University of Alberta

Managing Uncertainty in Environmental Decision-Making: The Risky Business of Establishing a Relationship Between Science and Law

by

Larry Arnold Reynolds ©

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fulfilment of the requirements for the degree of Doctor of Philosophy

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ABSTRACT

This thesis focuses on the developing interrelationship between science, law and risk in the context of environmental decision-making in Canada, and the resultant climate of regulatory uncertainty.

The primary presumptions are that:

a) the dynamics of the existing relationship between the legal and scientific communities in the context of legal environmental decision-making institutions and processes have created problems in Canadian environmental decision-making institutions and processes;

b) the problems arising create a latent but very significant internal or systemic uncertainty with respect to the decisions which may be produced by the legal system in addressing a environmental issues;

c) the nature and sources of a number of these problems can be identified by means of empirical research and scholarly inquiry; and

d) viable solutions to a number of these problems can be proposed which should enable Canadian legal environmental decision-making institutions and processes to more effectively carry out their responsibilities and reduce the level of internal or systemic uncertainty.

To evaluate these presumptions the thesis undertakes the following:

a) An overview of the use of scientific information in legal environmental decision-making institutions and processes in Canada for the purpose of establishing the context within which these legal and scientific issues arise.

b) An examination of the experience based observations of the author and advisory team, and in the current legal and scientific literature which addresses problems arising in the use of scientific and technical evidence in environmental decision-making.

c) Provides original empirical research for determining the validity of the problems identified by the experience based observations of the author and advisory team and as identified in the legal and scientific literature.

d) Selects, analyses and offers solutions to a series of three major problem areas identified by the experience based observations of the author and advisory team, the legal and scientific literature and the original empirical research.

e) Offers some overall conclusions which suggest that these problems may be creating latent but very significant internal or systemic uncertainty with respect to the decisions which may be produced by the legal system in addressing any given issue, and that any solutions require interdisciplinary understanding and cooperation between the legal and scientific communities.

University of Alberta

Faculty of Graduate Studies and Research

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled **Managing Uncertainty in Environmental Decision-Making: The Risky Business of Establishing a Relationship Between Science and Law** submitted by Larry Arnold Reynolds in partial fulfilment of the requirements for the degree of **Doctor of Philosophy** in Environmental Risk Management.

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1.0 Introduction

The management of environmental[1] risk[2] encompasses a wide variety of activities, including scientific research, risk analysis, risk communication and risk policy development to name but a few. However, Canada, like many other nations has entrusted decision-making responsibility with respect to many if not most environmental risk management issues to its legal system. Simply stated, Canadian society either implicitly or explicitly sees some environmental risks as acceptable and others as unacceptable. Other risks are sufficiently uncertain that society is unsure as to their acceptability. The mandate of the legal system is to allow those risks which are acceptable - prohibit and sanction those which are not - and attempt to ascertain the acceptability of those for which substantial uncertainty exists.

In attempting to carry out this mandate, the Canadian legal system, like its counterparts in other British Common Law jurisdictions, has created a network of environmental decision-making institutions and processes. In recent years these institutions and processes have been given the task of regulating a growing number of activities which raise increasingly difficult jurisprudential issues which often require the resolution of complex scientific issues in order to decide the jurisprudential questions. These issues of mixed law and science arise in a wide variety of legal contexts including the establishment of appropriate regulatory standards, the prosecution of regulatory charges for the alleged violation of environmental protection legislation, civil actions brought by way of a growing number of toxic tort claims, and administrative hearings relating to the approval of proposed and existing activities which raise environmental issues.

In response, these legal decision-making institutions and processes have turned to the scientific community for assistance in addressing the scientific issues necessary to resolve the broader jurisprudential disputes. In carrying out its environmental decision-making responsibilities the legal system has long operated under the assumption that the scientific

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1 For the purpose of this thesis, the term "environmental" is to be given a broad interpretation consistent with its application to the natural environment, and includes related areas such as environmental health and natural resources.

2 While many definitions of the term "risk" are found in contemporary literature, this thesis will adopt the definition initially suggested by Kaplan, S. and Garrick, B. in "On the Quantitative Definition of Risk" *Risk Analysis* (1981, vol. 1 at 1) as modified by Hrudey, S.E. in "Current Needs in Environmental Risk Management" *Environmental Review* (1997, vol. 5 at 121).

Kaplan and Garrick suggest that the concept of risk in any given situation may be defined in terms of answering three questions:

1. What can go wrong?
2. How likely is it?
3. What are the consequences?

To this definition Hrudey adds:

4. What is the time frame over which the risk will be considered?
5. What harm matters to those affected?

community is able to provide scientific information on demand and in a form compatible with the requirements of the legal system. However, history teaches us that science has not always been able to meet the needs of legal institutions and processes. There is a long history of the relationship between law and science within the common law world, and an almost equally long history of problems with that relationship. As early as 1554 the English courts expressed encouragement for the use of court appointed scientific expertise in resolving scientific issues arising within law:

> If matters arise in our laws which concern other sciences and faculties we commonly call for the aid of that science or faculty which it concerns, which is an honourable and commendable thing. For thereby it appears that we do not despise all other sciences but our own, but we approve of them and encourage them ... .[3]

By 1782 the acceptance of expert scientific witnesses in England had advanced to the point where in *Folkes v. Chadd*[4] the parties called their own expert witnesses for the first time. However, by the mid-1800's it appears that the common law legal system was beginning to have misgivings with respect to its relationship with the scientific community. Concerning the situation in England one author notes:

> In 1554 it might have been true that the courts adopted a generally encouraging attitude to the expert. But by the beginning of the twentieth century, a deep-seated suspicion had set in. Indeed, it was given voice in the 1870's by Sir George Jessel, Master of the Rolls, whose judicial life frequently obliged him to decide between the opinions of competing experts. According to him, the very system of the adversary trial, with its potential strength of submitting testimony to the gruelling scrutiny of cross-examination and conflicting evidence, encouraged the engagement of paid experts. Sadly, but inevitably, these mercenaries of the witness-box tended to become locked into the forensic battalions of those who hired them. The expert might begin with integrity. But the whole pressure of the adversary system would, more often than not, force him or her to the limits of expertise. All too often, the litigant's cause would become the expert's cause, as the expert was pitched from familiar surroundings into the contest which is the hallmark of the adversary trial.[5]

In the United States the earliest record of the use of expert witnesses at trial dates back to 1665, in a case with the interesting name *A Trial of Witches at Bury St. Edmonds*.[6] Concern with the use of expert scientific witnesses in trials began to appear in legal writing

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3 *Buckley v. Rice Thomas* (1554), 1 Pl. Comm. 118 at 124, per Saunders J.

4 (1782), 99 Eng. Rep. 589.

5 Freckelton, Ian R, *The Trial of the Expert: A Study of Expert Evidence and Forensic Experts* (Melbourne: Oxford University Press, 1987) at Foreword page x.

6 (1665), 6 Howell's State Trials 687 at 697.

prior to the turn of the twentieth century. Perhaps most notable was the appearance in 1897 of an article in the *Harvard Law Review* entitled "Expert Testimony, - Prevalent Complaints and Proposed Remedies", which considered the problem of confusion among decision-makers resulting from expert witnesses reaching contradictory conclusions.[7]

In recent years this problem has worsened due in part to the rapid growth and increasing complexity of the scientific issues arising in the context of environmental decision-making. This has resulted in the demands of the legal system far outdistancing the ability of the scientific community to provide the required assistance. This difficulty is well summarized by Dr. Richard Carpenter, the person generally credited with the development and enactment of the United States *National Environmental Policy Act* (NEPA),[8] when in a 1982 address to the National Science Foundation, he offered the following observation with respect to the relationship between science and law in the United States in the context of environmental decision-making:

> Environmental science has not been able to deliver the facts, understanding, and predictions that were anticipated by environmental law. This mismatch of capabilities and expectations has resulted in confusion, delay, and inefficiency in governmental efforts to manage natural resources and to protect environmental quality. The relationships between lawyers and scientists have led to familiar stereotypes: scientists are adverse to the adversary process; lawyers are unprepared academically for interdisciplinary cooperation; scientists disregard human factors; lawyers get their scientific information from popular magazines.[9]

Equally important, in those situations where the scientific community is able to provide assistance to legal decision-making institutions and processes, such assistance may be in a form which is incompatible with these institutions and processes.

The primary presumption of this thesis are that:

a) the dynamics of the existing relationship between the legal and scientific communities in the context of legal environmental decision-making institutions and processes have created problems in Canadian environmental decision-making institutions and processes;

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7 Foster, William L., "Expert Testimony, - Prevalent Complaints and Proposed Remedies (1897), *Harvard Law Review*, Vol. 11, 169.

8 42 U.S.C. 4321m 4331 - 4335, 4341 - 4347 (1976).

9 Carpenter, Richard A., "Ecology in Court, and Other Disappointments of Environmental Science and Environmental Law" (1982), *Natural Resources Lawyer*, Vol. 15 No. 3, 573 at 573.

b) the problems arising in turn create a latent but very significant internal or systemic uncertainty with respect to the decisions which may be produced by the legal system in addressing any given issue.

c) the nature and sources of a number of these problems can be identified by means of empirical research and scholarly inquiry; and

d) viable solutions to a number of these problems can be proposed which should enable Canadian legal environmental decision-making institutions and processes to more effectively carry out their environmental decision-making responsibilities and reduce the level of internal or systemic uncertainty.

Therefore, this thesis undertakes the following:

a) First, the thesis will commence with an overview of the use of scientific information in legal environmental decision-making institutions and processes in Canada for the purpose of establishing the context within which these legal and scientific issues arise.

b) Second, the thesis will examine the experience based problems identified by the author and advisory team, and by the legal and scientific literature which exists which addresses problems arising in the use of scientific and technical evidence in environmental decision-making.

c) Third, the thesis (including Appendices) will provide original empirical research for determining the validity of the experience based problems identified by the author and advisory team and by the legal and scientific literature. This will include a description of the research methodology employed (Appendix 1) and the results of the research (Appendices 2 - 6).

d) Fourth, the thesis will select, analyse and offer solutions to a series of three problem areas identified by the experience based observations of the author and advisory team, the legal and scientific literature and the original empirical research.

e) Finally, the thesis will offer some overall conclusions which suggest that these problems may be creating latent but very significant internal or systemic uncertainty with respect to the decisions which may be produced by the legal system in addressing any given issue, and that any solutions require interdisciplinary understanding and cooperation between the legal and scientific communities.

It is also important to identify at the outset what this thesis will not do:

a) First, the thesis is not a study of science and its relationship to the current regulatory process. Thus, the thesis does not address issues such as the process of standards setting.

b) Second, the thesis is not a sociological investigation of the belief structures of the players in Canadian environmental decision-making processes.

c) Third, the thesis does not direct itself to important environmental issues such as cumulative effects. The focus of the thesis is on problems associated with environmental decision-making processes in Canada, and not with specific environmental problems themselves.

d) Fourth, while the thesis utilizes a literature review and the experiences of the author and advisory team for the purpose of identification of issues to be studied, it does not adopt a case study approach to those issues. Rather, the focus of the research is to quantitatively and qualitatively study the perceptions of key players in environmental decision-making based upon as many experiences as possible rather than limiting these experiences to a small number of case studies.

e) Finally, while thesis attempts to address many important issues in this area, it does not purport do be an exhaustive treatment of the subject. Practical constraints as to thesis length had to be taken into consideration.

2.0 The Relationship of Law and Science in the Context of Environmental Decision-Making

2.1 Introduction

The relationship between law and science may be viewed in a variety of contexts. This thesis examines the use of scientific information in legal environmental decision-making institutions and processes in Canada to address scientific issues which must be resolved in order to reach decisions with respect to larger jurisprudential disputes.

2.2 The Legal Basis of Expert Scientific Evidence in Canada

2.2.1 Courts

While the history of the use of expert evidence in Canadian courts is not as lengthy as it is in Britain or the United States, such evidence is also well established in Canadian law. The use of expert evidence for the purpose of providing assistance to the courts with respect to factual scientific issues arising within jurisprudential disputes was acknowledged by the Ontario Court of Appeal in 1961 in *Fisher v. The Queen* as follows:

> ... the basic reasoning which runs through the authorities here and in England, seems to be that expert opinion evidence will be admitted where it will be helpful to the jury in their deliberations and it will be excluded only where the jury can as easily draw the necessary inferences without it.[10]

The role of expert scientific witnesses appearing before Canadian courts was summarized by the Supreme Court of Canada in its 1982 decision in *R. v. Abbey*:

> With respect to matters calling for special knowledge, an expert in the field may draw inferences and state his opinion. An expert's function is precisely this: to provide the judge and jury with a ready-made inference which the judge and jury, due to the technical nature of the facts, are unable to formulate. "An expert's opinion is admissible to furnish the Court with scientific information which is likely to be outside the experience and knowledge of a judge or jury. If on the proven facts a judge or jury can form their own conclusions without help, then the opinion of the expert is unnecessary": (*R. v. Turner* (1974), 60 Cr. App. R. 80 at p. 83, per Lawton L.J.).[11]

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10 (1961), 130 C.C.C. 1 (Ont. C.A.), affirmed at 130 C.C.C. 22 (S.C.C.), per Aylesworth J.A.

11 [1982] 2 S.C.R. 24 at 40, per Dickson J. See also *Sengbusch v. Priest et al.* (1987), 14 B.C.L.R. (2d) 26 (B.C.S.C.).

Put another way:

> The scientific or technical expert is an aid to factual discovery: an 'expert witness' is someone who, through special training, knowledge or experience, is able to assist the legal system (a) in determining what the facts are, relevant to a particular case, and (b) by offering opinion about what the facts might mean for the reconstruction of a course of events or the outcome of a decision. It is important to note that the legal process, and not the expert, defines the factual question which it is relevant for the expert to answer.[12]

The law with respect to the admissibility of expert scientific evidence in Canada has traditionally been the application of the conventional rules of evidence to a scientific context:

> To date, Canadian courts have not attempted to formulate a single rule for the admissibility of new scientific evidence. Rather, the courts first apply the traditional exclusionary rules, the expert evidence rule and then invoke policy reasons specific to the particular proffered evidence to determine admissibility. This appears to be the preferable route, and it accords with the present trend in the American federal courts.[13]

In 1995 the Supreme Court of Canada restated the law in this area in *R. v. Mohan.*[14] In that case the Court set out a four part test for the admission of expert evidence:

> Admission of expert evidence depends on the application of the following criteria:
>
> (a) relevance;
> (b) necessity in assisting the trier of fact;
> (c) the absence of any exclusionary rule;
> (d) a properly qualified expert.[15]

The Supreme Court went on to elaborate with respect to each part of the test.

a) <u>Relevance</u>

The first part of the test, that of relevance, was summarized by the Court as follows:

> Relevance is a threshold requirement for the admission of expert evidence as with all other evidence. Relevance is a matter to be decided by a judge as a question of law.

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12 Smith, Roger and Wynne, Brian, *Expert Evidence: Interpreting Science in the Law* (London: Routledge, 1989) at 4.

13 Sopinka, John, *The Law of Evidence in Canada.* (Toronto: Butterworths, 1992) at 569.

14 [1994] 2 S.C.R. 9.

15 *Ibid.*, at 20 per Sopinka J.

The test of relevance as it applies to expert scientific evidence was subsequently summarized in greater detail by the Ontario Court of Appeal as follows:

> Relevance is a matter to be decided by the trial judge as a question of law. It involves the determination of the logical relationship between the proposed evidence and a fact in issue in the trial. The logical relevance of the evidence is determined by asking the following questions:
>
> (a) Does the proposed expert opinion evidence relate to a fact in issue in the trial?
>
> (b) Is it so related to a fact in issue that it tends to prove it?
>
> If the answer to both these questions is yes, the logical relevance of the evidence has been established. This is the basic threshold requirement for the admissibility of any evidence.[16]

b) <u>Necessity</u>

With respect to the second part of the test, necessity in assisting the trier of fact, Sopinka J. quoted with approval the passage from Dickson J. in *Abbey* set out above, but provided a stricter interpretation of the requirement of necessity than the one referred to in *Fisher v. The Queen*[17] and commonly applied by the courts:[18]

> This pre-condition is often expressed in terms as to whether the evidence would be helpful to the trier of fact. The word "helpful" is not quite appropriate and sets too low a standard. However, I would not judge necessity by too strict a standard. What is required is that the opinion be necessary in the sense that it provide information "which is likely to be outside the experience and knowledge of a judge or jury": as quoted by Dickson J. in *R. v. Abbey*, supra. As stated by Dickson J., the evidence must be necessary to enable the trier of fact to appreciate the matters in issue due to their technical nature.[19]

In considering the application of the necessity test, in *R. v. McIntosh and McCarthy* the Ontario Court of Appeal offered a warning to courts which readily assume the need to admit expert evidence from the social sciences:

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16 *R. v. A.K.* (1999), 176 D.L.R. (4th) per Charron J.A. at 701-702 (Ont. C.A.).

17 *Supra*, note 10.

18 *Supra*, note 11.

19 *Supra*, note 14 at 23 per Sopinka J.

... I do not intend to leave the subject without raising some warning flags. In my respectful opinion, the courts are overly eager to abdicate their fact-finding responsibilities to "experts" in the field of the behavioural sciences. We are too quick to say that a particular witness possesses special knowledge and experience going beyond that of the trier of fact without engaging in an analysis of the subject-matter of the expertise.[20]

c) Exclusionary Rules

In explaining the third part of the test, the absence of the applicability of any exclusionary rule, the Supreme Court held that compliance with the other parts of the test "... will not ensure admissibility of expert evidence if it falls afoul of an exclusionary rule of evidence separate and apart from the opinion rule itself."[21] The Court went on to summarize the test used to determine whether evidence runs afoul of an exclusionary rule:

Although prima facie admissible if so related to a fact in issue that it tends to establish it, that does not end the inquiry. This merely determines the logical relevance of the evidence. Other considerations enter into the decision as to admissibility. This further inquiry may be described as a cost benefit analysis, that is "whether its value is worth what it costs." See McCormick on Evidence (3rd ed. 1984) , at p. 544. Cost in this context is not used in its traditional economic sense but rather in terms of its impact on the trial process. Evidence that is otherwise logically relevant may be excluded on this basis, if its probative value is overborne by its prejudicial effect, if it involves an inordinate amount of time which is not commensurate with its value or if it is misleading in the sense that its effect on the trier of fact, particularly a jury, is out of proportion to its reliability. While frequently considered as an aspect of legal relevance, the exclusion of logically relevant evidence on these grounds is more properly regarded as a general exclusionary rule (see Morris v. The Queen, [1983] 2 S.C.R. 190). Whether it is treated as an aspect of relevance or an exclusionary rule, the effect is the same. The reliability versus effect factor has special significance in assessing the admissibility of expert evidence.[22]

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20 (1997), 117 C.C.C. (3d) 385 at 392 per Finlayson J.A.

21 *Supra*, note 14 at 25 per Sopinka J.

22 *Supra, note 14* at 20-21 per Sopinka J. Classification of where the requirement of reliability of expert evidence fits into the legal rules of evidence is often elusive. See for example the recent decision of the Ontario Court of Appeal in *R. v. A.K.*, *supra* note 16, where that court classified the reliability issue in terms of relevance and necessity rather than as a rule of exclusion:

> The evidence must meet a certain threshold of reliability in order to have sufficient probative value to meet the criterion of relevance. The reliability of the evidence must also be considered with respect to the second criterion of necessity. After all, it could hardly be said that the admission of unreliable evidence is necessary for a proper adjudication to be made by the trier of fact.

The Court then deemed it appropriate to discuss the application of this test in the context of expert scientific evidence:

> There is a danger that expert evidence will be misused and will distort the fact-finding process. Dressed up in scientific language which the jury does not easily understand and submitted through a witness of impressive antecedents, this evidence is apt to be accepted by the jury as being virtually infallible and as having more weight than it deserves. As La Forest J. stated in R. v. Beland, [1987] 2 S.C.R. 398 at p. 434, with respect to the evidence of the results of a polygraph tendered by the accused, such evidence should not be admitted by reason of "human fallibility in assessing the proper weight to be given to evidence cloaked under the mystique of science".[23]

The Court then considered with approval 2 additional factors suggested in *R. v. Melaragni and Longpre*[24] which should be canvassed to determine if *prima facie* relevant expert scientific evidence should be excluded:

> (1) Is the evidence likely to assist the jury in its fact-finding mission, or is it likely to confuse and confound the jury?
>
> (2) Is the jury likely to be overwhelmed by the "mystic infallibility" of the evidence, or will the jury be able to keep an open mind and objectively assess the worth of the evidence?[25]

The factor which has attracted the most attention in determining whether relevant evidence should be otherwise excluded is the reliability of the evidence. The nature of this issue was well summarized in *R. v. J.E.T.*:

> Needless to say there is a continuum of reliability in matters of science from near certainty in physical sciences to the far end of the spectrum inhabited by junk science and opinion akin to sorcery or magic. Whether the technique can be demonstrably tested, the existence of peer review for the theory or technique, the existence of publication, the testing or validation employing control and error measurement, and some recognition or acceptance in the relevant scientific field all contribute to an assessment of the reliability of the opinion and hence its capacity to outweigh the prejudicial impact of imposing on the jury highly suspect opinion evidence masquerading as science ... .[26]

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23 *Supra*, note 14 at 21 per Sopinka J.

24 (1992), 73 C.C.C. (3d) 348 (Ont. Ct. Gen. Div.) per Moldaver J.

25 *Ibid.*, at 353. The Supreme Court did not adopt 7 other considerations set out in *R. v. Melaragni and Longpre*.

26 [1994] O.J. No. 3067, per Hill J at 49 par. 75 (Ont. C.J.).

The issue of admissibility of scientific evidence on the basis of its reliability has its early roots in the United States. In the 1923 decision in *Frye v. United States* the District of Columbia Court of Appeals made one of the earliest attempts at establishing a test for admissibility of scientific evidence, holding that:

> ... the thing from which the deduction is made must be sufficiently established to have gained general acceptance in a particular field in which it belongs.[27]

By 1968 some American courts were holding that the test was one of reasonable demonstrability or reasonable reliability.[28] By 1978 some courts expanded the use of the reasonable reliability test a balancing of the probativeness, materiality, and reliability of the evidence against a tendency to mislead or confuse the jury, or unfairly prejudice the defendant.[29] The rationale for this shift from a "general acceptance" test in Frye to a "reasonable reliability" test is explained by one American author in the following terms:

> The courts that have moved away from Frye have obviously done so because of a perception that the standard is too rigid, somewhat unclear, and an unnecessary and undesirable barrier to the admissibility of scientific evidence in some situations. The effect of the departure from Frye has been a liberalization in the admission of scientific evidence. A discernable trend toward an expansive admissibility standard plainly exists.[30]

Finally, in a unanimous decision of the United States Supreme Court in 1993 in *Daubert v. Merrell Dow Pharmaceuticals Inc.*[31], it was declared that the *Frye* test was no longer the law, and that the test was now a reliability and relevance test.

In applying the decision of the Supreme Court of Canada in *Mohan*, the Ontario Court of Appeal in *R. v. McIntosh and McCarthy* offered the following suggestions to determine reliability in the context of the social sciences:

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27 293 F. 1013 (1923). This test was never accepted in Canada, but prior to *Mohan* was one of the factors to consider in the assessment of relevance and helpfulness in the determination of admissibility. See *Wolfin v. Shaw*, [1998] B.C.J. No. 5 (B.C.S.C.); *R. v. Johnston* (1992), 69 C.C.C. (3d) 395 (Ont. Ct. Gen. Div.); and *Grant v. Dube* (1992), 73 B.C.L.R. (2d) 288 (B.C.S.C.). It is also used as an indicator of reliability in the post Mohan era. See for example *R. v. J.E.T.* [1994] O.J. No. 3067(Ont. C.J.) and *Petro-Canada v. Canada Newfoundland and Offshore Petroleum Board* (1995), 127 D.L.R. (4th) 483 (Nfld. S.C.).

28 See for example, *Coppolino v. State*, 223 So. 2d 68 at 70 (Fla. C.A.).

29 See for example, *United States v. Williams* 583 R. 2d 1194 (2nd Cir. 1978), which approach was subsequently approved by the United States District Court for Vermont in *United States v. Jokobetz*, 747 F. Supp. 250 (D. Vt. 1990).

30 M. McCormick, "Scientific Evidence: Defining a New Approach to Admissibility" (1982), 67 *Iowa L. Rev.* 879 at 904. This conclusion was acknowledged by Wilson J. in the decision of the Supreme Court of Canada in *R. v. Beland*, [1987] 2 S.C.R. 398 at 433.

31 118 S.Ct. 2786 (1993).

> ... it seems to me that before a witness can be permitted to testify as an expert, the court must be satisfied that the subject-matter of his or her expertise is a branch of study in psychology concerned with a connected body of demonstrated truths or with observed facts systematically classified and more or less connected together by a common hypothesis operating under general laws. The branch should include trustworthy methods for the discovery of new truths within its own domain. I should add that it would be helpful if there was evidence that the existence of such a branch was generally accepted within the science of psychology.[32]

d) Properly Qualified Expert

Finally, with respect to the fourth requirement, that of a properly qualified expert, the Court stated that "... the evidence must be given by a witness who is shown to have acquired special or peculiar knowledge through study or experience in respect of the matters on which he or she undertakes to testify."[33] In commenting on this requirement the Ontario Court of Appeal recently observed:

> This criterion is usually not difficult to apply. However, it must not be overlooked. Opinion evidence can only be of assistance to the extent that the witness has acquired special knowledge over the subject-matter that the average trier of fact does not already have. If the witness's "special" or "peculiar" knowledge on a subject-matter is minimal, he or she should not be qualified as an expert with respect to that subject.[34]

After setting out its four part test for the admission of expert evidence the Supreme Court in *Mohan* went on to discuss the application of the test in the context of novel or new scientific theories or techniques.

> In summary, therefore, it appears from the foregoing that expert evidence which advances a novel scientific theory or technique is subjected to special scrutiny to determine whether it meets a basic threshold of reliability and whether it is essential in the sense that the trier of fact will be unable to come to a satisfactory conclusion without the assistance of the expert. The closer the evidence approaches an opinion on an ultimate issue, the stricter the application of this principle.[35]

In effect the Supreme Court established that novel scientific evidence is subject to a threshold test, a higher level of judicial scrutiny, with respect to both the reliability and

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32 *Supra*, note 20 at 392 per Finlayson J.A..

33 *Supra*, note 14 at 25 per Sopinka J.

34 *Supra*, note 16 at 709.

35 *Supra*, note 14 at 25.

necessity requirements for the admissibility of such evidence. [36] Lower court decisions across Canada are now in the process of attempting to apply the new test for novel scientific evidence. From a practical perspective it is not surprising that the courts are attempting to apply the test in *voir dire*. The process was recently explained by Dillon J. of the British Columbia Supreme Court in *Wolfin v. Shaw*:

> Consideration of whether [scientific evidence] is 'novel' is undertaken here not to determine admissibility but to decide whether a stricter scrutiny of the evidence through a threshold test of reliability should apply, usually within a voir dire. In this sense, the concept of 'novel' is used to distinguish evidence that has gained certain acceptability from that which has not. The object of the voir dire is to prevent the trial becoming a "medical or scientific convention with an exchange of highly speculative points of view" (R. v. J.E.T., supra at para. 77). As stated by Langdon, J. in R. v. Johnson, supra at 418, it may be that a particular scientific method or theory may become so uniformly and widely accepted within the scientific community and by the courts that it can be admitted into evidence with little or not preliminary screening like fingerprint evidence.[37]

The more difficult question appears to be determining what constitutes novel scientific evidence. A variety of definitions have been provided by lower courts across Canada. For example, in R. *Melarangi and Longpre* Moldaver J. of the Ontario Court (General Division) spoke of new scientific techniques or bodies of knowledge.[38] In *R. v. Taillefer* the Quebec Court of Appeal referred to scientific evidence based upon a theory which has not yet been widely accepted or the accuracy of which has not been determined.[39] With respect to the use of standardized methodology the Ontario Court of Justice held in *R. v. Campbell* that a scientific technique was not novel even though it had been modified and adapted within a new situation.[40] Issues relative to those modifications were matters of weight and not admissibility. Finally, the Court in *Wolfin v. Shaw* offered a definition very

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36 Subsequent to the decision in *Mohan* some courts have rejected scientific evidence on the basis of this additional reliability requirement. See for example *R. v. Warren*, [1995] N.W.T.J. No. 7 (N.W.T.S.C.) where a trial court have refused to admit expert opinion evidence on the grounds that novel evidence was insufficiently reliable.

In addition, the decision in *Mohan* has also been accepted into Canadian civil cases as it pertains to the admissibility of novel scientific evidence. In this regard see *Petro-Canada v. Canada-Newfoundland Offshore Petroleum Board* (1995), 127 D.L.R. (4th) 483; *Kozak v. Funk*, [1996] 1 W.W.R. 107 (Sask. Q.B.); and *Green v. Lawrence*, [1996] 5 W.W.R. 378 (Man. Q.B.).

37 (1998) 43 B.C.L.R. 190 at 197 (B.C.S.C.).

38 *Supra*, note 24 at 353.

39 (1995), 100 C.C.C. (3d) 1 at 21 (Que. C.A.) app. denied 45 C.R. (4th) 398 (S.C.C.).

40 [1996] O.J. No. 4792 (Ont. C.J. (Prov. Div.).

reminiscent of the general acceptance test used for so many years in the United States in *Frye*:

> "Novel" refers to scientific evidence that has not been generally accepted as effective in medicine or that deviates from accepted standards.[41]

To date there is no standard test to determine what constitutes novel evidence in Canada.

2.2.2 Administrative Decision-Makers

The role of expert witnesses in environmental decision-making in an administrative context differs significantly from environmental decision-making in a judicial context, in that the ability of administrative decision-makers to draw inferences with respect to scientific issues appears to be less closely connected to the admissibility of expert scientific evidence than their judicial counterparts. This was confirmed by the Supreme Court of Canada in the context of complex human rights evidence considered by the Human Rights Commission of New Brunswick:

> This fact finding expertise of administrative tribunals should not be restrictively interpreted, and it must be assessed against the backdrop of the particular decision the tribunal is called upon to make. ... Since a finding of discrimination is impregnated with facts, and given the complexity of the evidentiary inferences made on the basis of these facts before the Board, it is appropriate to exercise a relative degree of deference to the finding of discrimination, in light of the Board's superior expertise in fact-finding ... .[42]

This is consistent with the theory that administrative tribunal members are appointed for their specialized expertise in a particular scientific area.

The courts have consistently held that the general rule is that administrative tribunals are the masters of their own procedure, including rules of evidence. This is subject to a number of exceptions, 4 of which are relevant to this discussion:

1) Mandatory Requirements

Mandatory requirements, such as procedural requirements, found in the legislation must be followed. A failure by an administrative decision-maker to follow rules of evidence found within its constituting legislation would almost certainly be fatal to any decision.

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41 *Supra*, note 37 at 196 per Dillon J.

42 *Ross v. New Brunswick School District No. 15*, [1996] 1 S.C.R. 825 at par 29, per LaForest J.

2) Fairness of Process

In the absence of express words to the contrary in the legislation, administrative tribunals must conduct their affairs with a certain level of fairness of process. Historically, Canadian courts distinguished between the concepts of "natural justice" and the "duty to be fair".[43] However, in recent years the courts have blurred the distinction between the two terms.[44] In an administrative law context the terms natural justice and the duty of fairness are used to denote concepts related to procedural safeguards available to people affected by the decisions of statutory delegates. The (common law) rules relating to natural justice and the duty of fairness attempt to prescribe minimum levels of procedural safeguards available in any given circumstance. This includes fairness with respect to the process established for the presentation of evidence.

The process which an administrative tribunal must adopt in order to meet this requirement is decided by the courts with reference to a continuum between the requirements of natural justice (higher level of procedural protection) and procedural fairness (lower level of procedural protection).In general, the courts will hold administrative tribunals with quasi-judicial functions (such as the National Energy Board, Alberta Energy and Utilities Board, etc.) to the higher level of procedural protection found in natural justice, whereas those tribunals with administrative or executive functions will be required to meet the lower standard of procedural fairness.

The courts have also held that with respect to administrative or executive statutory delegates there is a general duty of fairness and that what is required in every case is a consideration of what procedure is appropriate given the circumstances of each case. The courts have recognized that there is no one set of procedures which meets this requirement. Rather, the question to be addressed by the courts is whether "... there has been a breach of the duty to act fairly in all the circumstances". In order to provide some direction as to the extent of the duty of fairness, the courts have held that fairness depends on the nature of the inquiry and the possible consequences to the person affected.

3) Abuse of Discretion

Finally, the ability of an administrative decision-maker to establish its own process for the admission of expert evidence is also governed by the common law prohibition against a statutory delegate abusing its discretion. The Doctrine of Parliamentary Sovereignty permits the federal Parliament and the provincial and territorial legislatures to delegate very broad "discretionary" powers through the vehicle of legislation. The term "discretion" may

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[43] *Nicholson v. Haldimand-Norfolk Police Commissioners Board*, [1979] 1 S.C.R. 311, 88 D.L.R. (3d) 671 (S.C.C.).

[44] *Martineau v. Matsqui Institution Disciplinary Board (No. 2)*, 1 S.C.R. 602, 106 D.L.R. (3d) 385, (S.C.C.).

be defined as the power to make a decision that cannot be legally held to be "right" or "wrong". That is, while one could disagree with a discretionary decision, the courts are not as a general rule entitled to declare such a decision to be wrong and correct it. Thus, the concept of administrative discretion involves the right of a statutory delegate to choose between two or more courses of action in which there is room for reasonable people to hold differing opinions as to which course of action is to be preferred.

However, a statutory delegate does not have unlimited discretion. The courts have traditionally asserted their right to review a statutory delegate's exercise of discretion for a wide range of abuses, examples of which make up the balance of this section. An "abuse of discretion" is an error which is "jurisdictional" in nature in that even though the statutory delegate has met all of the requirements to acquire jurisdiction to hear and decide an issue, and thus *prima facie* has the right to exercise the discretionary power in question, the statutory delegate's error is so unreasonable or unacceptable that the courts will quash the decision on the basis that the federal Parliament or provincial legislature could never have intended to grant the statutory delegate the power to act in such a manner.[45]

An "abuse of discretion" is an error which deprives the delegate of its jurisdiction to exercise its discretion in the particular manner complained of, thereby making the exercise of discretion *ultra vires* and a nullity. With respect to the issue of the admission of expert evidence by an administrative decision-maker, the courts have held that a discretionary decision made by a statutory delegate will be *ultra vires* and of no force or effect if the decision is based upon irrelevant considerations,[46] where a statutory delegate makes a decision upon no evidence whatsoever,[47] or where in making its decision ignores relevant considerations.[48] Thus, in determining what evidence to admit and consider in its decision, the administrative decision-maker is also governed by a need to obtain and utilize evidence which does not offend any of the above prohibitions.

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45 This conclusion is subject to the Doctrine of Parliamentary Sovereignty which allows the federal Parliament or a provincial legislature to use specific language to allow the statutory delegate to abuse the discretion in the manner complained of.

46 For example, the Supreme Court of Canada has held that a labour relations board which exercised its discretion to reject an application for certification of a union as a bargaining agent on the basis of the fact that the secretary-treasurer of the would-be union was a communist was an irrelevant consideration and therefore *ultra vires*. (*Smith and Rhuland Ltd. v. R.*, [1953] 2 S.C.R. 95, [1953] 3 D.L.R. 690 (S.C.C.)).

47 See Elliott, D.W., "No Evidence - A Ground for Judicial Review in Canada?", (1972-73) 37 *Sask. L.R.* 48.

48 See for example *Service Employees International Union v. Nipawin District Staff Nurses Association* (1973), 41 D.L.R. (3d) 6 (S.C.C.) and *R. v. Alberta Labour Relations Board*, (1983) 27 Alta. L.R. (2d) 338 at 343 (Alta. Q.B.).

4) Reliability and Persuasiveness of Evidence

Finally, in the absence of any mandatory requirements to the contrary, administrative tribunals have an obligation to ensure that the evidence upon which they rely meets a threshold of reliability and persuasiveness. This requirement was set out by the majority of the Supreme Court of Canada in *Mooring v. Canada* (National Parole Board) in the context of the quality of evidence upon which administrative tribunals are to make their decisions:

> The Board must ensure that the information upon which it acts is reliable and persuasive.[49]

2.3 Purposes for the Introduction of Expert Scientific Evidence

Scientific information in the form of expert evidence may be introduced into legal environmental decision-making processes such as environmental trials and administrative environmental hearings for a variety of purposes. Some of the more common purposes are summarized below.

2.3.1 Explanation of Scientific Concepts

One of the most common purposes for the introduction of scientific information at environmental trials and administrative environmental hearings is to explain scientific concepts to the decision-maker. Scientific concepts and the technical terminology used to describe those concepts are often beyond the knowledge and experience of the decision-maker. Thus, in order to properly understand the issues the decision-maker may require an explanation of these concepts in terminology which is readily understood.

2.3.2 Presentation of Evidence Relating to Scientific Investigations

A second common purpose for the introduction of expert scientific evidence into environmental decision-making fora is the presentation of evidence relating to scientific investigations which have been carried out with respect to a particular issue before the decision-maker. The type of investigation conducted will be determined by the nature of the case, and may involve anything from a scientific literature review to empirical scientific research.

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49 [1996] 1 S.C.R. 75 per L'Hereux-Dube.

2.3.3 Opinion Based on the Facts of the Case

A third common purpose of expert scientific evidence is for the rendering of an expert opinion based upon the facts of a case. This involves an expert scientific witness providing an opinion with respect to a scientific issue arising from a particular set of facts. As only the trier of fact can determine the actual facts of a case, and these are not known until a decision is rendered, the expert witness provides opinion evidence with respect to a hypothetical set of facts. In the event that the hypothetical facts upon which the expert opinion is based are not proven, then the opinion must generally be discarded as not being relevant. However, if the hypothetical facts are accepted by the decision-maker, it is open to the decision-maker to accept or reject the opinion evidence.

2.3.4 Interpretation of Environmental Legislation

A fourth common purpose of expert scientific evidence is for the interpretation of environmental legislation. The rules of statutory interpretation have long held that words found in legislation should be given their "common" or "ordinary" meaning. This principle is summarized in *The Interpretation of Legislation in Canada*, where it is stated that "As it is presumed that the legislator wishes to be understood by the citizen, the law is deemed to have been drafted in accordance with the rules of language in common use".[50] However, it is also recognized that there are circumstances where the "common meaning rule" will not assist in the interpretation of legislation, particularly in situations where a scientific or technical meaning should be ascribed to a term:

> But this rule favouring the common meaning is not absolute. If the circumstances indicate that a scientific or technical meaning is appropriate, then it should be used, subject to proof of the technical meaning.[51]

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50 Cote, P. A., *The Interpretation of Legislation in Canada* (2nd ed.) (Montreal: Les Editions Yvon Blais Inc., 1991) at 219.

51 *Ibid.*, at 223. See also Cross, R., *Statutory Interpretation* (2nd ed.) (London: Butterworths, 1987) at 58-62; and Driedger, E.A., *Construction of Statutes* (2nd ed.) (Toronto: Butterworths, 1983) at 8, wherein the author states "Yet, there is a principle that when the legislature selects technical words to convey its meaning it is in general to be supposed that it uses them in their technical sense." The universality of this principle is seen in the Privy Council decision in *R. v. Mohindar Singh et al*:, [1950] 2 W.W.R. 835 at 843, per Lord Greene:

> Words having a technical meaning, words which are in effect words of art, are in essence more recalcitrant than words which do not possess that character. Where the Legislature selects technical words to convey its meaning it is not in general supposed that it uses them in any but their technical sense or that their technical sense was unfamiliar to it.

This principle was given approval by the Supreme Court of Canada in *Perka v. The Queen*, wherein Dickson, J. stated:

> It is well established that technical and scientific terms which appear in statutes should be given their technical or scientific meaning: see Maxwell on the Interpretation of Statutes (12th ed. 1969) at p. 28.[52]

Dickson, J.'s reference to *Maxwell on the Interpretation of Statutes* reads as follows:

> The first and most elementary rule of construction is that it is to be assumed that the words and phrases of technical legislation are used in their technical meaning if they have acquired one, and otherwise in their ordinary meaning.[53]

A good illustration of the use of scientific information for the interpretation of environmental legislation is found in the recent decision of the Provincial Court of Alberta in *R. v. Town of St. Paul*.[54] In that case the Town of St. Paul was charged, *inter alia*, that it "... did unlawfully carry on work that resulted in the Harmful Alteration, Disruption or Destruction of Fish Habitat in Lac St. Cyr, contrary to the provisions of Section 31(1) of the federal *Fisheries Act*".[55] Section 31(1) of that Act states:

> 31(1) No person shall carry on any work or undertaking that results in the harmful alteration, disruption, or destruction of fish habitat.

