ASSESSING RISKS FROM SOIL POLLUTION:

INVENTORY OF BOTTLENECKS AND POSSIBLE SOLUTIONS

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RAPPORTEN PROGRAMMA GEÏNTEGREERD BODEMONDERZOEK

VOLUME 15

Data:
Assessing risks from soil pollution: bottlenecks and solutions / A.G. Nijhof et al.
Wageningen: The Netherlands Integrated Soil Research Programme (Rapporten Programma Geïntegreerd Bodemonderzoek; vol. 15)
ISBN 90-73270-29-4; .pp., 4 appendices

Keywords:
Soil research, soil pollution, risk assessment.
Accountability:
This exploratory study conducted as part of The Netherlands Integrated Soil Research Programme had three aims: summarising the present state of knowledge; indicating bottlenecks; and sounding out opinion on the need for research. The report is based on 25 interviews with experts on assessing risks from soil pollution who work for government agencies, health organisations, consultants and research institutes in The Netherlands. It explores the technical, policy, organisational and communication bottlenecks experienced in the development and application of risk assessment and the possible ways of overcoming them. It concludes with the results of a workshop held to discuss the findings of the interviews.

Acknowledgments:
The leaders of The Netherlands Integrated Soil Research Programme wish to thank all who contributed to the success of this project by making their expertise and time available and by participating in the interviews and workshop. Th. Edelman (Gelderland Province), Prof. N.M. van Straalen (VUA) and R. van den Berg (RIVM) are thanked for supervising the project on behalf of the Integrated Soil Research Programme Committee. A.G. Nijhof (Tauw Milieu BV) is thanked for her implementation of the project.

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Report no.: R3473503.T01

Translation	: WORDSMITHS translations, Margaret Clegg
Word processing	: Tauw Milieu bv
Cover	: Ernst van Cleef
Printing	: Grafische Service Centrum Van Gils bv, Wageningen

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SUMMARY

The bottlenecks in current Dutch practice of assessing the risks from soil pollution have been inventoried in the context of the Netherlands Integrated Soil Research Programme by interviewing various parties involved in this risk assessment. The findings are also relevant for the development and application of risk assessment outside the Netherlands.

Although this study did not focus exclusively on soil (or, more precisely, on the system for assessing urgency), many of the bottlenecks described reflect this viewpoint. And although Dutch environmental policy strives to harmonise research on and treatment of the pollution of soil and sediment, there appear to be considerable differences in the conceptual approach to risk assessment, details of risk assessment and risk management and the resulting areas of focus. The limited exchange of knowledge and experience among 'soil' and 'sediment' experts may be a major impediment to optimally using the expertise in risk assessment present in the Netherlands.

The report is a reaction to the interviews and gives an overview of the various bottlenecks and developments experienced by the interviewees. It also suggests ways of overcoming the bottlenecks. The bottlenecks have been grouped as:

1. technical bottlenecks
2. policy bottlenecks
3. organisational bottlenecks
4. communication bottlenecks

A distinction is made between the assessment of toxicological risks to humans, ecotoxicological risks and risks from dispersion

Technical bottlenecks inventoried:
- toxicological risks to humans
  * interpretation of soil survey data
  * transformation of soil survey data to estimates of exposure
  * interpretation of exposure estimates
- ecotoxicological
  * lack of concepts
  * partition theory versus internal dose concept
- dispersion
  * simplification of assessing urgency
  * influence of soil heterogeneity/pollution
  * identification of objects to be investigated
  * breakdown, dilution

Policy bottlenecks inventoried:
- toxicological risks to humans
  * exposure to MTR level versus the ALARA principle
  * background exposure
  * inflexibility of standard scenarios
  * the double aims of Further Research: nature and extent versus risk assessment
  * current use, current land use designation and future use
  * adherence to various standards for testing

- ecotoxicological
  * 'actual risk' = use-specific potential risk
  * mandatory bio-assays
  * point versus diffuse sources
  * multifunctionality for ecosystems?
  * IBC for ecosystems?
- dispersion
  * interpretation of the system for assessing urgency
  * gap between designating urgency and remediation
  * differences between the Soil Protection Act and the soil remediation of active industrial sites

Organisational bottlenecks inventoried:
- role sharing among the parties involved
- quality assurance
- exchange of knowledge
- management of contaminated land; registration of
- basic assumptions on risks

Communication bottlenecks inventoried:
- communication between experts
- communications between experts and non-experts

Possible solutions
In general, the solutions comprise bringing experts together to exchange, confront and integrate expertise and experience. NISRP could organise and facilitate such a knowledge infrastructure. When working groups are being set up, their objectives must be clearly formulated in terms of output. The emphasis must be on liberating the knowledge present in experts' heads, to make it objective and accessible to a larger group (from brainware to documentware, via groupware).

A few bottlenecks need to be studied in greater depth.

The workshop discussion resulted in the following priority ranking for solving technical obstacles:
1. evaluate the actual risks to (effects on) humans and ecosystems from exposure to soil contamination, and the monitoring protocols that could be used to establish these risks
2. integrate knowledge on hazards from sediments with that on hazards from soils
3. interpret research data
4. interpret toxicological data. The main problems are TDI, matrix effects and the integration of different standards
5. mineral oil
6. corrections for soil type
7. ecotoxicological/human bio-assays
8. partition versus internal dose
9. transformation to exposure
10. verification of risks from dispersion

The greatest priority in terms of conceptual bottlenecks is the refinement of a concept for assessing the ecotoxicological risk from soil contamination. This will require a working group with sufficient expertise and mandate to be able to contribute significantly to the discussion and solution.

As regards bottlenecks in communication, it seems important to inventory existing networks and to link them. There must be a binding factor, however. Part of the knowledge management should perhaps be delegated to experts in communication and knowledge management. There is a danger that if the experts exclude academics, the non-experts will instinctively feel that the gap between experts and non-experts has widened. It is important to supply non-experts with proper, coordinated information, to enable them to form opinions about the situation.

"In the course of the twentieth century it has become increasingly clearer that truth and reality can never be entirely known. The closer we get to the core of a new problem we have been confronted with, the greater, often, are our uncertainty and doubt. Environmental problems are no exception to this. Who dare assert aloud that soil, water and air standards can be fixed scientifically in a manner that leaves no room for doubt?

The absence of an external reference (the scientifically established truth) and of a common reality result in a society in which everyone takes issue with everyone else. Experts in one and the same field often disagree and the difference between the expert and the layperson is becoming increasingly vague. The increasing differentiation in education and the sciences and a population that is increasingly better educated turn everyone into a bit of an expert and a bit of a layman. Careful analysis of a problem from the point of view of one's own discipline is no longer sufficient but needs to be supplemented by a balanced discussion with all the parties concerned with the problem."

Anonymous

1 INTRODUCTION

In the context of the Netherlands Integrated Soil Research Programme an inventory was compiled of bottlenecks that exist in the current practice of assessing risks from soil pollution. For this purpose a number of interviews were held with various parties occupied with this subject (see appendix 2 for list of persons consulted). The interviews were largely conducted on the basis of a questionnaire sent out prior to the interview (see appendix 1).

Although the area of focus of this study was not confined from the start to terrestrial soils (and within this to the application of the urgency system) many of the bottlenecks described have clearly been filled in from this viewpoint. Although it is the intention of environmental policy to harmonise research into and the tackling of soil and sediment pollution, it has become evident that in the field of 'risk assessment' there are considerable differences in conceptual approach, the fleshing out of risk assessment and risk management and the resulting areas of focus. The marginal exchange of knowledge and experience among the experts on sediment and those on soil is perhaps one of the chief bottlenecks in making optimum use of the expertise available in the Netherlands in the area of risk assessment.

This report is a reflection of the interviews and gives an overview of the various bottlenecks and developments as experienced by the interviewees. Suggestions are also given for solving bottlenecks. Unless specifically stated, the said bottlenecks, interpretations, analyses and conclusions were discussed in the interviews with one or several interviewees. Nonetheless, it was impossible to rule out the fact that the account of the interviews could be coloured by the way the interviewer perceived things. For this reason this report formed the subject of discussion at a workshop held on 19 June 1996, at which the participants in the interviews and other experts talked about the bottlenecks and possible solutions.

First of all, we shall look at the role of risk assessment in soil surveys and soil remediation and the concept of risk and actual risks as interpreted by the interviewees. This chapter (2) is a reflection of general aspects and serves to provide background information to the description of the bottlenecks and solutions given in chapters 3 to 7.

In chapters 3 to 6 the bottlenecks detected are discussed. They are grouped as follows:

1. Technical bottlenecks
2. Policy bottlenecks
3. Organisational bottlenecks
4. Communication bottlenecks.

In chapter 7 suggestions are put forward for solving the bottlenecks. This chapter formed the basis for a workshop with experts. Finally, the results of this workshop are summarised in chapter 8.

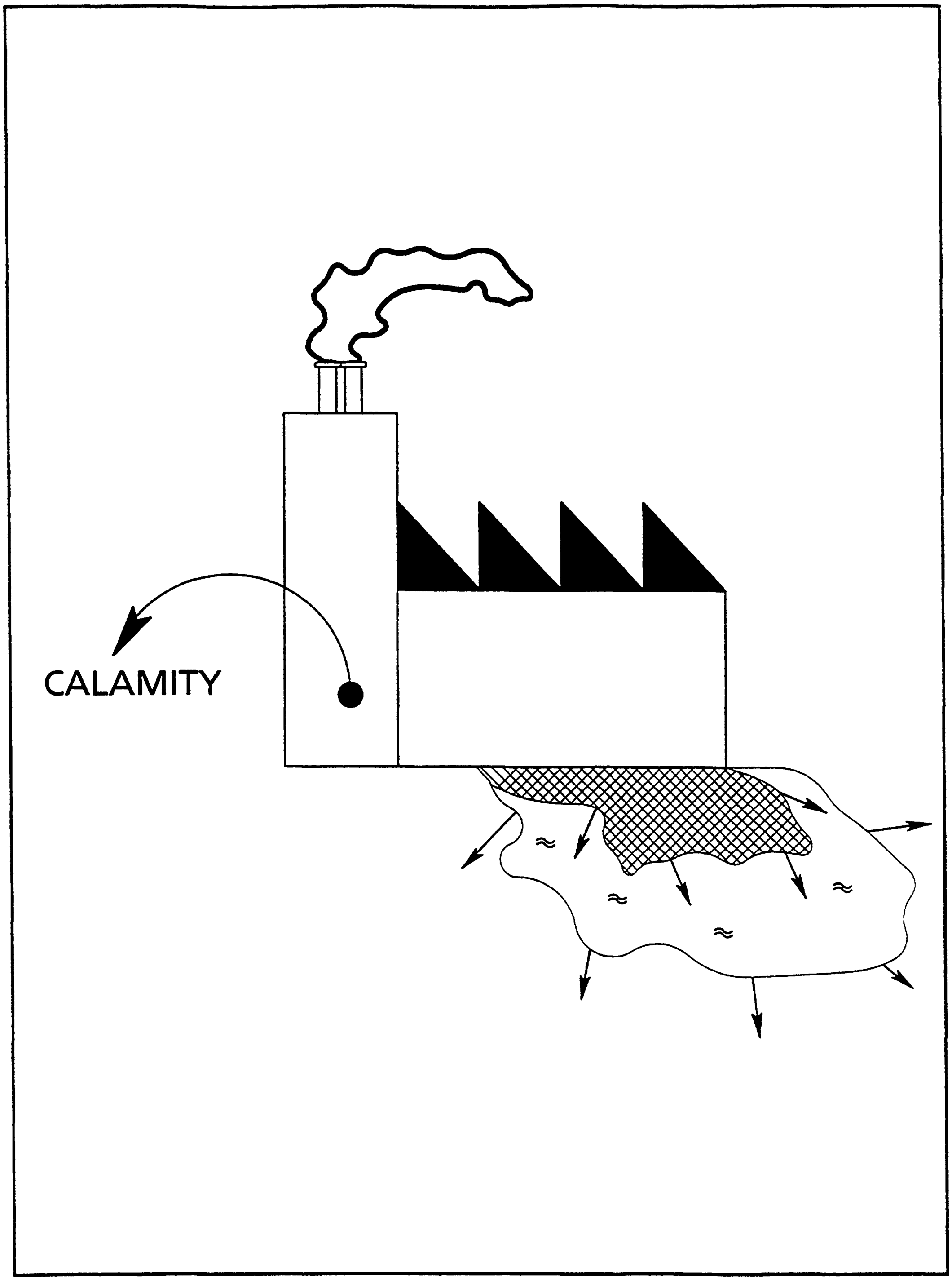


Figure 1. Historical and future 'sources'

When assessing risks from soil pollution the pollution that already exists is often taken as the 'source' for exposure. Future sources that may arise in the event of new emissions or changes in the pollution situation as a result of transport, dilution and decomposition are often not included in risk assessments for terrestrial soils.

2 ASSESSING RISKS FROM SOIL POLLUTION

2.1 Definitions

In general, the interviewees interpreted the concept of 'risk assessment' in relation to soil pollution as

> *comparing the (reasonably likely) exposure of people and the environment with examination criteria.*

Risk assessments relating to polluted aquatic soils go a step further by involving actual effects resulting from exposure in the risk assessment.
A risk assessment answers at least the following questions:

- are people likely to be subjected to impermissible levels of exposure when the site is used normally?
- is there likely to be an impermissible impact on the ecosystem as a result of the soil pollution present?
- is an impermissible dispersion of pollution likely to occur, resulting in a threat to clean soil and ground water?

Although most of the interviewees are of the opinion that all three aspects (man, ecosystem and dispersion) should be assessed in a risk assessment, there are clear differences in emphasis: in respect of terrestrial soils the emphasis lies on the risk to people and the risk of dispersion, whereas when assessing the risks in the case of polluted aquatic soils the emphasis is placed on the ecosystem and dispersion.

