ADAMAS ENVIRONMENTAL INC.
AND
ANACAPA CONSULTING SERVICES

REVIEW AND COMPARISON OF:

A PROTOCOL FOR THE DERIVATION OF ECOLOGICAL EFFECTS-BASED AND HUMAN HEALTH-BASED SOIL QUALITY CRITERIA FOR CONTAMINATED SITES (JULY 1993) CANADIAN COUNCIL ON MINISTERS FOR THE ENVIRONMENT, SUBCOMMITTEE ON ENVIRONMENTAL QUALITY CRITERIA FOR CONTAMINATED SITES

AND

A RATIONALE FOR THE DEVELOPMENT OF SOIL, DRINKING WATER, AND AIR QUALITY CRITERIA FOR LEAD (OCTOBER 1993) INCLUDING REFERENCE TO SCIENTIFIC CRITERIA DOCUMENT FOR MULTI-MEDIA ENVIRONMENTAL STANDARDS DEVELOPMENT (MARCH 1994) HAZARDOUS CONTAMINANTS BRANCH, ONTARIO MINISTRY OF ENVIRONMENT AND ENERGY

Prepared for:

Research Division,
Canada Mortgage & Housing Corporation
Project Officer: Philip Deacon

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June, 1994

Disclaimer

This study was conducted by Adamas Environmental Inc. and Anacapa Consulting Services for Canada Mortgage and Housing Corporation under Part IX of the National Housing Act. The analysis, interpretations and recommendations are those of the consultant and do not necessarily reflect the views of the Corporation or those divisions of the Corporation that assisted in the study and its publication.

Adamas Environmental Inc. of Nepean, Ontario is a multi-disciplinary consulting firm that specializes in environmental and geotechnical services. The staff includes professional engineers, hydrogeologists and scientists, encompassing a wide range of field, technical and management experience. Adamas Environmental has developed its own innovative procedures and practical technologies to facilitate the assessment and remediation of contaminated sites.

Anacapa Consulting Services is a small Ottawa-based firm. Its partners, J. Ann Hewitt, Ph.D. and Richard R. Hauge, M.Sc. are qualified in the fields of sociology, environmental psychology and health sciences (environmental and occupational health) and have many years of experience with government and private sectors in Canada and internationally. Anacapa Consulting specializes in projects requiring an understanding of the relationships among and between science, technology, the environment and society. The firm has successfully created multi-disciplinary teams capable of solving complex environmental and management problems.

EXECUTIVE SUMMARY

Two documents dealing with clean-up standards (quality criteria) for contaminated sites were issued for comment.

a) a generic protocol for deriving soil quality criteria, issued by the Subcommittee on Environmental Quality Criteria for Contaminated Sites - Canadian Council of Ministers of the Environment (CCME).

b) a proposed quality criterion for lead in Ontario soils, issued by the Advisory Committee on Environmental Standards - Ontario Ministry of the Environment and Energy.

The review critiques each of the consultation documents from the perspective of the housing sector, with a special emphasis on soils in urban centres. For each document, the review, (a) summarizes the rationale in layperson's terms, (b) identifies the relative strengths of the arguments of which it is comprised and (c) identifies other limitations such as: exclusions from scope, errors of omission, and simplifying assumptions.

The review goes on to assess the rationale and the limitations for appropriateness from the viewpoint of the housing sector, including flexibility to deal with different building forms and systems and predictability of costs and work required.

Finally, the report compares derivation methods contained in the documents.

Findings

a) For the draft protocol issued by CCME

The review found that if generic criteria were to be developed according to the proposals in the draft protocol, the likely result would be more restrictive and less equitable standards than today. The method of developing criteria would not lead to a more predictable situation for builders and developers, and would likely be a greater disincentive to the development (and hence, clean-up) of contaminated sites.

The review noted several flaws or weaknesses in the protocol's rationale. They included: sweeping categories of "land use" as the means of defining exposures and levels of clean-up; the attempt to derive generic criteria in isolation from site-specific circumstances - contrary to the realities of the development industry, and in spite of the awkward framework it poses for the estimating of effects on human health; the attempt to be fully comprehensive in an area where data are limited (and hence too much reliance on conservative estimates is applied at every stage of derivation.)

The protocol is almost exclusively focused clean-up of already contaminated sites and has no emphasis on the prevention of future pollution.

b) For the proposed lead guideline issued by Ontario

The review found that the proposed criterion was unclear in its purpose. While it would be formally part of the "decommissioning" regulations for industrial land, it is acknowledged that other parties may use the decommissioning guidelines for their own purposes, e.g. minimizing risk in a property purchase.

The proposed criterion is inflexible and cannot deal with site specific cases. It is easy to conceive scenarios where the assumptions behind the criterion are clearly unrealistic. Although the rationale for the soil lead levels refers to types of land-use, the health effects documentation on which it is based does not and there is an artificiality in the blending of the two.

In trying to move directly to exposures through categories of land-use, alternative approaches to dealing with risks do not get taken into account. The only remediation methods recognized are soil removal and soil treatment. Engineered solutions are not considered. Neither is the option given to manage the risk from lead in soil, in spite of the fact that for dealing with lead in water, and for existing housing, techniques for management of risk are considered entirely appropriate.

The rationale also states that the most effective means of addressing health risks of lead is through concerted education programs. No program is proposed and no cost-benefit analysis comparing education and soil removal is attempted.

c) For the comparison

The major difference between the two documents in terms of derivation methodology, is that the CCME protocol uses an approach based on risks to human health and ecology, while the lead rationale is based solely on health concerns. In terms of the application of the criteria, it appears that the Ontario lead rationale will be more restrictive vis-à-vis housing development.

RÉSUMÉ

On a distribué deux documents traitant des normes en matière d'assainissement (critères de qualité) afin qu'ils soient examinés.

a) un protocole général relatif à l'établissement de critères de qualité, publié par le sous-comité sur les critères de qualité environnementale des lieux contaminés du Conseil canadien des ministres de l'environnement (CCME);

b) une proposition de critère de qualité relatif à la présence de plomb dans les sites en Ontario, publiée par le Comité consultatif des normes environnementales du ministère de l'Environnement et de l'Énergie de l'Ontario.

L'examen porte sur chacun des documents de consultation, en fonction du secteur de l'habitation, et insiste particulièrement sur les terrains des centres urbains. Pour chaque document, l'examen a) résume le principe de base en termes prophanes; b) indique les points forts des arguments présentés et c) détermine d'autres limites comme les éléments exclus, les omissions et les hypothèses de simplification.

L'examen évalue également le fondement et les restrictions du caractère opportun des documents du point de vue du secteur de l'habitation, y compris la flexibilité par rapport aux divers types et systèmes de construction et à la possibilité de prévoir les coûts et les travaux requis.

Enfin, le rapport compare les méthodes d'établissement des critères proposées dans les documents.

Résultats

a) Ébauche du protocole du CCME

L'examen révèle que si les critères généraux étaient établis en fonction des propositions contenues dans l'ébauche du protocole, il en découlerait des normes plus restrictives et moins équitables que celles qui sont actuellement en vigueur. La méthode relative à l'établissement des critères ne faciliterait pas les prévisions pour les constructeurs et les promoteurs et serait probablement une source de démotivation plus grande pour l'aménagement (et donc la décontamination) des sites contaminés.

L'étude a relevé plusieurs défauts ou faiblesses dans le raisonnement du protocole, dont des catégories péremptoires d'«utilisation des terrains» comme moyen de définir le potentiel d'exposition et les niveaux de nettoyage; la tentative d'établir des critères généraux qui ne tiennent pas compte des caractéristiques propres aux sites et vont à l'encontre des réalités du secteur de l'aménagement, en dépit du cadre inadéquat que cela signifie pour l'estimation des répercussions sur la santé humaine; la tentative d'exhaustivité dans un domaine où les données sont limitées (par conséquent, toutes les étapes de l'établissement des critères sont trop basées sur des estimations prudentes).

Le protocole traite presque exclusivement du nettoyage des sites déjà contaminés et non de la prévention de la pollution.

b) Ligne de conduite sur le plomb présentée par l'Ontario

L'étude révèle que le but du critère proposé n'est pas clair. Bien qu'il doive faire officiellement partie des règles de désaffectation relatives aux terrains industriels, il est souligné que d'autres parties pourront utiliser les lignes de conduite de désaffectation à leurs propres fins, p. ex. pour réduire au minimum les risques au moment de l'achat d'une propriété.

Le critère proposé est rigide et ne peut être adapté à des sites particuliers. Il est facile de concevoir des scénarios où les hypothèses sur lesquelles repose le critère sont clairement irréalistes. Bien que l'on y indique que la teneur en plomb du sol soit liée aux types d'utilisation des terrains, la documentation quant aux effets sur la santé n'en fait pas état, et il y a un manque de naturel dans la combinaison des deux.

En tentant d'aller directement au potentiel d'exposition en fonction des catégories d'utilisation des terrains, on laisse de côté des solutions de rechange traitant des risques. Les seules méthodes d'assainissement reconnues sont l'enlèvement et le traitement du sol. Les solutions scientifiques ne sont pas envisagées. On ne tient également pas compte de la possibilité de gérer les risques que présente le plomb dans le sol, malgré le fait que pour l'eau et les habitations existantes, les techniques de gestion des risques conviennent tout à fait.