The Act goes on to define the term "fish habitat" as follows:

> 31(5) For the purposes of this section ... "fish habitat" means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.[56]

Considerable expert scientific evidence was presented by four fisheries biologists with respect to the interpretation which should be given by the Court to the phrase "... on which fish depend ...". In its decision the Court summarized the interpretations advanced by the parties in the following terms:

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52 [1984] 2 S.C.R. 232 at 264.

53 Langan, P. St. J., *Maxwell on the Interpretation of Statutes* (12th ed.) (London: Sweet and Maxwell, 1969) at 28.

54 (1994), 150 A.R. 372.

55 R.S.C. 1970, c. F-14, as amended. Now s. 35(1).

56 *Ibid.*, at s. 31(5).

In his definition [expert Crown witness] Dr. Bodaly appears to use the requirement of "dependency" in a theoretical or abstract sense of physical components within the ecosystem which fish "potentially could use" in contrast with the definitions provided by [Town expert witnesses] Drs. Smith, McCart & Bietz who viewed the concept of "dependency" in terms of physical features which fish are "actually required to use in order to sustain their populations".

Upon reviewing the scientific information which had been presented the Court went on to find that the requirement of "dependency" found in section 31(5) must be seen in terms of "actual" rather than "theoretical" dependency of fish on an area of potential habitat:

> This Court adopts the view that the term: "... fish habitat on which fish depend directly or indirectly to carry out their life processes" in s. 31(5) of the Fisheries Act, must be interpreted in terms of the protection of physical habitat factors necessary for the protection of fisheries rather than protection of physical habitat factors not required for the protection of fisheries.

Thus, scientific information introduced into the decision-making process enabled the Court to choose between two possible interpretations of the *Fisheries Act* legislation.

2.4 Applications of Scientific Information in Legal Decision-Making

Today, scientific information is primarily utilized by Canadian legal institutions and processes in four environmental decision-making contexts, each of which are summarized below.

2.4.1 Establishment of Regulatory Standards

The first application of scientific information within legal environmental decision-making institutions and processes is in the establishment of environmental standards.[57] In setting environmental standards the legislator reviews the available scientific information, including any scientific uncertainties which it may contain, and integrates this information into a decision-making process which considers a variety of factors prior to making what is essentially a political decision as to the appropriate "standard". Such standards may be "quantitative" in that they take the form of precisely described measurable levels set out within regulations enacted under the authority of parent environmental legislation. Alternatively, these standards may be "normative" whereby the standard is broadly described in terms of prohibited outcomes such as "harm to the environment". In the former case the

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[57] For a more detailed discussion of this topic see section 3.5, *infra*.

difficult decisions are those made by legislators setting the quantitative standards, with the trier of fact left with the less controversial task of applying the facts of a case to those standards. The opposite holds true for normative standards, where the easy decisions are made in creating the standard which often creates considerable difficulty in its application by the trier of fact.

2.4.2 Prosecution of Regulatory Offences

The second context in which scientific information is applied to legal environmental decision-making institutions and processes is found in the prosecution of charges brought for the alleged violation of environmental and natural resource protection legislation. A review of the development of this legislation across Canada over the last 20 years indicates a significant growth in the number of such legislative enactments and a corresponding increase both in the number of environmental prohibitions and the severity of the punishment options available to the courts for their violation.

Despite this growth of environmental and natural resource protection legislation, for many jurisdictions in Canada prosecution is often the final link in a long chain of enforcement options, leaving a number of governments open to the criticism that their failure to enforce the law in the courts has rendered this tougher legislation meaningless. There have also been criticisms that when charges are brought, the courts have been reluctant to treat environmental offences with the same seriousness as they would for other quasi-criminal matters.

With respect to the highly politicized issue of enforcement, a review of public opinion polls taken over the past 30 years indicates that the issue of environmental protection has undergone a series of peaks and valleys in the minds of the public. High points have occurred in the last 1960's and late 1980's. When such a review is compared with the development of environmental protection legislation, a pattern emerges. Periods of high public concern with the environment are followed by periods of increased legislative activity in the development of environmental protection legislation. For example, the increase in public concern with the environment in the late 1960's was followed by both federal and provincial enactments creating for the first time in Canada departments whose mandate it was to deal with environmental issues. See for example the creation in 1971of Environment Canada by Part I of the *Government Organization Act*[58] and the Alberta Department of Environment by the *Department of the Environment Act*.[59] The upsurge in public concern with the environment in the late 1980's was followed by a significant increase in

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[58] S.C. 1970-71-72, c. 42.

[59] S.A. 1971 c. 24.

environmental and natural resource protection legislation. Examples include the federal *Canadian Environmental Assessment Act* (1992),[60] *Canadian Environmental Protection Act* (1988)[61] and *Hazardous Products Act* (1987),[62] provincial legislation such as the *Alberta Environmental Protection and Enhancement Act*,[63] and territorial legislation such as the groundbreaking Northwest Territories' *Environmental Rights Act*[64] and major revisions *to* the *Environmental Protection Act*[65] in *An Act to Amend the Environmental Protection Act* (1990).[66] With vastly improved environmental legislation now in place, one is led to speculate as to the possibility of whether the next upsurge in public environmental concern will result in increased enforcement of this legislation?

Despite these criticisms, the fact remains that every year in Canada a significant number of federal, provincial, territorial and municipal charges are laid against those who are alleged to have violated regulatory environmental legislation, and there are indications that the courts are beginning to take these charges more seriously. For example, in *Metropolitan Toronto (Municipality) v. Siapas*,[67] in considering a charge brought against an officer of an electroplating company for breach of a Toronto anti-pollution by-law Austin J. offered the following comments with respect to his perception of the value of the by-law as a deterrent to water pollution:

> In my view, however, there is a wider perspective which must be considered. That is pollution. Much of our society does not yet appear to have grasped the notion that land and water are finite resources and must be treated as such. One of the by-products of this failure is laws such as Metro By-law 148-83. That by-law does not prohibit pollution; rather it attempts to regulate it in such a fashion that our children and perhaps even our grandchildren will have the benefit of some of "our" land and water. By exceeding the by-law limits Shoppe [electroplating company] encroached on the expectations and rights of

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60 S.C. 1992, c. 37.

61 S.C. 1988, c. 15.3. On September 14, 1999 the Act was supplemented by the *Canadian Environmental Protection Act, 1999*, S.C. 1999, c. 15.31.

62 S.C. 1987, c. H-2.7.

63 R.S.A. 1980, c. E-13.3. This legislation was proclaimed into force on September 1, 1993.

64 R.S.N.W.T. 1990, c. 38.

65 R.S.N.W.T. 1990, c. E-7.

66 R.S.N.W.T. 1988, c. 75 (Supp.).

67 (1988), 3 C.E.L.R. 122 (Ont. H.C.).

> those children and grandchildren. By his conduct Siapas [company officer] has encouraged that encroachment.[68]

In passing sentence on the company officer, Austin J. went on to give notice as to how his court intended to address environmental impairment issues in the future:

> It is often said that the first objective of sentencing must be protection of the public. In a very real sense, that is the case here. In my view the message to Siapas personally and to the public generally, must be that persons and industries who pollute the environment or assist in that pollution must be, and will be, dealt with firmly.[69]

Regardless of their nature, regulatory environmental prosecutions rely heavily upon the proof of scientific facts in order to resolve the larger jurisprudential dispute.

2.4.3 Civil Law Actions

The third area in which science is utilized in legal-based environmental decision-making is in the context of civil law, and in particular civil actions brought by way of a growing number of toxic tort claims.[70] While traditionally civil law actions have been rooted in historical common law causes of action, Canadian legislators are increasingly including civil liabilities in environmental legislation. Each of these sources is considered below.

2.4.3.1 Common Law Civil Actions

In the past, civil environmental litigation has generally been framed in one or more of the traditional common law causes of action, which include the familiar negligence, private nuisance, the Rule in *Rylands v. Fletcher*,[71] breach of riparian rights and trespass to land.[72] These causes of action have a long history of raising scientific issues which must be

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68 *Ibid.*, at 153-154.

69 *Ibid.*, at 156.

70 Other changes to the common law such as opening up the rules surrounding standing (*R. v. Findlay*, [1993] 2 S.C.R. 1009 S.C.C.) have expanded the types of claimants who may advance toxic tort claims.

71 (1866), L. R. 1 Ex. 265 (C.A.); affirmed L.R. 3 H. L. 330 (H. L.).

72 For a discussion of these common law causes of action in an environmental context in Canada see van Rensburg, Katherine M., "Civil Liability For Environmental Harm In Ontario" (1991), *Uberrima Fides*, Vol. 1 No. 1, 2; and Harvey, Christopher and Macdonald, Cynthia M., "Environmental Clean Up Costs and Damages: The Common Law (1992), *The Advocate*, Vol. 50 Pt. 1, 33.

resolved in order to decide the jurisprudential dispute. For example, the success or failure of an environmental lawsuit based on the popular negligence action almost invariably raises scientific questions of causation. So too a private nuisance claim may involve scientific consideration of whether an activity constitutes an unreasonable interference with the use and enjoyment of property. A *Rylands v. Fletcher* action will often involve scientific issues of whether a particular substance which escapes onto the property of another constitutes a dangerous non-natural use of land. Riparian rights litigation inevitably requires scientific consideration of whether a particular pollution event results in an alteration of the quality or quantity of water available to downstream water users. Trespass actions may require scientific information with respect to the effects of the trespass on the land of another.

2.4.3.2 Statutory Civil Actions

As stated above, civil environmental litigation has historically been framed in one or more of the traditional common law causes of action. However, motivated in part by a public perception that environmental impairment is a serious societal problem, and in part by a belief commonly held by the public that polluters have not been held sufficiently responsible for their actions, in recent years there has been a growing belief amongst legislators that a "polluter pays" principle must be more clearly established in environmental legislation. This in turn has lead to the creation of a new generation of statutory civil liabilities.

While the embodiment of this principle in legislation first gained notoriety in the United States in the *Comprehensive Environmental Response, Compensation and Liability Act.*[73] (CERCLA), the impact of the polluter pays principle is also beginning to be felt in Canadian legislation. For example, as part of its public consultation process prior to enacting the *Environmental Protection and Enhancement Act*[74] the Province of Alberta released a document entitled *A Guide To The Proposed Alberta Environmental Protection And Enhancement Legislation*[75] which set out the environmental principles which it wished the new legislation to reflect. Included within these principles was the following reference to the expansion of the cost and coverage of the polluter pays principle:

> The proposed Alberta Environmental Protection and Enhancement legislation seeks to place responsibility on parties who use the environment for any adverse effects they may cause.

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73 Pub. L. No. 96-50, 94 Stat. 2767 (codified at 42 U.S.C. at ss. 9601 - 9657 (1982 & Supp. 1989)). The Act was subsequently amended and reauthorized in 1986 by the *Superfund Amendments and Reauthorization Act*, (SARA), Pub. L. No. 99 - 499, 100 Stat. 1613, (codified at 42 U.S.C.A. at ss. 9601 - 9675 (Supp. 1988). The Act was again reauthorized in 1990, Pub. L. No. 101 - 508, 104 Stat. 1388 - 319, (codified at 42 U.S.C.A. at ss. 9601 - 9675).

74 *Supra*, note 63.

75 Alberta Environment, *A Guide To The Proposed Alberta Environmental Protection And Enhancement Legislation* (Edmonton: Queen's Printer, 1991).

One of the most important principles requires polluters to pay for environmental damage and for the cost of corrective action.

The application of the polluter pays principle has created two distinct types of statutory civil liability. The first is the creation of statutory liability for breach of environmental or natural resource regulatory legislation. The second is the creation of statutory civil liability for the cleanup of contaminated sites and response to prevent the release of contaminated substances. Each of these will be considered in turn.

a) *Civil Action Upon Breach of Regulatory Legislation*

The first new type of statutory cause of action is one which creates a civil cause of action against a polluter who has been convicted of an offence under regulatory legislation.[76] An example of this cause of action is found in the Alberta *Environmental Protection and Enhancement Act.*[77] That Act creates a civil cause of action for a conviction of an offence under the Act. Section 207 of the Act provides as follows:

> 207 Subject to section 208, where a person is convicted of an offence under this Act, any person who suffers loss or damage as a result of the conduct that constituted the offence may, in a court of competent jurisdiction, sue for and recover from the convicted person an amount equal to the loss or damage proved to have been suffered.[78]

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76 A variation on this theme is found in the *Canadian Environmental Protection Act* (R.S.C. 1985, c.15.3), which empowers a court to issue a form of restitution order compelling a person convicted of an offence under the Act to pay compensation for property loss or damage resulting from the commission of the offence. Section 131.(1) of that Act states:

> 131.(1) Where an offender has been convicted of an offence under this Act, the court may, at the time sentence is imposed and on the application of the person aggrieved, order the offender to pay to that person an amount by way of satisfaction or compensation for loss of or damage to property suffered by that person as a result of the commission of the offence.

Further, once such an order is filed, it is entered as a judgment and becomes collectable in the same manner as a civil judgment, pursuant to section 131.(2):

> 131.(2) Where an amount that is ordered to be paid under subsection (1) is not paid forthwith, the applicant may, by filing the order, enter as a judgment, in the superior court of the province in which the trial was held, the amount ordered to be paid, and that judgment is enforceable against the offender in the same manner as if it were a judgment rendered against the offender in that court in civil proceedings.

This raises the issue of whether such an order, once filed as a judgment, is covered under environmental impairment policies.

77 *Supra*, note 63.

78 *Supra*, note 63 at s. 207.

The purpose of this form of statutory cause of action is ostensibly to make it easier for a person who has suffered loss or damage[79] as a result of the actions of a polluter who has been convicted of an offence under the Act to bring a civil action and recover compensation from the polluter. The legislation accomplishes this goal by effectively removing two of the usual requirements for the bringing of a civil action in negligence. First, it removes the requirement that the claimant establish that the defendant owed the claimant a duty of care. Second, it also removes the requirement that the claimant establish the standard of care to be met and that the defendant failed to meet that standard. Thus, the burden on the claimant is reduced to establish that the defendant was convicted of an offence under the Act and that there is a causal link between the conduct that constituted the offence and the loss or damage suffered.

A second form of statutory cause of action for breach of statutory environmental or natural resource regulation has recently been implemented in some jurisdictions which attempts to combine the "polluter pays principle" with the "public trust doctrine". This hybrid form of legislation allows residents residing within a jurisdiction to bring a civil action under one or more of the common law causes of action against a polluter on behalf of another person or on behalf of the public trust, irrespective of whether the claimant resident has suffered any personal loss as a result of the actions of the polluter. An example of this type of legislation is found in the Northwest Territories *Environmental Rights Act*.[80] Section 6(1)(2) of that Act states that:

> 6.(1) Every person resident in the Territories has the right to protect the environment and the public trust from the release of contaminants by commencing an action in the Supreme Court against any person releasing any contaminant into the environment.
>
> (2) No person is prohibited from commencing an action under subsection (1) by reason only that he or she is unable to show
>
> (a) any greater or different right, harm or interest than any other person; or
>
> (b) any pecuniary or proprietary right or interest in the subject matter of the proceeding.

This legislation also provides the courts with the power to award damages to any person adversely affected by the pollution whether they are a party to the action or not, and to the Government of the Northwest Territories on behalf of the public trust. Section 6(3) of the Act provides, *inter alia*, that:

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79 It is interesting to note that this legislation uses the term "loss or damage" rather than the usual "personal injury or property damage". This suggests that this cause of action may also be available to claimants who have suffered pure economic loss.

80 R.S.N.W.T. 1990, c. 83 (Suppl.). This legislation was incorporated into the legislation of the Nunavut Territory on April 1, 1999.

> 6.(3) The Supreme Court, in respect of an action commenced under subsection (1), may,
>
> (c) order the defendant to pay an amount by way of satisfaction or compensation for loss or damage resulting from the release to
>
> (i) any person having an interest in property that is adversely affected by the release of the contaminant into the environment, and
>
> (ii) the Minister;

Any money awarded to the Minister must be placed in a special account which is to be used exclusively for environmental repair and enhancement. Section 6(4) of the Act states:

> 6(4) Any money received by the Minister pursuant to an order under paragraph 3(c) shall be deposited in an account in the Consolidated Revenue Fund and disbursed for the following special purposes:
>
> (a) the repair of any damages caused by the release of the contaminant; or
>
> (b) where action is not practicable under paragraph (a), the enhancement or improvement of the environment.

If other Canadian jurisdictions follow the lead of the Northwest Territories in allowing resident claimants to bring actions on behalf of any person or the public trust for loss or damage resulting from the release of a contaminant into the environment, it is reasonable to expect that the source and extent of claims for environmental damage will increase dramatically.

b) *Statutory Civil Liability for Preventive Response And Cleanup of Contaminated Sites*

The second form of civil statutory environmental or natural resource action is the creation of statutory civil liability for the cleanup of contaminated sites and response to prevent the release of contaminated substances. In response to a growing concern over unsafe disposal of hazardous wastes,[81] in 1980 the United States Congress enacted the *Comprehensive Environmental Response, Compensation and Liability Act*[82], commonly

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81 Including such high profile environmental problems as Love Canal in Niagara Falls, New York and Valley of the Drums in Shephardsville, Kentucky.

82 *Supra*, note 73.

referred to as "CERCLA" or "Superfund". This legislation embodied a four part scheme for dealing with the issue of environmental contamination:

1) First, it established a framework for the acquisition and analysis of information relating to contaminated sites, which information would be available to both the federal and state governments in setting up response strategies.[83]

2) Second, it empowered the United States Government through the Environmental Protection Agency (EPA) to take such action as deemed necessary to respond to prevent potential environmental contamination and to effect remediation of existing contaminated sites.[84]

3) Third, it created a statutory liability on the person or persons deemed to be responsible for a contaminated site.[85]

4) Fourth, it authorized creation of the Hazardous Substances Trust Fund to cover the costs of remediation when a person or persons responsible for a contaminated site could not be identified.[86]

Historically, limited statutory civil liability for response measures to prevent the release of contaminants into the environment was included in some Canadian natural resource legislation. However, much broader civil statutory liabilities are now being included in environmental legislation. The purpose of this legislation is similar to that of CERCLA, and a number of Canadian enactments reflect this similarity. Typical of the Canadian

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83 *Supra*, note 73 at ss. 102 - 103, 42 U.S.C. ss.9602 - 9603 (1988).

84 *Supra*, note 73 at s. 104, 42 U.S.C. at s. 9604 (1988). The response options open to the EPA have been summarized as follows:

> Under CERCLA, once the EPA receives notice that a hazardous waste site is releasing hazardous substances into the environment (or that such a release is threatened), the EPA has several choices. It can obtain an injunction to compel the polluter to clean up the site, postponing litigation of liability. Alternatively, the EPA can notify the responsible party and give it an opportunity to voluntarily clean up the waste site. A third option is for the government to conduct the cleanup and sue the responsible party for reimbursement.

(Cervon, Kathryn L., "CERCLA Cleanup Costs As "Damages" Under the CGL Policy: Is the Cost of Hazardous Waste Cleanup Merely Small Change for the "Deep Pockets" of Insurers?" (1991), *FICC Quarterly*, 391 at 395).

85 *Supra*, note 73 at ss. 106 -106, 42 U.S.C. ss. 9606 -9607 (1988).

86 *Supra*, note 73 at s. 111, 42 U.S.C. at s. 9611 (1988). In 1980 Congress authorized an initial budget of $1.6 billion for cleanup costs. When reauthorized in 1986 by the *Superfund Amendments and Reauthorization Act* of 1986 (SARA) this amount was increased to $8.5 billion (42 U.S.C. at ss. 9607, 9611). Upon once again receiving reauthorization in 1990, Congress approved a $5.1 billion budget for the period of October 1, 1991 to September 30, 1994.

approach is the *Canadian Environmental Protection Act*.[87] Section 36.(1)(2) of that Act sets out the following federal requirements with respect to preventing the release of contaminants into the environment and the cleanup of existing contamination:

> 36.(1) Where there occurs or is a reasonable likelihood of a release into the environment of a substance specified on the List of Toxic Substances in Schedule I in contravention of a regulation made under section 34 or an order made under section 35, any person described in subsection (2) shall, as soon as possible in the circumstances,
>
> (b) take all reasonable emergency measures consistent with public safety to prevent the release or, it cannot be prevented, to remedy any dangerous condition or reduce or mitigate any danger to the environment or to human life or health that results from the release of the substance or may reasonably be expected to result if the substance is released;
>
> (2) Subsection (1) applies to any person who
>
> (a) owns or has charge of a substance immediately before its initial release or its likely initial release into the environment; or
>
> (b) causes or contributes to the initial release or increases the likelihood of the initial release.

In the event that a person listed in section 36.(2) refuses to comply with an order to undertake preventive response measures or to clean up a contaminated site, the Act allows the government to step in and effect the cleanup. Section 36.(5)(7) of the Act states:

> 36.(5) Where any person fails to take any measures required under subsection (1), an inspector may take those measures, cause them to be taken or direct any person referred to in subsection (2) to take them.
>
> (7) Any inspector or other person authorized or required to take any measures under subsection (1) or (5) may enter and have access to any place or property and may do such reasonable things as may be necessary in the circumstances.

Consistent with most legislation of this type, in the event that a person refuses to comply with an order to clean up a contaminated site, the *Canadian Environmental Protection Act* allows the Federal Government to recover from the person or persons responsible any costs which it incurs as a result of undertaking a preventive response or contaminated site cleanup. In this regard, section 39.(1)(5) of the Act provides:

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87 *Supra*, note 61. Similar provisions may be found in the Alberta *Environmental Protection and Enhancement Act*, R.S.A. 1980, c. E-13.3, Pt. 4, and in recent amendments to the British Columbia *Waste Management Act*, R.S.B.C. 1979, c. 428.5, ss 10, 22.

39.(1) Her Majesty in right of Canada may recover the costs and expenses of and incidental to taking any measures under subsection 36(5) from

(a) any person referred to in paragraph 36(2)(a); and

(b) any person referred to in paragraph 36(2)(b) to the extent of the person's negligence in causing or contributing to the release.[88]

(5) A claim under this section may be sued for and recovered by Her Majesty in right of Canada with costs in proceedings brought or taken therefor in the name of Her Majesty in right of Canada in any court of competent jurisdiction.

Due in large part to the relative newness of statutorily imposed liabilities for preventive response measures necessary to prevent the release of contaminants into the environment and the cleanup of contaminated sites in Canada, there have been relatively few instances where governments in Canada have undertaken a preventive response or cleanup and have subsequently attempted to recover their costs from a responsible party through the courts. As a result, there is currently minimal judicial guidance in this area.

2.4.4 Administrative Law Applications

The final context in which science currently plays an important role in environmental decision-making in the legal context is with respect to administrative law applications. This context has a large volume of activity. These applications generally relate to the approval of proposed and existing activities which raise environmental issues. The Federal Government[89] and some provincial jurisdictions including Ontario,[90] Alberta[91] and most recently the new Nunavut Territory[92] have adopted an approach to environmental decision-making which shifts responsibility for many environmental decisions from the traditional decision-maker,

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88 *Supra. note 61.*This is in sharp contrast with the joint and several provisions found in CERCLA. While increasing the possibility that the Federal Government may have to assume responsibility for part of the costs associated with preventive responses and contaminated site cleanups in situations where all of the persons responsible for an incident cannot be located, this approach appears to be fairer to those persons with only a small degree of responsibility in the matter. This in turn should significantly reduce the amount of litigation in that there is no possibility that those persons responsible for an incident who have been identified will have to bear a disproportionate share of the liability.

89 Examples include the National Energy Board and the Canadian Environmental Assessment Agency.

90 Examples include the Ontario Environmental Assessment Board and the Ontario Municipal Board.

91 Examples include the Alberta Environmental Appeal Board, Natural Resources Conservation Board, Energy and Utilities Board, and a myriad of regional and local administrative tribunals such as Development Appeal Boards.

92 Examples include the Nunavut Impact Review Board, Nunavut Wildlife Management Board, Nunavut Water Board, Nunavut Planning Commission and Nunavut Surface Rights Tribunal.

government, to arms-length administrative tribunals. Many see this shift as desirable in that it has the potential of making environmental decision-making more transparent and more accessible to the public at large. An added advantage to governments is that it allows government departments and agencies to offload decisions involving controversial issues to "independent" decision-makers in the form of administrative tribunals.

While science plays an important role in environmental decision-making in an administrative context, it should be emphasized that it is often not the sole determinant in these decisions. Environmental decisions of this type are frequently made in the context of broad-based public policy decisions on resource management. For example, the Alberta Energy and Utilities Board makes its decisions with respect to resource project applications on the basis of what is "in the public interest". This criterion acknowledges the importance of value choices related to economic and social concerns in addition to scientific and technical choices.

2.5 Conclusions

The dynamics of the relationship between science and law have changed considerably from their early historical roots to the present day, and there are indications that these dynamics will continue to undergo change into the future as the legal system is called upon to address a growing number of complex environmental legal issues.

The rules established by the courts in Canada for the admission of expert evidence are long established and relatively clear. Expert evidence will be received by the courts if a judicial decision-maker is unable to draw the necessary inferences with respect to a scientific issue which must be resolved in order to resolve a larger jurisprudential dispute. However, such rules generally do not exist in administrative environmental decision-making, where the ability of a decision-maker to draw inferences with respect to scientific issues appears to be largely irrelevant to the admissibility of scientific evidence.

Expert evidence is employed for a number of purposes, including the explanation of scientific concepts, the presentation of evidence relating to scientific investigations, opinion based on the facts of a case, and the interpretation of environmental legislation.

Finally, expert evidence is most often applied in four legal environmental decision-making contexts, including the establishment of regulatory standards, the prosecution of regulatory offences, civil law actions (both common law and statutory) and administrative law applications.

3.0 Preliminary Identification of Problems in the Use of Science in Legal Decision-Making: A Review of the Experience Based Observations of the Author and Advisory Team and a Review of the Legal and Scientific Literature

3.1 Introduction

The experience based observations of the author and advisory team[93] indicated the existence of numerous problems with respect to the use of scientific information in legal environmental decision-making institutions and processes. Many of these experiences and observations are corroborated by the legal and scientific literature.[94] It is suggested that these problems may be classified into five general categories,[95] or "interfaces" between science and

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[93] The advisory team consisted of:

- Dr. Steve E. Hrudey, Professor, Faculty of Medicine and Dentistry, University of Alberta;
- Dr. Andrew Thompson, Professor *Emeritus*, Faculty of Law, University of British Columbia;
- Dr. Harvey Krahn, Professor, Department of Sociology, University of Alberta;
- Al Lucas, Professor, Faculty of Law, University of Calgary;
- Linda Reif, Professor, Faculty of Law, University of Alberta;
- Karin Mickelson, Professor, Faculty of Law, University of British Columbia; and
- His Honour Judge Leo J. Wenden, Provincial Court of Alberta.

[94] Smith and Wynne, *supra* note 12, have made a significant contribution to this field of study by bringing a wealth of case-specific evidence into the literature in this area through their case study analyses.

[95] A number of taxonomies have been suggested for the purpose of facilitating the identification and analysis of the problems which exist between science and law in the general context. For example, one popular taxonomy suggests that the relationship between science and law consists of the following six relationships:

1. scientific knowledge used to make adjudicatory determinations;
2. scientific knowledge compelling the reexamination of existing legal doctrines;
3. scientific developments creating hazards that require state intervention;
4. governmental inducements for scientific research;
5. tax incentives for technological development; and
6. scientific developments that force new international relationships.

(Cavers, "Introduction: Science and the Law Symposium" (1965), *Michigan Law Review*, Vol. 63, 1325).

A modified version of the Cavers taxonomy is advanced by Gibbons, Hugh in his article "The Relationship Between Law and Science" ((1981), *Idea: The Journal of Law and Technology*, Vol. 22 No. 3, 227 at 228 - 241):

A. The Judicial Process
   1. Science and technology used to make adjudicatory determinations
   2. Scientific information forcing a reexamination of law
   3. New technology compelling a change in legal doctrine or the development of new doctrines
   4. Use of scientific ideas, thought processes and investigatory techniques in law

B. The Political Process
   1. Technology utilized in the political process
   2. Scientific and technical information used in making laws

C. The Administrative Process
   1. Scientific information used to formulate laws
   2. Technology used to enforce laws

law in the context of environmental decision-making as set out below.

1) The quality of scientific information which is introduced into the environmental decision-making process at environmental trials/administrative environmental hearings.

2) The communication of scientific information at environmental trials/administrative hearings and the comprehension/understanding of that information by trial/hearing participants such as judges, administrative tribunal members and legal counsel.

3) The issue of scientific uncertainty at environmental trials/administrative environmental hearings.

4) The use of scientific information to establish the decision-making standards which are used by the legal system, and the translation of scientific information into those standards at environmental trials and administrative environmental hearings.

5) The suitability of existing legal decision-making institutions and legal procedures for the resolution of scientific issues in environmental decision-making.

A summary of some of the experience based observations of the author and advisory team and a review of significant legal and scientific literature with respect to each of these categories is set out below.

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3. Scientific studies of the effect of laws

D. Science and Technology affecting general society, giving rise to a response through law
1. Developments creating opportunities
2. Developments creating hazards
3. Developments causing social change
4. Scientific studies revealing or documenting presently existing dangers
5. Technological developments requiring or allowing new international relationships

3.2 Problems with the Quality of Scientific Information Introduced into Environmental Decision-Making Processes

The first major identifiable area with respect to problems in the use of science in environmental decision-making relates to the quality of scientific information which is introduced into environmental decision-making processes. This may be referred to as the "quality of scientific information interface". Indicators suggest that in some circumstances the scientific information provided by expert scientific witnesses at environmental trials and administrative environmental hearings for the purpose of assisting decision-makers in addressing scientific issues found within jurisprudential disputes may be of deficient quality, thereby compromising the factual basis upon which the jurisprudential decisions are founded.

3.2.1 Experience Based Observations

The author and some members of the advisory team indicated that they had experienced or observed first-hand problems with the quality of scientific information introduced into environmental decision-making processes.

A common complaint was the refusal of courts and tribunals to pro-actively screen the quality of evidence introduced by employing more rigorous "qualification" procedures with respect to prospective expert scientific witnesses. The perception of the author and advisory team in this regard is that Canadian courts are generally reluctant to refuse to qualify an expert witness (no matter how poor the qualifications of a prospective expert witness). Instead, the courts prefer to allow the admission of the evidence and later evaluate its value through the process of assigning evidentiary weight.

A related problem also noted was a failure by the courts in some cases to confine an expert scientific witness to the area of expertise in which they are qualified to give evidence. Rather, experts are often allowed to roam into related areas in which they have not been qualified as an expert.

A third problem observed was an apparent lack of understanding by expert witnesses of the decision-making process in which they are involved, and in particular the adversarial nature of that process. The author vividly recalls lengthy preparation sessions prior to a public health board hearing considering a controversial application for approval of a major solid waste management facility.[96] After countless hours spent evaluating the proposal and developing a strategy to highlight the weaknesses of the plan to the tribunal, in frustration a leading scientist turned to me and stated that he could save everyone a lot of time, effort

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96 City of Edmonton Board of Health Hearing with respect to an application by the City of Edmonton for a solid waste management facility at the Aurum site located on the eastern boundary of the City.

and money if he could have the opportunity to meet with the proponent's scientific and technical team for one half hour to demonstrate the flaws in the plan. My explanation that the adversarial nature of the process in which we were currently involved would not allow such interaction between scientists sounded nonsensical even to me!

A fourth problem involved distortion of scientific evidence through reliance on cross-examination for testing of veracity. If the quality of cross-examination is inadequate or misguided, then no effective testing of veracity will occur. Members of the advisory team from the scientific community relate observations of expert witnesses who try to "fly" opinions at trials or hearings that they would not dare put forward at scientific meetings. They observe that the quality of scientific evidence is open to manipulation by talented individuals with scientific knowledge and experience with the trial or hearing process. A person with such skills can effectively tip-toe through a complex issue, bringing out only those factors which support his opinion and avoiding those which would undermine him. In some situations only an equivalent expert will be able to catch someone doing this, with the reality being that in many situations equivalent experts are not available. An illustration of this concern occurred in *R. v. Suncor,* a case which involved the prosecution of charges under the federal *Fisheries Act* relating to the discharge of effluent into Alberta's Athabasca River.[97] During the course of that trial one internationally renowned scientist who appeared as an expert witness was obliged to admit under cross-examination that his opinions were "adventurous". However, the admission came only after a series of cross-examination questions closely guided by an expert of equal or better qualifications. Without skilled and insightful cross-examination such admissions are unlikely to be extracted from a skilled witness.

A fifth concern raised by the author and advisory team involved external influences on scientific witnesses. This concern focussed on the potential for expert scientific witnesses to be influenced in their evidence by external factors such as preparation by legal counsel prior to the giving of evidence, discussions with scientific advisors retained by legal counsel to assist with the conduct of the litigation, and interactions with audiences at environmental decision-making fora and with the news media. The author and some members of the advisory team had personal experiences with influence by legal counsel. An extreme example observed by the author was a trial where an expert scientific witness had been "briefed" so thoroughly by his legal counsel that questions to be asked by counsel and the expected reply of the witness were "scripted" on paper. However, counsel had neglected to advise the witness not to bring his script to court. During the course of the examination-in-chief the author observed the witness referring to his scripted answers, and could even see legal counsel and the witness turning pages of the script at the same time as they went through the examination-in-chief together. The judge, (who was busy examining and recording comments with respect to evidence referred to by the witness) and opposing

97 (1982), 3 F.P.R. 264 (Alta. Prov. Ct.)

counsel, (who were frantically recording the evidence of the witness to assist in preparation of cross-examination) were never aware of the carefully rehearsed play which took place before them.

A final problem identified by the author and advisory team concerned a lack of balance with respect to the scientific/technical information presented to decision-makers as a result of unequal resources of the parties responsible for presenting such evidence. It was observed that parties with superior resources were able to advance scientific/technical evidence more effectively than parties with inferior resources. As many environmental decision-makers currently rely exclusively upon the evidence presented to them in order to make their decisions, it was observed that evidence with inferior technical merit advanced in an effective manner by well funded parties would be accepted over evidence with technically superior merit presented less effectively by parties with lesser resources. This gives rise to the observation that In situations where a significant inequality of resources exists between the parties, a party with superior resources can unduly influence the decision-making process.

3.2.2 Review of Literature

Experience based observations of the author and advisory team which indicate problems in the quality of scientific information introduced into environmental decision-making processes found support in the legal and scientific literature and were supplemented by additional problems. A review of some of the more interesting problems identified in the literature follow.

A review of the literature revealed that there is a perception amongst many who are involved with environmental decision-making in environmental trials and administrative environmental hearings that the quality of scientific information presented by expert witnesses often suffers as a result of scientific objectivity being overshadowed by scientific advocacy. As one scientist has observed:

> If toxic perceptions commonly depart from the science of toxicology, nowhere is that disparity more manifest than in the courtroom. There, the wider the gap between perceptions and science, the greater the financial rewards. The interest of claimants is best served, not through dispassionate analysis of the merits of their toxic claims - sticking to the science. Rather, the drama of the courtroom and the salesmanship needed to sway juries, demands the magnification of perceptions and the minimization, or outright distortion of science.[98]

98 Gots, Ronald E., *Toxic Risks: Science, Regulation and Perception*, (Boca Raton: Lewis Publishers, 1993) at 152.

The potential for expert scientific witnesses to overzealously assist their clients has long been recognized by the courts. As early as 1884 in the United States the New York Court of Appeals observed that:

> ...twelve jurors of common sense and common experience ... would do better on their own than with the help of hired experts ... whose opinions cannot fail generally to be warped by a desire to promote the cause in which they are enlisted.[99]

This problem has also been recognized in Canada. In this regard the Honourable Mr. Justice Lance Finch of the British Columbia Court of Appeal has observed:

> The problem that has developed with opinion evidence generally is that experts have been encouraged by lawyers, and permitted by judges, to go far beyond the proper scope of opinion evidence. The experts have become advocates. They assume facts favourable to the parties who retain them.[100]

3.3 Communication and Comprehension of Scientific Information at Environmental Trials and Administrative Hearings

The second type of problem identified between science and law in environmental decision-making is concerned with the communication of scientific information at environmental trials and administrative environmental hearings and the comprehension/understanding of that information by trial and hearing participants such as judges, administrative tribunal members and legal counsel. This may be referred to as the "communication/comprehension interface".

3.3.1 Identification of Problems in the Communication of Scientific Information

The primary means of introducing scientific information into legal environmental decision-making processes is through the communication of that information by members of the scientific community to environmental decision-makers. However, indicators suggest that significant communication impediments may exist between the scientific and legal communities.

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99 *Ferguson v. Hubbell*, 97 N.Y. 507, at 514 (1884) (N.Y.C.A).

100 Finch, Lance S.G., "Experts and Experts' Reports: The Court's Perspective" *Experts and Experts' Reports* (Vancouver: Continuing Legal Education Society of British Columbia, 1988) at 3.1.01.

3.3.1.1 Experience Based Observations

The author and a number of members of the advisory team indicated that they had experienced or observed problems with respect to the communication of scientific evidence in environmental decision-making processes.

One of the most often cited of these problems were issues of language differences. While most often seen in the context of linguistic problems between the scientific and legal communities, this problem was often observed between scientific disciplines themselves, as different disciplines often have different concepts attached to the same words or different words for the same concept.[101] A classic example is the meanings which may be attached to the terms "reliability" and "validity". To an engineer or physical or biological scientist, a measure which is reliable is one which is accurate or truthful, whereas to a social scientist or epidemiologist, reliability means only that the measurement can be replicated, not that it is necessarily correct (accurate). This latter group uses the term validity to mean whether a measure is accurate. To further confuse matters, the legal community tends to use the terms reliability and validity interchangeably to refer to accuracy.[102] Another example involving the subtlety of language is the rampant confusion in the scientific community about the distinction between "accuracy" and "precision".[103] It is felt that these subtle sources of confusion are much more dangerous than openly recognized sources of confusion. If the decision-maker thinks he understands the issue, but does not really understand the terminology because of important but subtle nuances, an erroneous decision can readily follow.

A classic example of mis-communication between scientific disciplines was found in the joint experiences of the author and one of the scientific members of the advisory team. In that case in the course of representing a proponent of a proposed solid waste management facility before an administrative tribunal a hydrogeologist was retained to give expert evidence relating to potential groundwater contamination.[104] Following pictorial evidence presented by an earlier witness of foul-looking "new" leachate which had formed in flooded

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101 Kaplan, Stan, "The Words of Risk Analysis". *Risk Analysis* (Vol. 17, No. 4) 1997, 407 at 408.

102 See for example the reasons for judgment of Moldaver J. in *R. v. Melaragni and Longpre*, *supra* note 24.

103 Accuracy of a measurement refers to how well it represents the true value whereas precision represents how closely repeated measures of the same thing will agree. An ideal measure will be both accurate and precise. But, a measure may be precise (close agreement of repeated measures) but inaccurate. Likewise, a measure may be accurate but imprecise (repeat measures do not agree closely but their average is close to the true value). This distinction is obviously important because accuracy is usually more important than precision but sometimes excellent precision is offered, unreliably, as meaningful evidence of accuracy.

104 Hearing of the County of Red Deer, Alberta Development Appeal Board in the matter of an Application by the Central Alberta Regional Waste Authority for approval of a solid waste management facility near Pine Lake, Alberta.

landfill trenches, the hydrogeologist provided detailed model evidence relating to the escape of leachate through a clay landfill liner and the transportation of that leachate through groundwater to a nearby stream. At the conclusion of his presentation the image left in the minds of many hearing participants was a torrent of the new, foul leachate flowing into the stream. In presenting his evidence the expert witness had not distinguished between a water "quantity" leachate model which he was using and a water "quality" model which would also consider the contaminant value of that leachate. In this case a clay liner was provided to hold the leachate for a minimum of 150 years, during which time the new, foul leachate was to be pumped out for treatment, with the result being that the eventual quantities of long term leachate described by the hydrogeologist in his evidence would have been a relatively clean liquid because most contaminants will have been extracted by the foul leachate. Needless to say a "rescue operation" was undertaken during the following day's proceedings to properly communicate the distinction between modelling quantities of liquid and the quality of that liquid. Yet, even the experts advising legal counsel were confused by the hydrogeologist's evidence and the essence of the distinction only became apparent almost fortuitously.

A second concern in this area is with the control of information in environmental decision-making processes. Control of information may significantly impact the outcomes of environmental decision-making processes. This principle was recently recognized by the Federal Court of Canada in the context of the provision of scientific and technical reports prior to the commencement of an administrative environmental hearing. In *Qikiqtani Inuit Association v. Canada (Minister of Indian Affairs and Northern Development) and Nanasivik Mines Ltd.* Madam Justice Reed of the Federal Court criticized the Nunavut Water Board for not making scientific and technical information available to interested parties in advance of a public hearing:

> The control of information is a very effective method of controlling the decision that is ultimately made.[105]

Examples of how the control of information affects the evidence and arguments which are presented to an environmental decision-maker abound. For example, some administrative tribunals now allow proponents who are under time constraints to obtain approvals to submit part of the scientific and technical information relating to their proposal sufficiently in advance of consideration by the tribunal with the remainder of the information to be supplied close to the actual hearing date - thereby effectively precluding critical review of and response to this material by other parties.