How the above questions are answered depends on the context in which the question is placed (urgency system, building permit, remedial investigation, nature development etc.) and the line of approach and expertise of the assessor.

In general, when assessing risks from soil pollution consideration is mainly given to the risks from pollution that already exists, because in the case of terrestrial soils the emphasis is placed on investigating and cleaning up historical pollution. Risks resulting from future emissions into the soil (based on the possibilities of industrial processes failing) have until now not been included in assessing risks from dry soils (see figure 1), although they have in the case of measures to prevent soil pollution (soil checklist etc.). The failure of isolation measures in the context of so-called ICM (Isolate, Control, Monitor) scenarios are often considered in the remedial investigation, though.

However, when risks from polluted aquatic soils are assessed, account is taken of the emissions from existing sources of aquatic soil pollution, e.g. discharges or non-point pollution.

The concept of *'actual risks'* has several meanings:

1. most of the interviewees use the concept for a policy qualification of a site: risks are 'actual' if it is likely *using the method described for the urgency system that levels to which people and the environment are exposed will exceed the examination criteria established.*

2. a second instance in which the concept of 'actual risks' is used is situations in which soil pollution results in the contamination of subsoil infrastructure, e.g. drinking-water pipes or sewage pipes.

3. finally, the concept of 'actual risks' is often used as a counterpart to potential risks: the occurrence of effects as a result of exposure to pollutants from the soil, related to the actual configuration of soil and ground water pollution, use of the site and the surrounding area.

2.2 The role of risk assessment in relation to soil pollution

Risk assessments are occupying an increasingly important place in the process of deciding whether to carry out investigations and take steps in the event of soil pollution. Basing the intervention values on risks and elaboration of the urgency system have given this an enormous impetus. Even outside the Netherlands there is increasing activity in the field of standardisation and policy development based on risks.

In the interviews the following applications were mentioned for risk assessment in the Netherlands:

1. derivation of standards, e.g. target values, limit values and intervention levels;
2. an initial assessment of the results of an investigation for giving direction to and setting priorities for subsequent investigations of soil pollution and possible exposure;
3. assessing the results of the further investigation to assess the urgency of remediation (Soil Protection Act - Wbb);
4. assessing the results of the further investigation to establish the PR4 score (Plan for clean-up of industrial sites in use - BSB);
5. assessing soil quality in connection with an application for a building permit;
6. assessing the effectiveness of temporary safety measures or restrictions on use;
7. assessing isolation measures in the case of ICM scenarios in the remedial investigation;
8. deriving the remediation level for ICM scenarios;
9. drafting monitoring strategies;
10. setting priorities between several sites;
11. assessing residual risks of - stagnating - remedial operations;
12. assessing the possibilities for nature development and land redevelopment;
13. deriving 'intervention levels' for substances not incorporated in the list;
14. assessing risks when carrying out remedial operations (health and safety at work, risks to people living in the neighbourhood);
15. assessing the dispersion and reuse of dredging sludge;
16. assessing pollution in relation to control objectives;
17. assessing the effectiveness of remedial measures and treatment techniques (in terms of risk reduction).

This list shows that a large number of decisions are based on the assessment of risks in the present or future situation. Some of these applications are worked out in detail (for example, assessing the urgency of the remedial operation or building permit), whereas others can be fleshed out in a wide variety of ways (remediation levels or setting priorities). Various interviewees stressed that a risk assessment is not synonymous with establishing urgency. *Establishing urgency is interpreting the risk assessment in accordance with a given system.*

2.3 Conceptual approach to risk assessment

In all the applications mentioned in the preceding paragraph, the *source-pathway-object concept* plays an important part. The core of the risk assessment or the sequence of the steps to be taken differs, however, for the various applications. To derive soil quality standards (intervention levels, remediation - levels) a permissible concentration in soil and ground water is calculated proceeding from a defined object via pathways of exposure. This concentration represents a uniform soil quality (= 'source' of exposure) which is permissible over the entire site. In the case of existing soil pollution (historical source) the exposure for objects is estimated proceeding from a differentiation of the soil quality according to the relevant pathways of exposure for the objects (representative top-soil quality for ingestion, concentrations of volatile compounds under dwellings, etc.). When assessing isolation or temporary safety measures, the effectiveness of the impact on pathways of exposure is examined. The concept of 'source' in the source-pathway-object approach is therefore not synonymous in these applications with the historical source of the pollution. In risk assessment the situation with regard to existing pollution is interpreted in relation to the exposure potential. The representative soil quality for the risk calculation forms 'the source' for the source-pathway-object approach.

When assessing risks from aquatic soil pollution, both the 'original' source (in the case of continual emissions) and the polluted sediment at the site is considered as a source. Establishing the source in these assessments is consequently based on a dynamic characterisation of the existing situation and the expected changes in this situation over time.

The various interviewees commented that assessing dispersion risks in the light of the source-pathway-object approach occupies a somewhat distinct position: as a result of the standstill principle, dispersion should be seen not only as the pathway but also as finishing point. Paragraph 4.3 looks at this in more detail.

2.4 Phased approach

When assessing risks from soil pollution, the following procedure is generally followed:

1. Analysis of problem: hypotheses
2. Calculate, measure
3. Interpret
4. Communicate.

In the problem analysis phase, hypotheses are made with regard to the likelihood of the possible exposure of people and the environment to soil pollution. This consists of interpreting (interpolate and extrapolate) the soil survey data (historical survey, results of analysis, field observations, air photos, etc.) and forming a picture of the situation regarding pollution in the soil and ground water. Also, in some cases an estimate is made of the dynamic character of the pollution (dispersion with ground water, evaporation, decomposition, sedimentation, resuspension, etc.). Next, the likely exposure of people and the environment is then characterised as well as is possible for the *present situation*. Assumptions are made both when describing the pollution situation and the exposure profile. On the basis of knowledge and experience a hypothesis is often already formulated for the risk-determining pollution and objects.

Using exposure models, hydrological/geohydrological models, supplementary field measurements, monitoring data from contact media, toxicity tests and the like, the assumptions from stage one are examined.

The results of the model calculations, whether supplemented by measurement data or not, are interpreted by comparing them with examination criteria. In some cases toxicological literature or expertise is used to describe the expected effects of exposure.

The results of the soil survey and their interpretation in terms of exposure or risks are set down in a report incorporating explanatory notes.

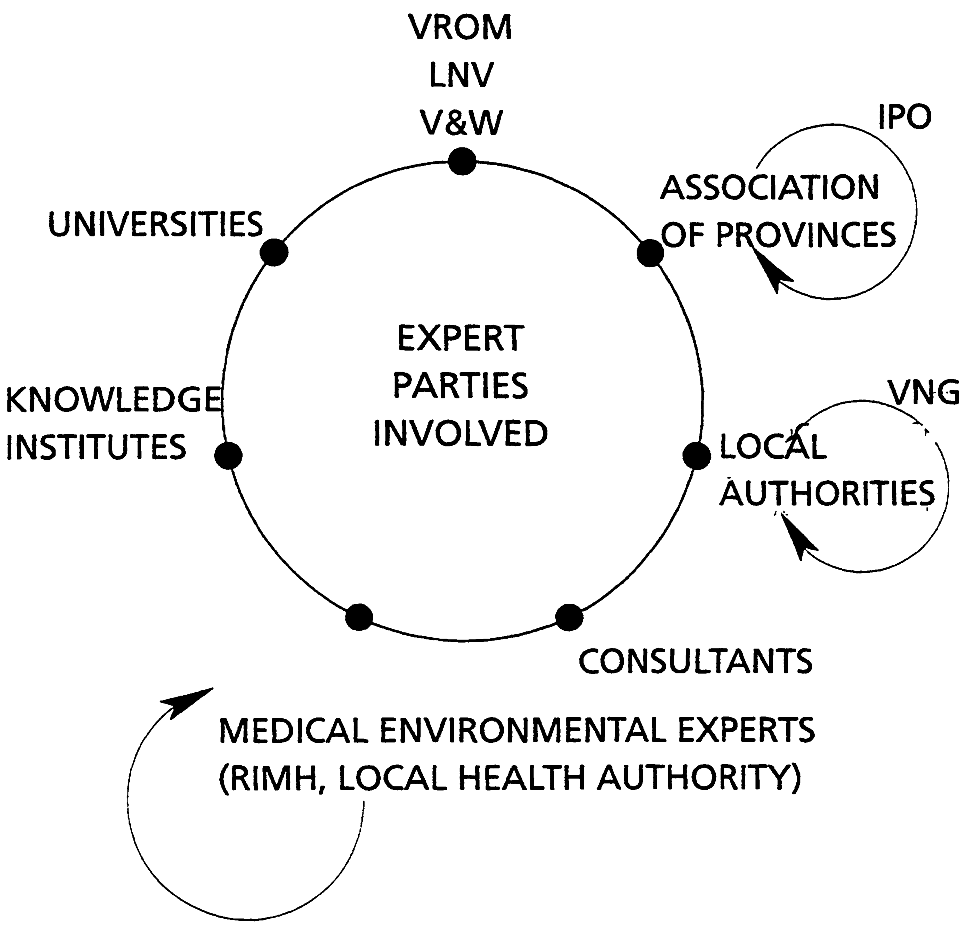
2.5 Areas of expertise

Various areas of expertise appear to be involved in assessing risks from soil pollution. Knowledge and experience of soil polluting activities is necessary for interpreting soil pollution data, as well as knowledge and experience of the soil sciences, soil and other chemistry, geostatistics and hydrology/hydrogeology. In addition, knowledge of Dutch and other policy in relation to risks in general and soil policy in particular is required, as well as knowledge of exposure and toxicology (human and ecotoxicology). Finally, knowledge and experience in relation to communication constitutes an essential area of expertise.

In practice, all these areas are seldom represented to an equal degree in one person or one agency. As a result, the core within risk assessment can differ somewhat depending on the area of expertise of the agency (or client) carrying out the assessment. Often, several parties are therefore involved in the risk assessment. Figure 2 shows the parties involved 'around the table of risk assessment'.

In most cases the provincial and local authorities, companies (terrestrial soil) and regional departments of the Directorate General for Public Works and Water Management and the water boards (aquatic soils) act as client for the risk assessment. They determine to a greater or lesser degree what can be worked out and in what depth and whether the work is to be carried out in compliance with a fixed method. The local and provincial authorities also carry out a policy examination of the risk assessment and formulate their decisions on the basis of this.

Consultants carry out the risk assessments, with the emphasis being placed on the interpretation of the soil pollution situation and the estimate of exposure. Consultancies carry out applied research to solve bottlenecks relevant to the practical situation.



VROM : Ministry of Housing, Spatial Planning and the Environment
LNV : Ministry of Agriculture, Nature Development and Fisheries
V&W : Ministry of Transport and Public Works
VNG : Association of Netherlands Municipalities

Figure 2. Parties involved around the table of risk assessment

Local health authorities often play a part in the assessment with regard to the substantive evaluation and verification of the exposure estimate made by consultancies. Recommendations for additional measurements are made in consultation between the parties. The local health authorities also play an important part in communicating the results of the risk assessments to residents. Universities and centres of knowledge (e.g. National Institute of Public Health and Environmental Protection (RIVM), Institute for Inland Water Management and Waste Water (RIZA) and the Institute for Coast and Sea (RIKZ) provide second opinions and are involved in complex issues. They play a pioneering role in elaborating and fleshing out policy: threshold values are derived, measurement protocols developed and scientific research carried out into substance behaviour and toxicology. The Netherlands Organisation for Applied Scientific Research (TNO) conducts research projects in the field of the residual risks of stagnating remedial operations, industrial risks and ecotoxicological risks.

The following chapters, elucidate the bottlenecks experienced by the various parties in current practice. According to the interviewees these bottlenecks result in part from the differences between 'policy risk assessment' and 'toxicological risk assessment' (policy decision versus effects on health). Another major cause of bottlenecks is the dichotomous character of decisions (yes/no) versus the uncertainties linked to the soil, exposure and toxicology sector. Finally, the uneven distribution of expertise among the various companies and agencies results in a number of organisational and communications bottlenecks.

3 TECHNICAL BOTTLENECKS

This chapter describes a number of bottlenecks resulting from gaps in the knowledge of the parties carrying out the investigations. This may be knowledge that has not been developed or knowledge that is not available. A distinction is drawn between gaps in knowledge relating to the assessment of risks to humans (human toxicological assessment) and the assessment of risks to the environment (ecotoxicological assessment and assessment of dispersion). Many of these bottlenecks relate to implementation of the risk assessment in the context of the urgency system, the assessment of applications for building permits and the use of risk assessment in remedial investigations.

3.1 Human toxicological risk assessment

The gaps in knowledge that occur when assessing risks to humans are related to the interpretation of soil survey data in relation to exposure, the quantification of exposure and the interpretation of the results. Table 1 gives an overview of the bottlenecks found. This table is elucidated in the following sections.

3.1.1 Interpretation of soil survey data

It emerged from the interviews that the present method used in soil surveys does not adequately take into account the data required for risk assessment. ('Soil surveys carried out according to protocols measure the wrong things'.) In many cases the emphasis lies on charting the historical sources of pollution and delimiting the pollution in connection with the size of the case. As the soil survey results are examined in the first instance for quantities in soil and ground water (exceeding intervention levels), insufficient attention is paid to characterising the pollution in relation to pathways of exposure. The soil survey focuses on a *static description of the condition of the soil instead of on a dynamic assessment* of the consequences of the pollution present in the soil and soil processes.