Le raisonnement indique également que les programmes d'éducation concertés constituent le moyen le plus efficace de s'occuper des risques pour la santé. Aucun programme n'est proposé, ni aucune analyse coûts-avantages comparant l'éducation et l'enlèvement.

c) Comparaison

La différence principale entre les deux documents, en ce qui a trait aux méthodes d'établissement des critères, est que le protocole du CCME utilise une façon de procéder basée sur les risques pour la santé humaine et l'environnement, alors que la ligne de conduite sur le plomb ne tient compte que des questions de santé. En ce qui concerne l'application des critères, il semble que la ligne de conduite sur le plomb de l'Ontario soit plus restrictive pour l'aménagement résidentiel.

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INTRODUCTION

This document provides a review and comparison of (a) the Canadian Council of Ministers of the Environment (CCME) Draft Protocol for the Derivation of Ecological Effects-Based and Human Health-Based Soil Quality Criteria for Contaminated Sites, and (b) the Ontario Ministry of Environment and Energy's Rationale for the Development of Soil, Drinking Water and Air Quality Criteria for Lead, including the Scientific Criteria Document supporting that Rationale.

The documents are of importance to the housing sector in general because the costs of developing housing on old industrial lands are often governed by environmental standards. They are also of direct interest to CMHC because of the Corporation's policies insuring mortgage loans for properties with contamination. It is presumed that the standards contained within the two documents will be changed as a result of the issuance of the Protocol and the Rationale. CMHC is also the federal housing agency and conducts housing-related research on issues such as sustainable community development and housing technology. Recently, the rigour of standards for the clean-up of contaminated sites has reached the level of public debate.

For those reasons, CMHC decided to commission a review of the Protocol and Rationale, a review that was conducted from the general perspective of the housing sector. The following pages review each of the documents and provide a comparison of their key points and implications.

ENVIRONMENTAL CONTEXT

Societal response to contaminated soils and clean-up procedures is symptomatic of the extent to which the environmental area is buffeted by seemingly limitless interests. These interests are often presented in reasonable, understandable, valid and valuable fashion and taken alone are very persuasive. However, when taken in context, the area is one of increasingly competitive interests. Our decision-makers find themselves in situations where determination of the common good is not easily achieved and where consensus may not be achievable. With respect to soil contamination and housing, a variety of factors must be taken into account in any decision-making process:

- Canada's Green Plan specifically recommends a reduction in urban sprawl and the utilisation of vacant land. Much of that land has a history of industrial use and contains toxic elements.
- The concept of sustainable development has been adopted by all levels of government, including CMHC, requiring decision-makers to ensure that today's decisions facilitate the health and prosperity of future generations.
- Our economic and geographic proximity to the United States affects our definitions of what is and what is not acceptable in terms of exposure to toxicity.
- Federal, provincial and local governments are actively involved in encouraging the development of green industries, including but not limited to firms specialising in soil remediation. While there may be no conflict for an individual firm, the fact is that one sector of Canada's business community is pushing for increasing regulations as the "engine" of their sectoral growth, while another sector (the housing and development industry) is pushing for reductions.

- Housing developers are calling for the reduction and softening of regulations, to allow more flexibility and ultimately the development of more housing stock.
- Canada's recession has reduced the supply of money for housing development and has resulted in reduced profits for businesses involved in the housing industry at a time when their contribution to affordable housing is badly needed..
- Canada's industrial nature is changing, as is our concept of downtown. The costs associated with clean-up of downtown cores may be transparent to those who do not live in the areas, but who use them for employment and recreation.
- Changes to Canada's demographic structure and to the geographic distribution of population have resulted in changes to housing demand and the need for new types of housing. The ways in which housing developers meet those demands and needs must be modified, at a time when environmental regulations stipulate extensive pre-development work, resulting in increased costs.
- Media attention to environmental contamination may result in less than complete information being provided to the public about the nature of soil contamination and the levels of effort required to clean that soil.
- Canadians are becoming increasingly aware of environmental sensitivities and government programs have been developed to assist them with the removal of environmental irritants

REVIEW OF "A PROTOCOL FOR THE DERIVATION OF ECOLOGICAL EFFECTS-BASED AND HUMAN HEALTH-BASED SOIL QUALITY CRITERIA FOR CONTAMINATED SOILS", CANADIAN COUNCIL ON MINISTERS FOR THE ENVIRONMENT, SUBCOMMITTEE ON ENVIRONMENTAL QUALITY CRITERIA FOR CONTAMINATED SITES JULY 1993

INTRODUCTION

In July 1993 a Subcommittee of the Canadian Council of Ministers of the Environment (CCME) issued a Draft Protocol for the Derivation of Ecological Effects-Based and Human Health-Based Soil Quality Criteria for Contaminated Sites. In all likelihood and in most cases, the results of the process outlined in the Draft Protocol will result in more stringent clean-up requirements of contaminated lands. This section of the report provides:

- an introduction to the Draft Protocol
- a brief summary of the status of soil assessment and remediation
- a summary of the document's key points, and
- a review of the document.

The CCME is a body of federal, provincial and territorial ministers responsible for the environment. In 1989, in response to growing public concern over issues relating to the environment and health, the CCME established a new program aimed at the clean-up of contaminated sites in Canada. The **National Contaminated Sites Remediation Program** (NCSRP) is based on a "polluter pays" principle and was designed to promote:

- the assessment of contaminated sites according to their potential adverse impacts on human health and the environment, and
- the removal of unwanted chemical substances or hazardous materials from the environment.

The program includes federal, provincial and territorial funds (on a 50/50 cost-shared basis), to be used for technology development and demonstration ($50 million) and, when no specific polluter can be identified, for "orphan site" remediation ($200 million). Orphans are contaminated sites where the owner or responsible party cannot be identified or is financially unable to carry out the work.

After a series of consultation workshops held in 1990, the CCME issued the 1991 "Interim Canadian Environmental Quality Criteria for Contaminated Sites". The philosophy upon which the criteria were based was defined as follows:

> *to encourage remediation to the lowest level practicable in consideration of the intended land use and other factors, such as technological limitations.*

The Interim Criteria included numerical values for the assessment and remediation of water and soil for three categories of land use: agricultural; residential/parkland; and commercial/industrial. Remediation values were based on those already being used in Canada, including those adopted by British Columbia, Alberta, Ontario and the Government of Canada as part of its Water Quality Guidelines. The criteria were portrayed as benchmarks, to

be used as indicators of a specific site's environmental quality, and for guidance on site investigation, risk assessment, risk management and acceptable site remediation. The criteria were also designed to assist in the establishment of site-specific remediation objectives and as "the basis for the development of legally enforceable standards". In adopting the criteria, the CCME stipulated that many of the numbers lacked a complete supporting rationale, and that a methodology for the assessment of criteria was to be established. The Draft Protocol is that methodology, as it relates to the remediation of contaminated soil.

Work on this Protocol was overseen by the CCME's Subcommittee on Environmental Quality Criteria for Contaminated Sites. The Subcommittee is chaired by a representative of the Ontario Ministry of the Environment, and includes members from New Brunswick's Department of the Environment, Quebec's Ministere de l'Environnement, Environment Canada, Alberta Environment, the B.C. Ministry of Environment, Lands and Parks, and Health Canada.

ENVIRONMENTAL MANAGEMENT: SOIL ASSESSMENT AND REMEDIATION

Under current practices, the extent and content of site assessments are determined by the individual site manager through a balance of technical, regulatory and budgetary constraints. This invariably results in the generation of site specific assessment plans based on the stringency of generic criteria. In addition, further variability is introduced through the divergent expectations of individual environmental officials, based on their own individual experiences, expectations and interpretations of the established criteria. As a result, the environmental management process lacks a consistency of approach and is subject to inequitable application of criteria.

As is the case with site assessments, the evolving trend in site remediation practice is towards a cost versus risk approach to the management of non-compliant soils. Site remediation plans developed for a non-compliant site provide varying levels of receptor risk protection, at varying costs. The remediation plan which is ultimately adopted attempts to strike the best balance among cost, future receptor risk and regional regulatory expectations.

Fundamental components of any environmental management process are the methods which are used to determine a site's compliance and to bring non-compliant sites into conformity. The criteria which are to be developed are only as good as the assessment protocol established to judge an individual site's compliance with those criteria.

SUMMARY OF PROTOCOL

The Proposed Protocol is an effort by the Canadian Council of Ministers of the Environment (CCME) to address the growing public concern over the potential ecological and human health effects associated with exposure to contaminated sites. The CCME is not alone in this effort, since the U.S. and Western European countries have also been engaged in standards development vis-à-vis contaminated sites. The proposed Protocol attempts to bring together traditional human health effects considerations with more general environmental or ecological-effects considerations to develop all encompassing and all protective soil criteria. It has been developed in order to ensure that the methodology for establishing contaminant levels is carried out in a consistent and scientifically defensible manner. Contaminants include both a vast array of chemicals such as petroleum products (e.g., gasoline) and heavy metals (e.g., lead).

Of paramount importance for the Protocol's derivation of criteria are three categories of land use: agriculture, residential/parkland/commercial and industrial. The method considers the effects of contaminated soil exposure on human and ecological life forms for each of the three land uses. They are also being developed in a manner which considers three main components: "Protection of ecological receptors, protection of human health and protection of groundwater as drinking water".