A final concern voiced by the author and some members of the advisory team involved communication problems in situations where it is necessary to translate scientific information into aboriginal languages, or where expert evidence in the form of traditional

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105 (1999) 155 F.T.R. 161 at 172 per Reed J.

knowledge is translated from an aboriginal language into English. Experiences of the author at administrative environmental hearings in both the Northwest Territories and Canada's new Nunavut Territory indicate that scientific and technical terms presented in the English language are often difficult to translate. For example, in Canada's eastern arctic region a large percentage of aboriginal Inuit inhabitants have Inuktitut as their first language, with a significant number being unilingual. Inuit translators providing translation at environmental hearings are unanimous in their view that scientific and technical terminology does not translate well into Inuktitut, as southern technology upon which these scientific and technical terms are based traditionally did not have a place in Inuit society. This problem is exacerbated by the fact that Inuktitut is traditionally an oral language, with written syllabics a relatively recent addition to the language. This reduces the value of written communication of scientific concepts through media such as reports, even when translatable into Inuktitut syllabics.

The reverse of the problem is in translating traditional knowledge from aboriginal languages into the English language at environmental decision-making processes. Continuing with our example of the Inuit of Canada's north, an Inuk elder may be called upon at a hearing to give evidence with respect to an issue such as conservation of wildlife populations. That evidence may provide useful information to decision-makers, including important long-term baseline information often absent from many industrial development proposals. The knowledge provided by the elder will likely be information passed along to him by generations of ancestors as interpreted through his own experiences. Thus, for example this knowledge may include the strongly held Inuit belief that you must live in harmony with the environment in order to survive, which includes the principle that a person should not harvest more than that which is needed to survive. While this principle is not unusual, the means of communicating it from one generation of Inuit to the next differs from the prevailing scientific paradigm. Rather than stating the principle outright, it is often presented in terms of a story or parable involving the legend of Sedna, the sea goddess who made all the animals of the sea. Inuit tradition requires respect for the animals that are hunted in order for Sedna to continue to provide these animals. Examples of respect include not harvesting more than you need, not wasting any part of the animal, giving back part of the seal to the sea; and taking snow from the hunter's mouth and placing it in the mouth of the seal to revive the spirit of the seal. Communication of otherwise valuable conservation information found within the story may be lost on non-Inuit decision-makers who are inexperienced at receiving information in the traditional Inuit style often used by elders.

3.3.1.2 Review of Literature

Experience based observations of the author and advisory team which indicate problems in the communication of scientific information in environmental decision-making found support in the legal and scientific literature and were supplemented by additional problems. A review of some of the more interesting problems identified in the literature follow.

Just as science and law have developed their own unique values, philosophies and procedures, so too have they developed their own languages for the purpose of effectively communicating the ideas developed within each discipline. Unfortunately, while these languages may be effective in communicating information within each discipline, the same cannot be said for interdisciplinary communication. The problem is illustrated by an anecdote in a speech delivered by the Honourable Howard T. Markey, Chief Judge of the United States Court of Appeals for the Federal Circuit:

> Another crying need is for the practitioners of science and law to understand each other -indeed even to talk to each other. I once had the honor of speaking to that extreme rarity, a meeting of scientists and lawyers. I opened with "because you have read my article Science and Law - a Dialogue on Understanding, my speech is *res judicata*. But then *res ipsa loquitur*. Fortunately, there is no collateral estoppel or exclusionary rule. Yet there is no subpoena, *ad testificandum or duces tecum*, or writ of habeas corpus. I am calendared, and there is not writ of certiorari and no question of venue. To interrogatories on my deposition I plead *nolo contendere*. I may demand a bill or particulars, proper execution, and a Brandeis brief." Not one scientist had the slightest idea of what I had said. The lawyers knew I said, "my speech has been pre-judged. But then it speaks for itself. Fortunately, it is not prevented by the article and cannot be excluded as having been illegally obtained. Yet I have not been forced to speak or to bring anything with me, not even my body. I am scheduled, and you can't change my errors or move me elsewhere. To questions on what I say, I plead no contest. I may demand that you be specific, deliver your questions to me properly, and base them on the facts."
>
> I then said, "I admit my empirical data were obtained in vitro and may not meet parameters developed in Vivo." Not one lawyer had the slightest idea of what I had said. The scientists knew. I said, "my facts were obtained by experience in the laboratory of my chambers and may not measure up to experiences in life."
>
> We need to think long and hard about the future of a society as technologically oriented and as law-soaked as ours when our scientists and lawyers cannot even talk to each other.[106]

In considering the issue of communication problems between the scientific and legal communities, two Judges of the United States Nuclear Regulatory Commission's Atomic Safety and Licensing Board Panel have suggested that they view the "... use of jargon as

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106 Markey, Howard T., "Science and Law: The Friendly Enemies" (1989), *Idea: The Journal of Law and Technology*, Vol. 30 No. 1, 13 at 17-18. The article was based upon a speech delivered for the Francis W. Davis Lecture on Law and Technology, Franklin Pierce Law Center, Concord, New Hampshire, March 22, 1989, as found in Markey, Howard T., "Law and Science - Equal but Separate" (1982), *Natural Resources Lawyer*, Vol. 15 No. 3, 619. See also, Markey, Howard T., "Science and Law: A Dialogue on Understanding (1982), *American Bar Association Journal*, Vol. 68, 154.

reflecting perhaps a more subtle problem in interdisciplinary communication".[107] That problem involves the fact that with respect to a given environmental problem the scientific and legal communities "... will approach the problem from a different perspective and with different values".[108] These result from differences in their training and experience". The Judges summarized their view as follows:

> We believe that jargon is just the most easily recognized manifestation of those differences, and that effective interdisciplinary communication depends not only on understanding and eliminating jargon, but also (and more importantly) on understanding differing points of view and values.[109]

3.3.2 Identification of Problems in the Comprehension and Understanding of Scientific Information

In the event that scientific information which is provided to an environmental decision-maker is of high quality and is communicated in an effective manner, there is still a concern that incompatibilities between the scientific and legal systems may inhibit or even preclude the comprehension of such information by legal environmental decision-makers.

3.3.2.1 Experience Based Observations

The author and members of the advisory team had a variety of experiences and observations involving problems in the comprehension and understanding of scientific information introduced into environmental decision-making processes. The author recalls having spent many hours in witness preparation rooms working with expert scientific witnesses and litigation scientific advisors attempting to gain an understanding of the scientific issue being addressed. In point of fact, the term "witness preparation" is really a misnomer. Much of the time spent "preparing" a witness really involves educating legal counsel of the scientific issues of the case. Unfortunately, the trier of fact does not have the luxury of spending as many hours as are necessary being "educated" by an expert scientific witness in a friendly, non-adversarial climate. Rather, the decision-maker only sees the

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107 Paris, Oscar and Frye, John, "Symposium on Law-Science Cooperation Under the National Environmental Policy Act: Appendix" (1982), *Natural Resources Lawyer*, Vol. 15 No. 3, at 655.

108 *Ibid.*, at 656.

109 *Ibid.*

"finished product", which product is itself subject to the vagaries of cross-examination.[110] The author recalls having on numerous occasions heard evidence presented by an expert witness representing a party adverse in interest - and having to subsequently caucus with one or more of his own experts and/or scientific advisors to determine firstly what the evidence was, and second the strengths and weaknesses of that evidence. Unfortunately few of the judges or administrative tribunals hearing that same evidence had the luxury of a team of experts at their disposal. Consequently, the author and the advisory team have often observed decision-makers struggling to understand a complex technical issue. Questions from the decision-maker or the final decision itself have made it apparent that a functional understanding was not achieved.

This problem also exists within the scientific community itself. Comprehension problems between scientific disciplines may create difficulty in bridging the gaps between disciplines in a complex issue which involves the input of a number of disciplines. A final scientific opinion based upon a complex variety of inputs from a variety of disciplines may be less valid than any of the individual disciplines are able to foresee. One reason for this failing is that a scientific discipline is more likely to accept, without sufficient scrutiny, the judgments they receive from another, than those judgments which take place in their own discipline. This may occur because competent practitioners in a given field will usually know their limitations at least as well as their strengths, and not knowing the weaknesses or assumptions which the other field must rely upon, may be prepared to uncritically accept findings offered by the other field which they would otherwise question in their own field. Thus, if a complex case requires an advocate (such as legal counsel) to coordinate inputs from a variety of scientific disciplines, the advocate may not be able to rely on the individual disciplines to critique adequately the interfaces between the different disciplines. This problem is less likely to occur in a scientific setting where all of the disciplines may have the opportunity to interact together in a common forum to flush out misunderstandings. However, in a linear legal process, where a sequence of witnesses is presented individually, the opportunity to expose inconsistencies is much reduced. For example, a fish toxicologist may rely on information about contaminant identification or exposure levels which have been supplied by earlier evidence. There may be inadequate attention directed to challenging the validity of sampling, analysis and/or modelling steps necessary to generate evidence as a foundation for his evidence about which toxic effects were likely.

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[110] Which may include the creation of confusion with respect to a scientific issue, or a situation of false reliance on cross-examination to test the veracity of scientific information when such cross-examination is poorly conducted or not conducted at all.

3.3.2.2 Review of Literature

Experience based observations of the author and advisory team which indicate problems in the comprehension of scientific information in environmental decision-making found support in the legal and scientific literature and were supplemented by additional problems. A review of some of the more interesting problems identified in the literature follow.

Problems involving the comprehension of scientific information in a legal context were summarized by former assistant United States Attorney General Lee Loevinger in the following words:

> ... lawyers, including judges and legislators, with rare exceptions have little comprehension of science or technology. Although the law continuously faces problems of quantum and weight of evidence, it has not yet learned to deal with uncertainty and probability as science does. ... Legal reception of scientific evidence would be much more advanced if lawyers generally knew more about the nature of the scientific method and the process of securing, testing and validating scientific data. In their impact on law, science and technology have changed,... and have increasingly provided data, or evidence, on a variety of specific questions. However, they have scarcely touched the foundations of the law, the logic and the thinking habits of lawyers and judges.[111]

This view is echoed by many within the scientific community. As one leading ecologist has observed:

> It is very frustrating as a scientist to deal with lawyers ... who want to have all of the facts immediately, even if the data have not been collected. They do not seem to understand the scientific process, which unearths new facts over time. They do not understand the ecological processes embodied in these principles, or that the natural principles cannot be altered.[112]

In a 1979 presentation at Duke University an American jurist noted for his support of mutual understanding between the scientific and legal communities offered the view that judges must be able to meet four criteria in order to be able to competently adjudicate jurisprudential disputes involving scientific issues:

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111 Loevinger, Lee, "Science, Technology and Law in Modern Society" (1985), *Jurimetrics Journal*, Vol. 26 No.1, at 8.

112 Willard, Beatrice E., "Symposium on Law-Science Cooperation Under the National Environmental Policy Act: Panel Discussion" (1982), *Natural Resources Lawyer*, Vol. 15 No. 3, 605 at 609. Dr. Beatrice Willard in Head of the Department of Environmental Sciences and Engineering at the Colorado School of Mines.

I cannot pretend that judges, through further training, or even with the assistance of science-trained clerks, will be able to engage in anything approaching a dialogue between equals with the experts testifying in their courts. But they must, at a minimum:

(1) understand the methods of scientific inquiry and proof;
(2) comprehend the merits as well as the pitfalls of statistical analysis;
(3) recognize the value premises and professional biases that often underlie natural scientific models just as they do social scientific models; and
(4) be willing to soil their hands with some of the key doctrines and premises of whatever scientific discipline that may be implicated in a case before them.[113]

3.4 Scientific Uncertainty in Environmental Decision-Making

The third category of problem identified between science and law in environmental decision-making involves the matter of scientific uncertainty in environmental decision-making processes. This may be referred to as the "scientific uncertainty interface".

3.4.1 Experience Based Observations

The author and advisory team found a strong consensus in having experienced and observed problems involving the issue of scientific uncertainty in environmental decision-making.

A problem which was regularly encountered or observed by the author and advisory team involved situations where scientific information necessary to reduce or eliminate the uncertainty was either readily available or obtainable with additional scientific investigation, but was not introduced into the environmental decision-making process. This was observed to occur in two contexts.

The first was where the adversarial process would break down. This was most often seen to occur in situations where there was ineffective opposition or no opposition in a matter, such as where inequalities in the financial resources of the parties to a dispute resulted in reduced access to qualified legal counsel and scientific expertise by one of the parties. These situations would typically be characterized by presentation of poor quality or no contradictory evidence and poorly conducted or no cross-examination. Occasionally the break down would simply the result of error on the party of a party. Irrespective of the source

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113 Leventhal, Harold, unpublished manuscript (1979), as repeated by Brannigan, Vincent,"Symposium on Law-Science Cooperation Under the National Environmental Policy Act: Appendix", *Natural Resources Lawyer*, Vol. 15 No. 3, 653 at 658. At the time of the presentation the late Honourable Harold Leventhal was a judge of the United States Court of Appeals, District of Columbia Circuit.

of the problem, the absence of meaningful challenge made it much easier for the party bearing the burden of proof to appear to achieve the requisite level of scientific certainty to meet the legal standard of proof, in that scientific information presented would not be rigorously challenged and missing information would not be identified to the decision-maker.

The second context was where the legal standard of proof was relatively low (such as in an administrative hearing or a civil legal action) and where the decision-maker would play a passive rather than active role in the matter before it and not require the party bearing the burden of proof to reduce or eliminate significant issues of scientific uncertainty. A stark and somewhat frightening example of this latter situation was recently experienced by the author in the judicial review of an administrative hearing for the renewal of the water licence held by a lead/zinc mine at Nanisivik, Northwest Territories. At a hearing held by the Nunavut Water Board with respect to the licence renewal application the Board heard evidence from a number of Inuit who resided and hunted near the mine which raised health concerns arising from possible contamination of local marine mammals such as seal and narwhal which were actively harvested in the region. One witness went so far as to state that some years previous Health Canada had advised the community not to eat seal harvested in the vicinity of the mine. The Government of Canada was represented at the hearing by the Department of Fisheries and Oceans whose representative advised the Board that the Inuit concerns fell within the jurisdiction of Health Canada. However, Health Canada did not attend the hearing or otherwise make representations and no other hearing participant addressed the health concerns which were raised. Despite the apparent scientific uncertainty surrounding this issue, the Board granted the licence renewal without making any additional inquiries of Health Canada or any other person, even though it had the power to compel witnesses pursuant to the Federal *Inquiries Act*.[114] In *Qikiqtani Inuit Association v. Attorney General of Canada et al.* the Federal Court of Canada considered an application for judicial review of the Board's decision brought on behalf of Inuit living in the region.[115] The application included the argument that once serious public health issues were raised by the resident Inuit witnesses "... the Board should have taken greater initiative with respect to the public health issues raised by this evidence, that there was an obligation on the Board to seek information held by Health Canada in this regard, that the Board has investigative powers under the *Inquiries Act* and should have used them."[116] In its decision the Court rejected this argument, stating:

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114 R.S.C. 1985, c. I-13.

115 *Supra*, note 105.

116 *Supra*, note 105 at 176.

> I cannot conclude that ... the Board declined to exercise its jurisdiction when it did not undertake independent investigations. The Board's authority to exercise powers under the Inquiries Act is permissive, not mandatory. It could have instituted a more extensive inquiry but it chose not to pursue that course of action; this is a decision that was reasonably open to it.[117]

A second problem identified by the author and advisory team involved the presentation of scientific information for the purpose of creating rather than minimizing scientific uncertainty. This phenomenon was observed to occur in the situation where a party to an environmental decision-making process who did not bear the burden of proof, but who also did not have the weight of scientific consensus on its side, would adopt a strategy of creating scientific uncertainty. Two approaches were observed.

The first approach involved the introduction of apparently contradictory or conflicting scientific information for the purpose of creating uncertainty with respect to a scientific issue, thereby preventing the party adverse in interest from attaining the required standard of proof. The absurd consequences which may result from this practice were illustrated in an application to an administrative tribunal for a solid waste management facility in central Alberta.[118] Upon conclusion of the proponent's submissions, which included addressing a variety of valid concerns raised by a group of concerned residents opposing the approval application, a scientist who was representing the residents' group in the dual role of scientific advisor and expert witness provided the tribunal with evidence in the form of a technical explanation of a geological concept known as "glacial thrust faulting" (withdrawal of glaciers left cracks or faults in some geological formations in North America). The scientist went on to give evidence that if glacial thrust faults existed in the vicinity of the proposed landfill site, contaminants could be transported through the clay till soil much more quickly than predicted by the proponent. Objections were raised by the proponent that there was no evidence of the existence of glacial thrust faulting before the tribunal, and there was no record of glacial thrust faulting within hundreds of miles of the proposed site. These objections were overruled by a concerned tribunal and the hearing was adjourned to allow the proponent sufficient time to bore a series of test holes at the proposed site to establish the absence of glacial thrust faults. Not unexpectedly none were found, and the approval was granted several months later. The irony is that the extra test holes if not properly sealed for abandonment would have a similar effect on the acceleration of the migration of contaminants as would the thrust faults themselves had they existed!

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117 *Supra*, note 105, at 183.

118 *Supra*, note 104.

A third problem observed by the author and advisory team involved assigning evidentiary weight or otherwise distinguishing between contradictory or conflicting scientific information. As stated earlier, it is common practice for courts and administrative tribunals in Canada to set a very low threshold of expertise in order to be qualified to give evidence as an expert witness. The courts choose to differentiate between the evidence of expert witnesses later in their deliberations, when evidential weight is assigned to the evidence of each expert. The difficulty of course, is for a decision-maker (who may have no scientific background and may not employ the services of an independent expert) to differentiate between two or more validly held but contradictory scientific opinions when assigning evidentiary weight to that evidence.

A final problem observed by the author and advisory team involved apparent incompatibilities between scientific and legal standards of proof. Legal counsel are constantly cognizant of the standards of proof which must be attained in the various legal fora used in environmental decision-making. Consequently scientists who give evidence as expert witnesses are commonly examined and cross-examined on issues of certainty of the scientific conclusions which they reach. It is during such questioning that one often observes a chasm between legal and scientific standards and understanding of certainty and uncertainty which may not be completely bridged. For example, in a regulatory environmental prosecution the Crown must prove its case "beyond a reasonable doubt". It logically follows that in order to meet this standard the Crown must also establish beyond a reasonable doubt the scientific conclusions necessary to resolve the larger jurisprudential dispute. However, if pressed, most scientists are reluctant to give scientific conclusions to this degree of certainty - and if they do they may leave their credibility exposed to attack if contradictory or conflicting evidence is presented. This inevitably leads to the conclusion that if the legal standard of proof is strictly applied, few prosecutions would ever be successful. At this point some may argue that the rules of evidence require that the decision-maker - not the expert witness - must make the determination with respect to the "ultimate issue" of a case, and thus it is the decision-maker and not the expert witness who will determine the degree of certainty which exists with respect to a jurisprudential issue. However, it is also very true that while an expert witness may not give evidence with respect to the ultimate issue in a case, most competent legal counsel will see it as their obligation to take their expert witness as close as possible to that ultimate issue when giving opinion evidence. This often means giving opinions on the certaintude of scientific conclusions required by a decision-maker in order to address the ultimate issue of a case - and thereby having the expert resolve the jurisprudential dispute.

3.4.2 Review of Literature

Experience based observations of the author and advisory team which indicate problems in scientific uncertainty in environmental decision-making found support in the legal and scientific literature which identified additional problems. A review of some of the more interesting problems identified in the literature follow.

3.4.2.1 Sources of Factual Scientific Uncertainty

The legal system reaches decisions which depict certainty with respect to a jurisprudential issue. This depiction of jurisprudential certainty often seeks a foundation of factual certainty. In order to provide this foundation the legal system has developed standards of proof which are thresholds of factual certainty such as "proof on the balance of probabilities" or "proof beyond reasonable doubt" or "proof sufficient to satisfy the administrative tribunal". However, science is often unable to provide the scientific information necessary to meet these factual standards. In this context there appear to be two sources of factual scientific uncertainty.

a) *Information Uncertainty*

The first is the result of an absence of information which could reasonably be obtained if sufficient resources are committed to its acquisition. This type of uncertainty has been called "information uncertainty", and may be said to occur "... when relevant data is not collected, although it could be, or when existing information is not made available to the decision-maker who needs it.[119]

b) *Knowledge Uncertainty*

The second area of scientific uncertainty exists with respect to matters which at our current level of understanding are "unknowable". This is described as "knowledge uncertainty", which "... stems from a lack of adequate scientific understanding, or from situations where the collection of necessary information is infeasible."[120]

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119 Latin, Howard, "The "Significance" of Toxic Health Risks: An Essay on Legal Decisionmaking Under Uncertainty (1982), *Ecology Law Quarterly*, Vol. 10 No. 3, 339 at 357. See also Latin, Howard, "The Feasibility of Occupational Health Standards: An Essay on Legal Decisionmaking Under Uncertainty" (1983), *Northwestern University Law Review*, Vol. 78 No. 3, 583 at 609 n. 186.

120 *Ibid.*, at 357.

3.4.2.2 Causation: the Root of Uncertainty

One of the strongest commonalities which exist between the scientific and legal systems is their relationship to the concept of causation. The desire to determine the cause of a particular phenomenon in the physical world has long driven scientific endeavour and research. So too in the legal system is there a desire to determine the cause of an event which may be subject to legal sanction (and in so doing assist in creating a link to who is responsible for the cause). In the realm of environmental decision-making the existence and degree of legal certainty with respect to the jurisprudential issue of causation is often largely dependent upon the existence and degree of scientific certainty regarding the scientific issue of causation.

In a medical science context causation may be defined as follows:

> A cause of a disease is an event, condition, characteristic or a combination of these factors which plays an important role in producing the disease.[121]

Deceptively simple in its definition, causation has proven to be a most troublesome concept for both the scientific and legal communities. Working under the assumption that the resolution of a jurisprudential issue of causation is predicated upon a determination of scientific causation, it is important to consider 3 key points relating to causation in the scientific context.

a) *Causation Difficult to Prove Absolutely*

First, it is important to understand that it is often very difficult for science to prove causal connections with high degrees of certainty. This point is well summarized by Marcia Angell in *Science on Trial*:

> ... science is also characterized by its tentativeness. This may seem counterintuitive to nonscientists who are accustomed to thinking of science as cut-and-dried. But in fact, good scientists rarely reach absolute conclusions. Particularly in medical research, certainty is extremely hard to come by. Instead, medical researchers almost always speak in terms of probabilities. When they do a study comparing two antibiotics to treat pneumonia, for example, they will couch their findings in terms of the probability that one is better than the other. When they look at the link between cholesterol and heart disease, they frame their results in terms of risks, not certainties. Very few studies are by themselves definitive. In general we should not embrace the conclusions of a research study until it has been confirmed by other, independent studies. Even then, the studies taken together merely add to the probability that the conclusion is correct, without proving it absolutely. Of course,

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121 Beaglehole, R. et al., *Basic Epidemiology* (Geneva: World Health Organization, 1993) at 71.

every aspect of life involves considering probabilities. When we drive to work, for example, we intuitively gauge the probability that an oncoming car will miss us. But scientific research is different in that probability and uncertainty are explicitly considered, measured and expressed as part of the study.[122]

b) *Cause May be Attributable to Multiple Factors*

In the event that science is unable to point to a single factor and state unequivocally that the factor is the cause of a particular physical phenomenon, (absolute proof of causation) health science addresses the possibility of multiple causes of a phenomenon through the concepts of sufficient cause, necessary cause and contributory cause. While terminology associated with these concepts is somewhat loose, a sufficient cause is one which will inevitably produce or initiate a disease. A necessary cause is one where a disease cannot occur in its absence, but its presence may not be sufficient to cause a disease.[123] The concept of sufficiency is very demanding and is rarely produced by a single factor. For example, exposures to high temperatures will inevitably produce burns and adequate exposure to HIV contaminated blood is usually sufficient to eventually cause AIDS. Necessary causes readily apply to infectious diseases where the disease itself is defined in terms of the action of a specific infectious agent (such as tuberculosis). Hence an agent is necessary because the disease requires the defining agent, but exposure to the defining agent is usually not sufficient to guarantee the disease.

In practical terms, the multi-factorial nature of disease causation make the finding of a sufficient cause rare. Further, while necessary causes are relatively common amongst infectious diseases they are far less apparent when applied to chemical contaminants.[124] As a result, in considering issues of causation in the environmental context the scientific community is often left with a series of "contributory causes". In recent years the term contributory cause has itself been supplanted in many contexts by the term "risk factors" which more clearly identifies the complexity of interactions and the uncertainty which exists in issues of causation.[125]

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122 Angell, M., *Science on Trial* (New York: W.W. Norton & Company, 1996) at 96-97.

123 *Supra*, note 121 at 71.

124 For example, benzene has been taken as capable of causing leukemia in humans, but it is neither necessary nor sufficient for leukemia.

A detailed discussion of this topic was provided by Hrudey, S.E., University of Alberta *Eco*-Research Chair in Environmental Risk Management 1998 Sponsor's Course.

125 *Ibid.*

> The term "risk factor" is commonly used to describe factors that are positively associated with the risk of development of a disease but that are not sufficient to cause the disease. ... Some risk factors (e.g. tobacco smoking) are associated with several diseases, and some diseases (e.g. coronary heart disease) are associated with several risk factors. Epidemiological studies can measure the relative contribution of each factor to disease occurrence, and the corresponding potential reduction in disease from the elimination of each risk factor.[126]

The use of risk factors is well illustrated in the context of the breast implant controversy:

> From the start it was clear that implants could not be the sole cause of connective tissue disease, even if they played some role, since women without breast implants also develop these diseases. And it was also known that breast implants do not invariably cause connective tissue disease, since most women with implants remain healthy. Thus, the most that could have been true is that breast implants *contribute* to connective tissue disease - that is, they might have been a "risk factor" (something that increases the chances of developing a disease). Whether a risk factor is one of several possible causes of a disease or whether it is merely correlated with a real cause may not be known. For this reason, scientists often say that a risk factor is "associated" with a disease, not that it "causes" it.[127]

It is also important to note that risk factors may vary in their strength.

> Risk factors can be strong or weak. For example, cigarette smoking is a strong risk factor for lung cancer. This means that smokers have a very much higher chance of getting lung cancer than nonsmokers. The more they smoke, the greater the risk. In fact, people are extremely unlikely to get lung cancer unless they do smoke. Cigarette smoking is so strong a risk factor for lung cancer that we are justified in saying it "causes" cancer, even though we do not yet know exactly how it does so. In contrast, alcohol may be a weak risk factor for breast cancer. The chances of a drinker getting breast cancer, according to some studies, are slightly higher than the chances of a nondrinker, but abstaining from alcohol is unlikely to confer much protection.[128]

For example, research indicates that only 17% of current male smokers are expected to develop lung cancer.[129] So, although we can say that smoking is a strong risk factor for lung cancer, the evidence is that not even a majority of smokers will in fact contract lung cancer.

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126 *Ibid.*, at 74.

127 *Ibid.*, at 98. A similar concept is found in the legal system in the form of multiple causation and intervening forces principles.

128 *Ibid.*, at 98.

129 Villeneuve, P.J. and Mayo, Y. "Lifetime Probability of Developing Lung Cancer, by Smoking Status, Canada". *Canadian Journal of Public Health*, 1994, Vol. 85 No. 6 at 385. See also discussion in Thomas, S.P. and Hrudey, S.E., *Risk of Death in Canada*, 1997 University of Alberta Press at 162 - 163.

Thus, we say that a risk factor is strong if exposure to it results in a large increase in the occurrence of the disease. This may be best understood by considering the size of the effect in terms of the proportion of exposed individuals who contract the disease.

c) *Size of Causal Connection Versus Degree of Causal Certainty*

Finally, when considering the issue of causation it is also important to draw a distinction between the concepts of the size of a causal connection (or risk factor) and the degree of certainty that a particular causal connection (irrespective of size) actually exists.

> ... some legal scholars confuse the concepts of the size of the effect (as, for example, when it is said that implants contribute more than 50 percent to the disease) with the degree of confidence we can have that it is true. For a scientific finding to be accepted, it is customary to require a 95 percent probability that it is not due to chance alone (I am here giving a shorthand version of a much more complicated statistical concept). Comparing the size of an effect with the probability that a given finding isn't due to chance is comparing apples and oranges. It would be possible to find a huge effect with a low degree of certainty, or a tiny effect with a high degree of certainty. The distinction between the size of an effect and the probability that a particular finding is not due to chance is important in debates about science and the courtroom.[130]

Put another way, the results of a particular scientific study may suggest a strong causal connection between factor A and result B (i.e. the existence of A makes the result B very likely), but the evidence supporting strong causal connection may itself be very certain or highly uncertain. Although both the strength of the causal effect and our level of confidence in the evidence showing causation are expressed as probabilities, their meaning is very different. So, regardless of how much causation can be attributed to one factor, for there to be a high degree of certainty that the connection actually exists we must have confidence in the manner in which the study was carried out, and in the body of other scientific information within which the study exists. Returning to the smoking and lung cancer example, we are now very confident that smoking is a causal, if not the dominant causal factor in most cases of lung cancer, however the fact of an individual smoking does not make it more likely than not that they will die of lung cancer. Of course, in this case part of the explanation is that smoking is so deleterious to health that many individuals die of other smoking-related diseases (heart disease and other cancers) before there is a chance for lung cancer to take its toll.

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130 *Ibid.*, at 114.

3.4.2.3 Relationship Between Factual Scientific Uncertainty and Legal Standards of Proof

The significance of scientific uncertainty in environmental decision-making goes far beyond the failure of science to provide the solid factual basis sought by the legal system for its decisions. An examination of this issue indicates the existence of three important incompatibilities between the scientific and legal systems.

a) *Standard of Proof*

The first fundamental incompatibility between science and law in environmental decision-making which may be found within the uncertainty interface is the incompatibility between scientific uncertainty and legal standards of proof. Indicators of this incompatibility are found in the numerous problems experienced in environmental decision-making associated with the use of scientific information to meet legal standards of proof. The legal system has a long-established tradition of placing a burden on one or more parties to a legal proceeding to establish their position to a pre-determined standard of certainty. For example, in the criminal and quasi-criminal context environmental protection legislation may require the Crown to establish its case "beyond a reasonable doubt". In civil litigation the common law burden is one of "proof on the balance of probabilities". Administrative law fora may require the observance of statutory guidelines, such as that a proposed activity be "... in the public interest ...".[131] However, the scientific community does not share the legal system's penchant for certainty. In science, uncertainty is considered to be an inevitable component of the investigative process which not only accepts but actually encourages validly held differences of opinion. As such, the greatest degree of scientific certainty, that of consensus within the scientific community, is often difficult to achieve, and will be quickly discarded in the event that new scientific developments call the consensus opinion into question. As a result, there is no meaningful equivalent to the legal principle of *res judicata* within the scientific system.

These widely differing views held by the scientific and legal communities with respect to standards of certainty in scientific information create a significant problem for environmental decision-making. Specifically, it is often difficult for an environmental decision-maker to determine whether the degree of certainty with which a particular view is held within the scientific community translates into the standard of certainty required by the legal burden of proof. For example, does the criminal and quasi-criminal "proof beyond a reasonable doubt" require that the Crown establish that a consensus exists within the scientific community with respect to each element of its case involving scientific issues, or

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131 See for example, the Alberta *Waste Management Regulation, Alberta Regulation 253/84*, enacted pursuant to the Alberta *Public Health Act*, R.S.A. 1980, c. P-4.

is the standard something less? Where on the scale of scientific certainty does the civil legal burden "on the balance of probabilities" fit? What about the rather nebulous administrative law standard of "in the public interest"? None of these concepts translates neatly into the concepts of certainty considered in scientific practice.

b) *Burden of Proof*

The issue of whether scientific information can ever truly meet legal standards of proof has major implications for environmental decision-making, in that scientific uncertainty has the potential to be used as a tool to facilitate the manipulation of the outcome of environmental decisions through the legislative structuring of burdens of proof. This form of manipulation is acknowledged by Smith and Wynne in the context of the sociology of scientific knowledge:

> ... the social and historical analysis of scientific knowledge has demonstrated the extensive and subtle ways in which 'natural' categories and facts may act as vehicles for implicit social values and political or economic interests. Although a simple 'dominant interests determine scientific knowledge' model has long since been superseded, more sophisticated analysis in current sociology of science continues to connect scientific knowledge to its social context ... .[132]

Smith and Wynne go on to further illustrate the point:

> ... the very act of referring an issue to the courts, rather than to some other forum where different kinds of evidence might be legitimate, inadvertently favours the defendant because of the legal-procedural requirement of proof (according to standards that are in principle unobtainable). Sociology of scientific knowledge is important here in that it has shown how 'adequate evidence' is fundamentally problematic in the context of unremitting scepticism. Hence the requirement of proof can always be legally exploited in demands for better science by well-briefed and well-funded lawyers.[133]

This also makes the distinction between information uncertainty and knowledge uncertainty discussed earlier an important one in the context of environmental decision-making:

> There is no clear demarcation between information uncertainty and knowledge uncertainty; the marginal point at which information becomes so difficult or expensive to collect that it is effectively unobtainable will often be indistinct. Nevertheless, the dichotomy is significant from a legal perspective because the consequences of allocating the

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132 *Supra*, note 12 at 6.

133 *Supra*, note 12 at 6.

burdens of production and proof may vary greatly depending on the nature of the uncertainty presented. Information uncertainty can be eliminated if the value of the missing data makes collection worthwhile. A doctrine designating one party responsible for resolution of information uncertainty presents that party with a realistic choice: either provide the information or surrender the point. Which alternative is selected depends on how the designated party perceives the relative costs and benefits of production. The picture is quite different when knowledge uncertainty is involved. Research may be directed toward a critical problem, but there is rarely any assurance that the desired knowledge can be acquired, especially within the time frame associated with a specific legal controversy. Thus, a rule assigning legal responsibility for knowledge uncertainty also determines the eventual result in most cases: whoever bears that burden generally loses.[134]

In Canada, the manipulation of scientific uncertainty to satisfy the sociological context is generally a function of the philosophical approach which is adapted to decision-making in situations of scientific uncertainty. Two such approaches are currently in use.[135]

a) *The Traditional Approach: Reactive Decision-Making*

When faced with situations of scientific uncertainty, environmental decision-makers have traditionally relied upon a "reactive" model of decision-making wherein account of potential negative environmental effects is only taken when the factual existence of these effects is established with a high degree of certainty, at which point the decision-maker will react to the problem. To achieve this result, the reactive model often relies upon a legislative framework which places a burden of proof on the party challenging the environmental safety of an activity. This has two effects. First, placing the onus of proof on the challenging party favours the proponent in that the degree of scientific certainty required to meet the legal standard of proof may be difficult to achieve in a legal context, with the level of advantage given to the proponent directly related to the legal standard which must be satisfied. Second, if there is sufficient scientific uncertainty so that the legal burden of proof is not satisfied, the decision will favour the proponent of the activity by default.[136]

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134 *Supra*, note 12, at 357.

135 For a detailed discussion on this issue see M'Gonigle, M. et al., "Taking Uncertainty Seriously: From Permissive Regulation to Preventative Design in Environmental Decision Making" (1994) 32 *Osgoode Hall Law Journal* 99.

136 *Supra*, note 12 at 357.

b) *The Precautionary Approach*

In recognition of the serious environmental problems which have resulted from the application of the reactive approach to environmental decision-making in situations of scientific uncertainty, some jurisdictions have opted for a more cautious approach in addressing this problem. This cautious approach has recently become recognized as a distinct decision-making process under the name "precautionary approach" or "precautionary principle".[137]

The essence of the precautionary principle of environmental regulation has been well summarized as follows:

> Briefly stated, the precautionary principle ensures that a substance or activity posing a threat to the environment is prevented from adversely affecting the environment, even if there is no conclusive scientific proof linking that particular substance or activity to environmental damage. The precautionary principle is a *guiding* principle. Its purpose is to encourage - perhaps even oblige - decisionmakers to consider the likely harmful effects of their activities on the environment before they pursue those activities.
>
> Definitions vary widely, from the general notion that it is desirable to prevent pollution, to the requirement that polluters establish by some appropriate burden of proof that their activities are not releasing potentially eco-reactive substances in to the environment and thereby causing damage. Proponents of the precautionary principle, as a new and progressive policy instrument, strive for a reversal of, or at the very least, a shift away from the current position whereby polluters can continue to discharge a wide variety of substances into the biosphere.[138]

The antithesis of the reactive approach, the inclusion of the precautionary principle into the legal system is achieved through official recognition by decision-makers of estimates of the chance of negative environmental effects which can not be established with a high degree of certainty. In this regard it has been noted that:

> The appeal of the precautionary principle is that it forces a debate about the types and quantities of human-induced harm to the environment that are acceptable. The legal process

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137 The terms "precautionary approach" and "precautionary principle" are often used interchangeably. However, strictly speaking, in international law parlance the term "precautionary principle" contains a legal connotation which the term "precautionary approach" does not have. There are a growing number of international documents that use the concept (either as an "approach" or a "principle"). See for example the Treaty on European Union signed at Maastricht, Principle 15 of the Rio Declaration on Environment and Development, and the UN Framework Convention on Climate Change.

It is currently open to debate as to whether this concept has crystallized into a principle of customary international law or whether it is still only in a formative state.

138 Cameron, James and Abouchar, Juli , "The Precautionary Principle: A Fundamental Principle of Law and Policy for the Protection of the Global Environment" (1991), *Boston College International and Comparative Law Review*, Vol. 14 No. 1, 1 at 2.

> attached to the application of the principle institutionalizes caution: when there is sufficient evidence that an activity is likely to cause unacceptable harm to the environment, the precautionary principle requires that responsible public and private powerholders prevent or terminate the activity.[139]

From a practical perspective, the precautionary approach may be achieved either by reducing the standard of proof for parties alleging possible negative environmental effects or by developing and implementing environmental legislation which shifts the burden of proof from the party challenging the environmental safety of an activity (as generally occurs under a "reactive" approach) to the proponent of the activity. As one author has observed:

> The precautionary principle shifts the burden of proof from those who would protect the environment having to prove damage, to industry which must not so much prove safety ... but must assume that any unnatural substances or natural substances in unnatural quantities, has the potential for harm and must therefore be either contained, or not used at all, especially if there is evidence of toxicity.[140]

The implications of such a shift in the burden of proof are significant, in that by placing the burden of proof on the proponent to establish that an activity is safe, failure to discharge this burden as a result of scientific uncertainty results in a "default decision" by the decision-maker to not allow or to terminate the activity. The ability of this principle to function relies upon a pragmatic notion of safety. Equating safety with zero risk will make proof of safety impossible. However, a notion of safety as being a risk too small to worry about is an attainable requirement.[141]

The precautionary approach to environmental decision-making appears to have its roots in reports which emanated from the Great Lakes Science Advisory Board in 1984, wherein the limitations of scientific knowledge relating to the toxicological effects of industrial chemicals was recognized.[142] The approach first received official international acceptance at the Second International Conference on the Protection of the North Sea,[143] with

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139 *Ibid.*, at 3.

140 Taylor, P.J., "The Precautionary Principle: Implications for the Paris Commission" (1988).

141 Hrudey, S.E. and Krewski, D., "Is There a Safe Level of Exposure to a Carcinogen?" *Environmental Science and Technology*, Vol. 29 No. 9 at 374A.

142 Johnston and MacGarvin, "Assimilating Lessons from the Past" (1990), *Greenpeace Paper No. 28*, 2 at 14.

143 The Conference took place in London, England on November 24 - 25, 1987 and was attended by representatives from Belgium, Denmark, France, the Federal Republic of Germany, the Netherlands, Norway, Sweden, the United Kingdom and the European Economic Community.

the issuance of a Ministerial Declaration which made the following references to the precautionary approach:

> ... in order to protect the North Sea from possibly damaging effects of the most dangerous substances, a precautionary approach is necessary which may require action to control inputs of such substances even before a causal link has been established by absolutely clear scientific evidence ; ... .[144]
>
> [The parties] therefore agree to ... accept the principle of safeguarding the marine ecosystem of the North Sea by reducing polluting emissions of substances that are persistent, toxic and liable to bioaccumulate at source by the use of the best available technology and other appropriate measures. This applies especially when there is reason to assume that certain damage or harmful effects on the living resources of the sea are likely to be caused by such substances, even where there is no scientific evidence to prove a causal link between emissions and effects ("the principle of precautionary action").[145]

The internal inconsistency of this statement is substantial. The first paragraph talks about acting "before a causal link has been established by absolutely clear scientific evidence" but the next paragraph talks about acting where there is likelihood of causation "even where there is no evidence to prove a causal link". This is a huge leap from being willing to act before "absolutely clear scientific evidence" to acting with "no evidence". Nevertheless, the principle has subsequently been incorporated in varying degrees into the environmental protection legislation of the signatory states.[146]

Some legislation in Canada already contains elements of the precautionary principle. For example, on an international level the *Canadian Environmental Protection Act*[147] provides, *inter alia*:

> 61(1) ... where the Ministers have reason to believe that an air contaminant emitted into the air ... by a source or by sources of a particular class or classes in Canada
>
> (a) creates or may reasonably be anticipated to create air pollution in a country other than Canada ...
>
> the Minister shall recommend to the Governor in Council regulations with respect to the

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144 *Ministerial Declaration, Second International Conference on the Protection of the North Sea*, article VII.