There are large *differences of scale* between the samples taken and the scale of the assessment. As sampling is seldom random, it is not clear how the 'representative' soil concentration should be determined. The spread of pollution according to place is not or is hardly included at all. Distributions of probability are virtually never employed, mainly due to a lack of reliable data for a distribution of probability and the lack of a decision criterion in terms of the probability of values being exceeded. Nonetheless, including uncertainties in the form of bandwidths or distributions is seen as providing differentiation in the black-and-white nature of numerical risk assessment.

Often, the existing pollution situation is taken as starting point when assessing human toxicological risks. *Pollution situations changing over time* as a result of transport or decomposition are not considered. This could result in either an overestimation or an underestimation (see figure 3.).

There are no generally accepted protocols for *strategy and procedure when measuring concentrations in contact media (indoor air, crops, animal products).*

Table 1. Overview of technical bottlenecks in the case of human toxicological risk assessment

Technical bottlenecks: human toxicological risk assessment
Interpretation of soil survey data: * static condition versus dynamic assessment * differences in scale of sampling versus exposure * changing situation of pollution over time * measurement strategy and procedures for indoor air and crops * interpretation of exposure potential
Transformation of soil survey data into estimate of exposure: * exposure models CSOIL/HESP/SUS/.. - overestimation of ingestion - underestimation (?) of household dust - unreliable estimate of indoor air and crop concentrations - permeation of drinking-water pipes superfluous * specific transfer problems - cyanide: transformation on absorption into crops, evaporation - mercury: volatilisation - vinyl chloride: depletion - mineral oil: behaviour of a mixture of substances
Interpretation of exposure estimate * time: life-time average for the individual, annual average exposure conduct, daily average threshold level * reliability of TDIs (Tolerable Daily Intake) * background exposure * toxicity of mixture of substances * matrix effects: absorption = ingestion? * lead: toxicological interpretation * health effects * harmonisation of various threshold values * misinterpretation of standards

The Ministry of Housing, Spatial Planning and the Environment (VROM) commissioned Tauw Milieu to develop a method of measurement for sampling vinyl chloride in the air. This measurement protocol is available. The results of the VC measurements carried out are recorded at a central point. Measurement protocols for measuring the air (which differ from each other) are available from regional inspectorates and local health authorities.

Methods of measurement used by the food inspection department are often used for studying the absorption of polluted substances in animal (meat, milk, fish) and crops products. It has not been established which crops need to be sampled in what quantities. The methods used have not been validated. There is therefore no insight into the reliability of various methods of measurement. However, it was the impression of most of the interviewees that a harmonisation of present methods and protocols is possible in the short term based on present knowledge and experience. The particularisation of the protocol Further Investigation may serve as a basis for this.

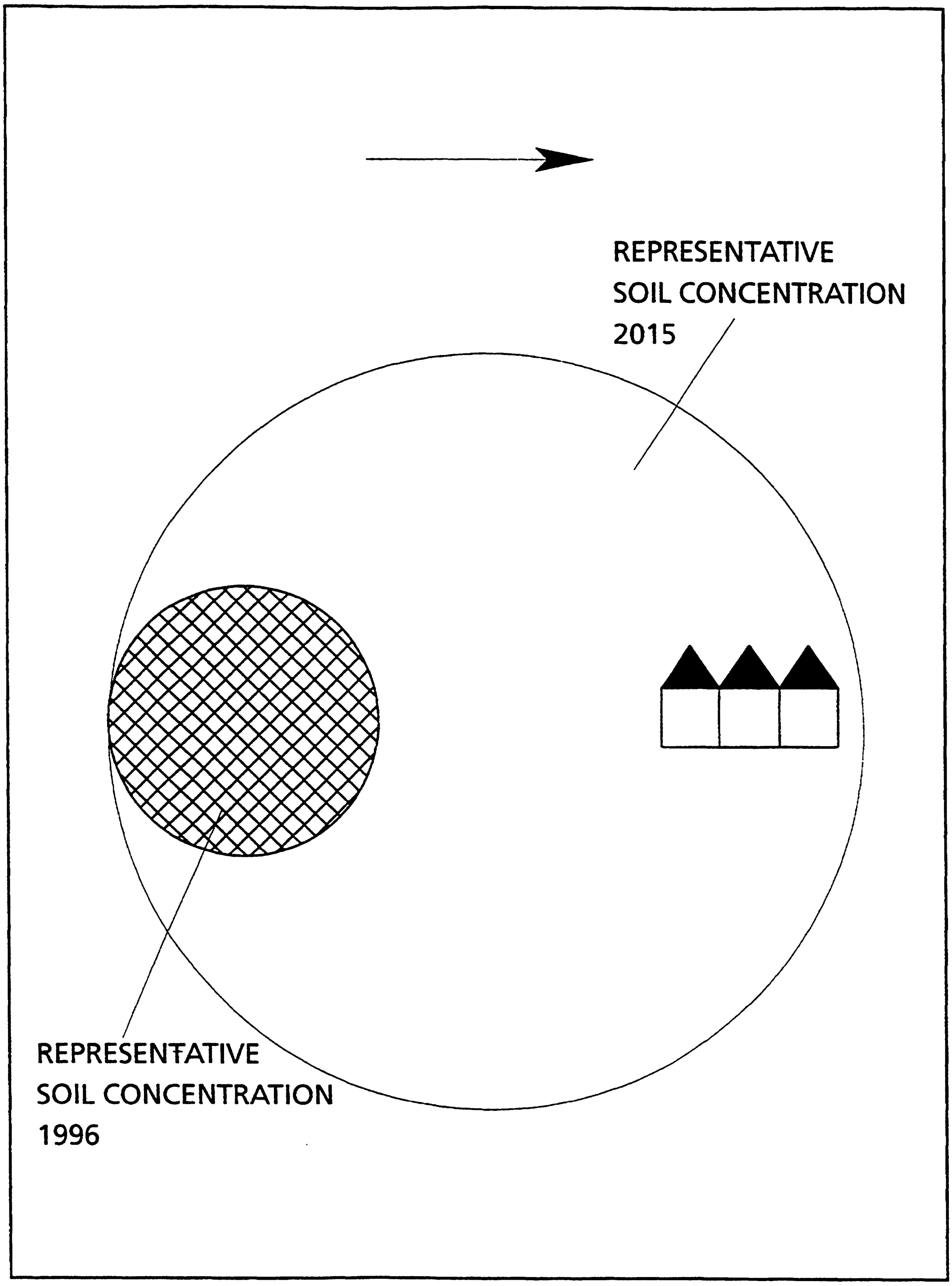


Figure 3. Statistical input versus dynamic reality

When establishing the representative soil content in relation to exposure potential, current soil survey data are not adequately translated to the future situation, whereas the time taken for policy decisions can stretch over years. Establishing departure points is a major focus of attention for 'active soil management'.

There is ambiguity about the *interpreting of exposure potentials* in the present situation: which paving can be deemed to be permanently present, is a surface course of 0.25 m sufficient guarantee against direct contact, to what depth must soil data on non-volatile substances be incorporated, etc. In view of the 'period of validity' of the designation as urgent, it is not desirable for a new risk assessment be carried out for each change in use. However, including all potential changes in the assessment results again in a potential instead of an actual risk assessment.

3.1.2 Transformation: from soil (and sector) data to exposure estimate

In the Netherlands, exposure models (CSOIL, Hesp, SUS) are used to translate soil (and sector) data into exposure. When estimating substance transport from solid ground, virtually no link is made between hydrogeological modelling and exposure in the future. The exposure models incorporate a number of direct and indirect routes of exposure. The set of formulae of CSOIL constitutes the basis of the urgency system and is hence the 'standard' in Dutch decision-making. With regard to the reliability of the calculations and measurements used the following comments can be made.

1. Ingestion of soil by children and (mainly) adults is classified as an overestimation.

2. There are doubts about exposure as a result of inhaling household dust. In present calculations this is never relevant, whereas this route is considered by some to be very important. Consequently, this route of exposure occupies a significant place in the German exposure model UMS.

3. The estimates of exposure through ingesting edible crops and inhaling indoor air are labelled as unreliable. As these two routes are very relevant for total exposure, a validation of these components is considered very important (by means of a reliable measurement protocol). However, there is great doubt as to whether the model can actually be improved so as to have a predictive value. For this reason, it needs to be clear when and how additional measurements need to be carried out. The local health authorities in particular are urging the measurement of indoor air and crop measurements to be made compulsory for relevant cases of pollution.

Last year the RIVM worked on the VOLASOIL model, in which the evaporation module from CSOIL is replaced by a scientifically better model. This model has not yet been validated, however. VOLASOIL will shortly be available for users. Opinions differ on the role of these models in the process of deciding whether or not to take measurements (for example, first make a model calculation and if it predicts that values will be exceeded, then start measuring) or their application in predicting future risks.

4. The module for calculating permeation of drinking-water pipes is labelled pointless. As monitoring the quality of drinking water is the task of the water companies, a company is often advised to measure the quality of the drinking water when it becomes known that the soil is polluted. Exposure via drinking water is deemed unacceptable by a large number of the interviewees in spite of its contribution to total exposure.

Specific transfer problems of substances (figure 4).
A permissible air concentration is known for *cyanide*, but this substance is assessed in CSOIL/SUS as non-volatile. The absorption of cyanide in crops probably goes hand in hand with a transformation of cyanide. The exposure calculated via crop consumption (100% of exposure) is therefore very unreliable. This applies in general to the modelling of inorganic compounds in Csoil.

The volatilisation of *mercury* is not assessed on a standard basis.

For highly volatile substances like *vinyl chloride*, the assumption of an inexhaustible source in the soil results in an enormous overestimation of its evaporation in the calculations.

The behaviour of *mineral oil* cannot be described using average physical/chemical constants. Its specific composition determines its behaviour in the soil and the toxicological assessment hereof. Assessments of the risk from *mineral oil* remain a point of focus and a cause of concern: work has been or is being done in various places (Tauw, Grontmij, Iwaco and RIVM) on refining the characterisation of substance behaviour and its toxicological interpretation.

3.1.3 Interpretation of exposure estimate

There is great uncertainty about the aspect of *time* in interpreting the exposure estimate. To find the average for the life of a human being, exposure characteristics of children and adults, which themselves are based in part on annual averages (ingestion figures, time fractions), have been averaged out over a life of 70 years. This life-averaging of annual averages is then examined against a toxicological standard that is day- or week-based. The basis of this TDI is usually (ideally) formed by chronic experiments lasting the 'lifetime' of a guinea pig. Cumulative loading with increasing body weight (at continuous dosages) is therefore implicit in the TDI values, but does not cover the changes resulting from the exposure behaviour of humans. The toxicological implications of exceeding the TDI during a given time (a year or 6 years for a child) cannot be determined on the basis of the TDI.

Background exposure is dealt with in rather different ways. Some of the interviewees use the RIVM's list of figures for average background exposure, others reserve a part of the 'TDI space', whereas in certain applications (e.g. designation as urgent) no account is expressly taken of exposure from sources other than the soil.

Where there are *several pollutants within the same soil pollution case* there is ambiguity regarding the combined exposure. In the urgency system, substance groups are indicated for which the additive effect of toxicity is presumed. However, it is not at all clear whether this additive effect does occur for a number of the fixed groups. Besides this, it has not been determined whether it is necessary to allow for this *toxicity of a mixture of substances* when working out ICM scenarios in the remedial investigation.

Consequently, the situation arises in which a case may be deemed urgent on the basis of the toxicity of a mixture of substances (e.g. through the addition of exposure to mercury, lead and cadmium), whereas in the remedial investigation no steps are being taken to counter exposure (because the addition of lead, cadmium and mercury is deemed irrelevant to human exposure and it is not prescribed anywhere). In general, toxicity of a mixture of substances is always used for polycyclic aromatic hydrocarbons and chlorophenols.

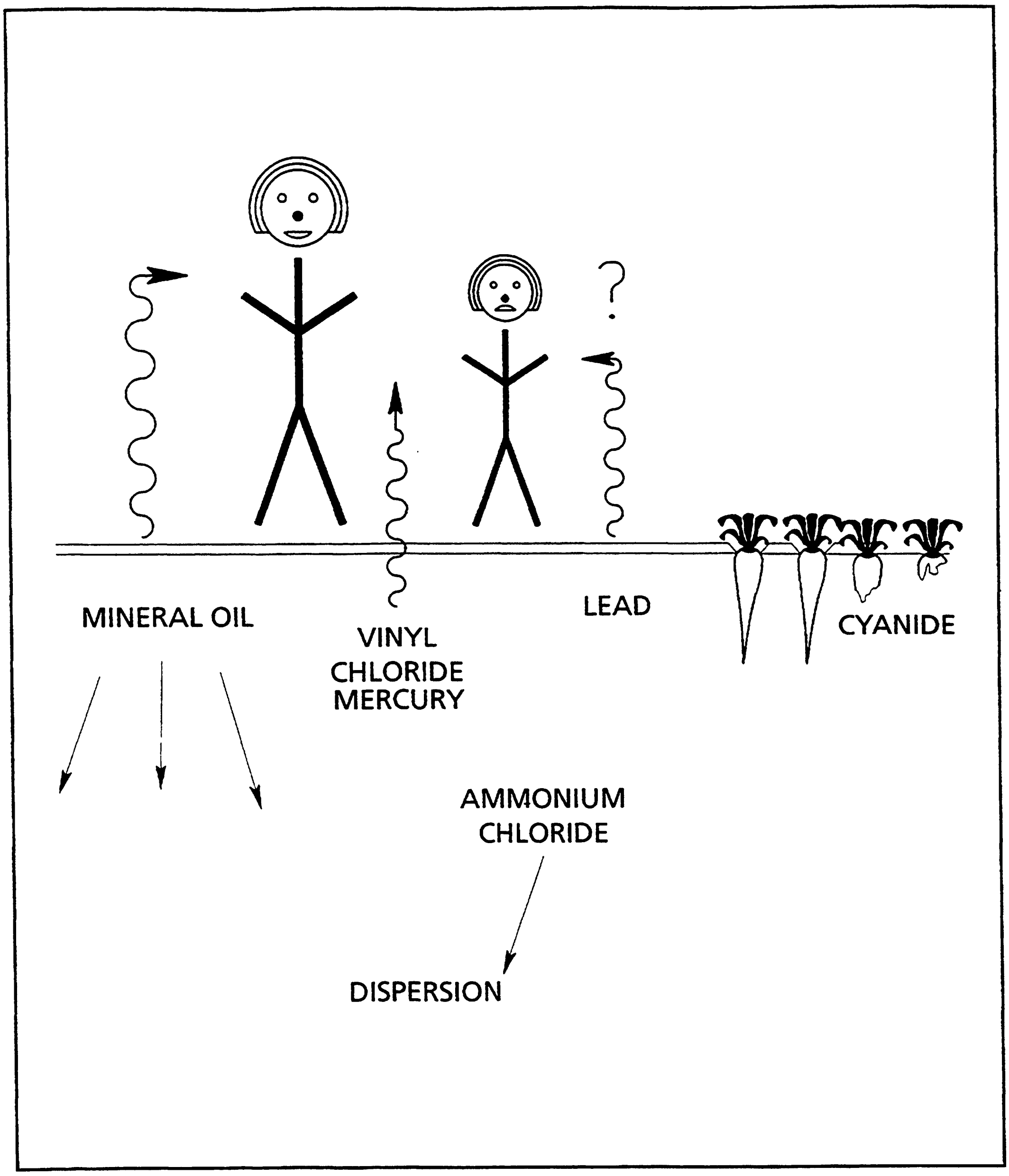


Figure 4. Problems relating to substance behaviour and toxicology of substances and mixtures