The basic way in which criteria will be developed is through the combined determination of effects on human health and effects on the ecological system. In working through the methodology, it is expected that scientists will follow two "paths": they will (a) determine human health impacts of contaminants and (b) determine ecological effects of contaminants. The more conservative (that which affords most protection) of the two results will be used in setting numeric values for adoption and implementation.

The determination of ecological effects is based on the following guiding principle: to ensure maintenance of important ecological functions that support activities associated with the land uses identified above. The Protocol proposes to use acceptable scientific data to determine contaminant levels that may result in damage to a variety of organisms, ranging from plants to micro-organisms to livestock to birds. There are three ways in which that contaminant damage is calculated. The first involves quantification of direct soil contact, in other words earthworms have "skin" contact with soil and absorb some of the contaminants in that soil. The second is the ingestion (or eating) of soil containing contaminants. For example, chickens require gravel for digestion. The third method of calculating contaminant damage is through the quantification of food ingestion. For example, a cow eating grass is also eating contaminants that have been absorbed into the grasses through the plant growth process. The lowest value of the three methods is used to identify levels above which contaminant ingestion is dangerous or unhealthy to the organism. Based on that allowable ingestion, allowable soil limits are defined.

While this may seem relatively straightforward, there are limitations to its application. These include lack of data upon which to calculate levels; the extent to which assumptions are incorporated into the process; a simplified characterisation of soil types; the questionable application of test data from one species to another. These limitations are recognised by the Protocol drafters, and may result in inaccurate conclusions and soil clean up criteria that are more or less stringent than necessary.

The human health based portion of the document involves three basic steps, based on identifying potential pathways of contamination: The first is to assess the risk posed by a chemical or heavy metal and to calculate the maximum tolerable amount for a person. The second is to determine a normal, or "background" level of exposure, in other words, what we would anticipate finding in humans regardless of exposure to specific contaminated sites. The third is to determine how much clean up of soil is required to bring levels down to such a point that humans are no longer at additional risk from contaminated sites or do not exceed the tolerable amount. The guiding principle behind these three steps is that human beings should be exposed to negligible risk, regardless of the source of that risk.

After the researcher has established (a) the acceptable contaminant value for soil based on the human health approach and (b) the acceptable contaminant value for soil based on the

ecological effects approach, the more conservative (i.e., protective) of the two numbers will be adopted as the final criterion for that particular metal or chemical.

The Protocol provides examples of the criteria derivation method for two materials: cadmium, a heavy metal and pentachlorophenol, a chemical.

Naturally, this summary is a simplification of the process since a number of logical and empirical checks are built into the methodology; nevertheless, it is a brief introduction to the way in which the CCME proposes to define to what extent contaminated soil must be cleaned.

COMMENTS ON DRAFT PROTOCOL

Overall Goals and General Comments: Despite the Protocol's need to recognise both ecological and human health principles, it is appropriate to conclude that the overall goal of the document is to provide a method or procedure for deriving generic criteria. These criteria are acceptable limits of soil clean up so that remediated soil is safe for plants, animals and humans. While this theoretical goal is laudable, the method proposed to meet it is cumbersome. There are flaws in the method, and furthermore, too many simplifying assumptions for it to gain acceptance.

Perhaps the first question the Protocol should have addressed is: what is the purpose of generic criteria? Without question, these criteria should enhance industry's (including housing developers') willingness to initiate the remediation process. This can only be achieved by improving the predictability of clean up costs. In other words, practicality is paramount. The absence of site-specific risk assessment guidelines in this document means that practicality is difficult to achieve.

The ways in which governments can facilitate remediation/clean-up are varied, including the establishment of guiding principles through to promulgation of strict regulations. Regardless of the method adopted, resultant criteria must be firm and fair. They must be firm in requiring that adequate protection of human health and the environment occurs at all remediation sites. They must be fair so that all contaminated sites (and site owners) will be treated consistently. When criteria are firm and fair, the result is predictability. Predictability means that all stakeholders (land owners, land developers, insurance companies, banks, governments, remediation contractors, etc.) can factor the economic and time costs of remediation into their decision making processes.

As the following pages will demonstrate, there is little promise that the Protocol will result in firm and fair criteria, nor will it assist in the predictability of remediation costs. As such, it is not an improvement over the status quo, and may in fact lead to additional regulatory burden and arbitrary establishment of site-specific remediation objectives.

Release of Generic Criteria and Site-Specific Risk Assessment Guidelines: The Draft Protocol does not address risk-based assessment or remediation, nor does it address the methods by which generic criteria may be modified, nor does it identify the circumstances under which criteria-based or risk-based solutions are appropriate. For example, the document states that modification of criteria may be based on physical soil conditions, background contaminant conditions and different exposure pathways, however, the document

gives no direction on when criteria may be modified and when complete, site-specific risk assessment is required.

The CCME proposes to publish a separate set of guidelines on site-specific remediation objectives, to be released in late 1994. At this point in time, public consultation is not being considered for the guidance document. As an introduction to the following summary, it is important for the reader to keep in mind that although **site specific risk assessment** and adoption of **generic criteria** may be treated separately from theoretical perspective, they are considered simultaneously in the applied world of land development, particularly when a decision maker is attempting to determine overall project feasibility and cost.
Site-specific factors include:

- consideration of unusual exposure by specific receptors, that is, by specific plants, animals, human beings, etc.
- the ecological sensitivity or uniqueness of the site, and
- an amorphous category of "other factors", including socio-economics, technological limitations, public perception/consultation and regulatory concerns.

The future document (Guidance on the Development of Site Specific Remediation Objectives) will provide methods for a) modifying generic criteria and b) establishing site-specific risk assessments and resultant objectives. The Interim Criteria provide instructions for both, however, in the 1993 update, they are separate, without explanation. This type of separation means that many of the difficult site specific considerations cannot be addressed in the generic criteria. In addition, public consultation on the Protocol is hobbled, since we are asked to examine half of an administrative and regulatory process. In addition, generic criteria can be characterised as "risk elimination" while site specific decision making often involves active and responsible management of risk. Should the numeric values resulting from the Protocol be excessively arduous, it is likely that almost all development projects will be delayed (or even cancelled) because generic criteria cannot be used.

In its current form, the generic protocol provides only half of what is required to make complete decisions and judgements about contaminated sites and appropriate remediation solutions. Therefore, it is recommended that CCME release site-specific risk assessment procedures and generic criteria simultaneously.

Document Clarity and Rigour: While we may not always agree with the fact that the medium is the message, the Protocol will be an influential document among land developers and government regulators, and will be used as source material in decision making processes. For this reason, the current organisation of the draft document has the potential to muddy issues rather than to clarify them. It appears that there are two entirely separate documents that have been artificially incorporated into one, that is, the ecological effects-based document and the human health-based document. These two sub-documents go so far as to make reference to different guiding principles (the health-based portion of the Protocol provides substantially more detail vis-à-vis beginning assumptions).

If it could be believed that generic criteria will be adopted in most cases, this would not be an issue of concern. The Protocol would be used by CCME Subcommittee scientific staff to develop generic numeric values, and would not enter into negotiation among building and development industry officials. However, since there is great likelihood that many situations

the criteria adopted, there is always decision making surrounding development and clean up. The current approach dictates the acceptable types of decisions and while this may be useful in a pollution prevention scenario, it may eliminate creativity in a clean-up situation.

In a way, the human health effects based portion of the Protocol recognizes that situation, and replaces land use with "critical human receptor". For all categories other than industrial that receptor is a child between 6 months and 4 years, and for industrial land uses it is a "working adult". While this approach moves towards one of richer texture, it needs improvement. For example, with respect to children, we are led to question the fate of children under 6 months and over 4 years (this may be problematic when we examine lead). We are particularly concerned about the assumption that the working adult on industrial land can be exposed to higher concentrations of contaminants: the Protocol does not recognise the demographics of "working pregnant women".

We are recommending that land use designations be radically altered, to be defined by measurable exposure criteria or contaminant pathways, and not vague titles. For example, such criteria could include: a) Surface Cover Distribution (soil and vegetation; impermeable surface (asphalt, concrete, etc.); structures) and b) Proposed Site Activities. This would provide proponents with the flexibility to modify the site cover configuration to create less potential for receptor exposure, particularly with respect to subsurface soils. This type of approach would also allow the Protocol to address depth of soil contamination - an omission which should be of substantial concern to all stakeholders. In addition, this approach would take into account not only the type of land use but the degree of human contact which flows from the use.

Water: Although the protection of groundwater is a fundamental component of all existing and emerging environmental criteria, a much more realistic application of this principle must be reflected in this proposed Protocol. Furthermore, the application of groundwater protection for drinking water purposes as a control mechanism is in conflict with the land use basis for risk and does not reflect the general difference between urban and rural communities (residential, industrial) in Canada. A reasonable use position (which exists but is not applied in Ontario) for the protection of groundwater is much more appropriate and equitable in today's environment. The existing use or expected future use or reasonable potential of the local groundwater system must be evaluated and classified into one of several general categories. Each category is then assigned a specific minimum level of protection or maximum acceptable contaminant level.

Management, Application and Flexibility: The current administrative and regulatory practices for soil remediation have resulted in situations where decisions about contaminant levels and soil clean up standards become part of the overall bargaining process associated with development permits. However, excessive hardening of standards can lead to avoidance of clean up responsibilities, i.e., similar to tax avoidance. The proposed Protocol is likely to result in more restrictive and less equitable residential soil standards than exist today. The absence of risk management considerations such as: vertical contaminant distribution, soil properties and exposure controls, in the Protocol will result in significantly increased housing development costs and an unwieldy management system. Too many site specific considerations will result in a site specific or localised application of the criteria.

will be based on site specific modification of the Protocol, the fact that it is not "user-friendly" is an important limitation to its flexibility.