145 *Ibid.*, at article XVI(1).

146 *Ibid.*.

147 *Supra*, note 61.

> source or sources for the purpose of controlling or preventing the air pollution or correcting or preventing the violation.[148]

This approach was carried forward in the *Canadian Environmental Protection Act, 1999* which states in its preamble:

> "Whereas the Government of Canada is committed to implementing the precautionary principle that, where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation;"[149]

Nationally, the federal *Oceans Act* provides for the "...development and implementation of a national strategy for the management of estuarine, coastal and marine ecosystems in waters that form part of Canada or in which Canada has sovereign rights under international laws."[150] The Act goes on to state that:

> 30. The national strategy will be based on the principles of
>
> (c) the precautionary approach, that is, erring on the side of caution.

At the provincial level, the Alberta *Environmental Protection and Enhancement Act* provides that the mere threat of damage resulting from the release of a substance into the environment is sufficient for a conviction under the Act:

> 98(1) No person shall knowingly release or permit the release into the environment of a substance in an amount, concentration or level or at a rate of release that causes or may cause a significant adverse effect.[151]

Other jurisdictions are giving serious consideration to the inclusion of the precautionary principle into future environmental legislation. For example, in a recent legislation discussion paper the Province of British Columbia's Ministry of Environment, Lands and Parks made the following recommendation with respect to the proposed *British Columbia Environmental Protection Act* (BCEPA):

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148 *Supra*, note 61 at s. 61(1)(a).

149 *Supra*, note 61 at preamble.

150 S.C. 1996, c. 0-2.4, s. 29.

151 *Supra*, note 63 at s. 98(1). See also the Ontario *Water Resources Act*, R.S.O. 1980, c. 361, s. 16(1).

Recommendation 18:

The BCEPA should provide a strong basis to not allow or to control a discharge if damage or harmful effects are likely to be caused, even where there is inadequate or inconclusive scientific evidence to prove a conclusive link between emissions and effects.[152]

While questionable, this appears to be an improvement over trying to run with "no evidence".

3.4.2.4 The Search for Scientific Truth and the Finality of Legal Decision-Making

A third, related incompatibility between science and law in environmental decision-making which appears to exist within the uncertainty interface is found within the goals and objectives of the scientific and legal systems themselves. The scientific community is primarily concerned with determining the "truth" of a scientific issue, and in its attempt to resolve uncertainty is continually prepared to seek out new knowledge and to discard old views in favour of such new knowledge. This may be contrasted with the main focus of the legal system, which is the conclusive and final resolution of the jurisprudential issue which is put before it. When these two objectives are brought together in the context of an environmental decision-making forum charged with the resolution of a particular jurisprudential issue which contains a scientific component, the fundamental incompatibility between these objectives manifests itself in three ways.

First, in their quest to resolve scientific issues required in order to decide jurisprudential disputes, decision-makers faced with scientific uncertainty may be reluctant to give appropriate recognition to new scientific knowledge. This was shortcoming was recognized by the United States Supreme Court in *Daubert*:

> It is true that open debate is an essential part of both legal and scientific analyses. Yet there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory. Scientific conclusions are subject to perpetual revisions. Law, on the other hand, must resolve disputes finally and quickly. The scientific project is advanced by broad and wide-ranging consideration of a multitude of hypotheses, for those that are incorrect will eventually be shown to be so, and that in itself is an advance. Conjectures that are probably wrong are of little use, however, in the project of reaching a quick, final and binding legal judgment - often of great consequence - about a particular set of events in the past. We recognize that, in practice, a gatekeeping role for the judge, no matter how flexible, inevitably on occasion will prevent the jury from learning of authentic insights and innovations. That, nevertheless, is the balance that is struck by the Rules of Evidence

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152 Province of British Columbia Ministry of Environment, Lands and Parks, *New Approaches to Environmental Protection in British Columbia: A Legislation Discussion Paper (1992) at 20.*

> designed not for the exhaustive search for cosmic understanding but for the particularized resolution of legal disputes.[153]

Thus, authentic insights and innovations may be lost in the greater volume of scientific evidence which supports an older more well established scientific theory.

Second, when asked by the legal system to provide their opinions in the form of expert evidence with respect to scientific issues, scientists rely upon their understanding of the scientific information available at that point in time, and provide their opinions with respect to the scientific issue based on that information. Presented with new scientific information six months later, an expert scientific witnesses' opinion might change. However, for the most part the legal system is not concerned with the change in scientific opinion. Rather, its concern with scientific information is limited to the assistance which that information provides in resolving the larger jurisprudential issue. Once the jurisprudential issue has been resolved, the legal system has little interest in re-opening the matter at a later date to accommodate new developments in scientific information.[154] This incompatibility between the scientific and legal systems has been summarized as follows:

> ... in most jurisprudence issues there is either no objective truth, or the truth consists of the determination of an individual's past act, rather than a repetitive and predictable law of nature.
>
> For example, scientists have an innate belief that there is an objective truth underlying the question of whether or not formaldehyde is a human carcinogen, or the extent to which an individual is at risk of leukaemia following exposure to a given level of benzene. Moreover, they have an optimistic faith that such truths will eventually be revealed. The legal profession, however, is more concerned with questions as to whether an event - such as whether exposure to a substance caused cancer - is more likely than not and need not concern itself with any outcome which becomes known after the litigation is complete.[155]

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153 *Supra*, note 31.

154 This places the expert scientific witnesses in a difficult position, in that the witness is required to provide a scientific opinion based on information for which a degree of uncertainty exists, in the knowledge that the opinion may have consequences for the jurisprudential issue which are final and may not be revisited. Yet subsequent changes in scientific knowledge may show the expert to have been wrong with his potentially influential testimony.

155 Goldstein, Bernard D.,"Risk Assessment and the Interface Between Science and Law" (1989), *Columbia Journal of Environmental Law*, Vol. 14 No. 2, 343 at 346. In this context the author appears to be using the term risk to refer to an increased "chance" or "probability" of injury. It may be recalled that the element of chance or probability is only one element of a complete notion of risk as used in this thesis.

The third indicator of this incompatibility is to be found in the fact that most legal rules of procedure which apply to courts and administrative tribunals engaged in environmental decision-making fail to require that uncertainties which are found to exist be recorded within the written record of environmental decisions. Indeed, there appears to be a general reluctance on the part of environmental decision-makers to publicly acknowledge the existence of scientific uncertainty with respect to their decisions. In discussing this reluctance in a 1981 speech to the American Bar Association Mr. Justice David Bazelon of the United States Court of Appeals for the District of Columbia Circuit observed:

> Perhaps scientists, who seek to conquer uncertainty, do not see eye to eye with regulators who must act in spite of it. A research scientist is usually acutely aware of the tenuousness of his assumptions, the competing interpretations of his data, and the limits of his knowledge. He presses onward upon the line between the known and the unknown. He does not resist disclosure; indeed, his career advances through it. If anything, the scientist is more likely to overemphasize uncertainty than to hide it. Those who must make practical decisions, on the other hand - physicians and engineers as well as regulators - cannot always afford science's luxury of witholding judgment. Indeed, they may be tempted to disregard or even suppress any lack of confidence they may have.[156]

It is submitted that this reluctance on the part of the legal system to recognize the existence of scientific uncertainty within environmental decisions creates an illusion of certainty with respect to the conclusiveness of the scientific evidence upon which such decisions are based.[157] This in turn has the effect of quelling the argument that jurisprudential decisions based upon scientific information containing a substantial degree of uncertainty should be subject to future review, which may explain why many legal environmental decision-making procedures do not contain provisions for taking account of future scientific developments which might conceivably remove some of the uncertainty upon which the earlier decision was based. Generally speaking the opportunity to revisit a matter is reserved to criminal matters where the conviction of an accused is later challenged on the basis of new scientific evidence. A leading example is where DNA evidence may now be available to support an acquittal. However, one must question why revisitation of criminal convictions on the basis of changing facts is accepted yet similar provisions are not available in matters of arguably equal importance to our society such as environmental health?

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156 Bazelon, David L., "Science and Uncertainty: A Jurist's View" (1981), *Harvard Environmental Law Review*, Vol. 5 No. 2, 209 at 213.

157 As noted earlier, this phenomena also makes a case analysis approach to legal research in this area of little or no value.

3.4.2.5 European and American Solutions

The literature also reveals that a wide variety of solutions to problems involving uncertainty in environmental decision-making have been attempted, particularly in Europe and the United States. These solutions have primarily arisen in the context of civil lawsuits based upon an increased chance of injury resulting from human exposure to potential environmental hazard.

In Europe, a number of jurisdictions have adopted an approach where a cause of action based on increased chance of future injury contemplates that a claimant who is wrongfully exposed to a contaminant with a known propensity for causing a particular illness at some future date is awarded damages in direct proportion to the probability of the illness actually occurring. Thus for example, if a claimant is wrongfully exposed to a chemical compound which contains a carcinogen which has a scientifically established probability of causing cancer in 10% of the population so exposed, the claimant is entitled to damages in the amount of 10% of what would be received if a similar cancer developed immediately upon exposure.

The advantages of this system are that it provides claimants with certainty and immediacy with respect to their quantum of liability, while at the same time relieving claimants of the burden of proving the existence of latent injuries. However, this system has a number of significant problems. First, this approach is misguided in that with respect to most exposures the percentage of the population who will develop cancer in response to a given exposure cannot be known with either reasonable precision or acceptable accuracy. Second, in practical terms the expectation of a scientifically established probability of developing cancer is not achievable. Third, this approach over compensates those who never develop injuries and under compensates those who actually do develop illness. Fourth, such a claim relies primarily upon speculative evidence. Finally, to allow such claims may encourage a flood of speculative lawsuits.

The European approach has been largely rejected In the United States, primarily because such an approach is antithetical to the fundamental principle of tort law that there can be no compensation in the absence of actual immediately apparent or detectable injury. However, in recognition of the difficulties presented by scientific uncertainty in resolving jurisprudential disputes involving environmental exposures some American jurists appear willing to explore potential solutions to this problem.[158] For example, when asked to consider

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158 For a detailed discussion on this topic seeWillis, Richard H. and Melchers, Joseph M., "Compensation For Imagination: Emerging (And Persistent) Theories Of Recovery In Toxic Tort Cases", *Environmental, Hazardous Waste and Toxic Tort Litigation Symposium* (Chicago: Defense Research Institute Inc., March 18 -20 1993, A-1). See also Ashton, David P.C., "Decreasing The Risks Inherent in Claims for Increased Risk of Future Disease", 43 *University of Miami Law Review* 1081 (1989).

the validity of a claim for injuries based directly on a claim of an increased chance of contracting cancer as a result of wrongful exposure to a toxic substance, one California District Court judge observed:

> This issue goes to the very heart of our tort system, and it divides courts and commentators. The tort system evolved to redress the wrongs of a society where injuries were much more direct. The issues of lengthy latency periods and increased risks of cancers are relatively new to our system of laws. The greatest lesson that we can draw from the common law of torts to apply here is that the system must evolve to meet the needs of society.[159]

Consistent with this view, a number of innovative solutions to the problem of scientific uncertainty have been attempted by American courts, some of which are summarized below.

a) *Injury to Immune System*

Where scientific uncertainty arises as a result of wrongful exposures which do not manifest themselves in the form of actual physical injuries in the conventional sense, but which cause injury to the immune system, thereby increasing the probability of future injury in the form of contracting future illness, a few courts have taken the position that such an increase in the probability of future injury is compensable. This theory of recovery is currently identified by a variety of names including "Chemically Induced AIDS", "Chemically Induced Immune Disregulation Syndrome" (CIIDS) or "Systemic, Progressive Chemical Intoxication".

For example, in *Barth v. Firestone Tire and Rubber Co.*[160] a California court considered an application by a defendant tire manufacturer to dismiss a claim by a former employee which alleged, *inter alia*, injury to the claimant's immune system which would render him more susceptible to developing various forms of cancer as a result of exposure to toxic chemicals in the course of his employment. The court dismissed the application, finding that a valid cause of action existed:

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159 *Barth v. Firestone Tire and Rubber Company*, 661 F. Supp. 193 (N.D. Cal. 1987) at 196 per Aguilar J. In this context the author appears to be using the term risk to refer to an increased "chance" or "probability" of injury. It may be recalled that the element of chance or probability is only one element of a complete notion of risk as used in this thesis.

160 *Ibid.*

> The Court here notes the troubling and complex issues raised regarding the nature of a legal injury. In this case, the plaintiff has already pled a current legally cognizable injury by alleging damage to his immune system ... .[161]

While the notion that a claimant should be compensated for the injury of loss of immune system may appear attractive on the surface in that it is an actual immediately apparent or detectable injury, this solution is inherently flawed, in that loss of immunity does not give us any indication of the type of injury which the claimant may or may not suffer in the future as a result of that loss. Any attempt to compensate for future injury is pure speculation on the part of the courts, and in no way resolves the scientific uncertainty which will exist until such time as the injury actually occurs or the claimant dies from some unrelated cause.

b) *Fear of Future Injury*

Where there is scientific uncertainty with respect to whether an injury may develop in the future as a result of a wrongful exposure which increases the chance of incurring an injury some U.S. courts have gone so far as to allow claims for fear of developing the injury, irrespective of whether it actually develops or not. This claim is essentially an extension of the traditional common law cause of action for nervous shock recognized across the common law world. While most American courts which have allowed this claim have required that actual physical injury must have occurred,[162] some have given a broad interpretation to the concept of actual physical injury.[163] Other courts have gone so far as to allow this type of claim in circumstances where emotional distress has occurred as a result of exposure where no injury is immediately apparent, but there is a reasonable ground for the plaintiff's fear that

161 *Ibid.*, at 197, per Aguilar J.

162 See for example, *Eagle-Picher Industries v. Cox* (481 So. 2d at 529 (Fla. App. 1985)).

163 Particularly noteworthy are those cases where the courts have found that the contracting of an immune disorder from an exposure satisfies the actual physical injury requirement and is therefore compensable. For example, in *Anderson v. W.R. Grace and Co.(* 628 F. Supp. 1219 (D. Mass. 1986))., a Massachusetts court considered an application by corporate defendants for summary judgment with respect to a claim by a group of plaintiffs for, *inter alia*, emotional distress resulting from a fear of developing leukemia after ingesting water contaminated with chemicals including trichloroethylene and tetrachloroethelyne. The defendants argued that these claimants were not entitled to recover as the plaintiffs' emotional distress was not caused by nor did it cause any physical injury. The court rejected this argument, finding that subcellular damage, which could not be detected by the victim but could be detected by medical experts was sufficient to meet the requirement that the emotional distress was the result of physical injury. The court summarized its findings in this way:

> None of these claims for emotional distress arise from physical injuries caused by defendants' conduct. Accordingly, they are not compensable under ... ordinary principles of recovery for mental suffering.
>
> However, certain elements of plaintiffs' emotional distress stem from the physical harm to their immune systems allegedly caused by the defendants' conduct and are compensable.

a latent injury has been suffered which may manifest itself at some later date.[164]

c) *Ongoing Medical Monitoring*

In order to resolve issues of scientific uncertainty arising in the context of jurisprudential disputes involving exposure to potentially harmful chemicals still other American courts are viewing with approval compensation for costs associated with determining on an ongoing basis the existence, nature and extent of injuries which have occurred or which may occur in the future.[165] Variously known as "ongoing medical monitoring" or "surveillance damage", this theory of recovery takes the generally accepted principle of personal injury law that a person who is injured as a result of an occurrence has the right to undergo and recover the cost of such medical examinations as are necessary to determine the existence, nature and extent of such injuries, and expands that principle in situations of exposure to environmental contaminants to include examinations of an ongoing nature in cases where the *prima facie* presence of injury is immediately apparent or

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164 Finally, some courts have gone so far as to allow this type of claim in circumstances where emotional distress has occurred as a result of exposure where no injury is immediately apparent, but there is a reasonable ground for the plaintiff's fear that a latent injury has been suffered which may manifest itself at some later date. The leading case in this area is *Hagerty v. L&L Marine Services Inc.* (788 F. 2d at 318 (5th Cir. 1986)). In that case a plaintiff seaman brought an action against his employer for damages, *inter alia*, for mental anguish due to fear of developing cancer, incurred as a result of his being soaked by toxic chemicals. The defendant was granted summary judgment by the District Court for the Eastern District of Louisiana on the ground that no cause of action had accrued. The plaintiff appealed. The United States Court of Appeals (5th Circuit) reversed that decision, holding that regardless of the existence of actual physical injury, a plaintiff is entitled to recover damages for serious mental distress arising from fear of developing an injury if the requirements of reasonability of the fear and a causal connection to the defendant's negligence can be established. In giving the reasons for its decision the court stated:

> The physical injury requirement, like its counterpart, the physical impact requirement, was developed to provide courts with an objective means of ensuring that the alleged mental injury is not feigned. W. Prosser, The Law of Torts 54, at 330-333 (4th ed. 1971). We believe that notion to be unrealistic. It is doubtful that the trier of fact is any less able to decide the fact or extent of mental suffering in the event of physical injury or impact. With or without physical injury or impact, a plaintiff isentitled to recover damages for serious mental distress arising from fear of developing cancer where his fear is reasonable and causally related to the defendant's negligence. The circumstances surrounding the fear-inducing occurrence may themselves supply sufficient indicia of genuineness. It is for the jury to decide questions such as the existence, severity and reasonableness of the fear.

165 This may be distinguished from claims for enhanced chance or probability of injury, "... which seek compensation for the anticipated harm itself, proportionately reduced to reflect the chance that it will not occur." (*Cook v. Rockwell Intern. Corp.* (755 F. Supp. 1468 at 1477 (D. Colo. 1991) per Babcock, Dist. Judge).

detectable[166] and even in cases where it is not.[167]

These European and American attempts at addressing the issue of scientific uncertainty in the context of civil jurisprudential disputes further illustrates the universal nature of this problem. However, the solutions which have been tried in these other jurisdictions do little more than illustrate the inability of either the scientific community or the legal system to cope with the problem. Rather, with the exception of ongoing medical monitoring, these solutions appear to be directed toward making decisions with respect jurisprudential disputes in spite of scientific uncertainty rather than attempting to resolve the underlying problem of uncertainty itself. In fact, solutions such as the European approach of awarding damages in direct proportion to the probability of the illness actually occurring or the American solution of awarding damages for loss of immune system and future injury

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166 The standard policy argument against the principle of ongoing medical monitoring in personal injury cases as a whole has been that such an approach is unfair to defendants (and their insurers) in that the quantum of damages remains uncertain over an extended period of time. For this reason the traditional approach to determining damage awards has been for experts appearing on behalf of plaintiffs and defendants to provide evidence to the courts which consist of predictions as to the nature and extent of both present and future injuries incurred by plaintiffs as a result of an occurrence, and for the courts to make immediate and final decisions on the basis of that evidence. While this approach may ultimately lead to individual plaintiffs being over or under compensated for their injuries, it does provide defendants and their insurers with a high degree of immediate certainty with respect to the quantum of their liability. There are indications that this traditional policy consideration may be overshadowed by a growing perception amongst judges that environmental impairment cases may raise unique issues which require ongoing medical monitoring in order to adequately to compensate injured parties.

167 The basis for this approach has been well summarized as follows:

> Those courts accepting medical monitoring as a new cause of action or element of damages often do so despite the absence of physical injury, reasoning that the necessity for periodic medical exams in order to determine the onset of injury is a real and present damage in itself. But for the wrongful exposure, plaintiffs would not be required to seek medical attention, therefore the costs of specific medical surveillance incurred as a result of the wrongful exposure, if proved by competent expert testimony, are recoverable.

(Willis, Richard H. and Melchers, Joseph M., *supra*, note 148 at A-27-28).

For a detailed discussion on this topic see Slagel, "Medical Surveillance Damages: A Solution to Inadequate Compensation of Toxic Tort Victims", *Indiana Law Journal*, Vol. 63, 1988, 849 and Gara, "Medical Surveillance Damages: Using Common Sense in the Common Law to Mitigate the Dangers Posed by Environmental Hazards", *Harvard Environmental Law Review*, Vol. 12, 1988, 265.

A number of rationales are given which support the awarding of costs for ongoing medical monitoring in situations where an exposure to a contaminant may result in an injury which may not be readily apparent. First, there may be a latency period with contaminant exposure wherein an illness resulting from the exposure may not manifest itself for months or even years. Ongoing medical monitoring may be able to detect the early stages of the illness, thereby reducing the time period for awareness and treatment of the illness. Second, early detection of a latent illness may be critical to establishing a claim within the time allotted by the various statutes of limitation. Third, in the absence of ongoing medical monitoring it may be difficult to establish a causal link to the earlier contaminant exposure when an illness finally appears. Fourth, in the absence of ongoing medical monitoring an illness with a latency period opens the door to the defence of "intervening cause". It is suggested that this possibility increases in proportion to the length of the latency period. Finally, the longer that a contaminant caused illness remains undetected the greater is the possibility that a potential plaintiff will be unable to locate a solvent defendant.

See also *Friends For All Children Inc. v. Lockheed Aircraft Corp.*, (746 F. 2d 816, 825 (D.C. Cir. 1984); *Askey v. Occidental Chemical Corp.*, (102 A.D. 2d 130, 477 N.Y.S. 2d 242 (1984); and *Merry v. Westinghouse Electric Corp.* (684 F. Supp. 847 (M.D. Pa. 1988)).

resulting from that loss reinforce the determination of legal systems to resolve jurisprudential disputes irrespective of the existence of solid scientific evidence upon which to base such decisions. Even more questionable is the American approach of awarding damages because of scientific uncertainty.

3.5 Scientific Information and Environmental Decision-Making Standards

The fourth area identified as containing problems between science and law in environmental decision-making involves the relationship between scientific information and environmental decision-making standards.[168] This issue includes both the use of scientific information to establish the decision-making standards which are used by the legal system, and the translation of scientific information into those standards at environmental trials and administrative hearings. These may be collectively referred to as the "environmental standards interface".

3.5.1 Experience Based Observations

In order to be effective, decision-making standards such as those commonly found in environmental protection legislation must take account of the scientific information available. Experience based observations of the author and advisory team revealed a sense that such standards do not always reflect the state of science. Observations of this problem covered a wide range of situations, but primarily focussed on quantitative environmental standards. These observations included examples where pollution standards were unjustifiably restrictive due to a negative public perception with respect to a particular compound. Other examples involved a failure to institute sufficiently stringent regulation where scientific concerns may have taken a back seat to overriding economic or political concerns.

The difficulty which arises when scientific information must be relied upon for setting environmental standards goes back to the unrealistic expectations which are held out for scientific information and its ability to guide complex decisions. In keeping with the asymmetry of decisions which has been referred to earlier, scientific knowledge is often able to tell us when something is not true, but it is often much more difficult to know that something is true. In other words, major scientific principles upon which our understanding of the universe is constructed allow us to scope out problems to say whether a particular scenario or hypothesis can be ruled out. If we defy the laws of gravity or of thermodynamics or conservation of mass, we will conclude that the hypothesis is not plausible and can be eliminated. But applying such principles to rule out some possibilities inevitably leaves

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168 This should be distinguished from legal standards of proof.

enormous scope for remaining possibilities. So, adopting a precautionary approach to environmental and public health regulation we have often evaluated standards from the perspective of wanting to be reasonably certain that there will be no measurable harm below the specified level. Recognizing the asymmetry of scientific evidence means that we do not necessarily expect to find harm if we exceed the levels at which we are very confident that there should be no harm. The expectation that science can precisely characterize this grey zone between harm and no harm is a recipe for frustration - yet it is one which is commonly applied, or at least implied.

Just as problems were perceived to exist with respect to the use of scientific information in establishing environmental decision-making standards, so too was there a perception by the author and advisory team that problems may exist with respect to the translation of scientific information into those decision-making standards at environmental decision-making processes such as trials and hearings. These perceptions took a variety of forms, particularly focussing on problems associated with meeting loosely defined normative environmental standards.[169]

While the quantitative standards approach creates difficulties for those who are charged with the responsibility of creating such standards, this approach does have the advantage of removing much of the uncertainty from decisions faced by "secondary" environmental decision-makers such as judges and members of administrative boards and tribunals in translating scientific information into those standards.[170] For example, in the quasi-criminal context the decision-maker is only required to look retrospectively at past events to determine whether the conduct of an accused resulted in a release of a contaminant in excess of the standard prescribed in the legislation. While an additional element of uncertainty faces secondary decision-makers in an administrative law context, in that they are required to prospectively decide whether a resource development or planning proposal will meet prescribed legislative standards, these decision-makers avoid uncertainty with respect to setting the standard itself, only addressing the issue of a proponent's future ability to meet it.

169 See discussion *infra*, at section 3.5.1.

170 Other advantages of the standard-based approach include the utilization of existing government resources such as environment and health departments to assist in determining standards; allowing these government departments to continue to monitor the situation and change the standards in response to scientific development; reducing the cost of litigation associated with effect based legislation, as it is not necessary for litigants to establish what the standard is before determining whether it has been met; it allows the public to more easily review the government's enforcement record; it increases public confidence in the system as discretion is employed at the initial stage, which is industry wide, rather than later on an individual basis; and it creates a climate of certainty with respect to what the standard is.

While the effect-based approach eliminates the need for the legislator to address the inevitable uncertainty associated with the creation of quantitative standards, it often replaces it with even greater uncertainty, in that decision-making responsibilities are transferred to secondary decision-makers who are required to address issues of uncertainty not only in determining whether the standard has been met, but also in determining what the standard actually is. For example, a common problem which occurs with normative standards is that they may be subject to variation from decision to decision. This is due to a wide range of factors, most notable of which is the degree of commitment to the prosecution of an environmental regulation. That is, limited resources devoted to prosecution result in the establishment of relatively lax environmental standards. Strong opposition, including the presentation of certain types of expert scientific evidence, may have the effect of raising the standard to unreasonably strict levels. A similar situation exists with respect to the degree of opposition which is encountered regarding a proposed project at an administrative approval hearing. It is this high degree of uncertainty associated with normative environmental standards which has led industry to label such standards as "moving targets" and to express a preference for quantitative standards. It is submitted that this uncertainty associated with the establishment of normative environmental standards on the basis of inconsistent scientific information is fundamentally incompatible with a legal system which places a high value upon certainty.

3.5.2 Review of Literature

Experience based observations of the author and advisory team which indicate problems in the use of science in the establishment of legal decision-making standards and the translation of scientific information into those standards at environmental trials and administrative decision-making processes found support in the legal and scientific literature and were supplemented by additional problems. A review of some of the more interesting problems identified in the literature follow.

a) *Quantitative Standard Environmental Legislation*

The first approach used in establishing standards within environmental legislation requires the legislator in its role as "primary" decision-maker to review the available scientific information, including any scientific uncertainties which it may contain, and integrate the information into a decision-making process which considers a variety of factors prior to making what is essentially a political decision as to the appropriate "standard". Such standards most often take the form of precisely described measurable levels set out within regulations enacted under the authority of parent environmental legislation. An example of this quantitative standard approach is set out is the *Alberta Environmental Protection and Enhancement Act*:

> 97.(1) No person shall knowingly release or permit the release of a substance into the environment in an amount, concentration or level or at a rate of release that is in excess of that expressly prescribed by an approval or the regulations.[171]

The *Substance Release Regulation* enacted pursuant to the *Environmental Protection and Enhancement Act* sets out a series of quantitative air particulate release prohibitions, including the following:

> 8.(1) The concentrations of particulates in each effluent stream from a source to the ambient air shall not exceed the following:
>
> (a) 0.20 grams per kilogram of effluent adjusted to 50% excess air for products of combustion resulting from the combustion of solid and liquid fuels including coal, coke, hogged fuel, distillate and residual fuel oils, but not including refuse;[172]

With the standard-based approach, the issue of resolving scientific uncertainty rests primarily with the legislator. While to the casual observer this form of legislation may appear to resolve or at least minimize scientific uncertainty, in reality it is often little more than a compromise solution to a difficult environmental issue. It is well said that:

> Pollution control legislation is typically drafted in language which suggests that implementation is a straightforward, almost mechanical process, when in fact government officials are attempting to cope with unstated unresolved scientific, political, technical and economic factors.[173]

It is submitted that in its present format the quantitative standard approach creates a potential for incompatibility between the scientific and legal systems in environmental decision-making. Whereas the scientific community is concerned with providing the best available technical information relating to environmental issues, such information is only one element to be considered by the legislator, who may also consider such diverse factors as public perceptions of environmental issues, politics, economics and social concerns in its environmental standard setting process.[174] This may result in the establishment of

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171 *Supra*, note 63 at s. 97(1).

172 Alta. Reg. 124/93, as amended by Alta. Reg. 191/96.

173 Webb, Kernaghan, "Between Rocks and Hard Places: Bureaucrats, Law and Pollution Control" in Paehlke, Robert and Torgerson, Douglas, eds., *Managing Leviathan: Environmental Politics and the Administrative State*, (Peterborough: Broadview Press, 1990) at 7.

174 For a detailed discussion on this point see Jensen, " Kenneth P., "Risk Assessment" *Environmental Science For Lawyers* (Vancouver: Continuing Legal Education, 1993) ch. 7; and Paustenbach, D.J., *The Risk Assessment of Environmental and Human Health Hazards* (New York: John Wiley & Sons).

environmental standards which do not reflect scientific realities. The incompatibility arises when the scientific input becomes such a minor input that it no longer has any meaningful influence on the decision. The absence of scientific realities within environmental standards may in turn make the meeting or failure to meet such standards little more than a legal fiction, in that the meeting or failure to meet such standards may have little or no rational connection with environmental harm.

b) *Normative Standard Environmental Legislation*

The second approach employed in establishing standards in environmental legislation in Canada involves the legislator setting normative (non-quantitative) standards based on the "effects" of an event. You may recall our earlier example of this effect-based approach in a quasi-criminal context found in section 35.(1) of the federal *Fisheries Act,*[175] which states:

> 35.(1) No person shall carry on any work or undertaking that results in the harmful alteration, disruption, or destruction of fish habitat.

While the Act clearly provides that the standard is one of "harm", the decision as to what actually meets this standard is left up to the individual secondary decision-maker to decide on a case by case basis.

The effect-based approach is also used the context of provincial environmental protection legislation. A typical example is found in Alberta's *Environmental Protection and Enhancement Act*, which provides that:

> 98(1) No person shall knowingly release or permit the release into the environment of a substance in an amount, concentration or level or at a rate of release that causes or may cause a significant adverse effect.[176]

The primary advantage of the effect-based approach is that it eliminates the need for the legislator to address the inevitable uncertainty associated with the creation of quantitative standards. However, by transferring the responsibility to the secondary decision-maker, the uncertainty issue arises at a different level, it does not disappear.

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175 *Supra*, note 55.

176 *Supra*, note 63 at s. 98(1).

3.6 Suitability of Legal Institutions and Procedures to Address Scientific Issues in Environmental Decision-Making

The fifth area in which problems between science and law in environmental decision-making is indicated is the use of legal decision-making institutions such as courts of law and administrative tribunals, and legal procedures such as are found in rules of court, rules of evidence and rules of administrative hearing procedure for the resolution of scientific issues in environmental decision-making. This may be referred to as the "institutional/procedural interface".

3.6.1 Experience Based Observations

Experience based observations of the author and advisory team suggest that problems of an institutional nature also exist in the use of scientific information in environmental decision-making. While these experiences and observations are varied, a common theme is that current legal institutions and procedures have significant problems in addressing scientific issues in environmental decision-making.

A primary concern which was identified by both the author and members of the advisory team was that rules of procedure used by environmental decision-makers such as courts and administrative tribunals often contain rigid time requirements which apply to all matters coming before a decision-maker, regardless of the magnitude or scientific complexity of a matter. A good illustration of this problem is found in many environmental assessment hearings conducted pursuant to the *Canadian Environmental Assessment Act* (CEAA).[177] An application coming before a CEAA panel for a public hearing contemplates a procedure whereby the scope of a proposed work or activity must be completed by a panel (including public review) within a fixed time period established by the panel. Ironically, that time period is often established in advance of the panel even understanding the magnitude or complexity of the proposed work or activity to be scoped - hence the need for scoping in the first place! Once a scoping exercise has been carried out, a CEAA panel has issued a directive to a project proponent with respect to the scope of the Environmental Impact Statement (EIS) to be prepared, and the proponent has prepared and submitted an EIS to a panel, that panel then sets a deadline for interested persons to review and respond to the sufficiency of the environmental impact statement provided by the proponent. The experience of the author and several members of the advisory team has been that in many cases the amount of time allotted for review of the sufficiency of the EIS is woefully

177 *Supra*, note 60.

inadequate.[178] A graphic illustration of this problem is seen in the environmental impact assessment of the proposal put forward by BHP/Diamet for approval of Canada's first diamond mine in the Lac de Gras region of the Northwest Territories. The environmental impact statement provided by the proponent of the mine included thousands of pages of technical information which covered such diverse subjects as mine site excavation and disposal of waste rock, water quality and fish habitat, effects on local animal populations, socio-economic impacts on local Dene communities, and reclamation and decommissioning of the proposed mines. The Agency took the position that those who wished to evaluate the project should upon receipt of this information be able to translate it into aboriginal languages where necessary (translated copies were not provided) review the information in its entirety, retain the necessary expertise to evaluate the scientific information, have the project evaluated by the appropriate scientific experts, develop a position and submit a response within a 3 month time frame. Such unreasonable time constraints inevitably impair the quality of the decision-making process.

Another problem relates to the purpose of administrative environmental decision-making processes. While the purpose of some processes are clear, others may be misleading. For example, the author and advisory team have noted a problem in this area with the Federal Environmental Assessment process. A reading of the *Canadian Environmental Assessment Act*[179] may leave one with the impression that the Parliament intended that activities and works which may have negative environmental impacts must be subjected to a thorough review. However, from a practical perspective, implementation of this legislation by the Canadian Environmental Assessment Agency often paints a very different picture. Some Federal environmental assessments leave the impression that the primary purpose of the process is to facilitate public participation in the decision-making process rather than to conduct a thorough review of proposed activities and works. As such, a Federal review may be little more than a public relations exercise intended to deflect public scrutiny of a proposed project by convincing the Canadian public that a thorough review is being conducted. As a result the process may even operate to discourage a thorough environmental assessment. The BHP/Diamet CEAA environmental assessment process referred to earlier provides an excellent example of this problem as well. A panel appointed by the Canadian Environmental Assessment Agency decided upon a public hearing process where it would hold general hearings in a series of communities followed by a hearing in the City of Yellowknife to consider technical issues. Prior to the technical hearing and during the technical hearing itself the Panel demonstrated a reluctance to hear detailed scientific and technical information. At one point in the technical hearing reserved for the subject of environmental management plans, in response to a series of objections by an intervenor

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178 These problems appear to be particularly acute in situations where there is considerable pressure for a speedy EIA recommendation to the Minister of Environment by a panel.

179 *Supra*, note 60.

relating *inter alia*, to the failure of the Panel to allow sufficient time for expert scientific witnesses to present information relevant to the issues before the Panel, rather unbelievably the Panel Chair responded:

> I would also like to stress that this is not a technical review, per se. As we were directed or informed by the CEAA -- the Canadian Environmental Assessment Agency -- if government had wanted a technical review, they would have gone out and hired a bunch of engineers. I would like to remind you of the overall context in Canadian society in which this review takes place. It occupies a spot in the regulatory system. This panel and this panel's review is not the last stop, in the event this panel recommends that this project proceed. There will be downstream regulation of this project if it is allowed to proceed. So it isn't a technical review, per se.[180]

If a Federal environmental assessment is not a technical review, then what is it? What other technical review opportunities are present in which a dialogue on scientific issues may take place?

A third issue identified by the author and advisory team related to the expertise of the membership of administrative tribunals. Administrative law is based on the premise that the sovereign appoints a statutory delegate to perform a duty on the basis of the special qualifications of that delegate. This presumption was confirmed by Wilson J. in *National Corn Growers Association v. Canada (Import Tribunal)*:

> Canadian courts have struggled over time to move away from the picture that Dicey painted toward a more sophisticated understanding of the role of administrative tribunals in the modern Canadian state. Part of this process has involved a growing recognition on the part of courts that they may simply not be as well equipped as administrative tribunals or agencies to deal with issues whic Parliament has chosen to regulate through bodies exercising delegated power, e.g., labour relations, telecommunications, financial markets and international economic relations. Careful management of these sectors often requires the use of experts who have accumulated years of experience and a specialized understanding of the activities they supervise.[181]

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180 *NWT Diamonds Project Environmental Assessment*, Federal Environmental Assessment Panel Public Hearing Transcript, Technical Session - Environmental Management Plans, Yellowknife, Northwest Territories, February 16, 1996, per Letha MacLachnan, Panel Chair.

181 [1990] 2 S.C.R. 1324 at 1336.

Thus for example, it is presumed that the membership of a planning board are appointed because of their expertise in the field of planning. It is for this reason that courts will often show a considerable degree of deference to decisions made by these statutory delegates, even though such decisions may be unreasonable or even patently unreasonable. While many statutory delegates are highly qualified individuals, the experience of the author and advisory team has been that a significant number of appointments to administrative tribunals are little more than political patronage appointments in which appointees have little or no expertise with respect to the area in which they have been appointed. Thus, the "special qualifications" of statutory delegates may be little more than an affiliation with a government which requires assurances that the actions of its statutory delegates on matters coming before it will for the most part be consistent with that government's policy. Three negative outcomes could potentially result:

a) It will likely reduce the confidence in environmental decisions based on scientific information made by these ill-qualified statutory delegates.

b) It may result in a failure of administrative decision-making bodies to retain the respect of the scientific community. This failure may in turn result in a reluctance by scientists to participate as decision-makers in these processes.

c) It also calls into question the legitimacy of the judicial deference which courts pay to the "expertise" of these boards.

A final concern of the author and advisory team involved legal processes and procedures which bear little relevance to the practice of science. An example is the hearsay rule. The rule, simply stated is that information provided to a witness with respect to what another person said, did or saw is not admissible as evidence of the truth of the information. Expert evidence is an exception to the hearsay rule in that it allows a person qualified by a court as an expert to give opinions within the scope of their expertise based on evidence which they have heard or seen at the trial. However, in giving an opinion the expert witness has rarely personally developed all of the scientific knowledge upon which he relies in giving the opinion. Rather, the expert witness usually will rely upon the scientific findings of others, often contained in scientific literature, in developing his opinion. This evidence is not directly presented before the court and thus can not be tested. However, it is indirectly considered by the expert who either accepts or rejects it when providing his opinion to the court. Thus, protracted arguments may ensue over whether scientific information which is relied on by an expert in developing an opinion, but which has not been tendered before the court as evidence, is admissible.

3.6.2 Review of Literature

Experience based observations of the author and advisory team which indicate problems in the use environmental decision-making institutions and processes found support in the legal and scientific literature and were supplemented by additional problems. A review of some of the more interesting problems identified in the literature follow.

Perhaps most noteworthy amongst those problems identified in the literature is the use by the legal system of an adversarial approach which relies heavily upon the advocacy skills of legal counsel to bring all relevant evidence supporting their respective clients' positions before a trier of fact. The legal system has attempted to use this same approach in resolving the factual scientific issues which may arise within an environmental decision-making context.

Whereas lawyers are concerned with factual scientific issues only insofar as they relate to the ultimate goal of resolving environmentally based jurisprudential disputes, for scientists the primary focus of such scientific issues may take one of two paths. The first path sees the validity of science as a means of knowing which is predicated upon a commitment to unrelenting challenge of current beliefs.[182] This is the approach taken by most so-called "pure" scientists, who can seek truth without having to compromise or make decisions based on current, often inadequate evidence. The second path adopted by the scientific community involves polling experts to determine the extent of consensus on interpretation of currently available facts or knowledge. This latter activity is part of the practice of scientific discourse rather than the scientific methodology used for discovery, and is primarily employed by applied scientists such as engineers and physicians who are routinely forced into making judgments on available evidence so that decisions can be made.