There is a need for research into and harmonisation of a number of specified substances. The dispersion behaviour, exposure estimate and ecotoxicological risk assessment for mineral oil is a major bottleneck in the practice of risk assessment. The evaporation of mercury, cyanide and vinyl chloride as well as the absorption and transformation of cyanide on accumulation in crops needs further underpinning. The various threshold values for exposure to lead result in practice in differing recommendations for the same situations: a differentiation of exposure to lead using research into matrix effects is deemed advisable. The dispersion of macro-parameters requires a frame of reference.

The *matrix effects* of soil and crops is not well enough known, so that the absorption of pollution by the body may be overestimated. The contribution of toxicokinetics may provide an answer here. The results of research into the absorption of lead and arsenic from the soil in dogs (carried out by the RIVM) indicate absorption significantly lower than 100 per cent (a few per cent). A study is being made of the usability of extraction methods and gastrointestinal simulations to estimate absorption.

The assessment of *macroparameters* like chloride and ammonia needs to be worked out, partly in the light of using ground water for agricultural purposes.

The various risk limit values for substances as a result of varying interpretations of the toxicological meaning of threshold levels is seen by most of the interviewees as unacceptable. This leads to ambiguity and a delay in decision-making, in particular for a common substance like *lead*, and to complications in communicating the decisions (Figure 4).

The interpretation of an exposure above the threshold levels (TDI/TCL) in relation to *expected health effects* constitutes a bottleneck. In general, the current view is that there is no harmful effect to public health at an exposure level around the TDI.

When deducing the TDI values, safety factors are used depending, inter alia, on the availability of toxicological data. The result of this is that the less there is known the higher the safety factor used, which results in the calculation of a more conservative threshold level. For some substances this results in very low TDI values. In the opinion of the experts, there has been *too little harmonisation with other toxicological 'sources of information'* such as the Working Party of Experts (health and safety at work). In view of the enormous significance of the TDI and TCL values, a broader toxicological basis of support seems justified. An uncertainty analysis with regard to the derivation of the TDI values is a research activity the RIVM intends to undertake.

When various threshold values are used simultaneously, different conclusions (and hence decisions) may be formulated. Large discrepancies have been detected between the TDI and TCL values for a number of substances. A number of intervention levels for heavy metals (based on TDI) lie above LAC values, which, where recommendations are to be made, gives rise to uncertainty about the possibility of crop cultivation. As a matter of interest, the interviewees also commented that various standards can exist alongside each other provided it is clear that the departure points for deriving these standards differ. Also, the circumstances in which the standards are used should be clarified.

In practice, however, there is a frequent *misinterpretation of standards* related in some way or another to a risk assessment. As a result of the integration of human toxicological and ecotoxicological intervention levels, when these levels are exceeded it cannot be concluded without further investigation that there are risks to public health, whereas these are indeed occurring. The linking of risks to public health to the various classes of aquatic soil quality also results in practice to a misperception of risks.

The TCL for benzene is above the limit value for outdoor air. On industrial sites air concentrations are often assessed on the basis of a comparison with MAC values (see figure 5). There is need for a *differentiation of air standards* and the *harmonisation of TCL and TDI values and other threshold values*.

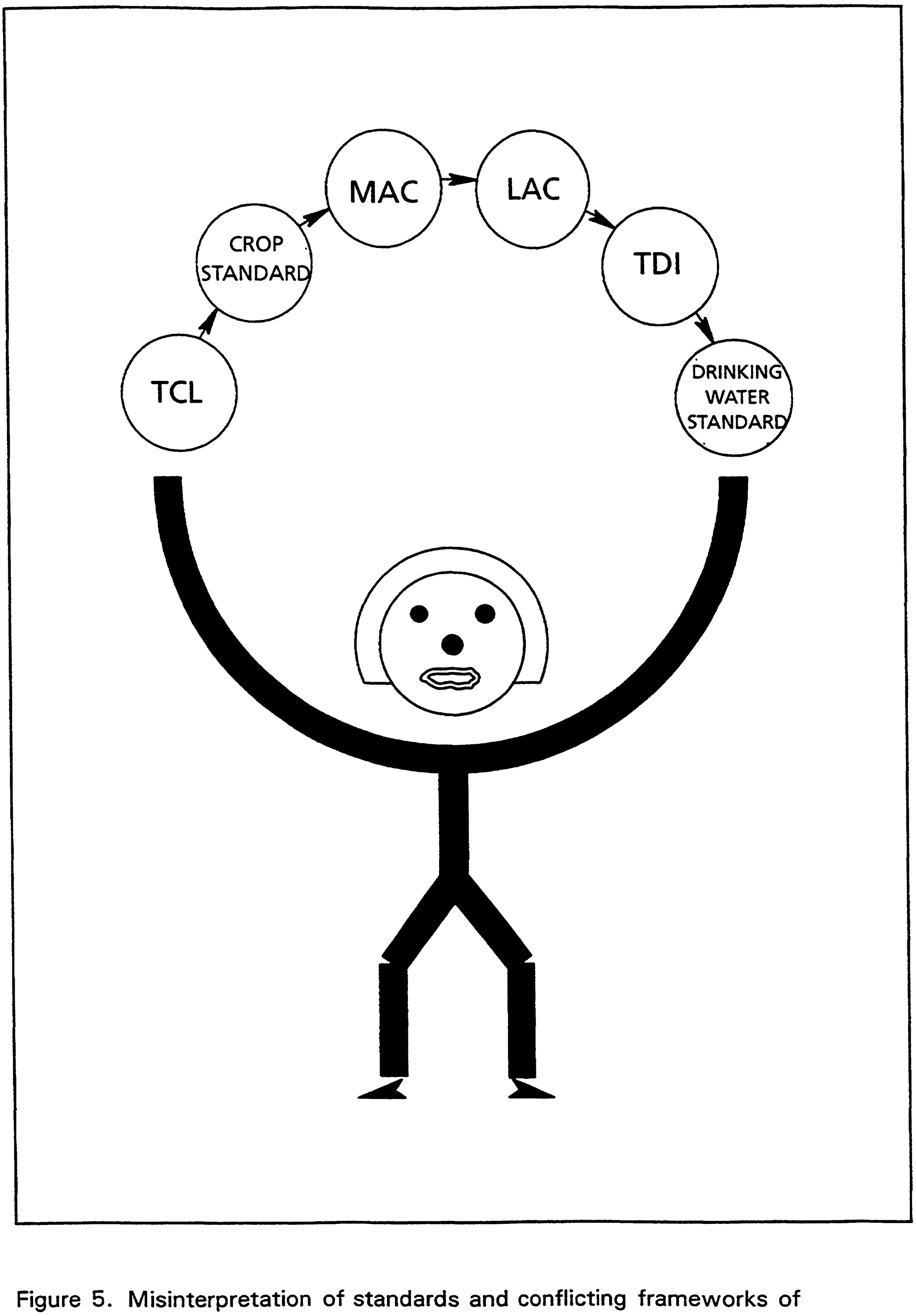


Figure 5. Misinterpretation of standards and conflicting frameworks of assessment

Using different frameworks of assessment in parallel results in practice in conflicting statements or arbitrariness in decisions. Often, the starting points on which the standards are based differ but this differentiation disappears when they are used as examination criterion.

3.2 Ecotoxicological risk assessment

Table 2 lists the technical bottlenecks in assessing risks to the ecosystem. The table is explained in more detail in this section.

Table 2. Technical bottlenecks in assessing ecotoxicological risks.

Technical bottlenecks: ecotoxicological risk assessment
* lack of concept - "generic" versus "specific" approach - practical value versus intrinsic value - group of species versus specific species * equilibrium partitioning theory versus internal dose concept * difference between point sources and non-point source pollution * influence of soil pollution on ecosystem * influence of biotic/abiotic factors * influence of soil remediation activities * time * group of species versus individual species: use of bioassays

When assessing the risks of soil pollution to the ecosystem, two main currents of thought can be distinguished: the ecosystem as a precondition (means) to a practical end or the ecosystem as main target.

From the environmental policy (soil remediation) approach pollution is considered undesirable and the risk assessment (inter alia for the ecosystem) serves for setting priorities for the operation that is intended to result in restoration of the functionality/ multifunctionality of the soil. In this, environmental protection departs from the viewpoint of *'generic protection'* of the ecosystem and not the protection of individual species.

For areas with a high 'ecological value' nature development (ecosystem) is the goal and soil quality constitutes the prerequisite (the means) for this, with defined species (key species, target species) often needing to be protected (*'specific protection'*).

According to the interviewees there is no clear concept for assessing the ecotoxicological risks of terrestrial and aquatic soil pollution: is the *intrinsic* value of nature or its *practical value* being assessed? In the urgency system a use-specific standard has been drawn up (based on groups of species potentially occurring). However, no use is made of other data specific to the site, e.g. soil type, ground water level and the vegetation present. There is therefore *no actual risk assessment*. It is noted that the possibility for a more site-specific assessment is provided by the law but that as a result of uncertainties in the assessment this is still not being used for dry soils.

This situation is totally different in the assessment of risks from aquatic-soil pollution, where instruments are available and are being further developed in order to record the *effects* of the pollution (and also of the components present which are not characterised as pollution) in the laboratory and in situ. If effects are demonstrated on the selected test organisms (in the laboratory), the conclusion is drawn that there may be risks. At the same time, translation to the field situation constitutes one of the bottlenecks identified.

"The biological availability of substances in terrestrial and aquatic soils is mainly determined by the fraction dissolved in the soil water. This forms the basis for the so-called equilibrium of partitioning theory, which assumes that internal exposure can be easily predicted for most organisms in terrestrial and aquatic soils from the concentrations in the water phase (soil water). A second assumption is that there is a thermodynamic balance between the concentrations of a substance in the soil, dry and wet, the soil water and the organism. It is concluded that this theory still has a number of limitations and uncertainties, *inter alia* through the occurrence of non-balanced situations, uncertainties in the estimation of concentration in the soil water using standard coefficients of partitioning and the fact that sometimes there is considerable absorption via other routes. This applies both to organic chemicals and to metals. A check needs to be made on the extent to which the internal dose concept can remove a number of the uncertainties in quantifying exposure."[1]

When assessing risks to the ecosystem for terrestrial soils in compliance with the urgency system, no distinction is drawn between *point-source and non-point-source* pollution. However, a distinction *is* drawn when assessing the ecotoxicological risks for aquatic soils.

The data requirements for assessing soil quality in relation to the consequences for the ecosystem or nature development or redevelopment are unknown. There is doubt about whether the influence of soil pollution on the development of the ecosystem can be measured or perceived. "Ecotoxicologists often feel, however, that the creeping effects of pollution are being veiled by the bulk effects of acidification, eutrophication and declining water tables and that only the more catastrophic events involving pollution can be seen." (Van de Guchte, et al., draft April 1996). It is only partly known how the effects of soil pollution can be monitored.

The impact of *biotic/abiotic circumstances and the consequences of remediation actions* (excavating sandbanks, changing level of ground water) are presumed to be much greater than the impact of the pollution itself. However, no method has been elaborated which enables these different 'impacts' to be weighed up.

Time aspects such as the changing mobility of pollution when the composition of the soil changes or the change in biological availability are in general not included in the case of terrestrial soils.

In the generic approach to the assessment of ecotoxicological risks based on *a general level of protection for a percentage of the group of species* no account is taken of the *protection of specific species*. The assessment therefore does not give a guarantee that the practical value is assured (with respect to wishes regarding vegetation in gardens, agricultural use, etc.).

On the other hand, the use of *bioassays* to assess the toxicity of soil pollution for individual species does indicate the possible effects on the ecosystem but cannot be simply tested against a percentage of species that is thus protected/unprotected. It is not clear to what extent a further differentiation of actual risks by means of carrying out toxicity testing fits into the generic approach from the point of view of environmental policy.

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[1] (from: Ecotoxicological Risk Assessment of Polluted Terrestrial and Aquatic Soils; Van de Guchte et al., draft April 1996)

3.3 Dispersion

Table 3 summarises the technical bottlenecks relating to assessment of the risks of dispersion. This table is discussed in more detail in this section.