We can speculate that some of the lack of clarity comes from the fact that large elements of the way in which criteria are to be derived depend on assumptions and inferences. In other words, there are no data to support the conclusions reached. In the absence of data, the Protocol attempts to incorporate all scientific considerations associated with soil criteria development, almost on a "just-in-case" basis.

It would be unrealistic to assume complete empirical support for any set of guidelines or standards: in all cases, regulatory criteria are based on a combination of logic, probability and data. Data, probability and logic generally provide us with decreasing levels of certainty concerning the decisions we are to make. It is difficult to trust the validity of final criteria when they are based on compounded assumptions, inferences and "unavailable data". The resulting unclear direction cannot help but result in the inconsistent application of the criteria, since it will necessarily lead to individual and arbitrary judgements. It is recommended that the Protocol begin by limiting itself to the areas of science which are well understood, allowing for continual evolution as the scientific knowledge base evolves. In addition, the Protocol should introduce an administrative procedure by which the CCME will incorporate that knowledge base into updated criteria.

Reconciliation of Ecological Effects-Based and Human Health-Effects Based Approaches: It is regrettable that the Protocol provides us with no way in which to reconcile the significance of ecological effects with those of human health. For example, page 23 states "...that protection of ecological values is not considered subordinate to human values". Does this imply that human values are subordinate to ecological values? Given this situation, it is not surprising that we also find no guiding light for how we then reconcile our need to protect our environment (human and ecological) with our need to foster responsible and economically feasible environmental clean up and contaminated site remediation.

Ecological Effects-Based Criteria: Unlike the methods established by many jurisdictions, the CCME has adopted a progressive approach to the development of remediation criteria by recognising the importance of the non-human, ecological environment. Such an approach is entirely consistent with Canada's Green Plan and overall objectives of sustainable development. By adopting an ecological approach, the Protocol takes into account many more factors than would be the case in a purely human health-based derivation method.

Although the statement is never directly made, it is inferred that we cannot make any sacrifices with respect to our primary ecology. Nevertheless, page 23 states: "...the maintenance of primary ecological functions is usually required to permit land use activities (**except some industrial processes**). " [Emphasis added]. Therefore, we begin reading the ecological section of the Protocol with questions about what exceptions are available and for what sectors of our economy? Is this consistent with health protection as a guiding principle? Does this exempt industrial applications and not housing ones? Does it exempt certain types of housing projects and not others? The forthcoming section on Land Use continues this line of questioning.

As an overall summary, the ecological effects-based section of the Protocol recognizes the three major pathways for environmental contamination: soil contact , soil ingestion and food.

It also focuses upon the concept of key receptors. There is clear acknowledgement in the document that there is little to no scientific data on the effects of contaminants on organisms whose natural habitat is soil. Because there are no data, it is then assumed that organisms directly dependent on the soil for survival and who come in direct contact with the soil as a function of their life cycle are at greatest threat from contamination. These organisms include: plants; soil invertebrates (e.g. earthworms, beetles, sowbugs), and soil microbes (soil decomposition bacteria).

The Protocol appears to stipulate that key receptors are, in all cases, the lowest form of life, as compared to livestock, mammals and birds. Nevertheless, the Protocol discusses these higher forms of life with respect to ecological effects and suggests that the criteria be based on data derived from experiments conducted on laboratory rates. This generates two comments: a) The Protocol fails to comment on or recognise the difficulty in reaching accurate and reliable conclusions about one species by conducting research on another species, that is, inter-species data are questionable. b) Despite the fact that soil-dependent organisms set the limits for acceptable contaminant criteria, the Protocol devotes substantial attention to organisms that are not directly dependent upon soil. What the Protocol lacks is a reasonable receptor prioritisation mechanism. Since the Protocol will be used for site specific modifications, this is particularly important for future remediation efforts and will avoid situations where remediation experts will be forced to make decisions about whether worms are more important than beetles or if ants are more important than maggots.
We have noted earlier in this review that the Protocol is based upon assumptions, and the derivation methods are also based on assumptions. This is particularly the case for the ecological effects-based formulae. In addition, when there is acknowledgement that no data exist, an additional weighting factor is added to lend even more protection. "When minimum data are not available for a particular method, a measure of conservatism is added to each subsequent method to account for the inherent uncertainties of deriving criteria from a less preferable data set." This approach may lead to criteria that are so cautious as to be restrictive. The Ecological-Effects Based portion of this document appears to forget that the purpose of the Protocol is clean up - naturally we would consider such stringent criteria for pollution prevention purposes, but we also want to ensure that clean up criteria are not so rigid that industry walks away from projects due to unrealistic and prohibitive costs.

Human Health-Based Criteria: Our review of the Human Health-Based Criteria portion of the Protocol leads us to conclude that experts involved in its drafting provide no more than luke warm support for the derivation and application of generic criteria. This may be as a result of substantially more articulated guiding principles, all of which are commendable and all of which are more suited to the development of site-specific risk assessment. For example, criterion number two states that the derivation of numerical criteria necessitates the definition of specific scenarios within which the exposure likely to arise on **the site** can be predicted with some degree of certainty. [emphasis added]. This criterion is far more pertinent to site specific investigations than to generalised standards. In fact, in stating their basic assumptions, the human health portion of the document states: that the establishment of numerical soil quality criteria must be conducted in such a way as to reduce uncertainty, yet p. 58 also states: "no distinctions have been made for differing soil type, or differing soil chemical or physical composition, all of which would be incorporated in a site-specific risk assessment".

In recent years, human health based risk assessment has moved towards the establishment of risk based on multi-media exposure assessment, multi-media meaning food, air, water,

consumer products and soil. The ability to determine the pathways by which contaminants enter the human body has greatly improved the reliability of conclusions about their potential impacts. This Protocol is no exception, and assumes multi-media exposure. It also assumes that exposure in excess of safe levels can arise from all media, not just soils. However, in determining the levels **up to and including** "safe" or "threshold" levels, the apportionment among the various media is based on research; in determining the levels **above** "threshold" the CCME has made a decision to allocate intake equally among the five media. In this case, an arbitrary 20% of excessive contaminant intake is allocated to soil. Clearly, site specific risk assessment would not adopt this type of approach. It is proposed that CCME consider allocating the intake above threshold levels on a basis proportional to the media exposure at levels below threshold.

The health-based portion of the document can be supported in the fact that it "draws the line" on certain carcinogens and mutagens. That is, for certain chemicals/metals the Protocol does not recognise a threshold level, and its application would require the complete cleanup of such substances. While there may be scientific argument about which substances have thresholds and which do not, in 1992 Health Canada clearly delineated those which do not. For the purposes of the Protocol, this clear message provides us with firm and fair guidance.

Although the human health portion of the Protocol references land uses in its derivation method, we conclude that they are an "overlay" and that human health effects documentation does not truly take into account varying land uses. As a result, this approach does not does not take into account the possibility of severing exposure pathways through engineered solutions.

Land Use: It is under the category of land use that we find most of the difficulties with criteria-based as opposed to site-specific risk management. The equal application of ecological-effect and human health-effect considerations for the establishment of soil criteria results in fundamental inconsistencies. Land use is by its nature risk-based. The risks of human exposure are determined by the proposed activities to be undertaken at the site. In addition, the human health portion of the document is based on the pathways of exposure and not on land use.

The categories of land use for the Protocol do not equate with those used in the Interim Criteria. The change is made without comment and no rationale is given for the introduction of new categories. The Interim Criteria listed agricultural, residential/parkland and commercial/industrial as categories. The Protocol provides for three different categories: agricultural, residential/parkland/commercial and industrial. The Protocol fails to explain why the categories were altered, and why commercial was separated from industrial and included within residential/parkland. The overwhelming impression is that the drafters have in mind a semi-rural suburbia when they think of residential. Their concepts seem to have little to do with the concrete and asphalt of high-rise and high density housing in urban core areas. The spectrum of parkland to residential to commercial is extremely broad in comparison with the other simpler categories of agricultural and industrial.

In any case, it may not be realistic to base criteria on land use categories at all, since they are useful for tax designation and zoning purposes, but may be of little use in determining the level to which we must clean our soils. These designations cannot convey the levels of human-ecological-environmental interactions in complex urban environments. Regardless of

In addition to standards, soil levels, etc. there is also the question of how the Protocol and resultant criteria will be administered. As mentioned earlier, the Protocol does not discuss the administrative realm within which it will operate, and provides no guidance for management of clean-ups. Should this Protocol be adopted, there will still be no set of nationally applicable standards for remediating soils. Provincial guidelines prevail. Perhaps someday (in the early 21st century) national standards will be available - in the meantime, industry can anticipate jurisdictional and individual interpretations of regulations, enforcement practices and application. Given this situation, what is necessary for effective remediation? Clear organisational responsibilities and authorities. This is not the current situation. For example, the Protocol states, on pages 6-7: "Remediation objectives will also be modified based on management considerations such as cost, technological feasibility and receptors of concern...Management considerations based on site specific circumstances could allow some modification or adaptation of the generic criteria for the site specific exposure pathways. **The [Subcommittee] expects that provincial jurisdictions will determine the extent of full site specific risk assessment.**" [Emphasis added] Therefore, although criteria are established at federal levels, they are interpreted and modified at provincial levels.