This suggests a strong divergence of values between legal practitioners and both pure and applied scientists. This clash of values has been described by one leading applied scientist in the following terms:

> One of the most fascinating interfaces in our society is that between science and law. The difference in the approaches of the two disciplines and resulting difficulty in communication between the two is highly significant as the two are based on very different values. At its base are completely different concepts and ethical values as to the appropriate manner to pursue truth. For instance, although it may be appropriate for a member of a law school faculty to present and discuss tactical approaches for including or disqualifying risk assessments as part of the adversarial "search for truth", such behavior from a faculty member in a science department would be quite inappropriate as it relates to the scientific "search for truth". The reason is simple. Lawyers are trained as advocates, and as such, present only one side of an issue in a civil or criminal suit. However, a scientist, to be

182 Sagan, *The Demon-Haunted World - Science is a Candle in the Dark* (New York: Random House 1995) at 210.

> credible, must present information that both supports and detracts from a hypothesis. Exclusion of negative evidence is unethical and a presentation which describes tactics to exclude pertinent negative information would be abhorrent to a scientist, although perfectly appropriate to attorneys.[183]

The legal perspective on science has some common ground with the pure science perspective whereby every hypothesis must withstand the continuing challenge of alternate hypotheses. Consensus among scientists provides no assurance of truth because advances in knowledge will invariably show previous consensus to be wrong. While the challenging which is inherent to the advocacy system has some parallel with the pure science model, the time frame and need for a decision clearly distinguish the legal advocacy system from the pure science challenge system. The objectives of the legal system and applied scientists are also similar in that they are both required to make decisions based on imperfect factual information. However, the scientific and legal communities have taken vastly divergent approaches to meeting this challenge. The legal community attempts to reach a decision on the basis of an adversarial approach where lawyers clash and scientist is pitted against fellow scientist. It is hoped that when the dust finally clears the best jurisprudential decision possible will be reached on available scientific information. This may be contrasted with the approach of the applied scientist, who when attempting to resolve a factual scientific issue will often adopt a consensus building approach for the purpose of obtaining as much agreement as possible regarding the issue. The consensus approach assumes that with respect to any given scientific issue most scientists will be in general agreement, with only a minority adopting divergent views. Thus, to return to our earlier *Fisheries Act* example, in determining what concentration of chemical X released into an aquatic environment would constitute the "... harmful alteration, disruption, or destruction of fish habitat" contrary to section 35(1) of the *Fisheries Act*[184], the consensus approach would expect that if a meeting of qualified scientists took place for the purpose of resolving the issue, and a poll of responses from these scientists was placed on a bell curve, the majority would fall somewhere in the middle of the curve, with a minority advocating concentrations at either the high or low ends of the spectrum. It is the majority group which provided mid-range concentrations which is of primary interest to the consensus approach, as this group represents the highest probability of scientific truth.[185] The motivation for members of the applied scientific community to reach such a consensus is interesting:

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183 *Supra*, note 155 at 344. Dr. Goldstein is Professor and Chairman of the Department of Environmental and Community Medicine, and Director of the Environmental and Occupational Health Sciences Institute, a joint program of UMDNJ and Rutgers University.

184 *Supra*, note 55.

185 See Goldstein, Bernard D., "The Scientific Basis for Policy Decision" (1987), *Environmental and Health Risk Assessment*, Vol. 9; and Goldstein, Bernard D., "Risk Assessment/Risk Management is a Three-Step Process: In Defense of EPA's Risk Assessment Guidelines (1988), *Journal of American Clinical Toxicology*, Vol. 7, 543.

> After discussing the subject, scientists would move toward a central consensus since most scientists intuitively huddle together on questions of this nature. This is because scientists do not want to be wrong, risking a loss of credibility. Scientists have more to lose by being the one person who turns out to be wrong, than they have to gain by being the one person who turns out to be right because credibility is the key to their success. Therefore, reputations are guarded by huddling together.[186]

The consensus approach employed by the applied scientific community is the direct antithesis of the adversarial approach, wherein:

> ... the lawyer selects scientists whose opinions are on one extreme of the bell-shaped curve, knowing full well there is a lawyer on the other side who is looking for scientists at the opposite extreme. There follows a confrontation among the scientific experts in a hearing or trial, in which the give and take of scientific discussion is neither possible, nor permitted.[187]

Thus, the underlying rationale for these two approaches may be summarized as follows:

> The best way to summarize this point is to keep in mind that the scientists' basic credo is that there is absolute truth and that it will some day be known. This makes us very hesitant to say anything which differs from other scientists, inasmuch as the inevitable discovery of truth may show us to be the only one who is wrong, with devastating professional consequences. In contradiction, the attorney is basically an advocate, with a professional reputation that is dependent upon the efficacy of the advocacy, not the eventual finding of truth.[188]

In summary, the adversarial approach to resolving jurisprudential disputes can be a matter of considerable frustration to pure and applied scientists alike:

> We must recognize that our society approaches environmental regulation with a unique blend of the scientific consensus and legal confrontational approaches to what are primarily matters of the laws of nature, *i.e.*, science. To a scientist, this interplay between approaches can be very frustrating, particularly when one is told by lawyers that a lack of agreement among the scientific experts is a major problem impeding regulatory approaches. Often what is impeding the regulation is not the fact that a lack of agreement exists, but the

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186 *Supra*, note 155 at 345 -346.

187 *Supra*, note 153 at 346.

188 *Supra*, note 153 at 346.

advocacy confrontational process of obtaining scientific information which tends to foster the disagreement within the scientific community.[189]

[189] *Supra*, note 153 at 347-348.

4.0 Exploring Problems in the Use of Science in Legal Decision-Making: Empirical Research

4.1 Introduction

While the preceding review of the experience based observations of the author and advisory team and the legal and scientific literature identifies the existence of a number of problems in the use of scientific information in environmental decision-making, research in this area has been relatively limited to date. That research which does exist is largely anecdotal and has primarily focused on process issues involving the rules of legal procedure required to accommodate scientific information.[190] In the preface to their book *Expert Evidence: Interpreting Science in the Law*, editors Roger Smith and Brian Wynne summarize the attitude of the legal community as follows:

> The role of scientific expertise in legal and quasi-legal decision settings is increasing steadily. What is true of the courts themselves is probably even truer of the growing number of quasi-legal settings, such as administrative tribunals ... . Proponents of these procedures hope that the objectivity of science will provide a firm and authoritative input, giving decisions a factual basis that cannot be questioned. That the science often appears equivocal is put down to procedural problems rather than inherent properties of scientific knowledge or methods, and much debate has centred on procedural innovations which attempt to make such decisions more efficient or more authoritative. Discussion about such matters is perhaps most developed in the United States, but their relevance is everywhere apparent.[191]

This predisposition to treat these issues as procedural anomalies rather than significant problems has resulted in only superficial examination of this subject with little in-depth investigation of the nature and sources of these issues. However, a detailed investigation of the nature and sources of problems between science and law in environmental decision-making is a difficult task. Four reasons for this difficulty are readily apparent.

First, in the past the relatively limited demands by the legal system on the scientific community[192] created a minimal number of problems for environmental decision-makers, and thereby generally failed to indicate those issues which exist between the scientific and legal systems. It is only the recent increased reliance of the legal system on the scientific community and the corresponding increase in problems experienced by the legal system in

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190 See section 2.2, *supra*.

191 *Supra*, note 12 at 1.

192 See discussion *supra*, section 2.

utilizing scientific information in carrying out its environmental decision-making responsibilities that is attracting attention to the source of these problems.[193]

Second, those problems which in the past were recognized by the legal community were generally considered to be minor difficulties which were attributable to shortfalls in scientific evidence. To compensate, the legal system took the position that jurisprudence would overrule juriscience and that these problems could for the most part be overcome through the modification of legal procedure.

Third, the scientific and legal communities have carried out their respective tasks with respect to environmental decision-making in relative isolation, with little or no interaction between them. As one American jurist noted with concern,

> Unless something is done to stem the seemingly pathological drive toward exclusivity of scientists and lawyers - in which each excludes the other and both exclude the people, in which we all become "strangers in the night" - I cannot be sanguine about our children's chances for the good life.[194]

Possibly as a result of this isolation, interdisciplinary investigation of problems between the two systems has not been done.

Finally, an interdisciplinary investigation faces a number of methodological difficulties. These difficulties include the following:

a) *Failure to Associate Problems*

The identification of individual problems in environmental decision-making most often takes place on an *ad hoc* basis wherein a problem is associated with the particular fact situation in which it arises, and where an association is seldom made with other seemingly unrelated problems which may be rooted in the same fundamental science/law incompatibility which gave rise to the initial problem. Thus,

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193 With respect to the availability of research on the relationship between science and law generally, it has been observed that:

> ... there is no survey of the literature presently available. To a great extent, the literature consists only of concerns, concerns of scientists that law is out to get them and concerns of lawyers that scientists are changing things often for the worst. The literature is surprisingly vituperative.

(Gibbons, Hugh, "The Relationship Between Law and Science" (1982), *Idea: The Journal of Law and Technology*, Vol. 22 No. 1, 43 at 43). Even less research is available on the relationship between science and law in the context of environmental decision-making. The research which is available is primarily centered in the United States, with extremely limited consideration of this issue in Canadian legal and scientific literature. Nevertheless, many of the observations found within the American literature have varying degrees of applicability to the Canadian context, and hence are judiciously included within this paper.

194 Markey, Howard T., "Law and Science - Equal but Separate" (1982), *Natural Resources Lawyer*, Vol. 15 No. 3, 619 at 620.

while the ability of both courts and administrative tribunals to effectively address scientific information has been the subject of considerable dialogue in recent years, most of the inquiry in this area has been anecdotal in nature, with little in the way of empirical data to support the proposition that the courts and administrative tribunals have been experiencing significant difficulties with scientific evidence in environmental trials and administrative environmental hearings. From a methodological perspective it is difficult to cast a net wide enough to identify a sufficiently broad spectrum of environmental decision-making problems which are traceable to common root causes of incompatibility between science and law.

b) *Failure to Classify Problems*

Those problems which are identified are often difficult to classify with clarity. For example, if factually contradictory scientific information is presented at an environmental trial by expert scientific witnesses appearing on behalf of opposing parties, the resulting problem may be categorized as uncertainty resulting from the existence of equally valid scientific points of view. Alternatively, that same problem may also be characterized as the manipulation of the adversarial process through presentation of inappropriate scientific information used for the purpose of creating uncertainty rather than resolving it. The difference between these two perspectives of any case will be a matter of opinion depending on what the person drawing the distinction knows or believes about the contradictory evidence.

c) *Failure to Acknowledge Problems*

The aforementioned failure of the legal system to recognize problems arising from incompatibilities between the scientific and legal systems as anything more than procedural anomalies, has resulted in such problems seldom being acknowledged in case law and administrative decisions, thereby significantly reducing the effectiveness of case/decision analysis in such an investigation.

Despite these difficulties, it is submitted that the experience based observations of the author and advisory team combined with a review of existing legal and scientific literature creates a sound basis upon which it is possible to explore the nature and sources of problems in the use of scientific information in environmental decision-making.

4.2 Empirical Research Survey

In January, 1994 an empirical research survey entitled "Environmental Decision-Making: The Interfaces of Science and Law" (hereinafter referred to as the "Research Survey") was undertaken by the Author in affiliation with the University of Alberta *Eco-Research* Chair in Environmental Risk Management. The details of the Research Survey, which was funded in part by the Social Sciences and Humanities Research Council of Canada and completed in January of 1995, are summarized in Appendices 1 through 6.

4.2.1 Purpose

The overall purpose of the Research Survey was, *inter alia*, to examine the perceptions of four of the primary participants in environmental/natural resource trials and administrative environmental/natural resource hearings - the judiciary, administrative tribunal members, legal counsel and members of the scientific community who appear as expert scientific witnesses, for the purpose of identifying the nature and sources of problems which may exist with respect to the ability of Canadian legal institutions and processes to address scientific issues necessary to resolving jurisprudential disputes found in environmental cases.

4.2.2 Methodology

In order to achieve this objective the survey examined the perceptions of Survey participants with respect to five contact points or "interfaces" between the scientific and legal systems which it is submitted are required for the effective introduction of scientific information into legal environmental/natural resource decision-making institutions and processes:

1) The quality of scientific information which is introduced into the decision-making process at trials and administrative environmental hearings involving environmental issues.

2) The communication of scientific information at environmental trials and administrative environmental hearings, and the comprehension of that information by participants in such trials and hearings.

3) The issue of scientific uncertainty in environmental trials and administrative environmental hearings.

4) The use of scientific information to establish the decision-making standards which are used by the legal system, and the translation of scientific information into those standards at environmental trials and administrative environmental hearings.

5) The suitability of legal decision-making institutions (such as courts of law and administrative tribunals) and legal procedures (such as rules of court, rules of evidence and rules of hearing procedure) for the resolution of scientific issues in environmental trials and administrative environmental hearings.

A detailed discussion of the methodology and procedures employed in the research survey is set out in Appendix 1.

5.0 Analysis of Identified Problems: Selection Criteria

5.1 Introduction

The overall conclusion reached as a result of the experience based observations of the author and advisory team, the review of the legal and scientific literature and the Research Survey results is that significant problems do exist with respect to the use of scientific information in legal environmental decision-making institutions and procedures. It is further concluded that the nature and sources of a number of the problems which underlie these issues are identifiable and in fact many have been identified.

The foregoing knowledge from the first phase of the research provides a collection of problems and issues. These are available for analysis and proposal of solutions. However, the confines of this thesis do not allow the scope to explore all of the issues and problems identified nor to attempt to offer solutions to each of them. A series of 3 major issues were selected for detailed discussion. The criteria used to determine which issues would be selected for detailed consideration was based on a two part selection process which included both qualitative and quantitative criteria.[195]

5.2 Qualitative Criteria

Prospective issues were first identified through qualitative identification of problems. Qualitative problem identification was undertaken in the context of 2 criteria:

a) experience based observations of the author and advisory team; and

b) legal and scientific literature.

This qualitative identification of issues is set out in section 3.

5.3 Quantitative Criteria: Screening of Research Survey Results

Prospective issues were also identified by subjecting Research Survey results to a quantitative screening process. This quantitative component of the selection process involved screening research survey results to determine three categories of results which are of primary interest to this thesis:

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195 Due to the diverse and qualitative nature of the elements used in the selection process, a quantitative model to evaluate the various criteria in order to make selection decisions was not considered appropriate. For example, any attempt to "weight" the various selection criteria would of necessity be purely arbitrary and result oriented.

5.3.1 Category 1 Results: Problems Meeting a Threshold Level of Concern and Meeting a Threshold Level of Consensus

This category occurs where a Threshold Level of Concern is met (50.0% response or higher by 2 of the respondent groups and 40% response or higher by the 3rd group, without a difference of 25.0% or higher between any of the groups)[196] between those members of all 3 respondent groups (judges, legal counsel and expert scientific witnesses or administrative tribunal members, legal counsel and expert scientific witnesses)who:

i) responded to a filter question that they either "strongly agreed", "agreed" or were "undecided" with respect to the issue raised in the filter question; or

ii) responded to a non-filter question that they considered the issue raised in the question to be a "major problem", "minor problem" or were "undecided" if it was a problem.

5.3.2 Category 2 Results: Problems Meeting a Threshold Level of Concern and Meeting a Threshold Level of Discord

This category occurs where the Threshold Level of Concern is met, but a Threshold Level of Discord also exists (25.0% or higher)[197] between one respondent group and one or more of the other respondent groups.

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196. This thesis will use the terms "eligible response percentage" and "eligible respondents" to refer to the percentage and identity of those survey participants who give a response of "strongly agree", "agree" or "undecided" to a filter question at the beginning of a question cluster, and who are thereby eligible to respond to the remainder of the questions in that cluster.

This thesis will use the term "total response percentage" when it adds to "eligible response percentages" those survey participants who responded either "disagree" or "strongly disagree" to a filter question and who therefore were ineligible to complete the remainder of that question cluster. In effect, these survey participants are deemed to have answered "no problem" to all questions in the cluster which they were ineligible to answer.

In this context the screening percentages only refer to total numbers of respondents who participated in the survey, and not to the smaller numbers of respondents who were eligible to respond to follow-up questions by virtue of a positive response to filter questions.

197. *Ibid.*

5.3.3 Category 3 Results: Problems Failing to Meet a Threshold Level of Concern while Meeting a Threshold Level of Discord

This category occurs where the Threshold Level of Concern is not met, but a Threshold Level of Discord (25% or higher) does exist.

While the percentages assigned to the Threshold Level of Concern, Threshold Level of Consensus and Threshold Level of Discord categories of results are arbitrary, they were selected to indicate strong levels of consensus and discord. The results of this quantitative screening process are set out in Appendix 7.

5.4 Synthesis of Qualitative and Quantitative Assessment into Issues for Analysis

Problems identified in the qualitative and quantitative assessments were synthesized into larger Problem Areas, with three Problem Areas emerging from the synthesis which were deemed to have the most significance to environmental decision-making in Canada selected for further analysis. The results of this synthesis are set out below.

5.4.1 Problem Area #1: Quality of Scientific Information in Environmental Decision-Making

Experience based observations of the author and advisory team suggested the existence of problems involving the quality of scientific information introduced into legal-based environmental decision-making.[198] The review of the legal and scientific literature tends to corroborate this view and further suggests that the problems in this area are both numerous and significant.[199]

Consistent with these indications, the Research Survey results also tended to support the existence of problems with respect to the quality of scientific information introduced into legal environmental decision-making institutions and processes.

For example, when asked in a filter question whether "Problems exist in environmental trials and other legal proceedings with respect to the quality of scientific information provided in the form of expert evidence by expert scientific witnesses", 56% of

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198 See discussion section 3.2.1.

199 See discussion section 3.2.2.

judges, 59% of legal counsel and 68% of expert scientific witnesses agreed that problems did indeed exist.[200] When survey participants who had participated in administrative environmental hearings were asked the same filter question, 62% of administrative tribunal members, 64% of legal counsel and 79% of expert scientific witnesses also agreed with the proposition.[201]

The respondent groups also provided considerable information with respect to the nature and possible sources of these problems. The identification of problems which related to this issue were largely found within Interface #1 of the "5 Interfaces" model used in the Research Survey.[202]

The relative significance of the issue of the quality of scientific information is seen when the impacts of poor quality information upon legal environmental decision-making are considered. Simply put, legal decision-making processes and institutions are predicated upon the notion of making decisions based upon the best available information. Failure to acquire such information casts doubt upon any decisions which are made. The products of the system can only be as good as the information which is put into it. Consequently the importance of the quality of scientific information introduced into legal environmental decision-making processes must be seen to be of fundamental importance.

5.4.2 Problem Area #2: Communication/Comprehension of Scientific Information in Environmental Decision-Making

Experience based observations of the author and advisory team indicate the existence of problems involving the communication of scientific information at environmental trials and administrative environmental hearings and the comprehension/understanding of that information by trial and hearing participants such as judges, administrative tribunal members and legal counsel.[203] The review of the legal and scientific literature tends to verify these observations and highlights the significance of these problems.[204]

200 Appendix 2 Table 2. Category 1 Result.

201 Appendix 2 Table 3. Category 1 Result.

202 Research Survey questions which relate to the comprehension of scientific information issue include Tables 2 -61 (Appendix 2).

203 With respect to communication see discussion section 3.3.1.1 and for comprehension see discussion section 3.3.2.1.

204 With respect to communication see discussion section 3.3.1.2 and for comprehension see discussion section 3.3.2.2.

Consistent with these indications, the Research Survey results also tended to support the existence of problems with respect to the communication and comprehension of scientific information introduced into legal environmental decision-making institutions and processes.

For example, with respect to the communication of scientific information, when asked in a filter question whether "Problems exist in environmental trials and other legal proceedings with respect to the communication of scientific information provided in the form of expert evidence by expert scientific witnesses", 61% of judges, 61% of legal counsel and 81% of expert scientific witnesses agreed that problems did indeed exist.[205] When survey participants who had participated in administrative environmental hearings were asked the same filter question, 57% of administrative tribunal members, 56% of legal counsel and 87% of expert scientific witnesses also agreed with the proposition.[206] When questioned as to the overall quality of communication between the legal and scientific communities at environmental trials and other legal proceedings, 69% of judges, 67% of legal counsel and 82% of scientists indicated that they perceived "Communication between the scientific and legal communities" to be either fair, poor or very poor.[207] Similar results were obtained with respect to administrative environmental hearings, with 73% of administrative tribunal members, 61% of legal counsel and 80% of scientists concurring.[208]

The respondent groups also provided considerable information with respect to the nature and possible sources of these problems. The identification of problems which related to this issue were largely found within Interface #2 of the "5 Interfaces" model used in the Research Survey.[209]

With respect to the comprehension of scientific information, 55% of judges, 73% of legal counsel and 79% of expert scientific witnesses agreed with the statement that "Problems exist in environmental trials and other legal proceedings with respect to the comprehension/understanding by the courts and/or legal counsel of scientific information presented in the form of expert evidence by expert scientific witnesses."[210] When survey participants who had participated in administrative environmental hearings were asked the

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205 Appendix 3 Table 62. Category 1 Result.

206 Appendix 3 Table 63. Category 1 Result.

207 Appendix 3 Table 74.

208 Appendix 3 Table 75.

209 Research Survey questions which relate to the communication of scientific information issue include Tables 62 -77 (Appendix 3).

210 Appendix 3 Table 78. Category 1 Result.

same filter question, 55% of administrative tribunal members, 56% of legal counsel and 77% of expert scientific witnesses also agreed with the proposition.[211]

The respondent groups also provided considerable information with respect to the nature and possible sources of these problems. The identification of problems which related to this issue were largely found within Interface #2 of the "5 Interfaces" model used in the Research Survey.[212]

The importance of communication and comprehension of scientific information is seen when the effects of poorly communicated or understood information in environmental decision-making are considered. Irrespective of the quality of scientific information introduced into the environmental decision-making arena, failure to effectively communicate and comprehend that information significantly impedes the environmental decision-making process. As a result, the relative importance of the communication and comprehension of scientific information introduced into legal decision-making processes should be acknowledged.

5.4.3 Problem Area #3: Scientific Uncertainty in Environmental Decision-Making

Experience based observations of the author and advisory team initially pointed to the existence of problems involving uncertainty pertaining to scientific information in legal-based environmental decision-making.[213] This evidence was supported by the legal and scientific literature which indicates that the issue of uncertainty is seen by legal and scientific scholars alike as a significant problem.[214]

Consistent with these indications, the Research Survey results also tended to support the existence of problems with respect to uncertainty involving scientific information introduced into legal environmental decision-making institutions and processes.

211 Appendix 3 Table 79. Category 1 Result.

212 Research Survey questions which relate to the comprehension of scientific information issue include Tables 78 -101 (Appendix 3).

213 See discussion section 3.4.1.

214 See discussion section 3.4.2.

For example, with respect to environmental trials and other legal proceedings 78% of judges, 60% of legal counsel and 84% of expert scientific witnesses agreeing with the statement that “Problems exist in environmental trials and other legal proceedings where the scientific information provided in the form of expert evidence results in uncertainty with respect to one or more scientific issues."[215] When survey participants who had participated in administrative environmental hearings were asked the same filter question, 76.1% of administrative tribunal members, 47% of legal counsel and 88% of expert scientific witnesses also agreed with the proposition.[216]

The respondent groups also provided considerable useful information with respect to the nature and possible sources of these problems. The identification of problems which related to this issue were largely found within Interface #3 of the "5 Interfaces" model used in the Research Survey.[217]

The relative significance of the issue of uncertainty with respect to scientific information is seen when the impacts of such uncertainty upon legal environmental decision-making are considered. Legal decision-making processes and institutions are founded upon the requirement of resolving a jurisprudential dispute on the basis of evidence which meets a requisite standard of certainty. Decision-making in the face of uncertainty with respect to scientific evidence creates a difficult task for the decision-maker, and goes to the heart of society's confidence in the legal decision-making framework.

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215 Appendix 4 Table 128. Category 1 Results.

216 Appendix 4 Table 129. Category 2 Results.

217 Research Survey questions which relate to the scientific uncertainty issue include Tables 128 -153 (Appendix 4).

6.0 Problem Area #1: Quality of Scientific Information in Environmental Decision-Making

6.1 Introduction

Problems with respect to the quality of scientific information introduced into environmental decision-making processes was recognized in the experience based observations of the author and advisory team[218] and in the legal and scientific literature.[219] The existence of problems in this area was corroborated in the Research Survey results.[220] An examination of the nature and source of these problems is set out below.

6.2 Failure of Canadian Courts and Administrative Tribunals to Adequately Screen Expert Scientific Witnesses

The experience based observations of the author and advisory team and the legal and scientific literature identified an important source of these problems to be a failure of the quality control mechanisms currently used by environmental decision-makers. These problems included an observed reluctance by many courts and administrative tribunals to invoke a rigorous qualification process and a corresponding willingness by those courts and tribunals to qualify prospective expert scientific witnesses with questionable credentials.[221]

In light of these qualitative observations the Research Survey investigated the perceptions of judges, administrative tribunal members, legal counsel and scientists with respect to the value of existing quality control mechanisms currently used by environmental decision-makers to ensure the quality of the scientific information upon which decisions are based. While quality control mechanisms may differ from decision-maker to decision-maker, the most common mechanism employed in Canada is that of screening experts by "qualifying" them prior to being allowed to give evidence before the decision-maker. The use of a qualification procedure by the courts is required by the rules of evidence which exist across Canada. However, there is no such requirement for most administrative tribunals. Rather, most tribunals are empowered to set their own hearing procedures, and may or may not opt to screen scientific witnesses. The Research Survey surveyed the perceptions of judges, administrative tribunal members, lawyers and scientists with respect to their

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218 See discussion section 3.2.1.

219 See discussion section 3.2.2.

220 See discussion section 5.4.2.

221 See discussion section 3.2.

perceptions as to the screening of scientific evidence and revealed considerable discord between the decision-makers and the scientific community with respect to this issue.

First, the Survey explored the perceptions of decision-makers and the scientific community with respect to whether problems exist with the screening of those persons giving scientific evidence at environmental trials and administrative environmental hearings. When questioned, 45% of scientists agreed with the filter question proposition that "Problems exist in environmental trials and other proceedings with respect to the screening by the courts of those persons who are qualified to provide the courts with scientific information as expert witnesses".[222] However, only 22% of judges concurred. Equally important, a relatively high percentage of judges (61%) stated that they disagreed with the proposition, while only 24% of scientists expressed the same view. When a similar filter question was posed to those respondents who had participated in administrative environmental hearings, 57% of scientists agreed with the proposition, compared with only 26% of administrative tribunal members. Again, a relatively high percentage of tribunal members (53%) disagreed with the proposition compared to only 23% of scientists.[223] The divergence of views between decision-makers and the scientific community on this issue are seen in the comments received by Survey Respondents. One administrative tribunal member stated:

> Anybody with any degree of experience in law courts or administrative tribunals can soon tell when an "expert" is not truly so .... .

This is in sharp contrast to comments received by the Research Survey from members of the scientific community, typified by the observation by one scientist that:

> Inadequate understanding of an individual's scientific credentials by lawyers and judges, often based on misleading c.v.'s. For example, an individual who may not have conducted any scientific work for many years may still be listed as a co-author of scientific papers, because of funding or other arrangements.

As there is no uniformity with respect to the screening of expert evidence by administrative tribunals across Canada, the comments from scientists tended to vary depending upon their experiences. However, a substantial number of scientists commented that the screening processes which they had observed appeared to be woefully lacking. One scientist summarized his experience with screening by administrative tribunals in the following way:

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222 Appendix 2 Table 32. This did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the degree of discord between scientific and judicial respondents is still worthy of note.

223 Appendix 2 Table 33. Category 3 Result.

A proceeding I was involved in which was charged with arriving at a very important, long lasting environmental decision failed to qualify experts at all! Witnesses were allowed to give opinions on topics they had no "expert" knowledge in.

These findings demonstrate that substantially more of the scientists see this issue to be a problem than the decision-makers. Given that the scientists are supposed to be the holders of the knowledge which is sought, this differential perspective is noteworthy.

When asked follow-up questions which attempted to pinpoint the source of these problems, 55% of scientists compared with only 17% of judges agreed with the proposition that "Distinguishing between the qualifications of expert scientific witnesses in situations where two or more experts in the same field give expert scientific evidence" constituted a problem.[224] Similarly, 58% of scientists compared to only 27% of administrative tribunal members agreed that a problem existed when the same proposition was applied to administrative environmental hearings.[225]

It is submitted the screening of would-be expert scientific witnesses appearing before courts in Canada is currently based upon four key principles.[226]

1) The purpose of expert evidence is to provide the court with inferences, in the form of opinions which, due to the technical nature of the information, the court is not able to formulate without assistance. To repeat the words of Dickson J. in *R. v. Abbey*, "An expert's function is precisely this: to provide the judge and jury with a ready-made inference which the judge and jury, due to the technical nature of the facts, are unable to formulate."[227]

2) In order for the evidence of a scientific witness to be received by a court it must first be determined by the court whether the witness is able to assist the court. It may also be recalled that in *R. v. Abbey* the Supreme Court of Canada adopted the test of admissibility of expert evidence set out by Lawton L.J. in *R. v. Turner* that "An expert's opinion is admissible to furnish the Court with scientific information which is likely to be outside the experience and knowledge of a judge or jury."[228] Thus, in order to determine whether a

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224 Appendix 2 Table 42. Category 3 Result.

225 Appendix 2 Table 43. Category 3 Result.

226 See discussion *supra*, section 2.2.

227 *Supra*, note 11.

228 (1974), 60 Cr. App. R. 80 at 83.

particular witness will be of assistance, courts must perform a screening function.

In all Canadian jurisdictions this screening function takes place in the form of a *voir dire* which allows the court to determine whether a prospective expert scientific witness is sufficiently qualified to provide the court with the necessary inferences. While this requires the court to perform a "gate-keeping" function, the court, of necessity, must rely heavily upon the scientific community for guidance in determining the nature and quality of the credentials of the prospective witness. This is often accomplished by reference to the recognition of the credentials of the witness through mechanisms such as peer review of publications, research grants, academic positions, etc.

3) Flowing from the first two principles is the notion that the primary role of the expert scientific witness is to assist the court, irrespective of who retains that witness.

4) Once an expert witness has been "qualified" by a court to provide expert scientific evidence within a prescribed area, the court will then assign weight to the evidence presented. The weight assigned by a court to the evidence of a particular expert witness may depend upon a variety of factors including the credentials of the witness.

While the theory is relatively simple, practical application of these principles is often difficult. First, decision-makers rely almost exclusively on the adversarial nature of the decision-making process to verify the qualifications of the proposed expert witness. This was confirmed by one judge who responded to the Research Survey in the following terms:

> So long as procedure is adversarial, court's will not verify qualifications beyond that undertaken by counsel or parties.

Thus, in situations where there is no opposition or ineffective opposition, there is no means of effectively verifying the qualifications of scientific experts for the decision-maker. This leaves the system open to abuse by legal counsel and scientists who may exaggerate the qualifications of a particular scientist with respect to his qualifications in a particular field or expand the scientist's field of expertise beyond that which he has expertise. In the words of one lawyer who responded to the Research Survey, "In my experience, virtually any witness will be qualified in whatever field counsel suggest."

Second, the experience based observations of the author and advisory team and the legal and scientific literature (including a review of Canadian case law) suggests that judges are generally reluctant to refuse to qualify a scientific witness as an expert (principle 2). In the words of one lawyer who responded to the Research Survey, "Anyone with a semblance of knowledge, technical expertise, or academic background is qualified as an expert." Instead, the preferred route is to allow the witness to give evidence as an expert within a prescribed area of expertise and then take account of the weakness of the credentials of a particular expert witness when assigning evidentiary weight to that evidence (principle 4). As one judge who responded to the Research Survey stated, "Qualification should not replace ability of [a] party to urge rejection of the evidence and the court to give no weight to the evidence when appropriate." It is noteworthy that the respondent judge did not suggest that the court would refuse to receive the evidence - only that it would be given no weight. While the test in *R. v. Abbey* appears sufficiently broad to allow courts to attach reduced or even minimal weight to evidence (all that is required is for the trier of fact to be unable to draw the necessary inferences and for the expert witness to be of some assistance in drawing the inference), it is doubtful if *Abbey* can be stretched to the point of admitting evidence which will be given zero weight, as this would mean that the court is unable to draw the required inference.

The temptations placed upon the courts to use an assignment of weight approach are obvious:

1) Courts have a great deal of familiarity with the exercise of assigning evidentiary weight to evidence. Courts are often on much less familiar ground when attempting to determine in advance whether the credentials of a particular scientific witness are sufficient to meet the test of admissibility.

2) When courts are faced with difficult issues relating to the admissibility of evidence on grounds such as relevance, the courts commonly will allow the evidence to be presented and will determine its relevance at a later time once other evidence relating to the relevance issue has been presented. This approach allows courts to defer the making of decisions on admissibility issues until they are able to evaluate all evidence, and consequently reduces the possibility of committing an error by excluding apparently irrelevant evidence early in a proceeding in situations where such evidence is later found to be relevant. So too, refusing to exclude an expert witness at the qualification stage and later assigning weight to that evidence allows courts the luxury of avoiding an early and immediate evaluation of the would-be expert's credentials. In other words, it significantly reduces the possibility of a successful appeal based on a court's refusal to qualify a witness as an expert and admit the evidence of that witness.

While administrative tribunals are not bound by the same strict requirements regarding the admissibility of expert evidence and the qualification of expert witnesses, many adopt the same approach to admissibility of evidence from questionable expert witnesses as is employed by their judicial counterparts. As one administrative tribunal member who responded to the Research Survey put it, "We shouldn't dwell too much on who is "qualified" but rather listen to any and all and then weight the evidence accordingly." The tendency of tribunals to use this approach was noted by numerous legal counsel who responded to the Research Survey. One lawyer offered the following opinion:

> You often hear that the failure to make a witness available for cross-examination or questionable expertise goes to the "weight" to be given to their evidence but seldom, if ever, is it excluded. It is a mystery to me how any judge of facts weights such evidence.

Another lawyer responded:

> Boards tend to let in the evidence whether the expert is qualified or not. Moreover they tend to not disclose what weight if any they have given to such evidence.

The motivations for tribunals to adopt an "open door" policy for expert witnesses with the issue of weak credentials left to a later consideration of evidentiary weight are obvious. Failure of an administrative tribunal to allow a witness to give evidence as an expert presents an obvious ground for appeal or judicial review of the tribunal's decision. It is much safer for tribunals to admit such evidence and consider its value at a later date behind closed doors.

It is submitted that the approach currently favoured by many courts and administrative tribunals is fundamentally flawed for three reasons.

First, it allows the trier of fact to hear expert evidence from an unqualified person. This may be particularly harmful if the trier of fact is a jury or an administrative tribunal unfamiliar with the judicial practice of disregarding inadmissible evidence. While the courts have embraced the practice of "admonishing" juries to disregard inadmissible evidence as a means of undoing the damage of hearing inadmissible evidence, sociological research indicates that this practice is ineffective. The research in this area and the reaction of the legal community is summarized by one sociologist in the following terms:

> Thirty years of empirical research demonstrates that admonishing jurors to disregard or limit their use of prejudicial evidence is ineffective. In some cases, admonitions only make things worse. This research has been brought to the attention of the legal community but has produced no measurable change in judicial behavior. Judges still give admonitions and appellate courts still approve their use.[229]

Second, the process of attaching "weight" to evidence takes place during the deliberations of the trier of fact, whereas the issue of the qualification of a proposed expert witness occurs in open court. Thus, a reliance on evidentiary weight rather than qualification effectively results in the loss of the "gate-keeping" function of the trier of fact. This in turn results in an absence of a clearly defined credential standard set by the court, and encourages rather than discourages persons with questionable credentials to attempt to appear as expert witnesses. This creates a potential for increased problems with the quality of scientific evidence in environmental decision-making.

Third, it is submitted that this approach also serves to foster the perception among scientific witnesses that they appear before a court or administrative tribunal to assist the party or legal counsel that retains them rather than to assist the trier of fact. By seeing the qualification process as a mere formality, with the trier of fact weighing the evidence after it is presented, would-be expert witnesses are encouraged to view their role as one of convincing the decision-maker rather than assisting him or her in an independent fashion. By more rigorously applying qualification procedures courts and administrative tribunals would instill in prospective expert witnesses the sense that they are allowed to appear to give evidence as an expert witness on the basis that the trier of fact concludes that he or she will be assisted by the evidence of that expert, and not on the basis that the expert has been retained by a party to give evidence.

6.3 Failure of Canadian Courts and Administrative Tribunals to Define Areas of Expertise in which Expert Scientific Witnesses are Qualified to Give Expert Scientific Evidence and a Failure to Confine those Expert Witnesses to the Area of Expertise in which they have been Qualified

Equally harmful to the failure of many Canadian courts and administrative tribunals to invoke a rigorous qualification process is the related problem where the areas in which an expert is qualified are poorly defined, or where an expert is allowed by the decision-maker

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229 Tanford, J.A., "Thinking About Elephants: Admonitions, Empirical Research and Legal Policy (1992) 60 *UMKC Law Review* 645 at 664. For a discussion of social science research in this area see Sue, Smith and Caldwell, "Effects of Inadmissible Evidence on the Decisions of Simulated Jurors: A Moral Dilemma", (1973) 3 *Journal of Applied Social Psychology* 345; and Wolf and Montgomery, "Effects of Inadmissible Evidence and Level of Judicial Admonishment to Disregard on the Judgments of Mock Jurors", (1977) 7 *Applied Social Psychology* 205.

to venture outside of the area of expertise defined by the qualification process. The problem of poorly defined areas of expertise was identified by the experience based observations of the author and advisory team, and was supported by those members of the scientific community responding to the Research Survey, with 53% of respondents considering "Failure of the courts to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert evidence" in trials to constitute a problem.[230] However, there was considerable discord on this issue, with only 28% of judges agreeing with the proposition. Similar findings occurred with respect to administrative environmental hearings, with 58% of scientific witnesses and only 29% of tribunal members supporting the proposition.[231]

Similarly, the experience based observations of the author and advisory team identified a problem to exist where an expert scientific witness is allowed by a decision-maker to venture outside of the area of expertise defined by the decision-maker. A common example of this problem occurs where a well-qualified expert in one field may, in giving evidence venture into a related field in which he or she is not qualified. In this situation a decision-maker who has already qualified a witness as an expert may be less vigilant in ensuring that the expert does not exert influence in areas outside of the expertise he or she was qualified for. In this situation the otherwise inadmissible evidence may be admitted unless opposing legal counsel is sufficiently vigilant to request its exclusion. Again, these observations were supported by scientists responding to the Research Survey, with 54% agreeing that the "Failure of the courts to limit the scientific evidence provided by expert witnesses to those defined areas of expertise in which they are qualified to give expert scientific evidence" constituted a problem. Only 33% of judges concurred.[232] Even greater support for this proposition was obtained from scientists who had participated in administrative environmental hearings, with 62% of expert scientific witnesses agreeing with the statement. This may be contrasted with only 29% of tribunal members who agreed with the proposition.[233] However, some tribunal member members did appear to recognize the problem, with one tribunal member responding:

> Most scientific witnesses have a narrow scope of expertise, yet the issues are complex & require the expertise of many experts. Limited resources can lead to experts "stretching" their evidence outside of their true area of expertise.

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230 Appendix 2 Table 36. Category 3 Result.

Appendix 2 Table 37. Category 3 Result.

232 Appendix 2 Table 38. This result did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the degree of discord between scientific and judicial respondents is still worthy of note.

233 Appendix 2 Table 39. Category 3 Result.

One scientist characterized this problem in the context of cross-examination at administrative hearings as follows:

> My experience is that during cross-examination witnesses are drawn outside their area of expertise. Some witnesses are reluctant to decline answering on the basis they are not qualified. Legal counsel and/or the tribunal does not instruct the witness not to answer because of his/her motivations. This leaves the witness to flounder; casting doubt on previous testimony.

In practical terms, a failure of decision-makers to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert evidence and to limit the scientific evidence provided by expert witnesses to those defined areas of expertise leaves the integrity of the entire system of expert evidence open to question. Leaving aside for the moment any issues of intentional manipulation of the system, a failure to strictly confine expert witnesses to their areas of expertise means that the evidence provided by even the most highly qualified expert witnesses may not be trustworthy. In situations where manipulation is present, the value of the evidence presented disintegrates completely.

6.4 Expert Scientific Witnesses as Advocates

A third problem with the quality of information identified by the experience based observations of the author and advisory team and the literature is a trend where expert scientific witnesses assume the role of advocates rather than providing independent scientific information to assist the trier of fact.

The Research Survey lends considerable support to this qualitative evidence. First, the Survey examined perceptions of the role of expert scientific witnesses at environmental trials and administrative environmental hearings. The Survey revealed that 31% of judges, 48% of legal counsel and 28% of scientists perceived a "... primary role(s) of expert witnesses in giving scientific evidence at environmental trials and other legal proceedings" to be to "... assist the party to the litigation who retains their services". Another 38% of judges, 45% of legal counsel and 32% of scientists considered a primary role of expert witnesses to be to "... assist legal counsel who retains their services on behalf of a client." These results were put into words by one judge who stated:

> The proper role of the expert is to assist the Court. Most experts perceive their role to be to assist the party or lawyer who hired them to "win" the case.