Table 3. Technical bottlenecks in assessing risks of dispersion.

Technical bottlenecks in assessing dispersion risks
* simplification of urgency system * impact of heterogeneity of soils/pollution * identification of objects * decomposition, dilution

To assess the risks of dispersion it is necessary to draw a distinction between the risks resulting from dispersion (dispersion as pathway) or the risk that dispersion will occur (dispersion as finishing point).

For both questions it is important to estimate the mobility of the pollution and movement of the water in the soil. In the urgency system a simplification is used in the form of a retardation factor and an average flow velocity. The *impact of the spread of velocities in the soil and the uncertainties in the characterisation of substance behaviour* result in the actual volume increase differing widely from this estimate. A refining of this part of the urgency system is desirable. In principle, legislation provides the possibility for a reasoned departure from the urgency system, but departures are only accepted to a limited extent (see chapter 4).

When identifying exposed objects or ecosystems, objects which in the future may be reached as a result of dispersion are not always taken into account. This does become part of the method for determining a point in time, however. The consequences of decomposition (declining concentrations or the creation of metabolites) are often not included in the assessment of the risks of dispersion. This also applies to the assessment of ecotoxicological and human toxicological risks, incidentally.

As dispersion is one of the three criteria on which the urgent/not urgent decision is based, the general opinion of the interviewees is that the method for determining the increase in volume needs to be worked out in more detail.

4 POLICY BOTTLENECKS

This chapter describes a number of bottlenecks originating in policy as a result of choices made (or, quite the reverse, not made) in legislation and regulations. Here again it makes sense to draw a distinction between the assessment of risks to people, the ecosystem and of dispersion.

4.1 Human toxicological assessment

Table 4. lists the policy bottlenecks in assessing human toxicological risks. The table is discussed in more detail in this section.

Table 4. Policy bottlenecks in assessing human toxicological risks.

Policy bottlenecks in assessing human toxicological risks
* exposure up to MPC level versus ALARA principle * background exposure * rigidity as a result of standard scenarios * double objective of Further Investigation: nature and scope versus risk assessment * current use, current zoning and future use * using different threshold levels

When assessing risks of soil pollution, exposure is compared with the TDI value, which is the interpretation of the maximum permissible concentration. Opting to use the TDI values as threshold level (when assessing the urgency and the objective of safety measures) results, in principle, in *exposure up to MPC level* occurring from the soil sector. The ALARA principle is at odds with this: in spite of the intention to strive towards reducing risks to below the MPC level, this in practice often presents funding problems (who pays for the extra effort?). Big differences have been found within and between provinces in using risk assessments for fleshing out remediation scenarios. Calculating 'remediation levels' on the basis of acceptable exposure is standard use in some provinces, whereas other provinces demand a clean surface layer for all ICM scenarios in order to prevent any contact with soil pollution. Handling residual pollution in the case of soil remediation or ground water remediation is in some instances based on risks and in other situations is not.

In the urgency system (and also in most risk assessments relating to soil pollution) no allowance is made for *background exposure*. Filling in the MPC from the point of view of soil can result in the MPC being permanently exceeded if there are significant loads from other sectors. Inter-sector harmonisation of standards hardly takes place at all.

By defining standard scenarios, standard exposures and standard soil data (for example flow velocities) there is a *risk* of rigidity occurring in the site-specific assessment (see Figure 6). The desire for uniformity in decision-making (and for developing a transparent, reproducible method for this) hinders the differentiating of non-uniform sites. For example, literally adhering to the rules for determining input concentrations can in some cases result in statements that are not very representative. As a matter of interest, experts are able to make very good use of the models to provide differentiation.

The *twin objectives of Further Investigation* have consequences for the framework of the investigation. Charting the nature and scope of the pollution often results in a high concentration of samples at the site of high or low concentrations (hot spot and delimitation). Data that are necessary for determining a representative soil concentration in a garden or ground water concentrations near a house are often not available. Determining the necessary contours for the risk assessment in compliance with the urgency system often goes hand in hand with much expert judgement (or guessing).

In risk assessment carried out according to the urgency system and risk assessment for ICM scenarios in the remedial investigation it is necessary to proceed from *current use or current planned use*. An undeveloped site where dwellings will be built after a change in the zoning plan need not necessarily or may not be assessed for this future use. A ruling can only be given when this situation is 'current'. In view of the period of validity of rulings it is necessary to consider changes in the existing zoning plan. How permanent is the paving, how great is the chance that a park or garden will disappear, etc.?

When testing the exposure data, *various standards* (TDI, TCL, MAC, drinking-water standards, Commodities Act standards) are used. Apart from the toxicological problems (see chapter 3), the harmonisation of policy in this sphere is desirable.

4.2 Ecotoxicological risks

Table 5 gives an overview of policy bottlenecks in assessing ecotoxicological risks. This table is then elucidated.

Table 5. Policy bottlenecks in assessing ecotoxicological risks.

Policy bottlenecks in assessing ecotoxicological risks
* 'actual risk' = use-specific potential risk * policy checking of bioassays * point source versus non-point source * multifunctionality for ecosystems? * ICM for ecosystems?

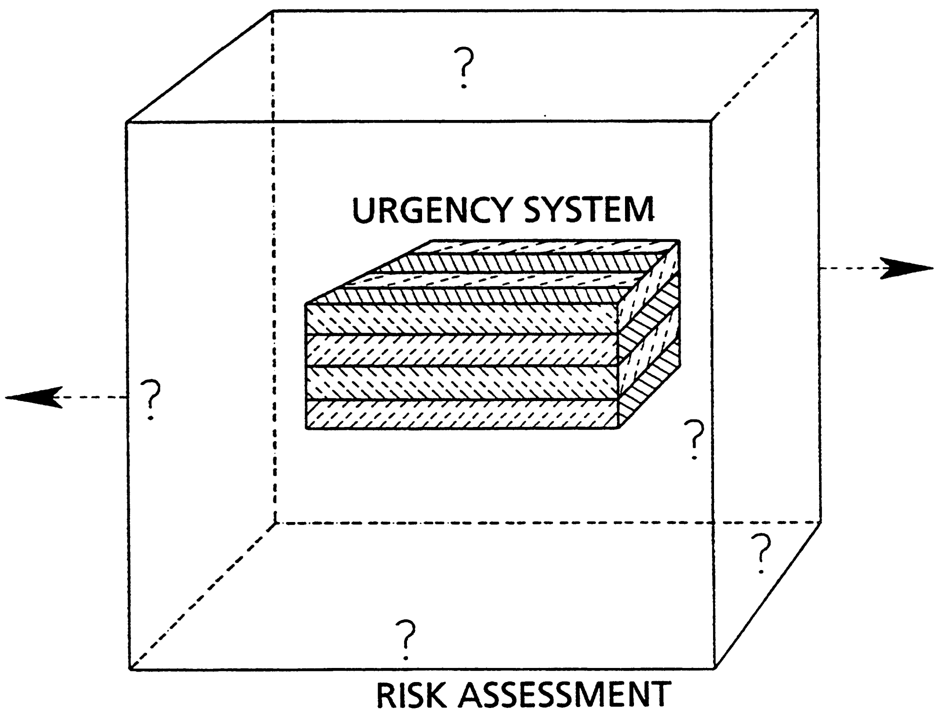

Figure 6. Area of tension: standardisation versus specialisation

Detailing of the urgency system gives rise to the fear that in the future there will not be enough room to depart from the system and that hence the impetus for the further development of expertise will be removed. On the other hand, the open ends in the system are seen as ambiguities that can lead to inequality in decision-making.

The concept of 'actual risk' to the ecosystem is fleshed out by linking the HC_{50} (a measure for the percentage of species that suffers effects as a result of exposure to the pollutant) to the surface that is polluted in excess of this concentration level. The surface is a measure for the area necessary for a given abundance of species to exist. In the system this surface area increases as more disruption takes place due to human activity. The HC_{50} indicates a potential risk, as it is not known whether the species that are being protected occur or could occur on the site. So, the differentiation according to surface area results in a *use-specific potential risk.* Whether there is a question of an actual risk (in terms of a serious attack on the ecosystem or specifically defined species within the system) is not known. Thus the ecotoxicological knowledge has been simplified into a default approach. According to some, the HC_{50} is not expected to differ significantly for various soil types, however.

The use of *bioassays* to monitor effects of soil pollution on test organisms is controversial for application in terrestrial soils. This is partly the result of the lack of a framework for checking the results of the bioassays in soil policy. This is much less so when assessing risks to aquatic soils, although "the existing regulations in the Netherlands leave little room for the actual use of ecotoxicological information when weighing up risks, and that on sites where this room is available, e.g. in monitoring, often no clear assessment criteria have been drawn up. In short, much work is still at the level of research and projects and not at the level of systems and regulations supporting decisions." (Van de Guchte et al., April 1996).

No distinction is drawn between *point sources or non-point sources* nor in different types of natural environment or target-type environment when assessing the urgency of a case. This means that the available policy instruments are not suitable for taking decisions on large-scale, non-point-source polluted areas. In the case of nature development projects initiated by other policy areas, soil pollution in many cases is seen more as a procedural and financial problem (where do I dump my excess soil when sites are being redeveloped?) than an ecotoxicological problem (can I achieve the type of natural environment I am aiming at if there is pollution present?).

When remediation scenarios are worked out it is impossible to define multifunctional remediation for the ecosystem. Large-scale excavations or extractions of ground water could have a negative impact on the ecosystem. A framework for weighing up these 'different' impacts is lacking and the concept of 'negligible' risk to the ecosystem needs fleshing out.

It is not necessary to take the ecosystem into account when putting meat on the bones of an ICM scenario.

4.3 Risk of dispersion

Table 6 gives the policy bottlenecks with regard to assessing the risks of dispersion. The table is elucidated in this section.

Table 6. Policy bottlenecks in assessing risks of dispersion.

Policy bottlenecks when assessing risks of dispersion
* interpretation of the urgency system * gap in assessment of urgency and remediation measures * differences in the Soil Protection Act (Wbb) and the plan for the clean-up of industrial sites in use (BSB)

There is uncertainty with regard to the *interpretation of the urgency system* as regards dispersion. If both horizontal and vertical dispersion takes place it is not clear whether this dispersion should be assessed separately or together. Dispersion of various pollution or of the same pollutant in several spots can be assessed separately or as a whole. It is not clear to what extent departure from the dispersion calculation in the urgency system will be accepted (for example, using monitoring data to establish actual dispersion).

When interpreting dispersion, a *big gap exists between the assessment* in the context of Further Investigation (under the urgency system) and in the context of the remedial investigation. The threshold level in the urgency system is based on a volume increase of 100 m^3 a year above the intervention level. This can be seen as the MPC dispersion level. For remediation sites the MPC level is not the upper limit; all remediation scenarios are required to meet a zero emission (or negligible = not measurable) level (the *standstill principle*). This results in pollution which in itself does not present an actual risk to people or the environment or of dispersion (e.g. benzene around T-values) not having to be cleaned up or controlled on the grounds of other actual risks from other substances (e.g. exposure to lead). Conversely this is not the case. (Within an ICM scenario for a benzene dispersion risk, no lead at T-value is excavated if the risk is below MPC) (see figure 7.)

It is virtually impossible to draw up a balance between efforts (costs, burden on the environment) on the one hand and dispersion on the other. The standstill principle also plays an important part when assessing the risks of dispersion from *residual pollution and stagnating ground water clean-up operations.*

How examination criteria for leaching and blowing about are to be fleshed out is also still uncertain. The checking in the urgency system differs from the checking for dispersion in the context of a BSB operation. Testing for dispersion is not carried out when assessing applications for building permits. There is a danger here of wrong decisions being made with regard to BSB priorities and building, where under the Wbb other conclusions might be expected. Closing the gap between the systems is desirable and will be effected in the short term.

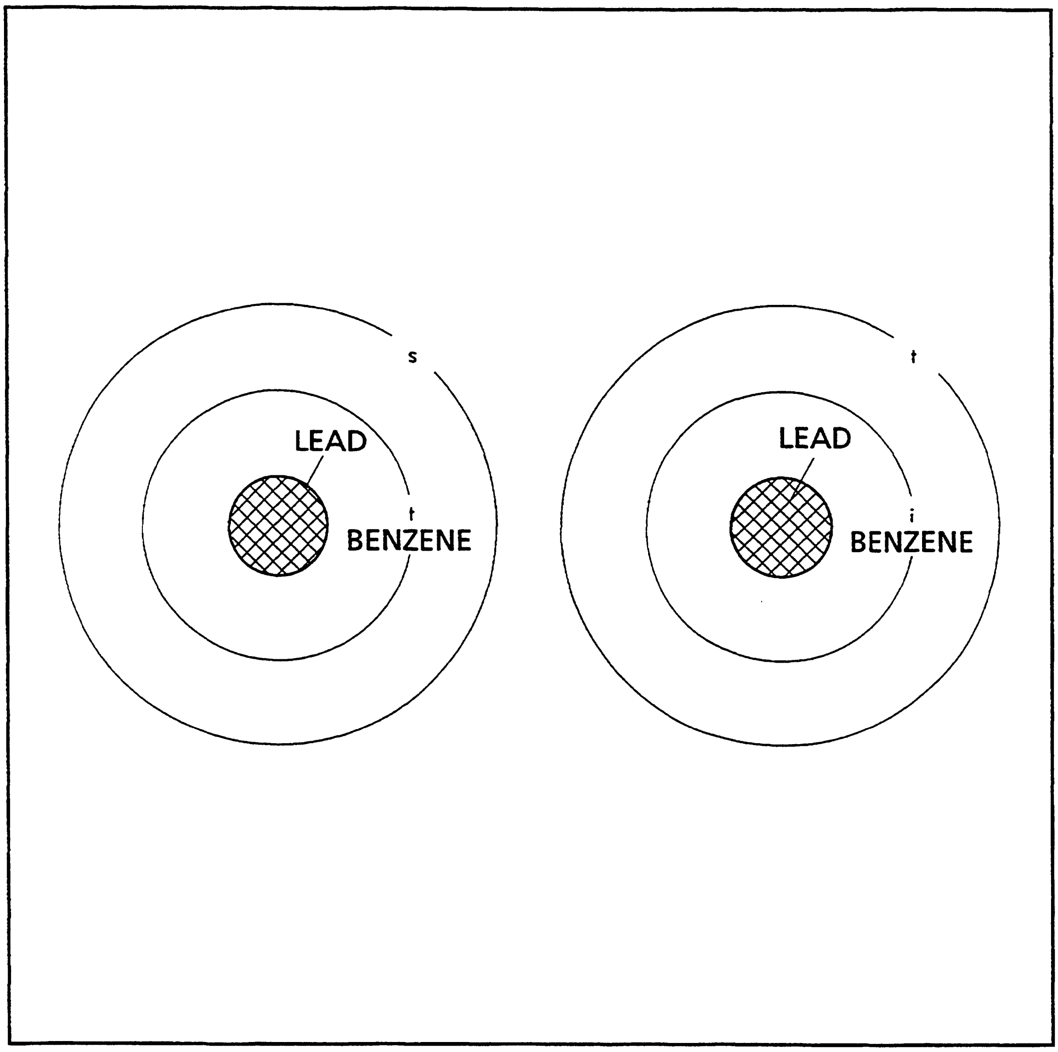

Figure 7. Remediation measures to below MPC level and standstill principle

A pollution situation in which both lead and benzene have been found in the ground water results in very different measures being taken.