Without the identification of responsible governmental regulators, it is difficult to establish appeal mechanisms or to ensure that criteria modification and/or site-specific risk assessments are equitably applied across the country. In addition, flexible and innovative solutions to remediation problems are impeded. For example, the State of New Jersey has introduced engineering and institutional controls in developing standards for remediation. Engineering controls limit or eliminate exposure to contaminants by controlling the ways in which humans and other organisms are exposed. Institutional controls restrict land use activities for various contaminant levels to maintain an acceptable level of receptor risk. Should the intended land use change so too would the acceptable contaminant level.

Housing and Cost: The cost of cleaning up and building houses on land that contains any contaminant may be so excessive as to be prohibitive. This will result in developers only seeking pristine land, eating up agricultural land and increasing urban sprawl. Not only is the cost direct (i.e., cost of consultants, cost of remediation, monitoring, etc.) but they are also indirect - loss of land value, loss of time, loss of tax revenues to inner city governments, failure of local businesses to thrive. Soil contamination can render land virtually valueless when the cost of clean up exceeds the return on investment associated with development.

The practice of lending institutions has been to require what amounts to "a clean bill of soil health" before they will lend or in many cases renew lending on a unit or building. Any building unable to meet this standard will not be able to be financed or to have its mortgage insured. This practice began with the promulgation of CCME Interim Guidelines, and, in fact, CMHC adopted these guidelines to determine whether property should be insured under the Mortgage Insurance Fund. When private mortgages are available for contaminated sites, they come at a price to the owner/developer and to the subsequent residents. This is particularly troublesome when we consider the need for affordable housing within our city centres.

Unfortunately the Protocol does not concern itself with these important questions, except to state that: "the Subcommittee recognizes that technical, social and economic issues are important to the overall site remediation plan. However, guidance on how to address such issues is beyond the scope of this document These issues, which include: availability of suitable remediation technology, cost of technology, public consultation, and aesthetics of

remediation technology, should be addressed by the agency responsible for the remediation plan." (Protocol, p. 7) These agencies are also left with the responsibility for dealing with community concerns when local background contamination levels exceed environmental clean-up criteria.

OVERALL CONCLUSION RE PROTOCOL

While CMHC may have a particular stake in the outcome of this Protocol, housing developers in general and affordable housing developers specifically may find themselves in an unusual alliance with land developers with whom they are normally in competition. We cannot fully support this Protocol from any perspective - scientific, environmental, health, social or economic, although we recognise the value of attempting to systematise criteria and their application.

In addition, it is regrettable that the Protocol does not provide appropriate disincentive for new contamination and does not provide a warning to those who may consider contaminating our urban soils in the future. In other words, the Protocol should contain stipulations that all contamination which occurs after a specific date shall be remediated to the lowest level achievable through the application of the best available technology in order to remove as much of the discharged contaminant as possible. This could allow for reduction of liability for those persons who are not in any way responsible for past discharges. These individuals conduct remediation to the current cleanup standards and should be able to get determinations that no further action is required with no continuing liability when the government amends the cleanup standards to be more stringent. Such a provision in the Protocol would place risk avoidance where it belongs!

REVIEW OF A RATIONALE FOR THE DEVELOPMENT OF SOIL, DRINKING WATER, AND AIR QUALITY CRITERIA FOR LEAD, HAZARDOUS CONTAMINANTS BRANCH, ONTARIO MINISTRY OF ENVIRONMENT AND ENERGY OCTOBER 1993

In October 1993 the Ontario Ministry of Environment and Energy (MOEE) issued a document (or "Rationale") recommending a revised drinking water objective, soil clean-up guidelines and air quality standards and guidelines for lead. The Rationale primarily deals with risk and policy issues, while a separate document "Scientific Criteria Document for Multimedia Standards Development", issued in March 1994, provides the toxicological assessment for lead and the levels of exposure for people in Ontario. This section of the report provides:

- an introduction to the Rationale;
- a brief summary of the status of soil assessment and remediation;
- a summary of the Rationale's key points and of the document outlining the Scientific Criteria upon which the Rationale is based;
- a review of the document;
- a discussion of the Rationale's approach to situations in which remediation is not undertaken; and
- overall conclusions.

Although this review does not address itself specifically to the questions of air and water, brief comments on the Rationale's treatment of the two pathways are provided.

INTRODUCTION

The Rationale for the Development of Soil, Drinking Water and Air Quality Criteria for Lead was released by the Ontario Ministry of Environment and Energy in October 1993. The document proposes a set of new guidelines for soil, water and air and the levels of lead in those media. The document is based on the risks to health of human beings, i.e., it is not based on ecological risk assessment. In addition to providing specific guidelines for the clean up of soil, it also provides recommendations to individuals to help them minimise their exposure to lead and to agencies that have regulatory authority over paint, food and other consumer products.

The soil guidelines established in the document are intended to be used in the decommissioning of sites, and will be used in conjunction with Decommissioning Guidelines. As such, they will be added to a plethora of regulations and standards used in the field, and do not contribute to a unified, consistent approach to soil remediation. They also do not reflect the draft Protocol issued by the Canadian Council of Ministers of the Environment (of which Ontario is a member) in July 1993.

ENVIRONMENTAL MANAGEMENT: SOIL ASSESSMENT AND REMEDIATION

Under current practices, the extent and content of site assessments are determined by the individual site manager through a balance of technical, regulatory and budgetary constraints. This invariably results in the generation of site specific assessment plans based on the stringency of generic criteria. In addition, further variability is introduced through the divergent

expectations of individual environmental officials, based on their own individual experiences, expectations and interpretations of the established criteria. As a result, the environmental management process lacks a consistency of approach and is subject to inequitable application of criteria.

As is the case with site assessments, the evolving trend in site remediation practice is towards a cost versus risk approach to the management of non-compliant soils. Site remediation plans developed for a non-compliant site provide varying levels of receptor risk protection, at varying costs. The remediation plan which is ultimately adopted attempts to strike the best balance among cost, future receptor risk and regional regulatory expectations.

Fundamental components of any environmental management process are the methods which are used to determine a site's compliance and to bring non-compliant sites into conformity. The criteria which are to be developed are only as good as the assessment protocol established to judge an individual site's compliance with those criteria.

It is intended that the soil levels recommended in the Rationale document be adopted as part of the Ontario Government's "Guidelines for the Decommissioning and Clean-Up of Sites in Ontario" (1989). In other words, the standards will be used when mothballing, partial closure or complete closure of facilities in intended. In practice, the guidelines have also been used when zoning or land use changes occur, as is often the case with the development of urban land for housing purposes. The document also states specifically that "The Guidelines may also be used when industrial and other sites are offered for sale, even if the decommissioning is not involved. Prospective purchases may use the Guidelines to assist in minimising their risk of assuming environmental liabilities when they purchase a site" (Section 4.1).
The Decommissioning Guidelines provide property owners/developers with options for developing clean-up criteria. They are: 1) application of relevant MOEE policies and guidelines [in this case, the guidelines for lead], 2) application of clean-up criteria developed in other jurisdictions, where appropriate; and 3) development and application of site specific clean-up criteria. In all cases, any remediation plans must take into account future land uses of the site and existing or proposed zoning, that is, agricultural, residential, parkland, commercial and industrial. The Guidelines go on to identify the activities associated with actual remediation, including design of the remedial work program and selection of technologies and implementation of the work program. Any "signing-off" by the Ministry does not relieve the proponent of liability, nor does it place any of the responsibility for future environmental problems at the site on the Ministry.

SUMMARY OF RATIONALE AND BACKGROUND DOCUMENT

Summary of Rationale: MOEE, under the Ontario Environmental Protection Act and the Ontario Water Resources Act, is responsible for achieving and maintaining a quality of the environment that will protect human health and the ecosystem. The MOEE chose to review the current limits for lead in ambient air, drinking water, and soil for two main reasons: 1) the ways in which Ontario residents are exposed to lead have changed, and 2) learning/behavioral deficits can occur in young children at levels of exposure previously believed to be safe.

The 1993 Rationale focuses on metallic lead, with a goal of reducing its negative effects on human health. The document provides justification for recommending revised drinking water objectives, soil clean-up guidelines & air quality standards and guidelines, to ensure protection

of human health and the environment. In general, the blood lead levels of concern are based upon research conducted and standards adopted by the United States' Centers for Disease Control. As is the case with the U.S. regulations, the Rationale identifies the group of people most sensitive to the adverse effects of lead as the unborn foetus, pregnant women, and children under the age of 4 years. Lead can cause harm to many bodily systems, heart and blood vessels, central nervous system and brain, kidneys, and blood forming system. Lead is measured in the body by determining the amount of lead in the blood (PbB = blood lead level). Nevertheless, it is deposited in the bones and, even when blood levels drop, it can leach out over a lifetime. Therefore, some of the benefits of reducing blood lea levels in children are reduction in medical and special education costs and prevention of lost productivity over the lifetime of children who have been poisoned with lead. It is estimated that approximately 18,000 children in Ontario may have blood lead levels greater than 10 ug/dL (MOEE level of concern).