These responses may be compared with 56% of judges, 58% of legal counsel and 58% of scientists who considered a primary role of expert scientific witnesses was to "... assist the court".[234]

Even more striking results were obtained when administrative tribunal members, legal counsel and scientists who had participated in administrative environmental hearings were asked the same question with respect to those hearings. No less than 54% of tribunal members, 62% of lawyers and 36% of scientists perceived a primary role of expert witnesses as being to "... assist the party to the litigation who retains their services. Another 30% of tribunal members, 49% of legal counsel and 21% of scientists considered a primary role of expert witnesses to be to "... assist legal counsel who retains their services on behalf of a client". These responses may be compared with 53% of tribunal members, 65% of legal counsel and 61% of scientists who considered a primary role of expert scientific witnesses was to "... assist the administrative tribunal".[235] One administrative tribunal member who responded to the Research Survey recognized the problem in the following terms:

> It appears that scientific presenters lean towards the group that has contracted the individual to make the presentation.

Surprisingly, 19% of judges, 8.0% of legal counsel and 9% of scientists stated that they believed that it was not the role of expert scientific witnesses to "... assist the court".[236] No less than 13% of tribunal members, 6% of legal counsel and 10% of scientists held the same view with respect to administrative tribunals.[237] Although these views are in a minority, they will determine the expert witness behaviour in those processes in which the opinion-holder participates.

This problem is freely recognized by legal counsel who retain scientists to provide expert evidence on behalf of their clients. One lawyer who responded to the Research Survey stated:

> Experts are so often just "hired guns" who tailor evidence to their client. Financial or counsel's influence, I'm not sure.

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234 Appendix 2 Table 26. Research Survey respondents were allowed to indicate more than one primary role for expert scientific witnesses, and therefore total percentages need not total 100%.

235 Appendix 2 Table 27. Research Survey respondents were allowed to indicate more than one primary role for expert scientific witnesses, and therefore total percentages need not total 100%.

236 Appendix 2 Table 30.

237 Appendix 2 Table 31.

The problem is often not as simple as an expert knowingly giving false or misleading evidence. The expert may simply adopt an opinion which, while favouring his client, is nevertheless scientifically valid. One lawyer who responded to the Research Survey summarized the issue in the following terms:

> I think it is unavoidable that experts tend to be biased towards the positions of their employers. Bodies of scientific knowledge usually have sufficient breadth to accommodate a diversity of equally valid opinions.

While not questioned on the subject in the Research Survey, a number Survey respondents from the scientific community volunteered the observation that private sector environmental consultants are at the heart of much of the scientific advocacy problem:

> Most expert witnesses are typically not really expert witnesses; especially if they belong to a consulting firm. Consultants normally are hired not to be independent, but to support a peculiar position. I have seen this so often in government; a consultant is hired to study a process or a unit, but the person hiring makes sure beforehand that the consultant will give the answer he wants.

Another scientist elaborated on this point:

> There is wide-spread contempt among scientific expert witnesses of the ethics of the legal counsel in both trials & administrative hearings on environmental issues. The exception ... is that many environmental issues which go to trial or hearing are such high stakes, that environmental advisors hired by the defendant (consultants) are now beginning to appear as "expert witnesses". These "experts" are paid advocates for the defendant's position, not neutral, objective experts. The ethics of these environmental consultants are also widely despised. The identify of consultants who "will say what they are paid to say" become quickly known within the environmental science profession, but the reputation of these individuals or firms is generally not known to the judge or administrative tribunal. Legal counsel, however, know of their existence and will "shop around" to find the "correct experts" for the proceeding.

Second, the Survey investigated the qualities which legal counsel look for when retaining an expert scientific witness. Not surprisingly, when legal counsel were questioned as to what qualities they look for when choosing expert witnesses at environmental trials and other legal proceedings, the "Ability to persuade a court with respect to a scientific issue" was high on the list, with 89% of lawyers identifying that quality as being either desirable or very desirable. However, the desirability of this quality also appears to be no secret. Similarly high results were obtained from both judges (73%) and scientists (84%).[238] Even higher results were obtained with respect to administrative hearings, with 86% of board

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[238] Appendix 3 Table 112.

members, 95% of legal counsel and 86% of scientists perceiving this to be a desirable or very desirable quality.[239] While this feature may seem natural to an adversarial process, the effects on decision-making will be negative if persuasiveness is not supported by accuracy.

Consistent with these findings were additional Research Survey results which indicate that the quality of scientific information introduced into environmental decision-making processes may be further impaired by a competitiveness factor on the part of expert scientific witnesses. When questioned, 59% of judges, 58% of legal counsel and 72% of scientists indicated that a problem existed due to "A competitiveness factor, wherein expert scientific witnesses are motivated to attempt to "win" environmental trials and other legal proceedings and "defeat" opposing parties (and their expert scientific witnesses) involved in the litigation.[240] Similar results (65% of tribunal members, 56% of legal counsel and 70% of scientists) were obtained with respect to administrative environmental hearings.[241] The results of this problem were summarized by one administrative tribunal member who responded to the Survey Questionnaire in the following terms:

> The "competitiveness" factor undermines the populist concept of scientists "seeking the truth". The tribunal is put in the position of finding something to be a scientific "fact" because experts are unwilling to cede their client's case to a better, but opposed, scientific approach to an issue.

Another tribunal member stated the view that:

> The major problem seen in the hearing process I participated in was a strong win-lose philosophy that colored the presentation of evidence and prevented full disclosure.

The impact of this competitive approach on the quality of evidence received by decision-makers was summed up by one scientist who responded to the Research Survey in the following terms:

> The motives to win the trial or hearing can be so strong that they overpower the responsibility to present all the information (scientific expert opinion) and for the witnesses to tell the truth. Intentional distortion of information presented as evidence occurs both by legal counsel and some expert witnesses.

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239 Appendix 3 Table 113.

240 Appendix 2 Table 8. Category 1 Result.

241 Appendix 2 Table 9. Category 1 Result.

In simplest terms, Canadian courts and most administrative tribunals are based on the premise that legal counsel will act as advocates for their clients and scientific witnesses will provide their expertise to the trier of fact. When experts assume the role of advocates, the system breaks down to the extent that the quality of information provided to the decision-maker becomes subject to question.

6.5 Expert Scientific Witnesses and the Adversarial System

Experience based observations of the author and advisory team corroborated by the legal and scientific literature indicated the inability of many scientific witnesses to function effectively within the adversarial system utilized by environmental decision-making processes. The Research Survey confirmed this view, finding that 44% of judges, 59% of legal counsel and 65% of scientists perceived "The inability of expert scientific witnesses to function effectively within the adversarial system used in environmental trials and other legal proceedings" to constitute a problem.[242] Similar results were obtained with respect to administrative environmental hearings, with 59% of tribunal members, 58% of legal counsel and 72% of scientists agreeing with the proposition.[243]

However, this conclusion should not necessarily be taken as a criticism of scientists appearing as expert witnesses. Rather, it may be better characterized as a problem arising from the incompatibility of the presentation of scientific information in a decision-making process which is inherently adversarial. One scientist who responded to the Research Survey summarized the issue in the following terms:

> The process does not present a forum where scientific information is fairly heard. The adversarial processes tend to draw out unfair and unsubstantiated criticisms that may be difficult to address.

Further, some scientists who responded to the Research Survey identified an additional element of the problem - that the adversarial process tends to interfere with the quality of scientific information introduced into decision-making processes through the selection of the scientists retained to provide expert evidence. One scientist described the problem as follows:

> Legal counsel ... will "shop around" to find the "correct experts" for the proceeding. (ie. Legal counsel will interview a large number of experts, and select the ones with views supporting their position and discard those not supporting their position).

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242 Appendix 2 Table 6. Category 1 Result.

243 Appendix 2 Table 7. Category 1 Result.

The artificial filtering of scientific evidence which is presented to decision-makers as a result of the selection of expert witnesses by legal counsel can have serious impacts upon the quality of the evidence upon which decision-makers must base their decisions - especially in situations where there is inequality between the parties to a dispute which precludes the decision-maker from receiving the full scientific picture. One scientist explained the problem in the following terms:

> Expert witnesses are selected by the adversaries based on whether the evidence the witness will give is favourable or not to their positions, rather than the witnesses' superior knowledge and experience on the topic.
>
> The selection of witnesses results in the selection of evidence which is presented which can result in a misleading impression, ie. avoidance of "the whole truth". In this way the evidence can be distorted.

Finally, while not explored in the Research Survey, a number of Research Survey Respondents identified the concern that the adversarial system breaks down where one or more parties to a dispute have insufficient resources to adequately present their case to the decision-maker. That is, the adversarial system contemplates opposing parties who each have sufficient resources to advance their cases before a trier of fact. In situations where this is not the case, serious difficulties are created in that the decision-maker receives only part of the available evidence and consequently must base its decision on an incomplete set of facts. Typical of the comments received with respect to this issue are the comments of one lawyer who observed:

> Generally the quality of scientific evidence is determined by the resources available to the parties and court.

Another lawyer elaborated on the problem in the following fashion:

> Most often parties with limited funds can't afford experienced lawyers and consultants:
> - They can't understand the issues well enough to be effective.
> - Court doesn't get the best evidence.

It has long been an axiom of criminal and family law that "there is one law for the rich and another for the poor". This is largely based on the notion that financial resources will often determine the availability and quality of legal counsel, ability to retain expert witnesses, etc. This principle also applies to environmental law. By their very nature environmental law issues are often complex and involve the need to resolve scientific issues in order to decide the larger jurisprudential disputes. This means that environmental law cases often require specialized legal and scientific expertise, which expertise is often expensive. Without equal expertise on each side of a dispute, the adversarial system breaks down, and the quality of decisions is impaired.

6.6 External Influences on Expert Scientific Witnesses

A fourth potential source of problems with respect to the quality of scientific information introduced into environmental decision-making processes identified by the experience based observations of the author and advisory team and by the literature involved external influences upon expert scientific witnesses, which influences might be reflected in their evidence. The Research Survey examined four possible sources of such influence - legal counsel, scientific advisors, audiences at trials and hearings, and the media.

Influence from legal counsel was found to be the influence on expert witnesses most commonly identified of those studied, with 55% of judges, 50% of legal counsel and 41% of scientists stating that they considered "Influence from legal counsel in the preparation of expert scientific witnesses prior to giving evidence at environmental trials and other legal proceedings" to constitute a problem.[244] Similar results were obtained with respect to administrative environmental hearings, with 49% of tribunal members, 45% of legal counsel and 50% of scientists agreeing with the proposition.[245] One scientist who responded to the Research Survey summarized the problem in the most basic of terms, "Expert witnesses will lie if enough pressure is put on them by their employer."

The Research Survey also looked at the influence exerted on expert scientific witnesses by scientific advisors, and found it to be a much less commonly identified factor. Only 22% of judges, 24% of legal counsel and 23% of scientists considered "Influence from scientific advisors retained to assist legal counsel in the preparation of expert scientific witnesses prior to these witnesses giving evidence at environmental trials and other legal proceedings" to constitute a problem.[246] A similarly low percentage of respondents (22% of tribunal members, 20% of legal counsel and 27% of scientists) considered it to be a problem in administrative hearings.[247]

A third possible influence on expert scientific witnesses examined by the Research Survey concerned influence from audiences attending environmental trials and administrative environmental hearings. This was seen as important by very few respondents, with only 11% of judges, 14% of legal counsel and 12% of scientists viewing "Influence from the audience

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244 Appendix 2 Table 18. Category 1 Result.

245 Appendix 2 Table 19. While these results did not meet the criteria for any of the 3 categories of results, they fell only 1% short (judges 49%) of meeting the criteria for a Category 1 Result.

246 Appendix 2 Table 20.

247 This may partly reflect the reality that scientific advisors are not commonly used in Canada.

observing environmental trials and other proceedings to constitute a problem.[248] It is worth noting that the results obtained from those Research Survey respondents who had attended administrative environmental hearings, while still relatively low, were substantially higher than those obtained for environmental trials, with 22%of tribunal members, 10% of legal counsel and 27% of scientists finding such influence to be a problem.[249]

A final potential influence factor considered by the Research Survey involved influences on expert scientific witnesses by the media. Again, this was not viewed as important by many respondents, with only 22% of judges, 29% of legal counsel and 28% of scientists concluding that "Influence from the media" was a problem.[250] Similar results were obtained with respect to administrative environmental hearings (judges 33%, legal counsel 20% and scientists 39%).

The results obtained are as important for those potential influence factors which the Research Survey tends to eliminate as being a concern to participants as for those which it confirms. The results tend to indicate that concerns regarding such factors as audience and media influence were not commonly identified as a problem whereas influence by legal counsel is worthy of note.

The issue of influence from legal counsel on expert scientific witnesses with respect to the evidence to be given by those witnesses provides a clear illustration of the incompatibility of the motivations of the scientific and legal communities in environmental decision-making. The juxtaposition of the scientist's search for truth and the lawyer's desire to win a jurisprudential dispute often creates a tension between scientist and legal counsel which is only resolved once the evidence has been received by the court. Unfortunately, in most cases one is never sure whether the evidence is solely that of the expert witness, or whether the evidence has been improperly influenced by legal counsel.

6.7 Discussion

The combination of the experience based observations of the author and supervisory team, the legal and scientific literature and the Research Survey results lead to a number of observations, conclusions and recommendations, as discussed below.

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248 Appendix 2 Table 22.

249 Appendix 2 Table 23.

250 Appendix 2 Table 24.

6.7.1 Fundamental Incompatibilities Between Science and Law in Environmental Decision-Making

An obvious conclusion which may be reached with respect to the quality of scientific information introduced into environmental decision-making processes is that there are many problems with the quality of scientific information, and the reasons range from constraints of legal processes for presentation of evidence to undue influence during pre-trial/hearing preparation to individual circumstances and behaviours. It is submitted that many of the problems identified by the author and advisory team, by the literature and by the Research Survey have as their root basic incompatibilities between the scientific and legal systems. One of the most important incompatibilities relates to the use of legal advocacy and the search for scientific truth. Fundamentally, a legal decision-making institution is created to decide an issue based upon the evidence placed before it at an arbitrary point in time. Science, at least in its idealized form, seeks to find the truth. If the evidence available to science is inadequate to make pronouncements on the truth, then the search continues. Thus, whereas legal decision-making bodies are constrained to make a decision, sooner or later, using the evidence at hand, science can continue its search for the truth forever. Strong concurrence with this conclusion was observed in the Research Survey from respondents from the scientific community, with 80% agreeing that a problem is created by the fact that "The motivations of expert scientific witnesses and legal counsel in environmental trials and other legal proceedings are incompatible, in that the primary goal of scientists is the attainment of scientific truth, whereas the primary objective of legal counsel is to resolve jurisprudential disputes which may contain scientific issues". However, agreement of the legal community was less than prevalent, with only 45% of legal counsel and 61% of judges in agreement.[251] Similar results were obtained with respect to administrative hearings, with 81% of scientists in agreement compared to only 36% of legal counsel and 57% of administrative tribunal members.[252] The difference in the perspectives of the respondent groups only serves to reinforce the nature of the incompatibility which exists.

Many of the problems identified in this thesis may be traced to a related fundamental incompatibility between the scientific method and legal decision-making processes. The scientific method involves proposing a hypothesis and then setting about trying to disprove that hypothesis - the so-called process of falsification.[253] Within the scientific community the best scientist is one who tests the validity of his hypothesis by most effectively and rigorously challenging it. This feature of the best scientist being a great critic of his own

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251 Appendix 6 Table 178. Category 1 Result.

252 Appendix 6 Table 179. This did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the strong response from the scientific community and the degree of discord between scientists and legal counsel is worthy of note.

253 Popper, K.R., *The Logic of Scientific Discovery* Rev. Ed. (New York: Harper & Row) 1968. Originally published as *Logik der Forschung* (Vienna: Springer) 1934.

theory runs opposite to what would be seen as the skills of the best expert witness, at least as judged through the eyes of legal counsel. While a decision-maker familiar with the scientific method may appreciate thoughtful self-criticism of the opinions being tendered by an expert, such self-criticism might just as easily be interpreted as self-doubt which would undermine the credibility of an expert opinion. Consequently, a first class expert will be discouraged from pursuing in her testimony the logical approach she has used to generate her expertise - that is, challenging and limiting the validity of her own theories. Likewise, scientists with weak abilities in using the scientific method may present expert opinions which may sound very convincing in a court or administrative hearing, but which have escaped the scrutiny of severe challenge.

The legal response to this incompatibility may be to suggest that the process of cross-examination provides the mechanism for testing the validity of expert opinions and a good expert will show his scientific ability in defending his theory against the challenges of cross-examination. While there is some merit to this perspective, that merit depends entirely on the existence and quality of the cross-examination. In some cases, cross-examination may not take place, or if it does it may be weak so that shaky theories will not be adequately exposed. The Research Survey examined this issue and found that 72% of judges, 66% of legal counsel and 68% of scientists were of the view that "Reliance by the courts on cross-examination for the purposes of clarifying and testing expert scientific evidence creates a problem in circumstances where cross-examination is not conducted or is not effectively conducted.[254] Similarly, 62% of administrative tribunal members, 56% of legal counsel and 77.1% of scientists agreed with the proposition.[255]

Alternatively, if a good scientist presents a quality theory in his examination-in-chief but while under cross-examination assumes his role of self critic and admits to the possibility of challenges being valid, a skilful lawyer may be able to represent an implausible (but not impossible) challenge as being important for the decision-maker. This illusion could be effective because an expert may fail to appreciate how his answers could be manipulated in argument, an activity which experts rarely see for themselves. It may be possible for counsel to give an impression of substantial doubt where the expert may recognize only trivial doubt.

A final danger associated with reliance by decision-makers on cross-examination was raised by a judge who responded to the Research Survey with the observation that "Often cross-examination is intended to confuse rather than clarify". Cross-examination is a two-edged sword when used to test scientific evidence. While the adversarial nature of cross-examination often results in additional clarity and a thorough testing of evidence, it by no means guarantees it. The same adversarial motivation may also result in the use of cross-

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254 Appendix 3 Table 96. Category 1 Result.

255 Appendix 3 Table 97. Category 1 Result.

examination to obscure important evidence and to make scientifically strong evidence appear weak.

Perhaps the best recommendation which can be made with respect to incompatibilities between the scientific method and legal decision-making processes is the raising of awareness of the problem amongst all participants in these decision-making processes. This may be accomplished through training, both in our colleges and universities and later through continuing professional education. An increased awareness of these incompatibilities may lead to a greater understanding between the scientific and legal communities, which in turn may serve to reduce the negative effects of these incompatibilities on environmental decision-making.

6.7.2 Quality Control

The second conclusion which may be reached is that the quality control procedures currently employed by environmental decision-makers with respect to the admission into evidence of scientific information may not be as effective as many within the legal community perceive it to be. The high degree of discord identified in the Research Survey between respondents from the legal and scientific communities with respect to the effectiveness of screening processes currently used by courts and administrative tribunals indicates that while decision-makers appear relatively satisfied with the level of quality control of scientific information, scientists have considerably less confidence in it. The clear divergence of opinion found in these results does not resolve the question of the effectiveness of current quality control mechanisms. One is left to look to the sources of these views to determine whether the legal or scientific community is best placed to evaluate this issue. There can be little question that matters of a predominately legal nature such as issues of receivability of evidence which involve issues of relevance, materiality and admissibility of evidence are best judged by those within the legal system. However, a strong argument may be made that matters such as the effectiveness of quality control mechanisms used to allow or disallow expert scientific evidence involve scientific issues for the most part (such as distinguishing between the qualifications of scientific witnesses and defining areas of scientific expertise) and thus are better judged by the scientific community. The message being sent by the scientific community appears to be that there are problems with the current system of quality control employed by decision-makers. One scientist responding to the Research Survey summarized the problem in the context of administrative tribunal decision-making in the following way:

> [Screening by administrative tribunals of those persons who are qualified to provide such tribunals with scientific information as expert witnesses] is a very difficult thing for members of a tribunal to do, as they are not qualified to do so nor do they generally understand what is involved in doing so. I really feel sorry for tribunals trying to do so.

Whether decision-makers will choose to recognize these problems or not is unclear.

If one accepts the view of the scientific community that problems do exist in current quality control procedures used by courts and administrative tribunals in environmental decision-making, the most obvious recommendation is for improvements to current screening processes. A good starting place is to reverse the current trend of making the qualification of potential expert witnesses almost automatic. The "let it in and determine relevance later" approach may work reasonably well with respect to issues involving the receivability of lay evidence. However, the same can not be said for allowing everyone with a scientific background to be qualified as experts and having the trier of fact distinguish the good from the bad later on during deliberations by attaching varying degrees of weight to such evidence. It is submitted that the risk of appeal associated with not allowing a potential witness with questionable credentials to be qualified as an expert witness is far outweighed by the greater damage to the legal system and the administration of justice generally in allowing scientists with dubious or irrelevant professional credentials to give evidence as court/tribunal recognized experts. First, there is the very real risk that a poorly credentialed but convincing witness will unduly influence the trier of fact (who may have no scientific background and no independent expert to assist him), thereby reducing the quality of the decision. Second, recognition of a questionable scientist as an expert may reduce the esteem in which environmental decision-making processes are held by the scientific community.[256] Alternatively, such recognition may serve to falsely inflate the reputation of the questionable scientist amongst the scientific community. This latter result may serve to encourage other questionable experts to attempt to be qualified as an expert by the courts, thereby further reducing the quality of scientific information being introduced into environmental decision-making processes.

In Canada, courts and administrative tribunals make the final determination of whether a scientist will be qualified as an expert witness or not. Thus, they are the "gate-keepers" of scientific information which is allowed to enter into environmental decision-making processes. However, in carrying out this role, decision-makers are of necessity dependent upon standards set by the scientific community. That is, environmental decision-makers must rely upon the scientific community to provide the standards of scientific credibility and the means to determine whether a prospective witness meets those standards. This is achieved through such mechanisms as rank and status of academic appointment, scholarly awards, publication in peer reviewed journals, presentation of papers at academic conferences, practical project experience, etc. Scientists generally recognize that no single measure can establish an individual scientist's stature in a manner relevant to qualifying as an expert witness. However, many would agree that tangible examples of how the scientist's

256 In this regard one Canadian judge stated to me that he recognized that "When I accept the evidence of scientist "A" over "B" I accept his science - and increase his stature in the scientific community."

work has been influential and been adopted by others who are independent in their choice should be regarded as a worthwhile signal of stature. Thus while courts and tribunals may be the "gatekeepers" of scientific information entering into decision-making processes, it is the scientific community which determines the size and nature of the gate over which decision-makers are to stand guard. Gatekeepers who fail to listen to the scientific community in this regard do so at their peril.

In exercising this gate-keeping function environmental decision-makers must not only be concerned with scrutinizing the qualifications of those scientists who wish to be qualified as expert witnesses. Decision-makers must also take considerable care to define the area or areas of expertise in which scientific witnesses are qualified to give expert evidence, and must be vigilant to ensure that these expert witnesses are confined to giving evidence only within the parameters in which they have been qualified. In response to this problem one judge who responded to the Research Survey expressed the view that "Lawyers should define narrowly the issue on which the expert's opinion is sought." While it would be helpful if legal counsel would assume responsibility for ensuring that the expert witnesses which they present have their areas of expertise narrowly defined, this is wishful thinking indeed. It must be remembered that environmental decision-making is most often an adversarial process, and it is often in the lawyer's best interest to have an expert witness qualified as broadly as possible.[257] While opposing legal counsel may be able to narrowly define the area of expertise for which the witness is qualified to give expert evidence, this is unlikely to occur if opposing legal counsel is not present or is ineffective.[258] Rather, it is submitted that it is primarily the responsibility of the decision-maker to be vigilant to ensure that the area of expertise of the expert witness is narrowly defined and that the expert confines himself to giving evidence only within those narrowly defined parameters. In carrying out this responsibility decision-makers should be mindful that while they are the gate-keepers of the environmental decision-making processes over which they preside, they have a counterpart and potential ally in the scientific community which has developed and refined its own gate-keeping function over many years. The scientific community has evolved a well-defined system of evaluating a scientist's stature. Scientists will judge another's stature most convincingly on the basis of the influence that a scientist's work has had upon the field. So it is not so much how many papers a scientist has published but whether the scientist's work has been cited by others and has it shaped the thinking in that field

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257 Examples include situations where a particular expert is a very effective communicator or where client resources are limited and one expert may be called upon to perform tasks which should be undertaken by several.

258 Legal counsel may be ineffective for a variety of reasons, including inexperience in handling cases involving scientific witnesses or through a lack of client funding legal counsel may not have a scientific expert advising him with respect to narrowly defining the prospective expert's area of expertise.

The decision-maker is well advised to draw upon the ability of the scientific community to evaluate scientists within that community in deciding whether to qualify a scientist as an expert witness and in determining the parameters of that expertise. In situations where a decision-maker is satisfied that the adversarial system is operating as it should, with both sides effectively bringing out the strengths and weaknesses of a proposed expert and the parameters of his expertise in a *voir dire* prior to being qualified or rejected by the decision-maker, the decision-maker can make his decision in reliance upon the fact a witnesses' stature within the scientific community will be brought out through operation of the adversarial system. However, in those cases where it is apparent to the decision-maker that the adversarial process has broken down either due to an absence of opposition or ineffective opposition, the decision-maker is encouraged to take the initiative to make such inquiry with the scientific community into the expertise of the proposed expert witness as is required to satisfy the decision-maker. In practical terms this may simply be a request from the decision-maker to be provided with a full listing of the academic credentials of the scientist as set out in a *curriculum vitae*. Or, as one judge who responded to the Research Survey suggested, it may mean presenting the decision-maker with the scientists' body of work:

> The writings of expert witnesses prior to the matter in question should be made available to parties and court on demand - prior to testimony.

If the decision-maker has difficulty in evaluating the scientist in terms of how the scientist would be judged by the scientific community, an independent expert could be retained by the decision-maker for this purpose. This process is widely used in scientific circles to judge the merits of an individual's work. Such an independent expert would also be of assistance to the decision-maker in determining the parameters of the witnesses' expertise, and later in determining if the witness was straying from those parameters in giving evidence.

6.7.3 Role Confusion for Scientific Experts

A third conclusion is that there is currently considerable confusion with respect to the role which scientific witnesses are to play in environmental trials and hearings. The Research Survey indicates that an unexpectedly high percentage of judges, administrative tribunal members, legal counsel and scientists perceive a primary role of expert scientific witnesses is to assist either the party to litigation who retains their services or legal counsel who retains their services on behalf of a client. The problem is summarized by one judge who responded to the Research Survey in the following terms:

> The problem is that the expert witnesses act as advocates for the client. We don't know how objective they are.

Another judge concluded:

> The proper role of the expert is to assist the Court. Most experts perceive their role to be to assist the party or lawyer who hired them to "win" the case.

As discussed earlier, the Supreme Court of Canada has made it quite clear that the role of the expert witness is to "... furnish the Court with scientific information which is likely to be outside the experience and knowledge of a judge or jury."[259] It is not the primary role of the expert witness to serve the interests of either the party or legal counsel who retains him. However, it is also obvious that parties and their legal counsel would want to choose experts whose service to the court was also beneficial to their case.

One response to this problem is for the decision-maker to instruct each expert witness prior to giving evidence of the proper role of that expert witness in giving evidence. Such instruction would ensure that expert witnesses are aware of their duties and are not operating under any misconceptions of improper loyalties while giving evidence. Failure to heed the instructions of the decision-maker could result in sanctions, such as dismissal of the witness, and in extreme cases the witness could be found in contempt.

A second response, suggested by a judge who responded to the Research Survey, would restrict the use of expert witnesses to consideration of factual scientific issues in question and eliminate situations in which the witness is encouraged to act as advocates:

> Lawyers should define narrowly the issue on which the expert's opinion is sought. Experts should be given fair and objectively based factual hypotheses on which to premise their opinions. Experts should not be asked for opinions based only on factual assumptions that favour one side, and should not be asked (or permitted) to "argue" the case for "their" side.

A third approach is for decision-makers to retain independent witnesses. One judge who responded to the Research Survey summarized the advantages of this approach in the following terms:

> Would prefer to have independent expert witnesses. Interpretation of scientific experiments & tests similar to statistical data can be misleading and lean towards the opinion of the party submitting the evidence.

Similarly, another respondent judge stated the view that "Courts should use ability to call independent evidence and "take a view" more often." The independent expert can be particularly helpful in situations where the adversarial system breaks down through a lack of opposition or ineffective opposition. The independent expert can also be useful where the decision-maker is aware in advance of a trial or hearing that a case will involve a

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[259] *R. v. Abbey*, *supra*, note 11.

considerable amount of complex scientific evidence and is likely to be conducted in an intensely adversarial manner. Finally, this approach may also be of assistance if the decision-maker is aware that one or more expert witnesses who will give evidence has a reputation as a "hired gun" whose primary loyalty is to those willing to retain him rather than to the decision-maker.

It is submitted that each of the above approaches are consistent with the law as it currently exists in Canada and would be relatively easy to implement by courts and administrative tribunals. Implementation of these responses would not prejudice any litigant, and would increase the confidence which our courts and administrative tribunals have in the scientific evidence which is presented to them.

6.7.4 External Influences on Scientific Experts

A fourth and related conclusion is that the quality of environmental decision-making is jeopardized by a susceptibility of scientific witnesses to certain types of external influences which may be reflected in their evidence. It is possible to conclude from the Research Survey that while there may be some mild influence from external factors such as scientific advisors, audiences and the media, the area of primary concern is influence from legal counsel. Given this conclusion it is recommended that judicial and administrative decision-making processes be revised to address this problem. Unfortunately this is not an easy problem to solve. The problem appears to cover a broad range of situations. Some examples of this problem are obvious, as in the earlier example of scripted evidence[260] or where legal counsel instructs the witness as to what evidence he is to give. In other situations the problem is much more subtle. For example, the line between proper witness preparation and improper witness influencing by legal counsel is often gray and difficult to pinpoint with precision. For example, the terminology which is used by an expert witness may have a significant impact on the outcome of the case. In the words of one legal counsel who responded to the Research Survey:

> The use of slightly different definitions of scientific/technical terms can have a very (surprisingly) large impact on the understanding of the total sum of the evidence.

A classic illustration of this point is seen in the conflicting definitions of the term "fish habitat", as found in section 35 (1) of the *Fisheries Act*, advanced in expert evidence by four fisheries biologists in *R. v. Town of St. Paul*, discussed earlier. [261]

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260 See discussion section 3.2.1.

261 See section 2.2 *supra*.

A second common example relates to the standard of proof which must be met in a particular case. Suggestions by legal counsel during witness preparation which enable the witness to better communicate his evidence before a court or board are clearly desirable. However, if a witness states to legal counsel during preparation that he is "fairly sure" that a particular contaminant caused injury to a plaintiff, is it proper conduct for legal counsel to suggest to the witness that he use the term "sure" rather than "fairly sure" when in court? Does this suggestion clarify communication to the court or convey a level of certainty that the witness does not actually possess? The issue is further complicated by the sticky issue that interpretations of levels of certainty may differ between the scientific and legal communities. Does the witness understand the consequences to the issue of meeting a legal standard of proof of in a civil case stating that he is sure rather than fairly sure? What about in a regulatory case? Similarly, during witness preparation legal counsel may explore with the witness what he means by the term "fairly sure". During the course of conversation in which all of the elements upon which the witness has based his conclusion are revisited, the lawyer may state to the witness "I'm getting from our discussion that you are really very sure of your conclusion - you may wish to make that clearer to the court". Is legal counsel's behaviour proper in that the lawyer has assisted the expert witness to clarify the manner in which he wishes to communicate his thoughts to the court? Or has the lawyer, in having the expert review all of the evidence in favour of his conclusion without raising issues which detract from that conclusion, improperly influenced the witness to give evidence which implies greater certainty in the witnesses' conclusion than is justified given the circumstances? Is it possible that legal counsel, concerned with establishing the various elements of his case, could unintentionally influence a witness in the manner described above? How could such influence ever be proven by a party adverse in interest?

The key point in all of this is that the expert witness is only helpful to the decision-making process if he or she functions as a servant to the court or administrative decision-maker. This premise must serve as the foundation upon which the lawyer - witness interaction is defined. Three possible solutions appear to have varying degrees of merit.

First, improper influence on expert witnesses may in some cases be ferreted out by effective cross-examination geared toward exposing such an impropriety. However, in addition to being technically difficult, this line of cross-examination is often perceived as a personal attack on the professionalism of the legal counsel presenting the witness for cross-examination, members of the legal community are often loathe to adopt this approach.

Second, lawyer - witness interactions in this area are fraught with fine distinctions, and the questions they raise are difficult to address in conventional mechanisms such as legislation or cross-examination. Thus, in more obvious cases this issue may be better addressed by the legal community through the professional conduct mechanisms employed by Canadian law societies[262] and by the scientific community through its professional conduct requirements and processes. Specifically, by characterizing this issue in terms of professional conduct rather than admissibility of evidence the legal system is able to utilize its professional conduct infrastructure including education of articling students and members of the bar, and as a last resort in code of professional conduct reviews.

A third recommendation is for expert witness training. In response to this problem one judge who participated in the Research Survey offered the opinion that, "Expert witnesses should take courses on being expert witnesses and testimony." Educational seminars which set out the expectations of the legal system toward expert scientific witnesses (including the issue of external influences) should be made available to the scientific community, and that completion of such training be a mandatory prerequisite to an expert being qualified to give evidence before a court or administrative tribunal in Canada. Such training could be provided under the joint auspices of various governing bodies of both the legal and scientific communities. The value of such training to the overall system would include providing expert witnesses with the knowledge and understanding to protect their role as servants of the court if they perceived they were being unduly influenced by counsel.

6.7.5 Linear Processes

It is also possible to conclude that the quality of scientific evidence is often constrained by the format for the presentation and adjudication of scientific evidence in current environmental decision-making processes. Scientific controversies are dealt with by bringing multiple inputs to bear in an iterative and interactive manner so that individual scientists can react and respond to insights which they may gain from debate with their colleagues. The linear process of presentation and cross-examination of evidence does not allow for this level of interplay which is often necessary to resolve complex scientific issues. However, additional mechanisms are available to improve quality assurance in scientific controversies, although these mechanisms are not common to legal decision-making processes. For example:

a) Doubts about measurement methodology might be resolved by submitting split samples to independent measurement.

b) Pre-trial and pre-hearing meetings between triers of fact and scientific experts could be utilized to determine areas of consensus between scientists and thereby limit the area of controversy.

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262 Such as discipline committees.

c) In some situations it may be advantageous for administrative tribunals to hear panels of witnesses rather than individuals. In the past this approach has usually been used to save time. However, there is potential to use the interplay among a panel of witnesses to ensure a more integrated picture of the evidence for the decision-maker which avoids the fragmentation which is characteristic of a strictly linear process. Taking this approach one step further, a tribunal could require that all experts giving evidence with respect to a particular issue appear together, irrespective of who they represent. This would allow the decision-maker to evaluate the views of the various witnesses directly by seeing how they respond to issues raised by each other and by the tribunal. However, for such an approach to be effective, direct cross-examination of individual panel members must be allowed.

Such co-operative and interactive approaches to quality assurance have not been commonly used with scientific evidence in legal proceedings. However this is not surprising, given an apparent reluctance of the legal community to recognize that existing legal processes may not be suitable for the introduction and evaluation of scientific evidence. When questioned in the Research Survey, only 36% of judges and 53% of legal counsel agreed that a problem is created due to the fact that "The existing legal process is poorly suited to address scientific issues."[263] This view is in sharp contrast to the very high level of agreement (87%) with the proposition by respondents from the scientific community. Presumably, scientists are best placed to judge the suitability of the forum for addressing the scientific aspects of a case.

6.7.6 Balancing Inequalities of Resources Available to Parties for the Presentation of Scientific/Technical Evidence

While there was no quantitative data received on this point, the observations of the author and advisory team and qualitative information received from respondents to the Research Survey indicate that problems with the quality of scientific/technical information introduced into environmental decision-making processes results from inequalities in resources available to parties participating in decision-making processes.

In response, it is suggested that Federal and provincial legislation should be amended to require parties applying for approval of proposed projects to be responsible for providing intervenor funding to decision-making agencies for the purpose of facilitating meaningful participation in decision-making processes by interested persons and organizations. These agencies would then be responsible for ensuring that such funding is equitably distributed to those persons or organizations wishing to participate in decision-making processes as

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263 Appendix 6 Table 172.

intervenors. The funding would be provided to assist under-funded intervenors to obtain scientific/technical information for presentation to the decision-maker. This would include the retainer of scientific/technical experts independent of project proponents. While intervenor funding is provided by some environmental decision-makers, such as the Canadian Environmental Assessment Agency, such funding is usually taken from the public purse and is extremely limited. By making intervenor funding a "cost of doing business" borne by project proponents, environmental decision-makers are assured that the scientific/technical evidence presented is reasonably balanced, the cost is borne by those who stand to make a profit from the project rather than by the public, and project proponents know well in advance that such costs will be incurred, thereby allowing them to budget accordingly.

Further, in situations where environmental decision-makers are aware of inequities in resources between parties appearing before them, decision-makers are advised to take pro-active steps to attempt to compensate for these inequities. For example, decision-makers may avail themselves of independent scientific/technical expertise to ensure that a balanced view of scientific issues is provided to them.

7.0 Problem Area #2: Communication/Comprehension of Scientific Information in Environmental Decision-Making

7.1 Introduction

Problems with respect to the communication of scientific information and the comprehension of that information in environmental decision-making processes was recognized in the experience based observations of the author and advisory team[264] and in the legal and scientific literature.[265] As seen earlier, the existence of problems in this area was corroborated in the Research Survey results.[266] An examination of the nature and source of these problems is set out below.

7.2 Communication of Scientific Information

On the basis of the experience based observations of the author and advisory team and the legal and scientific literature the first issue considered by the Research Survey involved identification of potential problems with the communication of scientific information in environmental decision-making.[267] An examination of the nature and sources of these problems was conducted by the Research Survey, the findings of which are set out below.

7.2.1 Failure of Scientific Witnesses to Effectively Communicate Scientific Information

The experience based observations of the author and advisory team[268] and the legal and scientific literature[269] identified a leading potential source of these problems to be the failure of scientific witnesses to effectively communicate scientific information. In light of

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264 With respect to communication see discussion section 3.3.1.1 and for comprehension see discussion section 3.3.2.1.

265 With respect to communication see discussion section 3.3.1.2 and for comprehension see discussion section 3.3.2.2.

266 See discussion section 5.4.2.

267 *Ibid.*

268 See discussion section 3.3.1.1.

269 See discussion section 3.3.1.2.

these qualitative observations the Research Survey investigated the perceptions of judges, administrative tribunal members, lawyers and scientists with respect to the communication of scientific information. There was strong support by each of the respondent groups that a failure to communicate did indeed exist, with 72% of judges, 67% of legal counsel and 85% of scientists agreeing that a problem is caused by "The failure of expert scientific witnesses to effectively communicate scientific information to participants in environmental trials and other legal proceedings such as judges and legal counsel".[270] Similarly, 63% of administrative tribunal members, 64% of legal counsel and 90% of scientists also agreed with the proposition in the context of administrative environmental decision-making.[271] One administrative tribunal member reduced the problem down to the simplest of terms, stating that "Scientific experts are frequently poor 'explainers'." Scientists themselves recognize the problem. As one scientist who responded to the Research Survey admitted, "Experts have a problem presenting science simply."

The strong evidence of problems with the communication of scientific information in environmental decision-making processes suggests that even if scientific information introduced into these processes is of good quality, the communication of this evidence is creating a bottleneck which interferes with the availability of this information to decision-makers. That is, even though the information may be of high quality, it is of no assistance to the decision-maker if it is presented in a manner which is unusable by the decision-maker.

7.2.2 Scientific Language

A second, related potential problem examined by the Research Survey was the use of technical language by scientists which may not be understood by other participants in environmental decision-making processes. When questioned, 72% of judges, 68% of legal counsel and 84% of scientists agreed that a problem is created by "The use of technical language including jargon and terms of art which may not be understood by participants in environmental trials and other legal proceedings such as judges and legal counsel".[272] Similar results were obtained in the context of administrative environmental hearings, with 63% of administrative tribunal members, 67% of legal counsel and 87% of scientists agreeing with the proposition.

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270 Appendix 3 Table 66. Category 1 Result.

271 Appendix 3 Table 67. Category 2 Result.

272 Appendix 3 Table 64. Category 1 Result.

A related possible reason for this failure looked at by the Research Survey involved problems with the use of technical language as between scientific experts themselves. In this regard 72% of judges, 53% of legal counsel and 80% of scientists concurred that a problem results from the fact that "The meanings to be attributed to technical terms (such as jargon and terms of art) may vary between expert scientific witnesses (for example, the meaning which a civil engineer associates with the term "physical stress" may be very different from the definition of that term which would be provided by a biologist)".[273] Similar results were obtained with respect to administrative environmental hearings, with 55% of administrative tribunal members, 47% of legal counsel and 81% of scientists agreeing with the proposition.[274]

The substantially higher proportion of response by scientists is noteworthy. Perhaps, judges, board members and legal counsel do not appreciate the prevalence of major differences in meaning for the same words which exist between disciplines. If the decision-makers and legal community are aware of these problems, they may be more confident than the scientists in their ability to recognize and deal with such problems. Either way, the concern expressed by the scientists who are more likely to appreciate the sublety and importance of such problems suggests that this issue does need attention.