If soil has to be cleaned up because it is polluted with lead, whereas the benzene pollution present is not serious (< i-value, situation on left), both the lead pollution and the benzene pollution have to be tackled in the clean-up operation: in the isolation alternative (ICM scenario) further dispersion of the benzene must be prevented even though benzene in itself does not constitute a serious case.

If a clean-up operation is required due to the presence of benzene, whereas the lead pollution present is not serious (<i-value, situation on right), the risk of exposure must be reduced to below MPC level in the isolation alternative (ICM), which is already the case without steps having to be taken. In the case of an ICM alternative, lead is therefore often not removed or isolated.

5 ORGANISATIONAL BOTTLENECKS

This chapter looks at the bottlenecks connected with the involvement of diverse disciplines and diverse agencies and organisations. These organisational bottlenecks are not closely dependent on the different aspects of risk assessment. The organisational bottlenecks are summarised in table 7.

Table 7. Organisational bottlenecks when assessing risks

Organisational bottlenecks in assessing soil pollution risks
* allocation of roles among the parties involved - competition versus cooperation - dependence versus independence * quality guarantee - supply side: competitive pressure and model misuse - receiving end: time and lack of knowledge * knowledge exchange * active soil management: registration of risk principles

5.1 Allocation of roles

As chapter 2 explained diverse disciplines and parties with differing interests are involved in assessing the risks of soil pollution. The allocation of the roles among the diverse parties, however, is not always clear. Frequently the situation arises that the party asked to provide additional expertise is regarded as or behaves as critic of the other expert. A great deal of attention is paid to mistakes, stupidities and nonsense. Universities deplore the lack of substance of the risk assessment, local health authorities accuse consultants of being inept, consultants complain about the lack of dialogue with their principals and the rigid attitude of the assessing agencies. In some situations, consequently, *competition rather than cooperation* prevails.

The *independence* of the implementing party is doubted at the point when this party earns money from carrying out the risk assessment. This has repercussions on the communication of the results to the parties involved.

5.2 Quality guarantee

A quality guarantee means that a check is made at essential times and on essential aspects and if necessary adjustments are made in the process of risk assessment.
On the *supply side* of risk assessment (consultants) we have growing pressure on costs arising from a competitive battle in a shrinking market. Consequently less and less money will be available for a careful interpretation of the soil data for risk assessment. The model may take the place of common sense, which is viewed by the majority of people interviewed as a major hazard. Moreover, the impression was that the expertise that has been developed in the field of eco-toxicological risk assessment has barely been absorbed by the firms of consultants to date, if at all.

The *receiving end* (the competent authority that uses the information provided by the risk assessment to take a decision) is frequently unable to implement conclusive quality checks through lack of time and knowledge. Some of those commissioning risk assessment assume that a designation as urgent has to be acted upon within a few hours which was explicitly denied by others interviewed.

5.3 Exchange of knowledge

Barely any exchange of knowledge takes place between the universities, knowledge institutes, firms of consultants, medical environmental experts and those commissioning risk assessment. As a result much of the knowledge available is not used and bottlenecks are tackled simultaneously in diverse places. There is no platform for the exchange of problems and experiences.

5.4 Active soil management

When remediating on the basis of risks it is important to keep a good record of the points of departure for the risk assessment so that in the event of circumstances changing on the site or altered insights, the basis for the decisions can be traced. At the same time a description has to be given of the limitations to use or aftercare.

The systems of spatial planning and environment are much too separate. Housing construction plans and nature development plans are worked out in detail at an advanced stage before the pollution present is considered. Coordination is required both in terms of planning and financing.

6 COMMUNICATION BOTTLENECKS

A number of the bottlenecks mentioned are in the domain of communication. A distinction can be made between communications among experts and the communications between experts and non-experts.
Table 8 summarises the communication bottlenecks.

Table 8. Communication bottlenecks in assessing risks.

Communication bottlenecks in assessing risks
* communication among experts - ministries, knowledge institutes and universities - provinces, firms of consultants - firms of consultants, medical environmental experts - medical environmental experts-knowledge institutes - knowledge institutes-consultants * communication between experts and non-experts - reports written by experts for experts - policy terminology versus emotional value - reason versus emotion (risk perception and risk acceptance) - confidence in expertise and independence

6.1 Communication among experts

As mentioned earlier, diverse areas of expertise and agencies are involved in implementing and interpreting risk assessment (see figure 2). There is no overall consultative structure within which these parties communicate with each other on risk assessment. Consultation does take place among some of the parties on an organised basis or incidentally.

Many of the assignments of knowledge institutes and universities come from the Ministry of Housing, Spatial Planning and the Environment, the Ministry of Agriculture, Nature Development and Fisheries and the Ministry of Transport and Public Works. Exchange between the party commissioning the work and the implementor takes place as part of this work on a project basis. Frequently no other parties are involved in these projects. Some of the survey work (draft protocols for air measurements, time determination) is farmed out to firms of consultants. In the case of such assignments *a guidance committee of representatives from all sectors* constitutes the basis for communication on progress and results.

Frequently the competent authority (the provincial or local authority) is the connecting link between the experts from *the firm of consultants on the one hand and the medical (environmental) experts* of the RIMH (Environmental Inspectorate - regional office) or the local health authorities. It is an exception for there to be direct communication between these parties.

The exchange of knowledge between *knowledge institutes and consultants* is not organised. Knowledge exchange takes place on an incidental basis by means of informal contacts, guidance committees and joint projects. Nor is there any permanent basis for consultations between *knowledge institutes and medical environmental experts*.

The knowledge and expertise present in universities is only deployed in practice to a limited degree. Frequently universities are called in without the knowledge of consultants for second opinions.

A number of 'risk projects' is being implemented as part of NOBIS with the endeavour being to achieve a wide representation of risk experts by means of a consortium and guidance committees. A consultative meeting of project leaders was recently started to achieve coordination among the diverse projects in NOBIS, NISRP and POSW.

Communication within organisations or agencies fluctuates. Medical environmental experts have a national coordination meeting and provincial and local authorities have national working parties to discuss policy viewpoints and develop joint guidelines. Consultants communicate among themselves solely through informal contacts.

The conclusion is that all the parties want to coordinate and all kinds of ways are found of doing this but there is no systematic clustering of knowledge in the Netherlands in the field of risk assessment, because of the diversity of activities and the fragmentation among diverse parties.

6.2 Communication between experts and non-experts

Once the experts have carried out the risk assessment the results have to be communicated to the non-experts involved, such as the residents, employees and the like. Here bottlenecks arise as a result of use of language and underestimation of the non-rational aspects involved among the recipients of the message.

Risk assessments that are carried out as part of the Soil protection act are reported on *by experts for experts*. They use policy terminology. The terms 'serious pollution', 'actual risks' and 'urgent case' for non-experts have a much more serious implication than is intended by the experts. The words 'actual', 'urgent' suggest the necessity for immediate measures, while in reality remediation measures are actually only taken after years (see figure 8).

Frequently insufficient account is taken of the *specific feelings* prevailing in a district. Thus residents' main worry may be the financial risks arising from a devaluation of their property, the nuisance arising from the remediation work, the requisite rerouting of traffic, the risk of the gardens being damaged, etc. while emphasis in the provision of information is on the health risks. On the other hand residents' biggest worry about the long-term effects to their children's health cannot be alleviated by providing practical information on the proposed remediation measures. The balance between 'hard and soft information', between *'reason and emotion'* is an underestimated factor in the communications on risks.

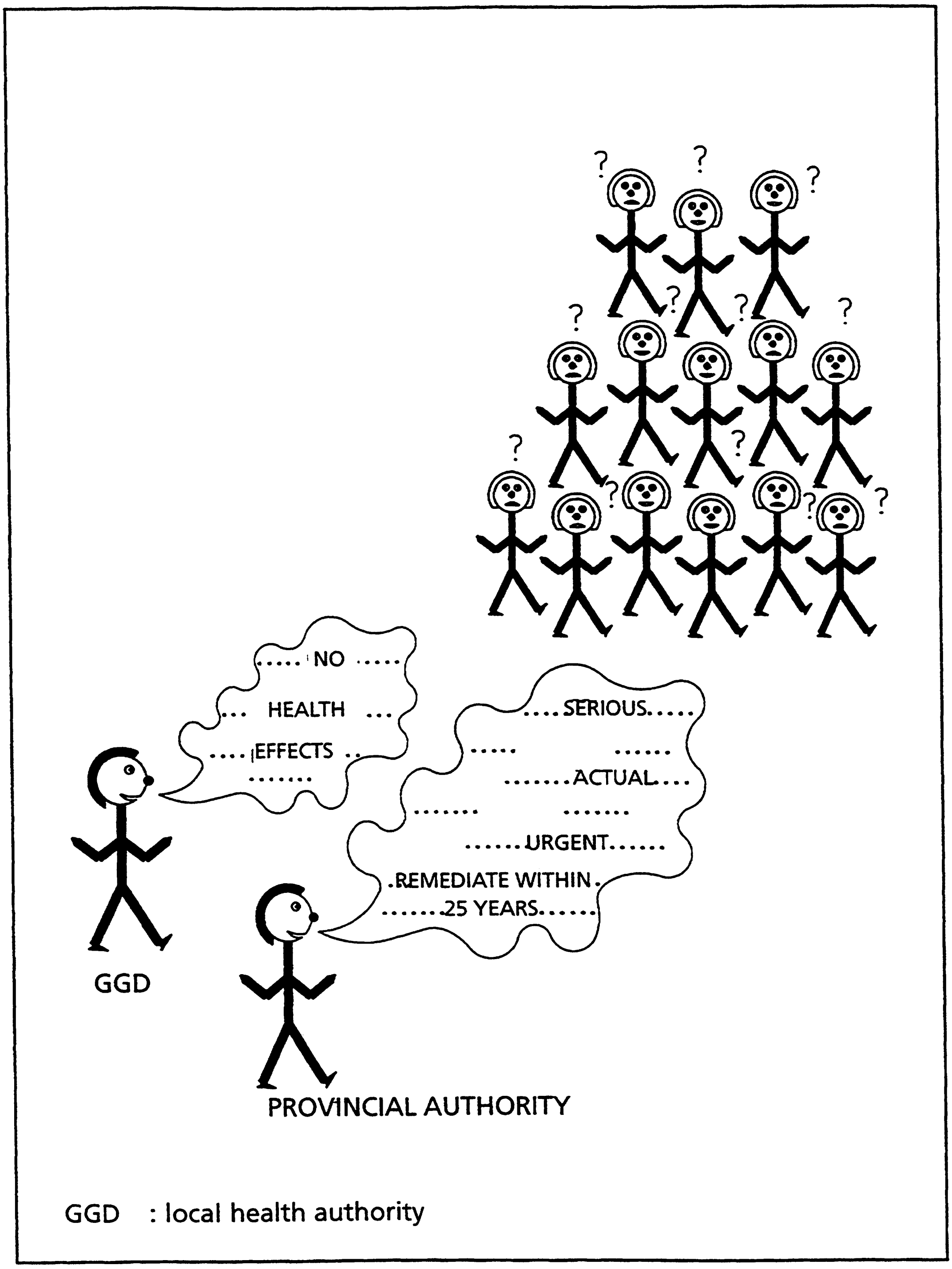

Figure 8. Communications between experts and lay persons

A major aspect of risk assessment is communication of the results to lay persons involved. This gives rise to various bottlenecks emanating from the use of policy terminology and technical jargon and from an underestimation of risk perception and risk acceptance in the parties concerned.

An accompanying problem in the communication of experts to non-experts is the *lack of trust* that those involved have in the expert. Doubts are raised about the objectiveness of the expert, especially if the expert is associated with the party who decides on the solutions. In practice this is frequently solved by having a third party, who has no interest in the remediation, be responsible for communication.