The MOEE is working toward lowering blood lead levels in the high risk group, primarily children, to levels below which adverse health effects have been demonstrated. To do so, they have chosen a multi-media approach, focusing on lead exposure from four main routes (media), food, soil, drinking water and air. Each medium has been allocated a percentage of "responsibility" for lead exposure by the individual. These percentages are: soil (64%), food (24%), drinking water (12%), and air (less than 1%).

The document is based upon a series of recommendations (16), for which a rationale is provided. Seven of these recommendations pertain to soil. These guidelines are intended to apply to sites undergoing decommissioning activities and the Rationale will provide new guidelines to be incorporated in the Provinces "Guidelines for Decommissioning and Clean-Up of Sites in Ontario (MOEE,1989). The recommendations are:
Recommendation 1: The revised residential/parkland soil guideline be set at 200 ppm, a value which, based on exposure modelling, will protect the health of children between the ages of six months to four years.

Recommendation 2: The exposure to lead through the consumption of backyard vegetables grown in lead contaminated soil should not be a driving factor for a revised residential/parkland guide.

Recommendation 3: The industrial/commerical decommissioning soil guideline for lead should remain at its present value of 1000 ppm.

Recommendation 4: The agricultural soil criterion for lead should be reduced from its present value of 500 ppm to 60 ppm to protect food crops from lead contamination.

Recommendation 5: The current distinction between coarse and fine-textured soils should be discontinued for lead.

Recommendation 6: Special consideration should be given to ensuring that the levels of lead in covering soil used for community or commercial play areas, like sand lots, baseball diamonds and sand boxes, is limited to the greatest extent possible. Soil quality consistent with rural background soil should be used for these areas wherever possible.

Recommendation 14: Because of the uncertainty in understanding the long term impact on soil resulting from atmospheric deposition, the Ministry, in co-operation with the lead industry, undertake a comprehensive soil monitoring program in the vicinity of industrial point sources of lead where lead has been identified as a concern.

Of primary concern to CMHC at this point in time are the recommended changes in soil clean-up guidelines for lead. These recommendations fall into three categories of land use, as follows:

1. residential/parkland - decreased from 500 ppm to 200 ppm.
2. agricultural - decreased from 500 ppm to 60 ppm.
3. industrial/commercial - no change from the current 1000 ppm.

The Rationale states that the guidelines have been developed based on consideration of several factors, including the need to protect human health and the environment, cost and technical feasibility. It discusses two major categories of soil remediation - removal/replacement and soil washing. Cost projections are based on these two methods of clean-up and are inconclusive.

The MOEE concludes its document by recommending ways to deal with other sources of lead, outside MOEE authority, e.g. lead-based house paint, lead in garden soil, lead in food cans and house-wares and other consumer products.

Summary of "Scientific Criteria Document for Multimedia Environmental Standards Development - Lead": As noted above, the 1993 Rationale document is based upon an in-depth attempt to chronicle the current knowledge on the human health effects of low level lead exposure and to provide a detailed risk assessment of environmental exposures in Ontario.

The document adopts a multi-media approach to risk assessment, considering total exposure from all environmental media, recognising that lead is present simultaneously in food, air, water, consumer products, soil and dust.

A considerable portion of the document is devoted to identifying the human health effects of lead, including its metabolic properties and its neurological, developmental, haematological and geotoxic effects and carcinogenicity and its effects on blood pressure.

Since lead has been demonstrated to have effects at very low levels of intake, the document does not identify a threshold for lead, rather, it identifies an intake of concern for individuals and populations. This intake of concern is regarded as a level which, if applied to the general population, should offer some measure of protection to individual children.

In assessing the extent to which various media contribute to overall blood lead levels, the background document examines epidemiological studies of lead exposure, including those undertaken in Ontario (1984), South Riverdale, Toronto (1982-1992), Northern Ontario (1987) and current research being undertaken in South Riverdale. On the basis of these and other studies, the researchers have derived a model of multimedia exposure. Other models are considered for use in site-specific evaluations of lead exposure.

Based upon a characterisation of risk (focusing on young children and foetuses) an apportionment of exposure is developed, where the relative contributions are as follows:

Food	24%
Drinking Water	12%
Air	<1%
Soil/Dust	64%

COMMENTS ON RATIONALE

Overall Goals and General Comments: It appears to be quite clear that the underlying objective of the MOEE discussion is to lower existing lead levels. The primary thrust of this initiative appears to be Ontario's desire to have the lowest blood lead level of any jurisdiction, for adequately documented reasons. However, the link between achieving that goal and mandating the lowest lead levels in soil is not a strong one. Although elevated blood lead levels have been found to cause negative health and developmental effects in children, the specific contributions, inter-relationships and direct effects from each of the numerous sources of lead impact have not been definitively established. As a result, much of the supporting rationale for revising the existing limits appears to be based on good conscience and not good data.

As a result of their generic application, the guidelines remove our ability to develop site specific risk assessment and thus may discourage creative solutions to the remediation of contaminated sites. Any such solutions must be undertaken in an environment in which budgets for remediation and subsequent housing development are shrinking - the ability to develop less costly solutions would greatly enhance our ability to house those in need. Although the document begins by acknowledging the importance of technological and economical considerations, the text and derivation methodologies give little attention to that "importance".

In general, it is very difficult to contest the philosophical principle that the concentrations of all contaminants present within the natural environment should be reduced. However, much of the necessary science (results, models, methods, etc.) has not reached an acceptable level to support the limits being proposed. This is particularly important when we look at the relationships between blood lead levels and soil lead levels. Naturally we would consider such stringent criteria for pollution prevention purposes, but we also want to ensure that clean up criteria are not so rigid that industry walks away from projects due to unrealistic and prohibitive costs.

Human Health and Multi-Media Exposure: In recent years, human health based risk assessment has moved towards the establishment of risk based on multi-media exposure assessment, multi-media meaning food, air, water, consumer products and soil. The ability to determine the pathways by which contaminants enter the human body has greatly improved the reliability of conclusions about their potential impacts. This Rationale is no exception, and assumes multi-media exposure. It also assumes that exposure in excess of safe levels can arise from all media, not just soils.

Recognising the importance of a multi-media approach, the Rationale and supporting Scientific Criteria document base their media-specific doses on projections and trend analysis from 1985 food data. Since food is an important pathway, considerable attention has been devoted to its contribution to overall ingestion levels. The actual data upon which the values are developed were collected in a 1985 study. Since that time, considerable changes to food processing and packaging have occurred, and it is reasonable to assume that food's contribution to lead ingestion has been reduced. Using the 1985 data, food's relative contribution was 48% and soil and dust was 43%. Based on projections, the values were changed and MOEE now proposes to attribute 24% to food and 64% to soil. In addition, the original value of 48% attributable to food have been questioned vis-à-vis reliability. Therefore, the 1993 numbers hide a number of assumptions concerning the relative contributions of each of the media to lead doses. These doses are directly reflected in the standards established for soil.

Even if one were to accept that the percentages noted above are accurate, and while the general range of values is consistent with other published material, there are problems with its specificity. The table is probably relatively accurate for very young children in areas with low water leads, which may be the target group. However, it does seem to overestimate soil importance for older children and adults, and is completely unrealistic for those in high water lead areas. In the absence of site-specific risk assessment, the guidelines offer the potential to underestimate and overestimate the contribution of lead in soil as a potential toxin, and may hamper education and management efforts in those situations where soil is not a factor.

Although the Rationale references land uses in its derivation method and develops standards based on those land uses, we conclude that they are an "overlay" and that health effects documentation does not truly take into account varying land uses. As a result, this approach does not does not take into account the possibility of severing exposure pathways through engineered solutions.

Relationship between blood lead and soil lead: Without doubt, the goal of reducing lead exposure and thus blood lead levels among Ontario children is a laudable one, with long term individual, social and economic benefits. However, it may be premature to posit direct relationships between levels of lead in soil and levels of lead in blood. Although the Rationale itself does not discuss the findings, the Scientific Criteria document states, on page 65:

> As a result of the complexity of exposures to lead, determining the specific contribution of any particular environmental variable like soil or dust to PbB is extremely difficult. This is further confounded by other significant factors, such as socio-economic status and dietary exposure. ...the numerous variables studied in two Ontario blood lead studies were unable to account for more than 30% of the variations seen in children's PbB. The large number of derivations for the relationship between soil lead and PbB in different studies further reflects the difficulties in determining such associations.

In response to this lack of certainty, the MOEE has adopted a conservative approach: "The principle areas of uncertainty in deriving an intake of concern are in calculating the oral intake which corresponds to the selected blood lead value. There are notable variations in the mathematical relationships derived between oral intake and PbB. The most conservative derived slope is therefore utilised in deriving the IOC [intake of concern]." (p. 55)

Another reservation that we have about lowering the lead in soil guideline is that there is little evidence that this results in lower blood lead levels in children, when soil leads have been lowered by remediation. There have been Cincinnati studies statistically relating soil leads to dust leads to hand leads and thence to blood leads in children. These have usually involved soil lead levels considerably above 500 ppm. Work by Roberts and others suggests that there are far less expensive and more effective measures that can be used to ensure low residential dust lead levels from tracked in dust. Considering that much of the inner-city redevelopment has already been stalled by current soil guidelines, it would seem counterproductive to now add to the complexity and cost of remediating these sites.