7.2.3 Distortion of Information Through Cross-Examination

A third potential source of problems with the communication of scientific information in environmental decision-making relates to the distortion of scientific information as a result of the use of cross-examination by opposing legal counsel. There was considerable disagreement between the decision-makers and the scientific community on this issue. While 83% of scientists agreed with the proposition that a problem is created by "The distortion of scientific information as a result of the use of cross-examination by opposing legal counsel", only 55% of judges also agreed.[275] Similarly with respect to administrative hearings, 84% of scientists were in agreement compared with only 48% of administrative tribunal members.[276]

The concerns of the scientific community on this issue were reflected in the large number of comments received from the Survey Respondents. A common view of many of

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273 Appendix 3 Table 70. Category 1 Result.

274 Appendix 3 Table 71. Category 2 Result.

275 Appendix 3 Table 68. Category 2 Result.

276 Appendix 3 Table 69. This did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the strong response from the scientific community and the degree of discord between scientific and judicial respondents is worthy of note.

the scientists who participated in the Research Survey was that "Reliance solely on cross-examination for clarifying and testing evidence may leave a distorted view of the evidence." In this vein one scientist observed:

> Court room proceedings conflict with the open flow of scientific information. Lawyers are skilled at manipulating information and this, along with cross-examination processes, often leads to confusion, distortion and over-simplification of scientific information.

It was also observed that cross-examination on scientific concepts requires a knowledge of the concepts in question both by the expert being cross-examined and by the cross-examiner. This is often difficult when the cross-examiner is trained in law rather than science.[277] This point was summarized by one scientist who responded to the Research Study in the following terms:

> During cross-examination it becomes evident that some legal counsel do not understand the technical evidence and cannot ask the questions properly or understand the significance of the evidence.

This view was echoed by another scientist who expressed the view that:

> Some legal counsel in cross-examination simply do not understand the scientific evidence. This demeans the whole process.

The greater prevalence of concern among scientists on the issue may also be attributed to their discomfort with the process of cross-examination as a means for establishing the veracity of scientific evidence. The procedures used for testing the veracity of lay witnesses may be effective for revealing character flaws in expert witnesses, but they are not necessarily useful for testing validity of scientific concepts. In principle, cross-examination should also be capable of challenging scientific concepts in an informative manner, but the focus must be on concepts and content, not on witness demeanour.

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277 Of course, this also applies to decision-makers. If the substance of the cross-examination cannot be understood by the decision-maker, effective cross-examination may achieve no effect.

7.3 Comprehension of Scientific Information

On the basis of the experience based observations of the author and advisory team[278] and the legal and scientific literature[279] the second issue considered by the Research Survey involved identification of potential problems with the comprehension of scientific information in environmental decision-making.[280] An examination of the nature and sources of these problems was undertaken by the Research Survey, the results of which are set out below.

7.3.1 Failure of Decision-Makers and the Legal Community to Understand Methods of Scientific Inquiry and Proof

The experience based observations of the author and advisory team and the legal and scientific literature identified a leading potential source of these problems to be the failure of decision-makers and the legal community to understand methods of scientific inquiry and proof. In light of these qualitative observations the Research Survey investigated the perceptions of judges, administrative tribunal members, lawyers and scientists with respect to the ability of decision-makers and legal counsel to understand methods of scientific inquiry and proof at environmental trials and other legal proceedings and at administrative environmental hearings. There was considerable consensus between the judges and scientists that a failure did indeed exist. With respect to the comprehension of scientific information by courts at environmental trials and other legal proceedings, 55% of judges and 69% of scientists agreed that a problem is caused by the fact that "The courts do not sufficiently understand the methods of scientific inquiry and proof".[281] However, there was more disagreement regarding the comprehension of scientific information by tribunal members at administrative hearings, with only 44.3% of tribunal members agreeing with the proposition compared to 73% of scientists.[282] Some tribunal members who responded to the Research Survey expressed the opinion that "Tribunals are better able to understand & weigh technical evidence". It seems that this confidence in the ability of administrative tribunals to understand scientific evidence is not shared by the scientific community. The view expressed by many scientists in this regard was summarized by one scientist who responded to the

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278 See discussion section 3.3.2.1.

279 See discussion section 3.3.2.2.

280 See discussion section 5.4.2.

281 Appendix 3 Table 80. Category 1 Result.

282 Appendix 3 Table 81. Category 1 Result.

Research Survey stating, "In my experience the Board/Panel members miss or fail to understand much of the technical information."[283]

Basic understanding of scientific methods of inquiry is important to provide a context for interpreting scientific evidence. If decision-makers have no appreciation of the practical realities inherent in scientific inquiry then they will have difficulty in being able to interpret the qualifiers which competent scientists should place on their evidence.

When asked the related question whether a problem is caused because "*Legal counsel* do not sufficiently understand the methods of scientific inquiry and proof, there was a general consensus between the respondent groups, with 61% of judges, 61% of legal counsel and 72% of scientists agreed that a problems is caused at environmental trials and other legal proceedings,[284] while 56% of administrative tribunal members, 54% of legal counsel and 77% of scientists also found a problem to exist at administrative environmental hearings.[285]

7.3.2 Failure of Decision-Makers and the Legal Community to Understand Statistical Analysis

A more specific source of problems associated with the comprehension of scientific information in environmental decision-making considered by the Research Survey involved a failure by decision-makers and the legal community to understand statistical analysis. There was consensus between the respondent groups that a failure did indeed exist. With respect to the comprehension of courts at environmental trials and other legal proceedings, 61% of judges, 67% of legal counsel and 79% of scientists agreed that a problem is caused by the fact that "The courts do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses".[286] Similarly, 56% of administrative tribunal members, 54% of legal counsel and 85% of scientists also agreed with the proposition in the context of administrative environmental hearings.[287] When asked the related question

283 For a detailed discussion of this issue see *infra*, section 7.4.2.

284 Appendix 3 Table 82. Category 1 Result.

285 Appendix 3 Table 83. Category 1 Result.

286 Appendix 3 Table 84. Category 1 Result.

287 Appendix 3 Table 85. Category 2 Result. It is noteworthy that there is a perception amongst scientists that administrative tribunal members, who are ostensibly appointed for their expertise, are less able to comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses than are judges, few of whom claim any scientific expertise (Table 84). This tends to led credence to the argument that many administrative tribunal members are not appointed for their scientific or technical expertise. It also lends weight to the argument that the courts should not provide such tribunals with a high level of deference when considering applications for judicial review.

whether a problem is caused because "*Legal counsel* do not sufficiently understand the merits and pitfalls of statistical analysis provided by expert scientific witnesses", 61% of judges, 61% of legal counsel and 72% of scientists agreed that a problem is caused at environmental trials and other legal proceedings,[288] while 56% of administrative tribunal members, 54% of legal counsel and 77% of scientists also found a problem to exist at administrative environmental hearings.[289]

Statistical analysis has become fundamental to the scientific experimental approach to knowledge generation. Yet, much confusion exists about the application and interpretation of statistical inference even among scientists. This is an area which is readily open to manipulation, either to mislead a decision-maker or to simply create confusion for the decision-maker which may become manifest as reasonable doubt. One administrative tribunal member who responded to the Research Survey summarized the problem in the following terms:

> You're really onto something here. Statistics are a real trap. Also especially, the unvoiced doctrines and biases (world views) that may inform the expert witness(es) but not necessarily the panel, or counsel.

7.3.3 Failure of Decision-Makers and the Legal Community to Understand the Value Premises and Professional Biases which Underlie Scientific Information

A third potential source of problems associated with the comprehension of scientific information in environmental decision-making considered by the Research Survey involved a failure by the legal community to understand the value premises and professional biases which underlie scientific information. With respect to environmental trials and other legal proceedings, 61% of judges, 59% of legal counsel and 75% of scientists agreed that a problem is caused by the fact that "The courts do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses".[290] Similarly, 52% of administrative tribunal members, 50% of legal counsel and 77% of scientists also agreed with the proposition in the context of administrative environmental hearings.[291] When asked the related question whether a problem is caused

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288 Appendix 3 Table 86. Category 1 Result.

289 Appendix 3 Table 87. Category 1 Result.

290 Appendix 3 Table 88. Category 1 Result.

291 Appendix 3 Table 89. Category 2 Result.

because "Legal counsel do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses", 36% of judges, 59% of legal counsel and 70% of scientists agreed that a problem is caused at environmental trials and other legal proceedings,[292] while 56% of administrative tribunal members, 53% of legal counsel and 71% of scientists also found a problem to exist at administrative environmental hearings.[293]

The advances in our technological society provide an aura to science which overlooks the reality that scientists are human. Accordingly, the institutions of science and individual behaviour are subject to all of the vagaries we recognize in other human endeavours. Interpretation of scientific data relies upon inferential processes which are culturally developed within the relevant scientific disciplines. Often these inferences are predicated on assumptions which are not readily transferable to other applications. If decision-makers have no appreciation of these science culture and value issues they will be ill-equipped to test the relevance and validity of scientific evidence to resolving the issues which they must decide.

7.3.4 Failure of Decision-Makers and the Legal Community to Understand the Key Doctrines and Premises of Whatever Discipline is Involved in Scientific Information Provided by Expert Scientific Witnesses

A final potential source of problems associated with the comprehension of scientific information in environmental decision-making examined by the Research Survey involved a failure by the legal community to understand the key doctrines and premises of the disciplines involved in scientific evidence. There was considerable discord between decision-makers and scientists with respect to whether a failure did indeed exist. With respect to environmental trials and other legal proceedings, 44% of judges compared with 78% of scientists agreed that a problem is caused by the fact that "The courts do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses".[294] Similarly, 48% of administrative tribunal members compared with 77% of scientists also agreed with the proposition in the context of administrative environmental hearings.[295]

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292 Appendix 3 Table 90. This did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the relatively strong response from the scientific community compared to the low response from judicial respondents is worthy of note.

293 Appendix 3 Table 91. Category 1 Result.

294 Appendix 3 Table 92. Category 1 Result.

295 Appendix 3 Table 93. Category 2 Result. It is interesting to note that despite the fact that administrative tribunal members are ostensibly appointed for their expertise, the responses of judges (Table 92) and administrative tribunal members (Table 93) are within 4 percent of each other. Equally significant, the perceptions of the respondents from the scientific community with respect to the ability of courts and tribunal members to comprehend key scientific doctrines and premises differed by only 1 percent!

When asked the related question whether a problem is caused because "*Legal counsel* do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses", 44% of judges, 63% of legal counsel and 80% of scientists agreed that a problem is caused at environmental trials and other legal proceedings,[296] while 59%f administrative tribunal members, 57%f legal counsel and 72% of scientists also found a problem to exist at administrative environmental hearings.[297]

When considering the issue of key doctrines and premises between scientific disciplines, it may be recalled from the discussion above that for scientists the primary focus of scientific issues may take one of two paths.[298] The first path, taken by most so-called "pure" scientists, sees science as a means of knowing which is predicated upon a commitment to unrelenting challenge of current beliefs. This approach allows the seeking of truth without having to compromise or make decisions based on current, often inadequate evidence. The second path, primarily employed by applied scientists such as engineers and physicians, involves polling experts to determine the extent of consensus on the interpretation of currently available facts or knowledge. This latter activity, which is part of the practice of scientific discourse rather than the scientific methodology used for discovery, is often used by those who are routinely forced into making judgments on available evidence so that decisions can be made. One scientist who responded to the Research Survey provided a practical focus to the outcomes achieved as a result of these two different approaches:

> I think a lot of people confuse technology and science; the first is really use of knowledge and the latter the obtaining of knowledge. Use of knowledge to solve problems often involves a narrow and restricted view of the matter, as can be seen in the advice given by many consultants. A scientist should take a wider view of matters .... .

Thus, this divergence of doctrines and premises between pure and applied scientists has significant practical significance for legal counsel, who as we have seen are primarily concerned with the resolution of scientific issues only insofar as they relate to the ultimate goal of resolving jurisprudential disputes. Thus, legal counsel may find that applied scientists such as engineers and physicians are better prepared to render opinions based on imperfect scientific information than are their pure scientist counterparts. This also suggests that decision-makers may find that scientific information in the form of opinions provided by applied scientists more readily meets the legal standards of proof in that these opinions may be rendered with a greater degree of certainty than those provided by pure scientists. One

296 Appendix 3 Table 94. Category 1 Result.

297 Appendix 3 Table 95. Category 1 Result.

298 See *supra*, section 3.6.2.

rather surprising outcome of this situation appears to be that many within the scientific community are coming to equate applied scientists with the employment status of "consultants", a group whose scientific credibility is being questioned by many scientists. As one scientist described the situation:

> Most consultants nowadays are engineers or technical persons, with very little knowledge of, and commonly little interest in, science. This has become very bad in recent years with the poor employment opportunities for scientists.

This conclusion is supported by a number of comments provided by scientists who participated in the Research Survey. These comments suggest that legal counsel prefer to retain applied scientists (usually employed as private consultants) over pure scientists whenever possible.

7.4 Discussion

The combination of the experience based observations of the author and supervisory team, the legal and scientific literature and the Research Survey results lead to a number of observations, conclusions and recommendations, as discussed below.

7.4.1 Inadequate Levels of Communication

The quality of environmental decisions is often compromised as a result of problems encountered in the communication of scientific information in environmental decision-making processes.

The first cause of this problem relates to a failure of many scientific witnesses to effectively communicate scientific information to environmental decision-makers. This is an important concern because the most highly qualified experts may not be the most gifted communicators. This may result in the evidence of a highly qualified expert not being understood by the decision-maker, or alternatively, being given less weight than the evidence of a less qualified witness with superior communication skills. Optimally, decision-makers are assisted by highly qualified experts who also possess highly refined communication skills. As this is often unachievable, there need to be mechanisms to assist decision-makers to recognize and utilize the best expertise even when it may not be delivered by skilled communicators.

The adversarial system often used in environmental decision-making processes promotes the philosophy that it is the responsibility of each party to a dispute to find the means to best present their case to the decision-maker. The pragmatic response by advocates such as legal counsel is to package their experts in a form which is likely to attract favourable attention by the decision-maker. This encourages form over function in expert witnesscraft. In the words of one judge who responded to the Research Survey:

> It can be difficult to sort out various scientific theories. Then one tends to follow the expert that makes most sense and that makes the ability of the witness to communicate very important (perhaps disproportionately so).

Another judge expressed a similar view, stating "An expert who can speak plainly to judge and jury will usually be much better "heard" than those who cannot and do not do so."

There is a need to confirm for decision-makers that expertise and communication skills are independent qualities. Decision-makers need to acquire the means to evaluate these qualities separately. A practical response would be the inclusion of information on this problem in decision-maker training programs. The training curricula for decision-makers could include relevant case examples for the purpose of encouraging vigilance with regard to form over function communication failures. Relevant case examples and even role playing by trained actors could be used to stimulate vigilance in this area.

A second, related cause of this problem is relatively predictable - scientific terminology which is not well understood by many decision-makers or by legal counsel. As one judge who responded to the Research Survey succinctly put it, "Lack of ability of experts to speak in plain language." This problem is not unique to the law - science interface. It even exists between scientific disciplines. Solutions to this problem are more difficult. One possible solution is to promote an awareness of the problem - amongst decision-makers, legal counsel and scientists. A heightened awareness of the problem should increase the vigilance of all parties to ensure that every effort is made to communicate effectively. A more pro-active approach suggested by one respondent judge was that "Expert witnesses should take courses on being expert witnesses and testimony." This approach could even be taken further, with scientists required to take courses to increase their effectiveness in communicating scientific information to non-scientists as a requirement of being qualified as an expert witness. After all, the premise of the expert being the servant of the court cannot be achieved unless the expert can communicate effectively.

A third cause of this problem appears to be distortion of scientific information through cross-examination. This distortion may be intentional, for the purpose of causing confusion. As one judge who responded to the Research Survey put it, "Often cross-examination is intended to confuse rather than clarify." Thus, decision-makers must be especially vigilant with respect to the purpose for which a cross-examination is conducted. However, this problem often has unintentional sources.

First, while the procedures used for testing the veracity of lay witnesses may be effective for revealing character flaws in expert witnesses, they are not necessarily valid for testing validity of scientific concepts.

Second, effective cross-examination on scientific concepts requires a knowledge of the concepts in question both by the expert being cross-examined and by the cross-examiner. This is often difficult when the cross-examiner is trained in law rather than science, or where the cross-examiner is unprepared or improperly prepared to conduct the cross-examination.

Finally, the extent to which cross-examination is conducted is often governed by the first rule of cross-examination - never ask a question to which you do not already know the answer. Legal counsel may be reluctant to ask questions which would clarify a scientific issue because they do not know what answer will be provided by the expert witness, or feel that the answer is likely to be unfavourable, and do not want to receive an answer which may be damaging to their case. This is particularly likely to be true if the lawyer is uncomfortable with his knowledge of the scientific issue in question. This problem was identified by one administrative tribunal member who responded to the Research Survey in the following terms:

> Lawyers are not often scientifically trained - they are trained only to ask questions they know the answers to - as a result, x-exam may be ineffective - this means the tribunal must be more aggressive in x-exam which can leave a party feeling the tribunal is biased.

This approach to obtaining scientific information is striking in its contrast to that used by scientists where the best questions are usually those to which an answer is unknown. Yet, we should not be surprised by these very different approaches. The goal of the scientist is to resolve a scientific issue. The scientist attempts to obtain as much information as possible to assist in resolving the issue, even if that new information requires the scientist to discard a previously held hypothesis. The lawyer, for his part, is not required to resolve the scientific issue, only to convince the decision-maker that the lawyer's theory of the case (including interpretation of available scientific evidence) is the correct one. In the words of one lawyer who participated in the Research Survey:

> Courts should not be relying on cross-examination for the purpose of clarifying scientific evidence. In many respects, cross-examination is a very strange way to test such evidence and the purpose of the cross-examiner may be far removed from arriving at the truth.

Simply stated, it is often not in legal counsel's best interest (or that of his client) to obtain as much information in cross-examination as may be available from an opposing expert witness to resolve a scientific issue.

In principle, cross-examination should be capable of challenging scientific concepts in an informative manner, but to do so the focus of the cross-examination must be on concepts and content, not on witness demeanour. It should also be conducted by someone who understands the concepts in question. If legal counsel does not have the knowledge to conduct such cross-examination effectively, reliance should be placed upon scientific advisors to assist with preparation of cross-examination. To this end, rules of procedure should be amended to facilitate the use of scientific advisors by legal counsel. This may include such changes as permitting advisors to work directly with lawyers at the legal counsel table, and even allowing scientific advisors to conduct cross-examination on scientific issues. However, scientific advisors acting in this capacity should never be called upon to perform a dual role as expert witnesses.

The issue of intentionally failing to elicit all available scientific information during cross-examination is more problematic. Rules of court generally allow issues which have been raised in cross-examination but which have not been fully answered to be raised again through re-examination by legal counsel presenting the expert witness to the court. However, this is not a completely satisfactory answer, as legal counsel are often reluctant to re-examine their witnesses. There are two good reasons for this reluctance. First, rules of court usually do not allow legal counsel to prepare the expert witness for the re-examination. Thus, the lawyer is uncertain as to what the witness will say if re-examined. This risk is increased by the fact that witnesses who are re-examined may feel that they have somehow made an error in their testimony and may be tempted to change their evidence in an effort to correct the perceived mistake. Second, if an expert witness has been damaged in some fashion by cross-examination, legal counsel presenting the witness may feel that the decision-maker may not be aware of that damage, particularly if it is with respect to a complex scientific issue with which the decision-maker may be unfamiliar. Thus, legal counsel will not wish to bring that damage to the attention of the decision-maker, which is almost certain to occur if the lawyer deems it necessary to re-examine and thereby rehabilitate his expert witness.

The decision-maker has an obligation to reach the best decision possible. In environmental cases we can not afford to have decision-makers simply decide winners and losers to jurisprudential disputes. Unfortunately, the view in many civil cases that there is no right or wrong, only winners and losers within the rule of law, may work against resolving the communication problems which exist. In this legal context the side which fails to provide an expert who can communicate will pay the price. The stakes are much higher in environmental disputes, where poor communication of scientific information which results in equally poor decisions may have consequences which go far beyond the parties to a dispute. The price of failure, whether immediate or delayed well into the future, may be severe and affect our society as a whole.

The goal of reaching the best decision possible can only be achieved if all relevant information has been obtained from expert scientific witnesses. This means that if the decision-maker becomes aware that information relevant to resolution of a scientific issue may be within the knowledge of an expert witness but that information has not be elicited through the processes of examination, cross-examination or re-examination, the decision-maker has an obligation to directly elicit that information from the witness. Admittedly, this recommendation runs counter to the tenets of the adversarial system which has fostered a general reluctance by decision-makers to "enter into the arena".[299] This reluctance is based on the notion that the operation of the adversarial system will result in opposing interests bringing forward all relevant information, and a degree of unfairness occurs if the decision-maker becomes actively involved in the fact-finding process. This concern appears valid in situations where the adversarial system is allowed to operate effectively. However, it is submitted that this is not the case in situations where the adversarial process is either non-operational or operating ineffectively, as typically happens in environmental cases where there is a mismatch of resources between the parties.. This includes the obvious situations where cross-examination is not conducted by a party to a dispute or is conducted ineffectively. To this list we would add the situation where information relevant to the resolution of the scientific issue required in order to resolve the jurisprudential dispute appears to be available through an expert witness but is not brought out by the parties to a dispute. It must be kept in mind that any unfairness resulting from the decision-maker entering into the arena in these situations relates only to the "winning" or "losing" of the jurisprudential dispute by the litigants. The consequences of this unfairness are likely to be far less than those resulting from unfairness where the decision-maker is required to make decisions which affect the environment, and therefore society as a whole, on the basis of incomplete scientific information which is readily available.

7.4.2 Inadequate Levels of Comprehension

The quality of environmental decision-making is negatively impacted by what appear to be significant deficiencies in the comprehension of scientific methodology and information by both decision-makers and legal counsel. The Research Survey confirmed the suspicions of the author and advisory team based on their experience based observations and as identified in the literature. Both judges and legal counsel admit to experiencing considerable difficulty in understanding the scientific information required to resolve jurisprudential disputes in the courts.[300] The result is hardly surprising, when one considers that only 39% of judges surveyed indicated that they had received any post-secondary science education. For the courts the problem is obvious - judges receive legal training, not scientific training, and therefore may lack the scientific skills necessary to resolve complex scientific issues required to resolve larger jurisprudential disputes. The problem was summarized by one scientist who responded to the Research Survey by making the following reference to a complex environmental trial in which he had been involved:

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299 Courts in particular generally restrict themselves to questions of clarification. A judge who is seen to have entered into the arena runs the risk of having his decision successfully appealed.

300 See Appendix 3 Table 78.

> I once gave evidence where land use planning, hydrology, environmental management & river engineering were vital aspects of the evidence. More than a year had been needed in preparing the evidence. Our lawyer, for whom I acted as a scientific advisor, had difficulty understanding some of the science and experts reports. But over the year, with periodic assistance from the experts and myself, he developed an understanding. But is it reasonable that the judge, with no particular training in these sciences, can grasp the significance of opposing views in a trial lasting several weeks.

What was more surprising was that administrative tribunal members, who in theory are appointed for their special knowledge and expertise, rated themselves no better able to comprehend scientific evidence than their judicial counterparts,[301] with scientists perceiving them to have equal or greater difficulty understanding scientific concepts.[302] However, these findings appear credible in light of the rather astounding fact that only 14% of administrative tribunal members surveyed had received any post-secondary science education! Without specialized knowledge and expertise, tribunal members experience the same deficiency. As one administrative tribunal member responding to the Research Survey put it:

> Very challenging/difficult for panels with non-scientific members or members from different sciences to evaluate credibility of scientific information. Getting more difficult as specialization increases.

Another administrative tribunal member responded:

> The tribunal I work for has many members with a relatively good understanding of the characteristics and limitations of scientific inquiry and interpretation. However, I have observed other tribunals that are less experienced in the review and interpretation of scientific evidence. In general, the growing complexity of the information base presents and ongoing challenge for environmental tribunals.

What is especially troublesome is that despite a high percentage of judges and administrative tribunal members admitting to problems comprehending scientific evidence, including an insufficient understanding of: a) the methods of scientific inquiry and proof;[303] b) statistical analysis;[304] c) the value premises and professional biases which underlie scientific information;[305] and d) the key doctrines and premises of whatever discipline is

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301 See Appendix 3 Table 79.

302 See Appendix 3 Tables 78 and 79.

303 See *supra*, section 7.3.1.

304 See *supra*, section 7.3.2.

305 See *supra*, section 7.3.3.

involved in scientific information provided by expert witnesses,[306] environmental decision-makers appear reluctant to concede that they are unable to effectively use that same information in reaching their decisions. The Research Survey found that only 33% of judges[307] and 34% of administrative tribunal members[308] concluded that they were "... unable to effectively use scientific information in environmental decision-making". This conclusion was not shared by those who understand scientific evidence best - members of the scientific community. A large percentage (75%) of scientists who participated in the Research Survey concluded that "Courts of law are unable to effectively use scientific information in environmental decision-making".[309] A similar percentage (73%) agreed with this proposition with respect to administrative tribunals.[310]

Recognition by decision-makers of their shortcomings in comprehending scientific information should logically translate into a recognition that they are unable to effectively use that information which they have difficulty comprehending. This apparent failure by judges and administrative tribunal members to equate their admitted inability to comprehend scientific information with their ability to use it in decision-making indicates an important problem.

Equally troublesome, based on the assumption that administrative tribunal members are appointed for their special knowledge and expertise, the Canadian legal system is structured to provide very limited opportunities to review the decisions of many administrative decision-makers. There is a general reluctance by the courts to interfere with decisions made by statutory delegates on the basis that legislators have chosen these delegates to make decisions within the ambit of their delegated jurisdictions. It is presumed that this delegation is the result of special knowledge and expertise possessed by statutory delegates to address certain types of issues, and that legislators do not wish the courts to interfere with this special knowledge and expertise except in very limited circumstances. For many years the law in this area has been characterized by confusion as the courts attempted to define the circumstances under which the courts would review the decisions of administrative decision-makers. Two recent Supreme Court of Canada cases have significantly clarified the issue. In *Pushpanathan v. Canada (Minister of Citizenship and*

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306 See *supra*, section 7.3.4.

307 Appendix 6 Table 174.

308 Appendix 6 Table 175.

309 Appendix 6 Table 174. This did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the strong response from the scientific community and the degree of discord between scientific and judicial respondents is worthy of note.

310 Appendix 6 Table 175. This did not meet the criteria of any of the 3 categories of results found in Appendix 7. However, the strong response from the scientific community and the degree of discord between scientific and judicial respondents is worthy of note.

Immigration)[311] the majority of the Court set out the general test for the standard of review to be applied to any application for judicial review:

> The central inquiry in determining the standard of review exercisable by a court of law is the legislative intent of the statute creating the tribunal whose decision is being reviewed. More specifically, the reviewing court must ask: "[W]as the question which the provision raises one that was intended by the legislators to be left to the exclusive decision of the Board?" (*Pasiechnyk v. Saskatchewan (Workers' Compensation Board)*, [1997] 2 S.C.R. 890, at para. 18, *per* Sopinka J.).[312]

The Supreme Court went on to summarize the "functional and pragmatic approach" which the Court requires be used in determining whether the general test has been met:

> Since *U.E.S., Local 298 v. Bibeault*, [1988] 2 S.C.R. 1048, this Court has determined that the task of statutory interpretation requires a weighing of several different factors, none of which are alone dispositive, and each of which provides an indication falling on a spectrum of the proper level of deference to be shown the decision in question. This has been dubbed the "pragmatic and functional" approach. This more nuanced approach in determining legislative intent is also reflected in the range of possible standards of review. Traditionally, the "correctness" standard and the "patent unreasonableness" standard were the only two approaches available to a reviewing court. But in *Canada (Director of Investigation and Research) v. Southam Inc.*, [1997] 1 S.C.R. 748, a "reasonableness *simpliciter*" standard was applied as the most accurate reflection of the competence intended to be conferred on the tribunal by the legislator. Indeed, the Court there described the range of standards available as a "spectrum" with a "more exacting end" and a "more deferential end" (para. 30).

The Court went on to set out four categories of factors which will be taken into account, a) privative clauses, b) expertise of the decision-maker, c) purpose of the legislation as a whole and the provision in particular, and d) the nature of the problem. Of particular interest is the second factor, the expertise of the administrative decision-maker. The Supreme Court set out the law in this area as follows:

> Described by Iacobucci J. in *Southam, supra*, at para. 50, as "the most important of the factors that a court must consider in settling on a standard of review", this category includes several considerations. If a tribunal has been constituted with a particular expertise with respect to achieving the aims of an Act, whether because of the specialized knowledge of its decision-makers, special procedure, or non-judicial means of implementing the Act, then a greater degree of deference will be accorded. ...

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311 [1998] 1 S.C.R. 982.

312 *Ibid.*, at 25, per Bastarache, J.

> Nevertheless, expertise must be understood as a relative, not an absolute concept. As Sopinka J. explained in *Bradco*, *supra*, at p. 335: "On the other side of the coin, a lack of relative expertise on the part of the tribunal *vis-à-vis* the particular issue before it as compared with the reviewing court is a ground for a refusal of deference" (emphasis added). Making an evaluation of relative expertise has three dimensions: the court must characterize the expertise of the tribunal in question; it must consider its own expertise relative to that of the tribunal; and it must identify the nature of the specific issue before the administrative decision-maker relative to this expertise. ...
>
> In short, a decision which involves in some degree the application of a highly specialized expertise will militate in favour of a high degree of deference, and towards a standard of review at the patent unreasonableness end of the spectrum.[313]

The Supreme Court of Canada recently clarified the law further in *Baker v. Canada (Minister of Citizenship and Immigration)*.[314] In a unanimous decision the Supreme Court reaffirmed its decision in *Pushpanathan* and summarized the development of the law as follows:

> The "pragmatic and functional" approach recognizes that standards of review for errors of law are appropriately seen as a spectrum, with certain decisions being entitled to more deference, and others entitled to less: Pezim, supra at pp. 589-90; Southam, supra, at para,. 30; Pushpanathan, supra, at para. 27. Three standards of review have been defined: patent unreasonableness, reasonableness simpliciter, and correctness: Southam at paras. 54-56. In my opinion the standard of review of the substantive aspects of discretionary decisions is best approached within this framework, especially given the difficulty in making rigid classifications between discretionary and non-discretionary decisions. The pragmatic and functional approach takes into account considerations such as the expertise of the tribunal, the nature of the decision being made, and the language of the provision and the surrounding legislation. It includes factors such as whether a decision is "polycentric" and the intention revealed by the statutory language. The amount of choice left by Parliament to the administrative decision-maker and the nature of the decision being made are also important considerations in the analysis. The spectrum of standards of review can incorporate the principle that in certain cases, the legislature has demonstrated its intention to leave greater choices to decision-makers than in others, but that a court must intervene where such a decision is outside the scope of the power accorded by Parliament.[315]

The evidence obtained from the Research Survey suggests that judicial deference on the basis of special expertise by administrative decision-makers is in most cases unjustified. The reality appears to be that many, if not most, administrative tribunal members are not

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313 *Ibid.*, at 28 - 29.

314 July 9, 1999 (Not yet reported).

315 *Ibid.*, at 21 per L'Heureux-Dube J.

appointed for their special knowledge and expertise, and in fact may have little or no background in the area in which they are appointed. One administrative tribunal member who responded to the Research Survey verified the problem in the following terms:

> The selection of candidates to serve on administrative tribunals should consider the need for scientific backgrounds to understand and evaluate scientific evidence. This also brings into question the terms and conditions of employment that are needed to attract qualified people to serve on tribunals.

Clearly, if administrative decision-making bodies lose the respect of the scientific community, it will become increasingly difficult to attract high calibre scientific and technical experts to these bodies.

In the past, governments wishing a particular type of industrial activity to receive the necessary environmental approvals would often become directly involved in the approval process by issuing approvals from the appropriate department - an action which was perceived by the public as highly politicized. In recent years, at least partly in an effort to give the appearance of de-politicizing the environmental approvals process some jurisdictions, most notably the Federal Government and the governments of Alberta and Ontario, have adopted a decision-making model whereby administrative tribunals are appointed and charged with making recommendations and/or decisions with respect to industrial activities which were previously made "behind closed doors" by government departments. While this approach is generally perceived as being more open to public scrutiny and less political in nature, this may be an illusion. As stated above, the findings of the Research Survey indicate that many administrative tribunal members are appointed to environmental decision-making bodies for reasons other than their scientific expertise. Speculating as to the basis for such appointments, if they are made for political reasons, it does not require a large leap of logic to conclude that there may be little real difference between a decision made by a tribunal member appointed by a government or a government department itself.

It is submitted that there is no justification for the current level of judicial deference to statutory delegates who have not been appointed for their special knowledge or expertise, and it is recommended that the courts carefully evaluate the special knowledge and expertise of statutory delegates before automatically assuming that such special knowledge and expertise exist. From a practical perspective, the current system makes this a difficult if not impossible task. An administrative decision-maker whose decision is being challenged through judicial review is characterized as a respondent and thus technically is a party to the application.[316] However, there is generally no requirement at law that a respondent decision-

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[316] The reason that tribunals are characterized as respondents is essentially an historical anomaly. Originally, in order to seek review of decisions of the King's officials in the King's courts, it was necessar for the action to be brought nominally by the King against the official. For example, "The King v. the Official or Tribunal, ex parte the Applicant." Even in those days, it was clear that the official

maker provide evidence with respect to the decision or the manner in which it was reached. Rather, the burden of proof rests with the applicant to establish that the decision-maker committed an error which is reviewable by the court. This means that the applicant must establish that the standard of review should be high. One means of achieving this is for the applicant to lead evidence establishing that the decision-maker did not possess special knowledge or expertise with respect to the matter before it. The difficulty is in obtaining evidence of this nature. Most judicial review applications are undertaken by way of affidavit evidence, with other parties entitled to cross-examine the affiant. If the decision-maker chooses to remain mute and refrain from filing an affidavit in its defence, the applicant (and hence the court) has no means of establishing the knowledge and expertise of the administrative decision-maker. Consequently, legal counsel representing administrative decision-makers often wisely recommend that their clients remain mute throughout the judicial review process, and the court is left without any evidence that the administrative decision-maker did not possess special knowledge or expertise.[317]

If Canadian courts are prepared to provide a high level of deference to administrative decision-makers on the basis of their presumed special knowledge and expertise, it is recommended that judicial review procedures be reformed to provide both those challenging the decisions of these decision-makers and the courts access to the information required in order to evaluate whether such special knowledge and expertise in fact exists. This could be accomplished in a variety of ways. Perhaps the simplest method would be to require respondent administrative decision-makers to file an "affidavit of qualifications" which would set out the decision-maker's qualifications as it relates to its relevant special knowledge and expertise. The applicant would then be entitled to cross-examine the respondent on its affidavit thereby eliciting the necessary information with respect to the special knowledge and expertise of the administrative decision-maker. Such a process would not be unlike the current approach used by the courts to qualify expert witnesses on the basis of their special knowledge and expertise.

Of course, once it is determined that an administrative decision-maker does not possess special knowledge and expertise, the courts should show minimal deference to these statutory delegates when reviewing errors.[318] In addition to increasing the public

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or tribunal was exercising a formal power of decision.

317 While it must be acknowledged that the scientific knowledge possessed by judges may often be demonstrated to be no better than that of their administrative counterparts, the Canadian legal system does not make a pretense that judges are imbued with scientific expertise as the system does with administrative decision-makers. Nevertheless, there may be merit to the suggestion that judges who "get the science wrong" in their decisions should be eligible for review upon appeal by a higher court.

318 The merits of the intrusion of judicial review on a "correctness" standard in situations where such review is based upon often legal tests applied by judicial decision-makers with limited scientific background may be open to question. However, it must be remembered that judicial review, unlike a statutory appeal, generally does not allow the courts to re-visit the merits of a decision - only the means by which it was arrived at. Thus, the courts are usually looking at the process by which a decision is reached, not the decision itself. Only in cases where it is argued that an administrative decision-maker has committed an abuse of discretion which

accountability of administrative tribunals, this approach would also offer strong encouragement to governments to re-evaluate the criteria used to appoint statutory delegates to environmental decision-making bodies.

An alternative approach would be to reduce the politization of the appointment process for administrative decision-makers through the creation of an independent gate-keeping process for administrative appointments. This would offer some assurance that statutory delegates possess special knowledge and expertise.

One possible solution to the problem of comprehension of scientific information by environmental decision-makers which has been suggested on numerous occasions is the creation of the so-called "science court" wherein judges hearing cases with complex scientific evidence would have both scientific and legal backgrounds. The science court concept, which presumes specialized training in the scientific issues presented in any case before such a court is generally considered to be impractical. Apart from the myriad of logistical problems associated with this concept, its impact upon the quality of environmental decision-making may not justify the high cost. The reason is that the nature and complexity of scientific issues found in environmental trials varies greatly, as does the expertise which is brought to bear on those issues by the respective parties. Some trials may involve issues of chemical analysis, others may consider principles of mechanical engineering, still others may require specialized knowledge of toxicity in invertebrates. No judge could become competent in all of the scientific disciplines which may appear before him, and without that competence a judge with a scientific background in an area wholly unrelated to the evidence before him may be little better off than a judge with no scientific background whatsoever. As one judge who responded to the Research Survey put it:

> Obviously scientifically trained people would catch on quicker in environmental cases. So would accountants understand fraud cases more easily. Are we going to throw out DNA evidence because it is technically challenging? Or decide that cases dependent on it should not come to court?

However, it is submitted that the advantages of having judges with general training in science, and particularly with respect to scientific methods, are considerable. Judges with this background are likely to be much better equipped to address the problems associated with scientific evidence than those who do not have such knowledge. As one judge who responded to the Research Survey put it, "Obviously scientifically trained people would catch on quicker in environmental cases. So would accountants understand fraud cases more easily." The logistics associated with obtaining and utilizing this expertise are neither complicated nor expensive. Certain judges within a legal system may undergo scientific

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takes it outside of its jurisdiction will the courts consider substantive issues on judicial review. This would include issues such as a failure to consider relevant evidence, considering irrelevant evidence, etc. These issues doe not examine the merits of the evidence, only whether it ought to have been considered or not - an assessment which judges are usually skilled at making.

methodology training as part of their in-service professional development. These judges would then be assigned to those cases identified by the pre-trial judge as having a high potential for complex scientific issues.

Another readily available solution is for decision-makers to avail themselves of the appropriate independent scientific expertise required for each case. This approach has two significant advantages:

a) first, it provides decision-makers with assistance in defining terms of reference and focussing issues to prevent the situation where parties submit large amounts of information (which may not be relevant) causing information overload for decision-makers; and

b) second, it allows decision-makers to obtain expertise from persons who do not have a vested interest in the outcome of a case.

This is the approach taken by many university departments and environmental consulting businesses. While often staffed by a variety of scientific personnel, no matter how large or how diverse a university department or company may be, it is not possible to have the appropriate scientist on staff to address every situation. Rather, when it is determined that a department or company requires expertise which it does not possess, that expertise is identified and brought in to deal with the matter. It is submitted that the most sensible solution for environmental decision-makers who find themselves in the situation of needing to understand complex scientific issues in order to resolve larger jurisprudential disputes is to borrow the solution used by universities and consulting firms - obtain access to independent scientific experts in the appropriate fields to assist the decision-maker in understanding the scientific issues which arise during the course of the decision-making process.[319] While this alternative is currently available to courts and tribunals in many jurisdictions, the Research Survey results confirmed the experience based observations of the author and advisory team that few courts or administrative tribunals avail themselves of independent scientific experts, with 83% of judges indicating that they had never been involved in a trial or other legal proceeding in which the court had retained an independent scientific expert. Administrative tribunals appear only slightly more willing to retain expertise, with 71% of tribunal members responding that they had never been involved in an administrative environmental hearing in which the tribunal had retained an independent scientific expert. Further, while some administrative tribunals retain in-house scientific staff, 53% of tribunal members also indicated that they had never retained a scientific expert on their support staff.

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319 It is somewhat ironic that decision-makers require their own scientific experts to assist the decision-maker in understanding experts whose responsibility it should be to assist the decision-maker.

8.0 Problem Area #3: Scientific Uncertainty in Environmental Decision-Making

8.1 Introduction

Problems with respect to scientific uncertainty in environmental decision-making processes were recognized in the experience based observations of the author and advisory team[320] and in the legal and scientific literature.[321] As seen earlier, the existence of problems in this area was corroborated in the Research Survey results.[322] An examination of the nature and source of these problems is set out below.