7 POSSIBLE SOLUTIONS AND FOLLOW-UP ACTIONS

A number of suggestions are made in this chapter for solving the bottlenecks that were described in the preceding chapters. On the whole, the possible solutions comprise bringing together experts and exchanging, confronting and integrating knowledge and experience. The organisation and facilitation of a knowledge infrastructure of this kind could be steered by the Netherlands Integrated Soil Research Programme. Clear objectives as regards output have to be formulated for setting up the working parties below. The emphasis is on getting at the knowledge in the heads of experts with the aim of making this knowledge objective and accessible to a large group (from 'brainware' via 'groupware' to 'documentware').

In-depth research is necessary for a limited number of bottlenecks.

The order of the solutions follows the order of the bottlenecks described and consequently does not reflect any setting of priorities. The priorities for solving the bottlenecks are the subject of debate at the workshop.

7.1 Solutions to technical bottlenecks

human toxicological risk assessment

A risk checklist could be drawn up to coordinate the soil survey data sets better to the intended risk assessment. This checklist could contain a definition of the minimum data regarding site use, soil and ground water quality, surrounding factors and the like. It also has to be indicated what sample taking strategy can be used as well as sample pre-treatment and methods of analysis. The risk checklist gives indicative limit values above which air measurements and crop measurements are recommended.

An inventory has to be carried out into the existing methods in the field of sampling crops and air. This will allow *a programme of requirements to be drawn up for the strategy and methods for air and crop measurements.*

Insight can be obtained into the relevance of the exposure route of ingestion of pollutants by means of household dust, by measuring at polluted sites the soil content in household dust and the concentration of pollutants in this, as well as research into the ingestion of household dust by children.

Research should be carried out *for cyanide, mercury and the macro-parameters* into the behaviour of these substances in relation to exposure and the assessment of this.

Efforts in the field of risk assessment of mineral oil should be coordinated, for example by means of a *'mineral oil' working party.*

A working party on *'human toxicology with reference to soil pollution'* should handle the bottlenecks relating to toxicological issues with regard to time, combined toxicology, absorption and biological availability, threshold levels for lead, as well as the coordination of the diverse toxicological threshold values. The working party should make recommendations as to how to deal with the gaps in knowledge in practice, define research questions and function as the guidance committee for such research.

Research into matrix effects and speciation of pollutants is to be continued and coordinated. Coordination needs to be organised between the experts in the field of chemical speciation (leaching research) and biological or toxicological availability. The way the results are to be interpreted and applied within the current system is also to be worked out.

ecotoxicological risk assessment

Further specification of the role of ecotoxicological risk assessment is required in the decision-making surrounding soil surveying and soil remediation of dry land. Optimal use should be made of the knowledge and experiences gained in the wet soil world. The overview report drawn up by a group of experts (Ecotoxicological risk assessment of polluted (aquatic) soils) could serve as a basic document for a *working party on 'ecotoxicological risk assessment in the event of soil pollution'*. The working party should develop a general concept and tackle bottlenecks that have been spotted on the basis of this in line with the objective set by the working party. The emphasis of the activities of the working party must be on the implementation of existing knowledge in practice. There are two key questions: 1) how can we assess existing soil pollution situations (bearing in mind the changes that occur over time, diagnosis) and 2) how can we assess measures in the case of actual risks and weigh these in relation to the contribution to risk reduction for the ecosystem.

risk of dispersion arising from soil pollution

A *working party on 'the risk of dispersion arising from soil pollution'* would concern itself with the further development of the method to determine the increase in scale of pollution over time. This should result in a proposal for modifying the method and an action plan for monitoring to establish actual dispersion.

7.2 Solutions for policy bottlenecks

Many of the policy bottlenecks arise from interpretation of the law or lack of coordination among the diverse policy fields. There is enormous doubt as to whether it is feasible to close all the loopholes in every piece of legislation or system, or whether it is desirable. There is a need for the exchange of experiences and viewpoints with regard to policy decisions on risk assessment. A platform on policy decisions surrounding risk assessment could be formed for this purpose. The results of the discussions in this platform would be published by means of a newsletter.

7.3 Solutions to organisational bottlenecks

To enhance cooperation and mutual understanding among the diverse parties a *regular meeting of representatives of these parties could be organised*. The meeting could be based on specific case histories which are assessed from the angle of the diverse parties involved.

To encourage quality guarantees on the supply side voluntary participation and second opinions could be organised. This would involve regular checking of the quality of the risk assessment taking place by a second party. Participants assess and are assessed. This could possibly be combined with discussion sessions during which different interpretations are discussed, based on a number of case histories.
Another possibility for quality guarantees on the supply side is the implementation of a *survey of a ring of laboratories* for instance. To enhance quality on the receiving end a *'control checklist'* could be considered or *'control training courses'*. It can also be established in which cases an assessment of the risk assessment is needed by medical environmental experts (*rules for notification or compulsory consultation*).

The knowledge developed at the universities and knowledge institutes can be deployed faster and more effectively in practice if a *'risk assessment information network'* is set up. The network would keep a record of supply and demand and parties would be matched to ensure that knowledge was developed in the most market-oriented way.

7.4 Solutions for communication bottlenecks

It is proposed that the parties should take part in the risk assessment information network to promote communication among them. If several working parties or platforms are created, this will promote communication through these channels.

Communication between experts and non-experts can be promoted by having a *'lay person's summary'* included in every survey. This lay person's summary will set forth in comprehensible Dutch, without using any policy terminology, what is wrong with the soil and what the consequences are for the users of the site. A prototype of a lay person's summary could be drawn up by communication experts in conjunction with the Stichting Gifvrij and representatives of residents and medical environmental experts.

A *training programme* could be set up for soil and remediation experts to convey both *knowledge of psychology and communications as well as skills*.

8 RESULTS OF THE WORKSHOP OF 19 JUNE 1996

The results of the workshop in main outline are given in this chapter. The *aim* of the workshop is to arrive at an evaluation and selection of the bottlenecks described and to establish promising possible solutions for these bottlenecks. Three subgroups were formed each of which debated a key question.
Insight was obtained into the importance accorded to the bottlenecks identified and the support for the proposed possible solutions on the strength of the discussion of the items in appendix 3.

The following subdivision was chosen because the identified bottlenecks are highly diverse in character.

Subgroup 1: bottlenecks for which further research is required or for which coordination among researchers is desirable.

Subgroup 2: bottlenecks where a debate at conceptual level is necessary before the actual gaps in knowledge can be specifically filled.

Subgroup 3: bottlenecks for which organisational parameters have to be created to promote the communication and exchange of knowledge on risks.

A programme of research or action plan was drawn up to eliminate the major bottlenecks in separate working sessions.

An overview of the results of the subgroups is presented in the sections below.

8.1 Subgroup 1: Technical bottlenecks for which further research and coordination of research is required

General comments
Those present at the session were asked before the discussion to give their comments and additions to the bottlenecks listed in the report.

The following points were then made:
- Risk assessment mainly involves matters that are measured. However, not everything is measured because of the high expense or because of the lack of historical information. Nothing is known about the contribution of substances that are not measured.
- The typology of the source in relation to the substances to be expected could be addressed. The substances taken as a yardstick in particular ought to be identified.
- The simple method from the urgency system with regard to the dispersion risks is difficult to verify by means of measurements. The identification and interpretation of data on risk groups is still underexposed in the current systems. If specific children's TDIs have been derived for certain substances account has to be taken of this in the risk assessment.
- Debate on bottlenecks (notably with reference to ecotoxicological risks) cannot be seen separately from the debate in the second workshop on conceptual bottlenecks. Many bottlenecks arise precisely because of the limitations of or the lack of concepts.
- As the reports indicate the objective of a risk assessment is very important.
- Interpretation of bio-assays is a problem.

Additions
After a first round of listing items, discussion ensued on the additions to the items in the table in appendix 3. These additions could be included when deciding on further research.
The following additions to research themes were mentioned:
- It would be desirable to evaluate the real effects of the soil pollution that are plausible. The evaluation would have to include both human and ecotoxicological effects.
- Tests using biological indicators are underexposed for the assessment of dry land soils in comparison to aquatic soils. The following points were made on this subject:
  - the human risk assessment could possibly make use of bio-markers. This would allow a better relationship to be made between pollution and effects;
  - the correlation between diverse tests could be investigated, thus allowing for a possible coordination between human risk assessment and ecosystem risk assessment.
  - Wider concepts for risk assessment need to be sought to allow for a better coordination between human, ecological and dispersion risks.
- The relationship between bio-availability and effects remains an important direction of research which could involve the following aspects:
  - link between the 'traditional' availability tests and the recent effect-oriented tests;
  - relationships between total concentrations, partition and bio-availability;
  - relationship between partition and bio-availability;
  - relationship between soil type correction and effects.

- The influence of heterogeneity should be systematically ascertained. This would allow a recommendation to be made as to how to deal with heterogeneity.
- Evaluation of further investigations already carried out.

Priorities and Possible Solutions
A list was made among those present of subjects that had priority for further processing on the basis of the possible solutions given in the table and the additions to these. The form in which the further detailing ought to take place was also looked at. A brief account is given below of each subject discussed.

Human:
Interpretation of research data:

It was generally acknowledged that the current research protocols do not produce the right data for a risk assessment of the pollution of soil. An integrated approach to the said bottlenecks is needed. At the moment Chemielinco, Grontmij and Tauw are already working to a commission from the Ministry of Housing, Spatial Planning and the Environment on refining the Further Investigation protocol. Measuring protocols for crops and indoor air/ambient air are part of the exercise.

Transformation to exposure:

Household dust was not seen as a bottleneck in view of the fact that exposure to household dust plays a subordinate role in comparison to ingestion of soil particles. The inhalation of dust particles provides a rough overestimate of exposure in the German UMS model.
Transformation cannot be seen separately from other bottlenecks such as interpretation and speciation. Of the pollutants given mineral oil in particular was regarded as a bottleneck, while the macro-parameters were also mentioned. A number of starts have been made with regard to mineral oil, the Tauw system was given as an example, moreover research into the effects of mineral oil are being done at the RIKZ Institute for Coast and Sea (E. Evers).

Interpretation of human toxicological exposure

The bottlenecks regarding toxicological interpretation were endorsed. It was indicated that the local health authorities in Groningen (F. Duin) are working on integrating diverse criteria for volatile compounds.

Ecosystem

Partition versus internal dose

An effect-oriented approach was proposed as a research subject. By integrating this subject with the two previous ones a more effect-oriented approach to soil pollution could be developed. This approach could be used not only for ecological but also for human risks.

Application of Bio-assays

Interpretation is essential when using bio-assays. The proposed exchange of experience between the land and water worlds was regarded as necessary to arrive at a solution.

Dispersion

Simplification of the dispersion module
A different concept was proposed with regard to dispersion risks that was based on a load approach. This would avoid many practical problems.

The following priorities were set with regard to the possible solutions by those present:

1. evaluation of the real human and eco(toxico)logical risks effects as a result of exposure to soil pollution and the use of the accompanying measuring protocols;
2. integration of knowledge of risks with regards to sediment and soils;
3. interpretation of research data;
4. interpretation of toxicological data, main problems: TDI, matrix effects, integration of different standards;
5. mineral oil;
6. soil type correction;
7. bio-assays ecotoxicologic/human;
8. partition versus internal dose;
9. transformation to exposure;
10. verification of risks of dispersion.

Further research is required on these subjects in order of importance.

8.2 Subgroup 2: Conceptual bottlenecks on which coordination among the diverse decision-making levels must take place

Ecosystem

The discussion in subgroup 2 mainly focused on the role of ecotoxicological risk assessment.

First of all there was a fairly extensive discussion on the need for a concept for ecotoxicological risk assessment. In the opinion of those present there was a definite need for a clear concept that was properly fleshed out. There were two reasons why insufficient attention had been paid to this subject to date in the opinion of the subgroup:

* impairment of the ecosystem is not visible ('earthworms with headaches', 3 million bacteria instead of 30 million).
* the 'real' (theoretical) ecologists up to date have barely involved themselves, if at all, in the environmental world: there is little, if any, communication between the world of ecologists and that of environmental protection experts.

At the level of the development of instruments for tests and measurements the terrestrial soil world can avail itself of the knowledge that has already been developed in the aquatic soil world. This can be a useful addition to the set of instruments of risk assessors of terrestrial soil contamination. It would be necessary to establish conceptually:

- When the ecosystem has to be assessed and to what degree of detail (depending on use, depending on type of contamination, depending on size, etc.).
- How the results of the measurements can be interpreted in the light of the acceptance of risks for the ecosystem.

A useful start could be the proposed working party on ecotoxicology in the case of soil pollution, uniting specialists in terrestrial and aquatic soil ecology. This working party would first of all have to work out the concept of ecotoxicology in relation to soil pollution. The concept would have to be verified among the diverse parties involved. The working party would have to steer developments on the basis of the general concept, commissioning and guiding projects the aim of which is to expand further on the concept. The working party will also have to play an active role in communicating research results (knowledge broker).

The second bottleneck with regard to ecotoxicological risk assessment is the weighing of risks of contamination versus the risks of measures. The subgroup was of the opinion that this was not a conceptual bottleneck, but that there was a lack of a set of instruments to allow for a weighing of the diverse risks. At the point at which the concept of the role of the ecosystem within the risk assessment of soil pollution was clear this system could also be set up.

Human

The bottlenecks mentioned as regards human toxicological risk assessment were discussed briefly. Acceptance of the application of risk assessment in defining measures was generally accepted as an important issue to be addressed for coordinating policy. A working party as proposed could be a solution, provided this working party not only results in the exchange of information but at the same time carries sufficient weight to be able to steer decisions in this direction or to take these.

Setting up a good record-keeping system to guarantee risk management in the event of functional remediation, is admittedly important, but will not lend itself so readily to uniform regulation. In addition to risk assessment other flows of information, for example aftercare relating to clean-up measures, may be important to guarantee sound soil management. This bottleneck will have to be worked out in another context.