Establishment and Correlation of Limits: Although our review primarily examines lead in soil, the rationale does not establish an overall limit or objective for future environmental lead levels. As a result, no correlation is made between contribution or effect of the lead level in one media on that of another. Specifically, no comment is made on the effect of long-term lead deposition resulting from the existing or proposed air limits on the future soil lead levels. This limits the Rationale's ability to identify and prevent future contamination of soil.

Caution and Conservatism: To compensate for the lack of definitive scientific information, the rationale adopts a conservative approach to the establishment of new lead levels. Examples of the conservative and inconsistent rationale that is presented are:

- Establishment of background levels for agricultural soils even though discernible health or environmental effects are not indicated at much higher levels.
- No consideration of the time of exposure.
- Inconsistent use of exposure/risk formulae. In the event that the formula produces a lower concentration than the existing limit then a revised concentration is proposed, with it often being lower than the level calculated (e.g. Agricultural limit). However, in the event that the calculated limit is higher than the existing allowable concentration, no revision is proposed and the existing limit is re-affirmed (e.g. Industrial).

Land Use: Although the Rationale recommends new soil clean-up guidelines for lead for three different land uses, residential/parkland, agricultural, and industrial/commercial, it fails to define these land uses or to identify why they have been grouped (for example, why are industrial/commercial considered as a single category, given their different potentials for exposure.) The Rationale also identifies the most sensitive populations with respect to lead as the foetus, pregnant women (as surrogates of foetal exposure), and children under the age of 4 years. (Page 20). "Health-based standards are derived to protect the most sensitive receptor exposed to the contaminant. This sensitive population may vary with the type of site, depending, for instance, on whether the site is residential or industrial. (p. 29)" Given the focus on the sensitive receptor, the addition of land use categories when stipulating lead levels is questionable, since it is the types of <u>users</u> and not the types of <u>uses</u> that are used to determine risk.

Our comments on specific land use categories and the resulting recommendations are as follows:

Agricultural - Even though health effects in livestock of phytotoxicological effects have not been demonstrated to have resulted from the existing lead levels, the MOEE feels it would be much better if the agricultural soil limit was established at the provincial background level of 60

ppm. The proposed limit is not supported by their own exposure formula, which results in a much higher level. In addition, given their own recognition of the types of technologies available for soil remediation, it is difficult to imagine any site ever being returned to agricultural use once it has been used for even limited residential purposes, since the removal of lead to the required level is prohibitively expensive, if not impossible to achieve.

Industrial/Commercial - The Rationale states, on page 31, that: "For industrial soils, a typical receptor is considered to be an adult worker who only spends a portion of the day exposed to the site." Clearly, this "typical receptor" is assumed to be an adult male. In this case, all of the Rationale's focus on "sensitive receptors" is abandoned, since it is assumed that pregnant women will not be found in industrial or commercial sites.

In addition, the most significant inconsistencies of the MOEE rationale are evident within this section. Although a reasonable exposure scenario is applied and the resulting concentration limit calculation yields a much higher limit than the existing limit (4100 ppm versus 1000 ppm), the existing limit is re-affirmed for no other reason than it has been around for a long time and people are used to it. Furthermore, the rationale for the original limit is neither presented nor discussed.

Based on their own data, there is justification for establishing higher limits for lead in industrial and commercial decommissionings, yet there is also justification (based on sensitive receptors) to lower the level. Both scenarios are ludicrous and demonstrate the fact that generic risk assessment often results in higher than unrealistic application of risks on site.

Residential/Parkland - Both the residential and parkland limits have been developed from an assessment of the health and developmental effects of lead in children between 6 months and 4 years. However, the proposed limits do not recognise the typical surface treatments applied to these distinctive land uses, with sites being considered to be comprised of bare, uniform soil with similar lead concentrations through its profile. This approach clearly presents a far too conservative limit for many significantly different residential land uses, for example, dense urban development (condos) versus rural development. In addition, further deviations from an objective, scientific approach are evident in the recommendation that parkland soil concentrations should approach those recommended for agricultural lands, where possible (recognising of course that the technologies for achieving these goals may not be economically feasible).

Finally, the document deals with a category of "special" land use - Page 14 states, "Special consideration should be give to ensuring that the levels of lead in covering soil used for community or commercial play areas, like sand lots, baseball diamonds, and sand boxes, is limited to the greatest extent possible. Soil quality consistent with rural background soil should be used for these areas whenever possible." That lead level is 45 ppm and may be impossible to achieve.

In any case, it may not be realistic to base standards on land use categories at all, since they are useful for tax designation and zoning purposes, but may be of little use in determining the level to which we must clean our soils. These designations cannot convey the levels of human-social-ecological-environmental interactions in complex urban environments. Regardless of the criteria adopted, there is always decision making surrounding development and clean up. The current approach dictates the acceptable types of decisions and while this

may be useful in a pollution prevention scenario, it may eliminate creativity in a clean-up situation.

In a way, the Rationale recognizes that situation, and replaces land use with sensitive receptor. For all categories other than industrial that receptor is a child between 6 months and 4 years, and for industrial land uses it is a "working adult". While this approach moves towards one of richer texture, it needs improvement. We are particularly concerned about the assumption that the working adult on industrial and commercial land can be exposed to higher concentrations of contaminants: the Rationale does not recognise the demographics of "working pregnant women" and could result in the types of "foetal protection" policies that emerged in the United States, whereby pregnant women were denied maternity benefits.

In keeping with recent MOEE and CCME land use criteria the lead levels proposed have been based on the worst case land use scenario - bare soil with all impacted soil within easy access to children under 4 years. The proposal does not incorporate any consideration of exposure minimisation due to:

- surface cover modifications (grass versus concrete)
- vertical contaminant distribution (deep versus near surface impact)
- soil type (clay versus sand)

As noted above, it is under the category of land use that we find most of the difficulties with the development of generic standards as opposed to site-specific risk management. Land use is by its nature risk-based. The risks of human exposure are determined by the proposed activities to be undertaken at the site. In addition and in reality, the document is based on the pathways of exposure and not on land use.

We are recommending that land use designations be radically altered to match the focus on exposure pathways, to be defined by measurable exposure criteria, and not vague titles. For example, such criteria could include: a) Surface Cover Distribution (soil and vegetation; impermeable surface - asphalt, concrete, etc. - structures) and b) Proposed Site Activities. This would provide proponents with the flexibility to modify the site cover configuration to create less potential for receptor exposure, particularly with respect to subsurface soils. This type of approach would also allow the Rationale to address depth of soil contamination - an omission which should be of substantial concern to all stakeholders. In addition, this approach would take into account not only the type of land use but the degree of human contact which flows from the use.

Treatment of Remediation Technologies: In general, the Rationale does not encourage creative solutions to remediate lead contamination problems. In fact, on page 33 of the Rationale, the following statement about technologies is made: "Technologies that immobilise lead in the soil matrix do exist, but they are not generally used in Ontario and are not considered further." It is difficult to imagine that we will progress in our ability to remediate environmental hazards if we are only willing to consider measures that have been used in our relatively narrow range of geo-political experience. In addition, the omission of new technologies is in direct contradiction to that adopted in the province's Decommissioning Guidelines, (Section 8.1.3): "Technologies selected for undertaking remedial actions at a site should be those that best protect human health and the environment while meeting MOE policies and objectives and satisfying site-specific remedial requirements. Generally, for

example, approaches that include the recycling/reuse and on-site management of wastes will be preferred over other approaches, provided site-specific remedial requirements are also achieved."

The Rational does not acknowledge solutions other than soil treatment or removal. Surely if lead was the only contaminant in excess of MOEE guidelines in a proposed residential site, there are technologies and engineered solutions to reduce the exposure without the very high costs associated with lead removal. In fact, as lead is unlikely to migrate significantly when the soil is no longer disturbed, it might be wise to have a lead clearance guideline applied only after construction is complete, testing those parts of the soil to which occupants are still potentially exposed. These types of considerations are fundamental to the development of realistic standards which contain the necessary flexibility to permit the modification of exposure pathways to suit site specific cost-risk considerations.

Management, Application and Flexibility: The current administrative and regulatory practices for soil remediation have resulted in situations where decisions about contaminant levels and soil clean up standards become part of the overall bargaining process associated with development permits. However, excessive hardening of standards can lead to avoidance of clean up responsibilities, i.e., similar to tax avoidance. The proposed Rationale is likely to result in more restrictive and less equitable residential soil standards than exist today. The absence of risk management considerations such as: vertical contaminant distribution, soil properties and exposure controls, in the Rationale will result in significantly increased housing development costs and an unwieldy management system. Too many site specific considerations will result in a site specific or localised application of the criteria. The absence of evaluation data on the province-wide efficacy of decommissioning guidelines renders it difficult to assess the specific consequences of introducing more stringent, less flexible standards.

In addition, the Decommissioning Guidelines do not provide us with clear appeal mechanisms and do not appear to ensure consistency of application across the province, and flexible and innovative solutions to remediation problems are impeded. For example, the State of New Jersey has introduced engineering and institutional controls in developing standards for remediation. Engineering controls limit or eliminate exposure to contaminants by controlling the ways in which humans and other organisms are exposed. Institutional controls restrict land use activities for various contaminant levels to maintain an acceptable level of receptor risk. Should the intended land use change so too would the acceptable contaminant level.

