotment soil	sample 1059	allotment garden	0,872	0,861	0,147	7,2	200[illegible]
5	Katowice	allotment soil	sample 1060	allotment garden	0,416	0,417	0,067	7,04	200[illegible]
6	Katowice	allotment soil	sample 1061	allotment garden	0,554	0,605	0,104	7,27	200[illegible]
7	Katowice	allotment soil	sample 1062	allotment garden	1,184	1,157	0,238	7,23	200[illegible]
8	Katowice	allotment soil	sample 1063	allotment garden	0,956	0,927	0,166	7,36	200[illegible]
9	Katowice	allotment soil	sample 1064	allotment garden	1,006	0,982	0,197	6,94	200[illegible]
10	Katowice	allotment soil	sample 1065	allotment garden	0,36	0,359	0,042	7,18	200[illegible]
11	Katowice	allotment soil	sample 1066	allotment garden	0,794	0,865	0,159	7,22	200[illegible]
12	Katowice - Szopienice	playground soil	17, Wiosny Ludów Str	playground	0,299	0,306			
13	Katowice - Szopienice	playground soil	1, Ciesielska Str	playground	2,873	2,985			
14	Katowice - Szopienice	playground soil	22, Wiosny Ludów Str	playground	0,199	0,231			
15	Katowice - Szopienice	playground soil	50, Brynicy Str	playground	0,785	0,809			
16	Katowice - Szopienice	playground soil	86, Morawa Str	playground	0,313	0,339			
17	Katowice - Szopienice	playground soil	60, Hallera Str	playground	0,546	0,578			
18	Katowice - Szopienice	playground soil	72, Hallera Str	playground	0,8	0,944			
19	Katowice - Szopienice	playground soil	11, Korczaka Str	playground	3,526	3,57			
20	Katowice - Szopienice	playground soil	29, Szopienicka Str	playground	0,061	0,061			
21	Katowice - Szopienice	playground soil	61, Oswobodzenia Str	playground	0,425	0,64			
22	Katowice - Szopienice	playground soil	10, Zamkowa Str	playground	0,115	0,125			
23	Katowice - Szopienice	playground soil	13, Marcinkowskiego Str	playground	0,535	0,663			
24	Katowice - Szopienice	playground soil	Szambelniana Str	playground	0,18	0,243			
25	Katowice - Szopienice	playground soil	Chemiczna Str	playground	1,492	1,772			
26									
27									
28									
29									
30									
31									

lead | cadmium | PAHs