Dispersion
The bottleneck as described in the report regarding the assessment of dispersion on the standstill principle, was not discussed in the subgroup. The conclusion is that the highest priority within this subgroup was to work out more closely a concept for ecotoxicological risk assessment in the case of soil pollution. On the whole, the group took the view that ecotoxicological risk assessment had to be given a more appropriate place in the urgency system, for example, than is at present the case. If a clear concept fails to be forthcoming within the foreseeable future there is a fear that only human toxicology and dispersion will in fact be looked at. It is important for there to be an unambiguous and accepted concept before knowledge exchange can take place between aquatic soil risk assessors and terrestrial soil experts at the level of monitoring and testing. The working party required for this must have sufficient expertise and decision-making power to be able to make a significant contribution to the debate and the solution.

8.3 Subgroup 3: Communication and organisational bottlenecks

General
It was pointed out in a general round that the role of risk assessment has grown enormously. Not only does the instrument serve to prioritise cases but also to decide whether or not to remediate. As a result the interests at stake have become greater and clear and effective communication has become more important.
A distinction in urgency and timing on the one hand and establishing the clean-up objectives with the aid of risk assessment on the other is important. The lack of guidelines or protocols with reference to the latter makes it essential for there to be clear records, reports and communication of the points of departure and results. What is lacking in the report is the embedding of risk assessment in the case of soil pollution in general risk policy and risk philosophy. Concepts such as MPC (Maximum Permissible (Risk) Concentration, negligible risk, ALARA and the like are based on other policy documents which are frequently taken for granted by the experts but require explaining for outsiders.
The definitions and concepts are of fundamental importance for communication. Communication is vital precisely in the area in which the details of policy are worked out. We are dealing here with a multi-actor trans-disciplinary domain, so that the debate must not be conducted in a mono-disciplinary way. This is precisely the reason for many of the bottlenecks.

Communication among experts
The point is made that there are actually two categories of experts:
1. the appliers of risk models, those who have to assess the outcomes of the risk assessment (local authorities, provincial authorities);
2. the developers, experts in individual areas of risk assessment.

The type of question differs for the two categories. Those applying the models need systematic information (helpdesk) and on the other hand answers to more specific questions arising with the assessment, both substantive and in terms of how policy has to be interpreted.

The developers need to coordinate their developments with market issues, developments in adjacent areas and comparable developments in other countries. For this networks are necessary.

On the whole there is reasonable to good coordination within a particular type of institution, for example the universities or the knowledge institutes. But there is little, if any, among the different types of institution.

It would seem to be a good idea to inventory and link up the existing networks. These networks, however, won't operate of their own accord, was the opinion of those present. There has to be a binding factor that repeatedly brings the people together. Doing things together, producing products, can be a good basis for exchange. Some of the knowledge management may perhaps have to be farmed out to experts in the field of knowledge management and communication.

Communication among experts and non-experts
There is a danger that, if experts close their ranks by means of successful networking, the distance between the experts and the non-experts could be widened for the latter in their perception. While at present the local health

authority is still an independent critical expert, it would become part of the system in a well-oiled expert machine. It is important to provide the non-expert with sufficient and well-coordinated information to allow them to form their own opinion on the situation. Information officers can play an important role here. The compilation of a lay person's summary and serious consideration of recommendations in the book "Communication on Soil Pollution" by Fred Woudenburg of the Rotterdam local health authority would be worthwhile.

APPENDIX 1. INTERVIEW DOCUMENT

INTRODUCTION

Risk evaluations are playing an increasingly more important role in the decision making surrounding the implementation of surveys and measures taken in cases of soil pollution. The risk underpinning of the intervention values and the fleshing out of the urgency system has given this an enormous boost. In practice risk evaluation or risk assessment covers a broad variety of activities. On the whole, one or more of the following aspects is usually involved:
- the quantifying (or qualifying) of *exposure* (for example an exposure model such as HESP or Csoil);
- the *comparison* of exposure to threshold levels (TDI values, TCL values, MAC values, etc.);
- the description of *health effects* as a result of exposure;
- *comparison* of soil concentrations with threshold levels (intervention values, HC50-values etc.);
- the *prediction* of transport processes (dispersion);
- the *communication* of the results.

The steps that are carried out depends on the aim of the risk assessment and the level of knowledge of the person carrying it out. A number of aspects have been established in detail as part of *policy decisions* (for example adding up substance groups for the urgency system), while for example when working out a risk assessment at the request of a residents' association, the risks predicted by models and assessed for policy purposes have to be *converted* into detrimental effects.

These different objectives each result in their own specific bottlenecks which may arise in different areas of expertise.

The project 'to inventory bottlenecks when assessing the risks of soil pollution' implemented as part of the Netherlands Integrated Soil Research Programme, presents an overview of the different objectives being aimed at in practice in implementing risk assessments and the relevant actors involved. This can also be seen as the framework for the desired knowledge infrastructure. A brief overview is also given of the foreign developments.

The *objective* of the project is to obtain a picture of the present state of the art in the domain of risk assessment in the Netherlands to arrive at an underpinned and widely supported overview of *bottlenecks* and suggestions for *possible solutions*.

To get a good impression of the main problems it is important to exchange thoughts on this subject with numerous actors (the list is not exhaustive, the subdivisions are not rigid):
1. implementary bodies: consultants;
2. assessing bodies: local authorities, provincial authorities, Ministry of Housing, Spatial Planning and the Environment (VROM), Institute for Inland Water Management and Waste Water (RIZA), the local health authority (GGD), National Institute of Public Health and Environmental Protection (RIVM), Technical Committee on Soil Protection (TCB).

3. developing bodies: National Institute of Public Health and Environmental Protection (RIVM), universities, knowledge institutes, consultants.

This document is a framework for the talks that take place in the months of March, April and May. The framework seeks to give some structure to the talks so that they can be systematically processed. It is by no means the idea that all the subjects mentioned should be discussed. Nor that no other subjects can be added. Perhaps it is useful to evaluate a specific case and discuss the bottlenecks that have arisen.
Questions that might crop up are given in the next chapter.

QUESTIONS FOR INTERVIEWS

Positioning of respondent

Name, training, post, field of attention.
In what capacity are you involved in 'risk assessment'?

Role of risk assessment in decision-making

What is the aim of risk assessment?
For whom is the risk assessment being carried out?
At what stage of the survey is risk assessment carried out?
When is a statement made?
What decisions are supported by this?
What role do you play in this?
What are the requirements with regard to the set up/implementation in relation to decision-making, what is decided, what is free?

Definition 'Risk assessment and actual risks'

What are the components of a risk assessment and in relation to which goal?
When is reference made to 'actual risks'?

Human toxicological risk assessment

source

What (input) data are used to characterise the source of the soil pollution?
How is the representative soil concentration determined (dealing with monitoring data, heterogeneity, etc.)?
How are soil, ground water and soil air measuring values used?

path

What exposure paths are considered?
What calculating methods are used for this?
Do you use models?

object

For which objects is the human toxicological risk assessment carried out (child, adult, life-long average scenario)?
What exposure data are used?
What time-scale is covered by the risk assessment?
Is account taken of the group size of the objects?

Toxicological assessment

What threshold levels are used (TDI, TCL, MAC)?
Do you make a distinction between carcinogenic and non-carcinogenic substances?
Do you make statements on health effects if threshold levels are exceeded?
Do you ever make a recommendation for a population survey?
Who carries this out. What additional data do you use (when, why, how)?

Ecotoxicological risk assessment

Under what circumstances do you assess the risks to the ecosystem?
What aspects do you evaluate when making an ecotoxicological risk assessment?
How do you assess the risks for the ecosystem?
How do you make the link between soil quality and the potential of an ecosystem to develop?
What is the relationship between individual species and the ecosystem?
Do you use monitoring of risks for ecosystems?
Do you bear in mind the change in soil quality over time?

Dispersion of pollution

Does dispersion constitute a fixed part of the risk assessment.
How do you define the dispersion risk: risk as a result of dispersion or risk that dispersion occurs?
How do you check the dispersion occurring or predicted?
What timespan has to be considered?

Other risks

Which other risks do you include in the risk assessment:
working conditions
risks of remediation activities
other?

<u>Options</u>

Do you bear in mind future scenarios or potential use of the site in the risk assessment?
Do you bear in mind background exposure?
How do you handle the presence of several contaminants?
How extensive is the risk assessment, 'quick and dirty' or 'as complete as possible'.
What are the costs of a risk assessment?
When do you recommend that additional measurements be taken?
How do you deal with discrepancies between calculated and measured values?
Do you use risk assessments for setting priorities?
Are there suggestions for improving the method?
Are there examples known to you of cases in which wrong conclusions have been drawn?

Communication

For whom is the risk assessment intended in the first instance?
What other parties involved can be identified?
Are all the interested parties informed in the same way?
What other information/supplementary information is provided?
Who is responsible for communicating the results?
Is there feedback with reference to any responses with those involved and those carrying out the assessment?

Final conclusion

What do you perceive as being the main bottlenecks?
What research ought to be carried out in your opinion to solve these bottlenecks?

APPENDIX 2. PERSONS CONSULTED

Ministry of VROM/DGM	C. Denneman
Guidance Committee	Dr. J.J. Vegter
Province of Gelderland/ Association of Provinces (IPO)	C. Beurmanjer
Province of Overijsel	A. Grinwis
VNG	D. Moet
Milieudienst Amsterdam	F. van Hage
GG&GD (local health authority) Amsterdam	Dr. J. van Wijnen T. Fast
RIMH Utrecht	A. van Breemen
RIVM	Dr. F.A. Swartjes E. Soczo
TNO MEP (Apeldoorn)	D. de Weger
TNO (Den Helder)	Dr. M. Scholten
RIZA	C. van de Guchte
Agricultural University Wageningen	Dr. S. van der Zee
Grontmij	J. Wezenbeek
Iwaco	J. Tuinstra
Witteveen en Bos	G.J. van den Munckhof
Tauw Milieu	Dr. R.M. Theelen
Stichting Nederland Gifvrij	H. de Baas
Shell Internationale Petroleummij	Dr. W. Veerkamp

Guidance committee:

Province of Gelderland/IPO	Th. Edelman
Vrije University Amsterdam	Prof. N.M. van Straalen
RIVM	R. van den Berg

APPENDIX 3. SET-UP OF THE DISCUSSION IN SUBGROUPS

Subgroup 1: Technical bottlenecks for which further research and coordination of research is necessary

Bottleneck	Is this a bottleneck?	Is it important?	Possible solution	Potential?	Alternatives
Human					
Interpretation of soil survey data (3.1.1):			drawing up risk checklist		
dynamics					
scale					
time					
measurement					
protocols			programme of requirements air and crop measurements		
Transformation to exposure (3.1.2):					
household dust					
ambient air			household dust measurements		
cyanide, mercury			research		
lead			research		
mineral oil			working party toxicology		
.....					
.....			working party mineral oil		
Interpretation (3.1.3.):					
time - TDI					
background					
combi-tox			tox. working party		
matrix effects			tox. working party		
macroparameters			tox. working party		
effects public health			research		
			research		
coordination of threshold values			local health authority communication		
.....					
.....			tox. working party		
Ecotoxicological (3.2)					
partition theory vs internal dose			research		
application of bio-assays			exchange of research experience sediment, soil		
......					
Dispersion (3.3)					
Simplification of the dispersion module			Application of existing models to estimate dispersion for heterogeneity, dispersion, decomposition etc.		

Subgroup 2: Conceptual bottlenecks for which coordination among diverse decision making levels must take place

Bottleneck	Is this a bottleneck?	Is it important?	Possible solution	Potential?	Alternatives
Human					
Acceptance of application of risk approach when defining remediation measures (risk-steered remediation)			Harmonisation points of departure risk-driven remediation in platform policy decisions		
Working definition and active soil management: current intended use vs. future use			registration of points of departure for risk assessment: link to rental agreement, perpetual clause		
......					
......					
......					
Ecotoxicology					
Role of ecotoxicology in risk assessment of dry land soils: intrinsic value or value for use ?			ecotoxicology working party in the event of soil pollution (exchange of sediment and soil)		
Weighing of risks of pollution versus risks of remediation measures			ecotox. working party		
Dispersion					
Stand still principle versus 'MPC'-dispersion			working party on dispersion risks in the case of soil pollution		

Subgroup 3: Communication and organisational bottlenecks

Bottleneck	Is this a bottleneck?	Is it important?	Possible solution	Potential?	Alternatives
Allocation of roles of parties involved			Regular consultation by representatives of parties		
Quality guarantee					
supply side			second opinions 'ring' survey		
receiving end			monitoring checklist monitoring-training notification - compulsory advice Local health authorities		
Exchange of knowledge					
experts - experts			information network risk assessments		
experts - non-experts			lay person's summary training communica-tion for risk communication		

APPENDIX 4. ACRONYMS

ALARA principle	As Low As Resonably Achivable
BSB	A Dutch programme for the soil remediation of active industrial sites
Csoil	the exposure model used as a standard in the Netherlands
HC_{50}	measure of the percentage of a species that suffers effects as a result of exposure to pollutants
HESP	human exposure model
ICM	isolation, control, monitoring
LAC	agricultural threshold value
MAC	maximum tolerable concentration
MPC	maximum permissible concentration
MTR	maximum permissible concentration (the acronym is Dutch
NISRP	Netherlands Integrated Soil Research programme
NOBIS	Netherlands research programme on biological in situ remediation
POSW	research programme on the remediation of contaminated sediments
PR4 score	score in priority system (BSB)
RIMH	Environmental inspectorate: regional Office
RIVM	National Institute of Public Health and Environment Protection
T-value	mean of target value plus intervention value
UMS model	exposure model used in Germany
SUS	an exposure model
TCL	permissible air exposure value
TDI value	toxicological standard: daily or weekly intake of a toxin
Wbb	Soil Protection Act