Housing and Cost: It must be recognised that the proposed revisions are to be incorporated into the existing Decommissioning Guidelines and as such apply only to those sites being proposed for or which are the process of being decommissioned. The lead levels do not represent maximum acceptable standards or trigger levels for clean-up. Therefore, they will not have an immediate effect on existing CMHC interests with respect to mortgage insurance, although their impact on the development of affordable housing on abandoned industrial lands will be almost instantaneous. It is unclear at this time what the effect of the proposed revisions will be on future regulatory initiatives.

Despite the prohibitive costs of the measures identified in the Rationale, alternative technologies are not considered for cost analysis. We question their omission. If such

alternatives can immobilise the lead and reduce health risk at less cost they should be offered as an alternative to expensive remediation methods.

It is likely that the proposed revisions will have a profound effect on the proposed future re-use of abandoned industrial lands for non-profit and affordable housing. As a result, serious consideration should be given to amending the proposal (especially in the area of risk management) to enable these and future initiatives to go forward. The cost of cleaning up and building houses on land that contains any contaminant may be so excessive as to be prohibitive. This will result in developers only seeking pristine land, eating up agricultural land and increasing urban sprawl. Not only is the cost direct (i.e., cost of consultants, cost of remediation, monitoring, etc.) but they are also indirect - loss of land value, loss of time, loss of tax revenues to inner city governments, failure of local businesses to thrive. Soil contamination can render land virtually valueless when the cost of clean up exceeds the return on investment associated with development.

The practice of lending institutions has been to require what amounts to "a clean bill of soil health" before they will lend or in many cases renew lending on a unit or building. Any building unable to meet this standard will not be able to be financed or to have its mortgage insured. When private mortgages are available for contaminated sites, they come at a price to the owner/developer and to the subsequent residents. This is particularly troublesome when we consider the need for affordable housing within our city centres.

There are very high costs associated with this new guideline, which are alluded to in the document. Despite the recognition of prohibitive costs, the Rationale provides no option for **management** of lead in soil, something that is technically feasible with reasonable expenditures and follow-up monitoring. This exclusion is perplexing, given the fact that in-situ management is the Rationale's **major** method for dealing with (a) water and (b) lead pathways outside the legislative realm of the province of Ontario.

"UNREMEDIATED" EXCESSES OF LEAD AND PREVENTION

Although the Rationale stipulates clean-up of sites where land use change is occurring, it does not stipulate that other land be cleaned up to meet new requirements. In fact, the document Page 27 recognizes that "... exceedances of the current 500 ppm criterion are not uncommon in older urban residential areas and that exceedances of the revised standards are anticipated ..." On Page 39 the document goes on to state that: "The background concentration of lead in some urban environments is expected to exceed the revised residential/parkland guideline of 200 ppm because of the many historical used of lead. It should be stressed, however, that this does not mean that these sites now pose an unacceptable risk to human health. The health risk to an individual depends on the degree of exposure to the lead-contaminated soil." The Rationale (Sec. 5) discusses means by which exposure to soil lead can be reduced, including consultation with the medical field, ensuring that children have well balanced diets, teaching children the importance of personal hygiene, and keeping homes clean and free of dust. Interestingly, these management techniques are considered appropriate for already existing housing, regardless of the levels of lead in the surrounding soil, yet in-situ management is not considered at all for residential use after decommissioning. We are forced to ask: If the recommendations given in Sec. 5 are sufficient enough to protect the segment of our population at greatest risk (children in existing housing), perhaps modification of the current clean-up guidelines is unnecessary at this time? We recognize that this would not

move us towards the greater goal of cleaning up past contamination, however, the document does not recognize the incremental ways in which complete remediation must be effected.

OVERALL CONCLUSION RE LEAD RATIONALE

Although the bulk of the Rationale discusses the development of standards for remediation of lead, there are interesting comments about the importance of education and in-situ management of health risks associated with lead. For example, page 12 of the document states: "While environmental standards and guidelines for lead will play a role in reducing exposure in the long-term, the most effective means of addressing the health risks of lead is considered to be through concerted education programs which target areas of high risk and address all potential routes of exposure." Clearly the Province believes that education is an effective way of ameliorating risk from lead, yet substantial funds have been and will be spent in developing and implementing new lead standards. Given limited budgets for affordable housing development, and the siphoning off of those budgets to expensive remediation efforts, we believe a combination of site-specific remediation to reasonable levels and effective education could result in more long term benefits to the public as a whole. If education is one of the most effective means to reduce lead exposure, perhaps more effort should go to education and training and less spent on clean-up of sites of questionable human health risk.

In addition, it is regrettable that the Rationale does not provide appropriate disincentive for new contamination and does not provide a warning to those who may consider contaminating our urban soils in the future. In other words, the Rationale should contain stipulations that all contamination which occurs after a specific date shall be remediated to the lowest level achievable through the application of the best available technology in order to remove as much of the discharged contaminant as possible. This could allow for reduction of liability for those persons who are not in any way responsible for past discharges. These individuals conduct remediation to the cleanup standards that are current today, and should be able to get determinations that no further action is required with no continuing liability when the government amends the cleanup standards to be more stringent. Such a provision in the Rationale would place risk avoidance where it belongs!

AIR AND WATER

While the purpose of this review is to examine the impacts of the soil guidelines within the rationale on urban land development, we also include the following comments on water and air, since they are of some importance in determining overall exposure.

Water: Although we concur with the recommendation to maintain the existing standard of 10 ug/l in drinking water, the recommended actions proposed to achieve this limit are of some concern. Although a variety of measures are proposed to ameliorate the current situation, we recommend that the only logical and likely the most cost-effective action is the institution of a rigorous distribution system repair program.

Our primary concerns with the recommended actions are as follows:

- Flushing is not a solution, but rather a long-term, indefinite control measure. It results in exposure that is difficult to control on an individual (let alone an institutional) basis. We have serious doubts that school maintenance staff are doing early morning five minute

flushes of water fountains, as implied in Recommendation 10. Are there any data to support that this recommendation has been followed? Although it should be promoted as an interim solution until such time as system upgrades can be completed, flushing cannot be considered cost-effective. In fact, it is likely to be the most costly alternative in the long run due to the ever-increasing costs of water treatment. Currently, municipal water bills in Ontario do not reflect the actual water treatment and distribution costs and, given the current fiscal situation, it is unlikely that this situation will persist.

- In encouraging corrosion control (to reduce risk of exposure to lead) the recommendations may actually result in undesirable health effects resulting from other constituents (e.g., bacteria tend to flourish at higher pH levels). There is little information on how increased pH levels will be maintained throughout the water distribution system.

In summary, the Rationale should present a stronger recommendation for the implementation of a rigorous system upgrade program within the schools and other public buildings where water consumption by children is likely to be high.

Air: The 30-day limit for air, from which the 1/2 hour and 24 hour limits are derived, has been developed from the worst case lead levels recorded at the only two (2) secondary lead smelters in the province. The limit of 0.7ug/m^3 was selected because it was expected that both plants could meet this limit rather than developing an acceptable limit from a technical or health risk basis. A more defensible approach might have been to establish an annual limit of acceptable lead deposition which would be protective of human health, from which the corresponding air limits are calculated.

Unlike the soil or drinking water limits, which attempted to develop acceptable limits based on health effects, the air limits were developed directly from air monitoring results. Rather than establish a health-based or technically supported lead level and then evaluate the costs of compliance, the existing system's performance was used to establish the acceptable limits.

COMPARISON OF CCME AND ONTARIO MINISTRY OF ENVIRONMENT AND ENERGY DOCUMENTS

As part of the tasks identified in the terms of reference for this report, the consultants have been asked to compare the derivation methods used by the Canadian Council on Ministers for the Environment (CCME) and the Ontario Government's Ministry of Environment and Energy (MOEE). The most obvious difference between the two is that the CCME document describes a methodology for developing standards, while the MOEE rationale provides the standards themselves. In order to facilitate our comparison, it was necessary for us to refer to the more complex background document upon which the Lead Rationale was based. These lead criteria provide us with some evidence concerning the methodologies utilised.

The second major difference between the two methodologies is that the CCME document uses a broad-based approach for the development of standards, i.e., the standards are based on assessments of risk to both human health and the ecological environment. In contrast, the Lead Rationale and supporting methodologies are based solely on human health concerns. By broadening the base and introducing requirements for ecological data, it is inevitable that the degree of uncertainty is higher for the CCME process, since missing or inadequate data result in increased need for assumptions.

The CCME process allows for two types of substances - threshold and non-threshold. In the case of the latter, there is no evidence to indicate levels below which a substance is considered to be absolutely risk-free. Lead is one such substance, and, similarly, the MOEE recognizes the fact that lead is non-threshold. Until the Ontario Ministry develops guidelines for threshold substances, comparison with the CCME Protocol is premature.

A major difference in formula derivation with respect to lead and the project at hand (see p. 29 of the Rationale document and p. 78 of the CCME document) is that the Ontario guidelines do not take into account soil inhalation rates, whereas the CCME document separates soil ingestion from soil inhalation.

At first glance, it would appear that the CCME Protocol will result in more strict clean up criteria, however, our close examination of the Ontario Rationale leads us to conclude that assumptive factors play a large role in the setting of standards and that, in fact, the Ontario Rationale may result in more restrictive clean up criteria for some types of land uses. For example, the development of soil remediation standards for commercial and industrial projects is not based on formula derivation, in other words, a more strict standard is set due to concerns for plant life and surrounding uses, without incorporating those types of concerns into the scientific methodology.