8.2 Factual Scientific Uncertainty

The experience based observations of the author and advisory team[323] and the legal and scientific literature[324] identified a leading source of these problems to be factual scientific uncertainty. In light of these qualitative observations the Research Survey investigated the perceptions of judges, administrative tribunal members, lawyers and scientists with respect to problems involving factual scientific uncertainty at environmental trials and other legal proceedings and at administrative environmental hearings. The Research Survey revealed considerable discord between the various respondent groups with respect to this issue.

First, the Survey explored the perceptions of the decision-makers, legal counsel and the scientific community with respect to whether problems exist where there is factual uncertainty in the form of information uncertainty.[325] Two common situations of information uncertainty were explored. First, the Survey looked at the situation where scientific information which would reduce or resolve the uncertainty is available but is not presented. In the context of environmental trials and other legal proceedings 66% of scientists and 56% of judges agreed that a problem is created "Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is available, but such information is not presented as evidence at an environmental trial or other

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320 See discussion section 3.4.1.

321 See discussion section 3.4.2.

322 See discussion section 5.4.1.

323 See discussion section 3.4.1.

324 See discussion section 3.4.2.

325 See discussion section 3.4.2

legal proceeding."[326] This problem was acknowledged by one judge who responded to the Research Survey in the following terms:

> The more difficult problem arises when counsel do not present relevant, available information. If both sides do their homework then the court will receive both aspects of a problem.

However, only 47% of legal counsel agreed with the proposition. The results obtained with respect to administrative environmental hearings differed markedly, with higher percentages of administrative tribunal members (78%) and scientists (77%) indicating that they perceived a problem in this regard. Consistent with the results obtained for environmental trials, only 45% of legal counsel agreed.[327]

The second situation in which information uncertainty may arise which was explored by the Research Survey involved the situation where scientific information which would reduce or resolve the uncertainty is not immediately available, but could be obtained with additional scientific investigation. In this situation a much lower percentage of judges (39%) agreed with the proposition that a problem is created "Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not immediately available for presentation at an environmental trial or other legal proceeding, but could be obtained with additional scientific investigation". However, the percentage of scientists who agreed with this proposition was higher at 76%.[328] When the same question was asked of respondents with respect to administrative environmental hearings, tribunal members once again took a very different view from that of their judicial counterparts, with even more tribunal members (81%) agreeing that a problem was created. Similarly a higher percentage of scientists (87%) also agreed with the proposition. Once again, a relatively low percentage (45%) of legal counsel concurred.[329] In this regard a number of administrative tribunal members who responded to the Research Survey offered comments with respect to the issue of information uncertainty. One tribunal member offered the observation that "Lack of scientific data & evidence is probably the greatest problem." Another board member stated the problem more bluntly:

> Decisions are almost always made on the basis of incomplete, outdated or even plain wrong data.

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326 Appendix 4 Table 132. Category 1 Result.

327 Appendix 4 Table 133. Category 2 Result.

328 Appendix 4 Table 134. Category 3 Result.

329 Appendix 4 Table 135. Category 2 Result.

A third tribunal member illustrated these concerns with an example from a case which had come before his board:

> ... there were obvious health problems suffered by the appellant but no compelling linkage to the suspected cause which was air emissions from a neighbour's boiler ... the discretion of the public sector manager granting the boiler's emission permit was too wide, and the range of emissions measured too narrow, for the tribunal to come to a meaningful decision. We were left with suspicions that there was more to explore but in absence of information had to uphold the permit.

There are indications that this problem may be worsened by expert scientific witnesses who fail to acknowledge an absence of scientific information on an issue, choosing instead to provide an opinion to the decision-maker despite a limited scientific basis for that opinion. As one administrative tribunal member who responded to the Research Survey put it:

> Also, some experts are prepared to provide opinion that has limited basis in fact due to limited research being available on the subject of interest.

If the basis for an expert opinion is not presented, there is a danger that an opinion based on limited scientific evidence may be accorded equal or even greater weight to evidence based on solid scientific research.

A second element of factual scientific uncertainty investigated by the Research Survey involved knowledge uncertainty.[330] Consistent with the results obtained with respect to information uncertainty, a relatively low percentage of judges and legal counsel perceived problems with knowledge uncertainty, compared with a much higher percentage of administrative tribunal members and scientists. Specifically, only 33% of judges and 39% of legal counsel agreed that a problem is created in situations "Where it appears that scientific information necessary reduce or eliminate the scientific uncertainty relating to a scientific issue is not available for presentation at an environmental trial or other legal proceeding, and cannot reasonably be obtained given the present state of science". This may be contrasted with 67% of scientists who agreed with the proposition.[331] Similarly a full 73% of administrative tribunal members and 77% of scientists agreed with the statement in the context of administrative hearings, while only 36% of legal counsel concurred.[332].

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330 See discussion section 3.4.2

331 Appendix 4 Table 136. Category 3 Result.

332 Appendix 4 Table 137. Category 3 Result.

Thus, amongst judges there appears to be an inverse relationship between the availability of information to resolve factual scientific uncertainty and the perceptions of the judiciary that problems exist in the resolution of such uncertainty.

It is submitted that the divergent views of legal counsel and representatives of the scientific community with respect to the issue of factual scientific uncertainty in environmental decision-making are not not surprising given the motivations of each of these respondent groups. Scientists who are primarily motivated by the search for scientific truth would also logically be concerned by an absence of readily available scientific information in drawing conclusions in their evidence. However, legal counsel have a distinctly different motivation - to win the case. Thus the presence or absence of readily obtainable scientific evidence when viewed through the eyes of the lawyer may simply be an issue of whether the presence or absence of such evidence is helpful or harmful to the case being presented on behalf of a client.

The divergence of view between decision-makers - judges and administrative tribunal members - is more difficult to explain. One might be tempted to attribute these findings to a higher level of scientific expertise amongst administrative tribunal members than judges which translates into a greater awareness of the problem of scientific uncertainty, particularly where the attainability of additional scientific information is less obvious. However, as noted earlier, the scientific training received by board members who participated in the survey was actually less that the training received by judges who participated. Another explanation is that judges are more experienced in the resolution of uncertainty of all types and hence are more comfortable with it and less likely to perceive it as a problem. A related explanation is that judges are more comfortable, because of their legal training, with the requirement for a decision regardless of the evidence, whereas a board may be more uncomfortable making a decision "in the public interest" if they are operating in an information vacuum.

8.3 Contradictory or Conflicting Scientific Information

A second concern identified by the experience based observations of the author and advisory team[333] with respect to the Problem Area of scientific uncertainty was the introduction of contradictory or conflicting scientific information at environmental trials and other legal proceedings and at administrative environmental hearings. These concerns were corroborated in the legal and scientific literature[334] and thus were explored in the Research Survey.

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333 See discussion section 3.4.1.

334 See discussion section 3.4.2.

The Research Survey results provided considerable support for these concerns across the respondent groups. When questioned in a filter question as to the existence of problems in this area, 61% of judges, 57% of legal counsel and 85% of scientists agreed with the statement that "Problems exist in environmental trials and other legal proceedings where contradictory or conflicting scientific information in the form of expert evidence is provided by expert scientific witnesses."[335] Similar results were obtained with respect to administrative environmental hearings, with 74% of administrative tribunal members, 50% of legal counsel and 85% of expert scientific witnesses also agreeing with the proposition.[336] However, there was considerable disagreement between the respondent groups as to the source of this problem.

8.3.1 Adversarial System

One possible source investigated by the Research Survey was the use of the adversarial system in environmental decision-making processes, which has often been attributed with promoting the presentation of conflicting scientific evidence. There was strong support by the scientific community (87%) and moderate support by judges (67%) and legal counsel (52%) for the general proposition that a problem is created by the fact that "The use of the legal adversarial approach in environmental trials and other legal proceedings promotes a confrontational climate which inhibits obtaining a consensus in resolving scientific issues".[337] Similar results were obtained with respect to environmental hearings, with 91% of scientists compared to 70% of administrative tribunal members and 45% of legal counsel agreeing with the proposition.[338] Not surprising was the fact that the Research Survey also found very high support amongst scientists (88%) for the proposition that "The adversarial system used in environmental trials and other legal proceedings promotes the presentation of conflicting scientific information which creates confusion with respect to scientific evidence". However, support amongst respondents from the legal community was less evident, with 50% of judges and 47% of legal counsel considering the adversarial system to constitute a problem in environmental decision-making.[339] Even more striking is the divergence of opinion between the legal and scientific communities with respect to the significance of this problem source, with a high percentage (64%) of scientists considering

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335 Appendix 4 Table 144. Category 2 Result.

336 Appendix 4 Table 145. Category 1 Result.

337 Appendix 6 Table 176. Category 1 Result.

338 Appendix 6 Table 177. Category 1 Result.

339 Appendix 4 Table 138. Category 2 Result.

this to be a major problem, compared with only 28% of judges and 25% of legal counsel. A very different result was obtained in the context of administrative environmental hearings. A substantially higher percentage (73%) of administrative tribunal members than judges agreed that a problem is created by the adversarial system, with 40% viewing the problem as major.[340] As one administrative tribunal member put it:

> Please remember that, as legal counsel, it is often in an client's interest to create conflict in the evidence. Indeed it is often the most prudent legal strategy.

In contrast, legal counsel continued to view this issue as unimportant, with only 36% of lawyers seeing a problem of some type, and only 14%considering it to be major. Similarly, a high percentage of scientists (77%) found this to be a problem, with many (47%) viewing it as a major problem.

Exploring possible sources of this problem one step further, the Research Survey also investigated the possibility that a problem is created where contradictory or conflicting scientific evidence is intentionally presented for the purpose of creating rather than resolving confusion with respect to a scientific issue. Common examples would include the situation where scientific information introduced is irrelevant to the issue being considered, or where the information is introduced is marginally relevant but is raised for the sole purpose of presenting remote possibilities not addressed in the evidence of the opposing party.[341] When asked about the effects of introducing irrelevant scientific evidence at environmental decision-making processes, 50% of judges, 57% of legal counsel and 81% of scientists agreed that a problem is created "Where irrelevant scientific information is presented at an environmental trial or other legal proceeding on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue".[342] Legal counsel who responded to the Research Survey freely admitted to the use of this tactic in environmental trials. As one defence lawyer described the issue in the context of regulatory prosecutions:

> ... using any evidence to "create confusion" is perfectly good practice in criminal defence, where the whole job is to create reasonable doubt. It may or may not be appropriate in civil trials, but "muddying the waters" is (for better or worse) a litigation tactic. So what?

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340 Appendix 4 Table 137. Category 3 Result.

341 See example *infra*, in section 3.4.1. This illustrates the importance of decision-makers acting as gate-keepers to keep this type of information out of the decision-making process. See discussion *infra*, section 6.6.1.

342 Appendix 4 Table 142. Category 2 Result.

Viewing the issue from the other side of the courtroom, the frustration of prosecution lawyers with this tactic was summarized by one prosecutor in the following terms:

> Generally speaking, I think that if defence counsel ... didn't try to "muddy" the waters in the hope that the Court would be confused enough to throw up its collective hands in despair ... there would be fewer days in court spent trying to establish that which, on the given scale of proof, is obvious .... .

In the context of administrative environmental hearings a substantially greater number of tribunal members (73%) saw this as a problem than did their judicial counterparts, with 45% of legal counsel and 74% of scientists also in agreement.[343] Of course, the key determinant of whether a problem is created is whether the decision-maker recognizes that the information is being adduced for the purpose of "muddying the waters". If this is recognized then the only problem may relate to wasted time. However, if the decision-maker is unable to recognize this situation, the merits of the resulting decision may be prejudiced by the influence of the information.

The divergence in Survey results between the respondent groups on this issue may be explained in terms of the familiarity which a respondent group has with an adversarial system generally. Thus, the lower amount of concern expressed by judges and legal counsel compared to scientists in environmental trials may be attributed to the familiarity of the members of the legal community with the adversarial system employed by the courts. Similarly, administrative tribunal members, who are generally not members of the legal community, had a greater perception of problems attributable to the adversarial process. This is particularly noteworthy given that administrative environmental decision-making processes are generally considered to be less adversarial in nature than those used by the courts.[344]

A related problem not explored in the Research Survey but identified by a number of Survey Respondents is the creation of uncertainty with respect to scientific issues by overwhelming a decision-maker with factual scientific information, irrespective of whether that information is relevant to the resolution of the dispute or not. In the words of one administrative tribunal member who identified this problem:

> Not infrequently there is a snowstorm of "data" some of it often decades out of date or out of context with the local geographic setting, either of which can be misleading in the extreme.

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343 Appendix 4 Table 143. Category 2 Result.

344 For example, the guidelines for hearing procedures developed by the Canadian Environmental Assessment Agency expressly attempt to minimize the adversarial nature of the process, despite the fact that the environmental assessment issues before a panel may place parties in direct opposition to each other.

As scientific information is often complex, subtle and difficult for anyone but a specialist to understand, one effective way to create doubt is simply to create confusion through sheer volume of evidence. Faced with a mountain of complex scientific evidence and no reasonable way of interpreting it, a decision-maker may simply reach a conclusion of reasonable doubt because of having no way of understanding what has been presented. It is comparatively easy to raise doubt in environmental trials or hearings by overloading decision-makers with large volumes of complex information, much of which may be irrelevant. This is particularly true if the decision-maker has no scientific background. If there is no mechanism for sorting the wheat from the chaff, the decision-maker may become overwhelmed and make his or her decision based upon anything he is able to understand. This approach may be effectively used by legal advocates in a number of situations. For example, legal counsel acting for the proponent of a proposed project may direct that a large quantity of scientific information be provided to the decision-maker for the purpose of overwhelming the decision-maker. The strategy is that if the decision-maker is unable to properly evaluate the information, weaknesses in the proponent's case may be camouflaged, and the approval will be given. Alternatively, legal counsel representing an opponent of a proposed project may employ the same tactic of overwhelming the decision-maker with scientific information for the purpose of creating sufficient confusion and uncertainty in the mind of the decision-maker that it will refuse to issue the approval.

8.3.2 Assigning Evidentiary Weight

A second, related possible source of the problem considered by the Research Survey was the assigning of evidentiary weight to conflicting scientific information. The Research Survey found relatively strong agreement across the respondent groups for the proposition that assigning evidentiary weight to contradictory or conflicting scientific evidence creates a problem for environmental decision-makers. When questioned on this subject 67% of judges, 63% of legal counsel and 76% of scientists stated that they considered "Assigning evidentiary weight to the contradictory or conflicting scientific information" to constitute a problem.[345] Even more significant, an unusually high percentage of judges (44%) and scientists (47%) advised that they considered this to be a major problem. A substantially higher percentage of administrative tribunal members (81%) and scientists (86%) found this to be a problem in the context of administrative hearings, with 59% of legal counsel also agreeing.[346] A high percentage of tribunal members (50%) and scientists (51%) also confirmed that they considered this to be a major problem. The Research Survey went on to probe in more detail the nature of the problem of assigning evidentiary weight to scientific evidence.

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345 Appendix 4 Table 146. Category 1 Result.

346 Appendix 4 Table 147. Category 2 Result.

First, the Research Survey inquired with respect to the level of understanding by environmental decision-makers of how scientists would decide which scientific evidence is most credible. The Survey found that 61% of judges, 51% of legal counsel and 88% of scientists considered "Lack of understanding by the courts as to how scientists knowledgeable within the area where conflicting evidence exists would decide which information they would find most credible to constitute a problem.[347] Similar views were received from administrative tribunal members (61%), legal counsel (45%) and scientists (85%)[348] in the context of administrative environmental hearings.

Second, the Survey looked at the perceptions of the respondent groups with respect to the issue of whether decision-makers assign evidentiary weight on the basis of the "performances" of witnesses rather than on the basis of the scientific evidence itself. The Survey found that 50% of judges, 68% of legal counsel and 87% of scientists were of the view that "Choosing the scientific evidence of one expert witness over another based upon their respective "performances" in giving evidence rather than on the basis of the scientific information itself" constituted a problem.[349] Similar results were obtained from respondents with respect to administrative environmental hearings, with 69% of tribunal members, 58% of legal counsel and 87% of scientists also agreeing with the proposition.[350] Indicative of the comments received with respect to this issue is the observation of one lawyer who stated:

> Decisions made by the trier of fact appear to be based on choosing the scientific evidence of one expert witness over another based upon their respective performances in giving evidence rather than on the basis of the scientific information itself, where the expert with the best appearance and delivery/confidence carries the day ... .

Another lawyer stated:

> A judge will inevitably be swayed by a witnesses' credentials and "performance" on the stand, neither of which is a guarantee of the truth of what the witness asserts.

Finally, the Survey considered the ability of decision-makers to distinguish between scientific evidence which is widely accepted in the scientific community from that which is not. When questioned on this issue in the context of environmental trials and other legal proceedings, 61% of judges, 64% of legal counsel and 82% of scientists agreed that "Distinguishing between scientific information which is widely accepted in the scientific

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347 Appendix 4 Table 150. Category 2 Result.

348 Appendix 4 Table 151. Category 2 Result.

349 Appendix 4 Table 152. Category 2 Result.

350 Appendix 4 Table 153. Category 2 Result.

community from minority views, new theories or junk science" constituted a problem.[351] Similar results were obtained with respect to administrative environmental hearings, with 68% of tribunal members, 54% of legal counsel and 77% of expert scientific witnesses perceiving a problem.[352]

These results tend to demonstrate a perception amongst a relatively high percentage of all respondent groups that contradictory scientific evidence creates problems of evidentiary weight for judges and administrative tribunal members alike. In the words of one judge who responded to the Research Survey:

> It is hard for a judge to know what is mainstream & what is fringe science. Opinions are strongly held by both sides and those opinions are defended at all cost. We see very little objectivity.

The results also indicate recognition by a large percentage of respondents (including decision-makers themselves) that environmental decision-makers are often unable to weigh the credibility of conflicting scientific evidence with the same ability as a scientist would, that decision-makers are susceptible to being influenced by the performances of witnesses in giving scientific evidence, and that they may have difficulty distinguishing widely accepted scientific evidence from new theories or junk science. While it is encouraging that such a high percentage of decision-makers recognize these problems,[353] it is also frightening to think that our current environmental decision-making processes are apparently so vulnerable.

8.4 Translation of Scientific Information into Legal Standards of Proof

A third concern identified by the experience based observations of the author and advisory team[354] with respect to the Problem Area of scientific uncertainty was the translation of scientific information into legal standards of proof by environmental decision-makers. These concerns were corroborated in the legal and scientific literature[355] and thus

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351 Appendix 4 Table 148. Category 1 Result.

352 Appendix 4 Table 149. Category 1 Result.

353 Despite recognition of these problems by a relatively high percentage of decision-makers, these problems are recognized by a substantially higher percentage of scientists, raising the possibility that decision-makers are still underestimating the pervasiveness of these problems.

354 See discussion section 3.5.1.

355 See discussion section 3.5.2.

were explored in the Research Survey.

The Research Survey results revealed considerable divergence of opinion as between decision-makers and the scientific community on this issue. When questioned in a filter question as to the existence of problems in this area, only 39% of judges compared to 79% of scientists agreed with the proposition that "Problems exist in translating scientific information into the decision-making standards which are used by the legal system in environmental trials and other legal proceedings."[356] Less divergence of opinion was seen with respect to administrative hearings, with 57% of administrative tribunal members and 72% of expert scientific witnesses agreeing with the proposition.[357]

A related problem not addressed in the Research Survey but identified by a number of Survey Respondents is that decision-makers may not have the ability to translate levels of certainty and uncertainty expressed by expert scientific witnesses into legal standards of proof. Related to the issues of evidentiary weight discussed earlier, ... The problem was identified by one lawyer in the following terms:

> The law does not understand that scientific conclusions are statistically based and therefore unable to provide the "certainty" that the law expects of science.

8.5 Discussion

The combination of the experience based observations of the author and supervisory team, the legal and scientific literature and the Research Survey results lead to a number of observations, conclusions and recommendations, as discussed below.

8.5.1 Recognition of Existence of Scientific Uncertainty

The first conclusion which may be reached from the above evidence is that environmental decision-making processes often fail to formally recognize the existence of scientific uncertainty in reaching their decisions. Despite strong evidence in the experience based observations of the author and advisory team and in the literature of the presence of some degree of scientific uncertainty in most environmental decision-making situations, a review of case law and administrative tribunal decisions across Canada are noteworthy for their almost complete failure to address the issue of scientific uncertainty. All too often, weeks of complex scientific evidence on a matter of scientific controversy are reduced to the

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356 Appendix 5 Table 164. Category 3 Result.

357 Appendix 5 Table 165. Category 1 Result.

same one line in a decision "I find on the evidence that ...".

Our society is not well served by a legal based system of environmental decision-making which is so uncomfortable with the issue of scientific uncertainty that it refuses to acknowledge its very existence. Without acknowledgment of the existence, nature and degree of scientific uncertainty present in a given case, a legal fiction is created that no scientific uncertainty exists with respect to the resolution of particular scientific issues required in order to resolve a larger jurisprudential dispute. Three potential problems with this state of affairs come immediately to mind. First, it precludes any analysis of the bases upon which a decision is made. Second, it may operate to preclude re-opening a matter at a later date should new scientific information be forthcoming. Third, it may also perpetuate the fiction of scientific certainty in subsequent decisions which follow any precedent set in the initial decision.

Similarly, decisions made by administrative tribunals seldom contain any acknowledgment of scientific uncertainty. The common practice today is for a tribunal to issue reasons for its decision which contain a review of the important relevant evidence considered by the tribunal (to reduce the possibility of an application for judicial review on the grounds of a failure to consider relevant evidence) followed by the conclusions of the tribunal with respect to that evidence. However, rarely do these reasons for decision contain any acknowledgment of uncertainty with respect to a scientific issue.[358] Instead, most administrative decisions simply summarize the scientific evidence and state a brief conclusion on the basis of that evidence, with no acknowledgment of any scientific uncertainty which may exist.

Ironically, our legal system has long recognized the existence of legal uncertainty, and has developed its own mechanism for dealing with issues of legal uncertainty. Every Canadian jurisdiction has appellate courts which are established to resolve issues of legal uncertainty which may arise with respect to decisions of lower courts. Equally significant, most appellate courts are comprised of a minimum of three justices who may or may not reach consensus as to the matter of legal uncertainty before them. While consensus is desirable, there is often disagreement between appellate justices, which disagreement is resolved through the long established practice of majority and dissenting decisions of the court. In the event that legal uncertainty results in disagreement, dissenting judgments are encouraged as they often serve to develop jurisprudential dialogue in controversial legal

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358 A notable exception is found in the May, 1996 Report of the Joint Review Panel of the National Energy Board and the Canadian Environmental Assessment Agency with respect to the *Express Pipeline Project*. (*Express Pipeline Ltd. Application for the Express Pipeline Project* (1995), OH-1-95 Decision and Reasons of the Joint Review Panel of the National Energy Board and the Canadian Environmental Assessment Agency). The proposed project contemplated the construction and operation of a crude oil transmission line originating at terminal facilities at Hardisty, Alberta and continuing south to the international border near Wild Horse, Alberta. In that Report two of the panel members recommended approval of the proposed project. In a dissenting opinion (a true rarity for an administrative tribunal in Canada) the third panel member recommended against the project proceeding on the grounds that "...the evidence produced by the Applicant, Express Pipelines Ltd., is inadequate from both a legal and scientific perspective to permit this Panel to determine whether or not the Project will have significant adverse environmental effects in accordance with the CEAA."

issues. The justification for this approach is that as societal views evolve over time, yesterday's dissent may become tomorrow's law. Similarly, the decisions of many administrative tribunals are subject to judicial review wherein the courts are allowed to review a decision in circumstances where a tribunal has committed an error of law and send it back to the tribunal for reconsideration. Such decisions by courts are themselves often appealable to higher courts.

Why then should the legal system openly acknowledge the existence of legal uncertainty and provide itself with a means to publicly address this uncertainty, and not provide similar acknowledgment of scientific uncertainty and a means to address this uncertainty in resolving a larger jurisprudential dispute? As one judge responding to the Research Survey noted, "There shouldn't be any obstacle to court's stating its uncertainty & the consequences of it." Thus, while a lower court will not be permitted to get the law wrong, it can get the science wrong with impunity and not even acknowledge the existence or nature of any scientific uncertainty which it experienced in reaching its decision. This is particularly disturbing when one considers that the expertise of most judges is in law and not science. An ability to reconsider a decision which is flawed because of its misinterpretation of a scientific issue upon which a jurisprudential decision is based would seem to be at least as important as reconsideration of a legal error in that decision, particularly in science-laden environmental cases.

From this it seems natural to suggest that the first step in addressing problems of scientific uncertainty in environmental decision-making be formal recognition of the existence, nature and degree of scientific uncertainty encountered by decision-makers in reaching their decisions. It is submitted that the changes to existing judicial and administrative decision-making processes and procedures to institute such a requirement would be minimal. Legislative and common law requirements for reasons for decisions of courts and administrative tribunals need only be amended to require decision-makers to include within their reasons the existence, nature and degree of scientific uncertainty found to exist. The decision-maker may go on to state its conclusion that, recognizing the uncertainty which exists, the standard of proof was either satisfied or not satisfied.

Flowing from this, once the existence of scientific uncertainty is formally recognized by environmental decision-makers it then becomes possible to make modifications to existing environmental decision-making processes and procedures to take account of that uncertainty and thereby improve the quality of environmental decision-making. This may occur in the contexts of both judicial and administrative environmental decision-making processes. Recommendations for such modifications include those set out below.

8.5.1.1 European and American Solutions

As seen earlier, many of the solutions to the issue of scientific uncertainty attempted in Europe and the United States have serious flaws.[359] With the exception of ongoing medical monitoring, the solutions attempted in these jurisdictions seem directed toward making decisions with respect jurisprudential disputes in spite of scientific uncertainty rather than attempting to resolve the underlying problem of uncertainty itself. The European approach of awarding damages in direct proportion to the probability of the illness actually occurring or the American solutions of a) awarding damages for loss of immune system and future injury resulting from that loss; and b) awarding damages because of scientific uncertainty, do little more than reinforce the perception of legal systems determined to resolve jurisprudential disputes irrespective of the existence of solid scientific evidence upon which to base such decisions.

8.5.1.2 Uncertainty Training for Decision-Makers

Other solutions hold considerably more promise. For example, a training requirement could be instituted for members of the judiciary and administrative tribunal members to assist them in coming to grips with the nature of scientific uncertainty so that they can be equipped to place that uncertainty within the context of the legislative/regulatory intent. This would allow judges and tribunal members to use their judgment skills, which they can not doif they have little or no understanding of the character and dimensions of scientific uncertainty.

8.5.1.3 Ongoing Monitoring

As noted earlier, another solution with potential is for the courts and administrative tribunals to issue awards for ongoing medical monitoring for claimants who have been unlawfully exposed to contaminants resulting in unknown or unmanifested injuries. The most attractive feature of this approach is that it reduces the information uncertainty characteristic of this type of case. In order for this approach to be implemented in the judicial context, the legal system must ensure that 3 requirements are met:

a) First, the courts must be willing to recognize ongoing medical monitoring as an independent head of damage which may be awarded notwithstanding the presence or absence of any other head of damage. While this has occurred in the United States, Canadian courts have yet to take this step.

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359 See discussion *supra*, section 3.4.2.5.

b) Second, an award for ongoing medical monitoring must not extinguish any future claim which may arise as injuries from the unlawful exposure manifest themselves through continued monitoring. In essence, legal reform is required to ensure that an award for ongoing medical monitoring does not allow a defendant to raise a defence of *res judicata*.

c) Third, statutory limitations must include a "discoverability" clause wherein statutory limitations begin to run when an injury is actually discovered or ought reasonably to have been discovered.[360]

In the administrative context where appropriate tribunals should seriously consider making their regulatory approvals contingent on results obtained from ongoing monitoring. However, if they do so, tribunals must also ensure that they receive the monitoring results directly and review them personally. Administrative tribunals should not rely on parties who appeared at an administrative hearing in opposition to an approval application to review monitoring reports on an ongoing basis and bring areas of concern to the attention of the tribunal.

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360 See for example section 3(1) of the Alberta *Limitations Act* (S.A. 1999, c. L-15.1) which states:

> 3(1) Subject to section 11, if a claimant does not seek a remedial order within
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> (a) 2 years after the date on which the claimant first knew, or in the circumstances ought to have known,
>
> (i) that the injury for which the claimant seeks a remedial order had occurred,
>
> (ii) that the injury was attributable to conduct of the defendant, and
>
> (iii) that the injury, assuming liability on the part of the defendant, warrants bringing a proceeding,
>
> or
>
> (b) 10 years after the claim arose,
>
> whichever period expires first, the defendant, upon pleading this Act as a defence, is entitled to immunity from liability in respect of the claim.

While this legislation provides that a 2 year limitation period begins to run only after the injury is discovered or ought reasonably have been discovered, there is a 10 year limit on bringing any action. Thus, in Alberta a person who is unlawfully exposed to contamination and whose injuries do not manifest themselves within 10 years of the date of the contamination can not recover for those injuries.

8.5.1.4 Pro-Active Approach by Decision-Makers to Ensure Consideration of All Relevant Evidence

In theory, judicial and administrative decision-makers operating in the context of an adversarial based system are expected to rely upon the respective parties to bring forward all relevant evidence in support of their respective positions and thus all evidence required for a good decision will be before the decision-maker. However, theory is often very different from practice in modern environmental decision-making. The reality is that many judges and administrative tribunal members are faced with situations in which one party may be well funded and well prepared, with access to both scientific expertise and legal advocacy to present that expertise, while other parties may be neither well funded nor prepared. In such situations the playing field is clearly not level and the result is often predetermined simply by the resources of the respective parties, because an administrative decision-maker can only decide on the basis of the information presented. Alternatively, scientific information necessary to resolve an issue of scientific uncertainty may not be available to the parties to an environmental decision-making process. Yet, the absence of such information may determine the outcome of the matter. These conditions mitigate against good environmental decision-making.

Two recommendations which would significantly improve the quality of environmental decision-making in these situations appear to be readily available. The first recommendation is amendment of enabling legislation or the common law to place a mandatory positive requirement on judicial and administrative decision-makers to ensure that all relevant evidence (which is otherwise receivable) which is readily obtainable or obtainable with some effort (if the matter justifies it) is before the decision-maker. This would significantly improve the likelihood that decisions are made on the basis of most if not all of the available evidence. Enforcement of such a requirement could easily be carried out through appeal or judicial review. The second recommendation would be to amend enabling legislation to create an adverse evidential inference in the event that it is established that scientific information necessary for the resolution of scientific uncertainty is readily obtainable or obtainable with some effort by a party to a judicial or administrative proceeding, but has not been presented by that party.

8.5.1.5 Legitimacy of Scientific Uncertainty

Uncertainty may be "legitimately" created through the course of a decision-making process or it may be "illegitimately" raised for the purpose of creating confusion and thereby winning a jurisprudential dispute.[361] If a tribunal finds that a party has led scientific evidence

361 In this context, the term illegitimacy is used with regard to the determination of scientific truth, and is not a comment on the relative legal legitimacy of the advocacy tactic of raising confusion to prevent an opponent from meeting a required standard of proof.

for the purpose of creating confusion, it would then be open to the decision-maker to censure that party, with options including a reprimand in the decision itself or an award of costs against the offending party. It is submitted that a court or tribunal which takes a proactive role in discouraging illegitimate uncertainty through the use of such deterrents may well find that the amount of uncertainty encountered by the tribunal will significantly decrease over time. The requirement of formal acknowledgement of scientific uncertainty in the reasons for decisions of courts and administrative tribunals could be incorporated in legislation delegating administrative decision-makers their powers, or alternatively by changes to the right to reasons requirements of the common law. Failure to meet the legal requirement would expose the decision-maker to appeal or judicial review.

8.5.2 Information and Knowledge Uncertainty

Solutions to the problems associated with information and knowledge uncertainty go to the resolution of the underlying problem of uncertainty itself - a lack of reliable scientific information upon which to resolve a scientific issue required in order to decide a larger jurisprudential dispute. Elimination of information uncertainty in circumstances where the information is readily available but is not presented requires decision-makers to adopt a two step process. First, the missing information should be identified by decision-makers. Second, decision-makers should be required to make reasonable efforts to ensure that the missing information is made available to them.

From a practical perspective, the first step of identification of missing information may be undertaken by decision-makers in a variety of ways. The most obvious approach is for decision-makers to be vigilant to identify missing information. This is particularly important in situations where the parties to a dispute possess unequal resources, making reliance on the adversarial process to bring to light missing information a risky proposition. This approach is most effective in situations where the decision-maker possesses scientific expertise in a relevant discipline or where the decision-maker has access to independent scientific expertise. Once missing information is identified decision-makers should then require that such information be provided to them for consideration. Alternatively, amendments to rules of court and to rules of administrative procedure could place a positive requirement upon parties to a dispute to at least identify, and preferably to provide all relevant information - both in support of their position and contrary to it - to the decision-maker. The adversarial process would remain intact, in that a party presenting scientific information contrary to its position could attempt to argue why that information should not be relied on by the decision-maker in reaching a decision. At the same time the decision-maker is alerted to the existence of this contrary information. Such an approach is hardly unique to legal decision-making. The rules of legal ethics of law societies of many Canadian jurisdictions require legal counsel making legal arguments before a court to bring to the attention of that court any legal cases contrary to their position if such cases are not brought out by opposing counsel. Typical of this rule is Rule 18 of the *Law Society of Alberta Code of Professional Conduct*:

> 18. A lawyer must inform the court of relevant adverse authority of which the lawyer is aware and that has not been raised by opposing counsel.[362]

This safeguard is put in place to prevent the situation where a judge is persuaded by legal counsel to render a decision in a jurisprudential dispute without having access to all relevant jurisprudence on an issue. Should we not afford judges and administrative tribunal members the same safeguards against making a decision on a scientific issue relating to a jurisprudential dispute without access to all relevant scientific information? This point is particularly important given the fact that most judges are likely to have a much greater understanding of current jurisprudence with respect to a legal issue than they are current research on a scientific issue.

An additional problem is presented with respect to scientific information which is not readily available but which is obtainable. The problems and solutions are similar to those encountered where the information is readily available, with the added issue of determining what cost is justified for obtaining the missing information. In situations where the adversarial system is functioning effectively the parties to a dispute will usually answer the question for themselves. In simplest of terms, how much is it worth to a party to obtain the missing information? Once that missing information is identified to the decision-maker, the decision-maker is then faced with the choice of requiring one or more parties to a dispute to provide the information or to proceed to render a decision in the absence of that information. The first alternative may result in considerable delays and expense in the decision-making process. The second alternative may result in an inferior decision. The modern realities of busy court dockets for environmental trials and the strong desire within our society for development of important industrial projects often places enormous pressures on environmental decision-makers to adopt the second alternative. It is much easier for a decision-maker to conclude that it has "enough information" to make a decision than to adjourn a decision-making process to require one or more parties to obtain and provide missing information, irrespective of the potential importance of than information. This is especially true if that missing information requires additional scientific investigation or the preparation of additional scientific reports. Unfortunately, this approach not only places the

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362 The Law Society of Alberta goes on to provide the following commentary on Rule 18:

> Rule #18: The court is entitled to expect that counsel will bring to the court's attention any law that may be of importance in its deliberations. A lawyer must therefore inform the court of all relevant authority of which the lawyer is aware. "Relevant authority" for the purposes of Rule #18 means decisions based on similar situations giving rise to similar issues at the superior court level or higher in Canada.

Of course, once such adverse cases are presented to the court legal counsel will usually attempt to distinguish them from the case under consideration.

quality of the decision in question in jeopardy, it also sends a signal to future litigants that the standard of proof may be relaxed if certain information is not provided. It is submitted that decision-makers have an obligation to maintain standards of proof in the face of missing but obtainable scientific information, even if delay is the result. Any other choice diminishes public confidence in the process itself - a cost which far outweighs a trial adjournment or delays the development of a proposed project.

8.5.3 Manipulation of Scientific Uncertainty in Environmental Decision-Making

A final observation with respect to the issue of scientific uncertainty in environmental decision-making is its potential for manipulation by lawmakers to achieve policy goals. Simply stated, the legal system establishes pre-determined standards of behaviour, often referred to as environmental standards, with decisions as to whether these standards of behaviour have been met or not decided on the basis of evidence which must meet a specified standard of proof. The outcome of an environmental decision-making process may be pre-determined by a lawmaker through manipulation of the burden of proof placed upon one or more parties participating in that decision-making process. Thus for example in the regulatory context, if there is scientific uncertainty with respect to possible negative environmental effects from exposure to a particular by-product of a manufacturing process, placing the burden of proof on the Crown to prove beyond a reasonable doubt that exposure to that by-product resulted in environmental damage contrary to regulatory legislation places a burden on the Crown which it likely will not be able to discharge.

The implications of this potential for manipulation are of equal concern when considered in the context of administrative decision-making. If a lawmaker wishes to ensure that a particular type of project will receive approval it need only manipulate the burden of proof found in enabling legislation to require those alleging unacceptable environmental impacts to prove it to a specified standard of proof. If the scientific issues surrounding the environmental effects are uncertain, approval is very likely as those opposing the proposed project will be unable to prove their case. Conversely, if a lawmaker wishes to discourage a particular type of activity it need only structure the legislation wherein the burden of proof is on the proponent to establish that the proposed activity will not have negative environmental consequences - often an equally daunting task.

Manipulation of burdens and standards of proof by lawmakers to achieve policy objectives through predicted outcomes of administrative decisions involving issues of scientific uncertainty may not be evil in and of itself. However, carrying on such subtle manipulation of outcomes while at the same time projecting an image of administrative environmental decision-making as being open and de-politicized is worrisome. A system which is perceived by the public as being open and de-politicized may also be one which the public feels does not require a high degree of scrutiny. The potential for improper manipulation of outcomes through structuring of burdens and standards of proof in the context of scientific uncertainty, combined with a failure by the public to recognize such potential, creates a cause for concern in environmental decision-making.

9.0 Recommendations

Throughout this thesis recommendations have been offered in response to the problems which have been identified with respect to environmental decision-making. A summary of these recommendations follows.

9.1 Quality of Scientific Information in Environmental Decision-Making

9.1.1 Recommendation #1: Increased Awareness of Incompatibilities Between Scientific and Legal Systems

In response to the existence of incompatibilities between the scientific method and legal decision-making processes, efforts should be made to raise the level of awareness of the nature and consequences of this problem amongst all participants in environmental decision-making processes. This may be accomplished through training, both in our colleges and universities and later through continuing professional education. An increased awareness of these incompatibilities may lead to a greater understanding between the scientific and legal communities, which in turn may serve to reduce the negative effects of these incompatibilities on environmental decision-making.[363]

9.1.2 Recommendation #2: Improved Screening of Expert Scientific Witnesses and the Evidence which they Introduce

In response to problems in quality control procedures used by courts and administrative tribunals in environmental decision-making, a general recommendation is for improvements to current screening processes for potential expert witnesses and the evidence they intend to introduce.[364] This recommendation includes a number of practical suggestions which can be implemented without significant restructuring of existing decision-making structures and processes:

a) Bringing to an end the current trend of making the qualification of potential expert witnesses almost automatic, replacing it with a system where judges and administrative tribunals strongly assert their roles as gate-keepers of scientific information which is allowed to enter into environmental decision-making processes.

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363 See discussion section 6.7.1.

364 See discussion section 6.7.2.

b) Gate-keepers should apply the standards of scientific credibility and the means to determine whether a prospective expert witness meets those standards that are evident within the relevant scientific community. If the decision-maker has difficulty in evaluating the scientist in terms of how the scientist would be judged by the scientific community, an independent expert could be retained by the decision-maker for this purpose.

c) Gate-keepers should also take considerable care to define the area or areas of expertise in which scientific witnesses are qualified to give expert evidence, and be vigilant to ensure that these expert witnesses are confined to giving evidence only within the areas in which they have been qualified. Retainer by a court of an independent expert (see previous recommendation) would also be of assistance to the decision-maker in determining the areas of the witnesses' expertise, and later in determining if the witness was straying from those areas in giving evidence.

d) Finally, in those cases where it is apparent to the decision-maker that the adversarial process has broken down either due to an absence of challenge or ineffective challenge to the qualification of an expert, the decision-maker should be encouraged to take the initiative to make such inquiry with the scientific community into the expertise of the proposed expert witness as is required to satisfy the decision-maker.

9.1.3 Recommendation #3: Clarification of the Role of Expert Witnesses

In response to problems associated with the role of the expert scientific witness, decision-makers should clarify and enforce the appropriate role of expert witnesses.[365] This recommendation includes the following suggestions which can be instituted with only minor modification to existing legal processes:

a) In response to problems associated with confusion as to the role which expert scientific witnesses are to play in environmental trials and hearings, decision-makers should provide improved direction to these scientific witnesses as to their proper role prior to giving evidence.[366] Such instruction would improve the expectation that expert witnesses (and legal counsel presenting them) are aware of their duties and are not operating under any misconceptions of improper loyalties while giving evidence. Failure to heed the instructions of

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365 See discussion section 6.7.3.

366 See discussion section 6.7.3.

the decision-maker could result in sanctions, such as dismissal of the witness, and in extreme cases the witness could be found in contempt.

b) The use of expert witnesses should be restricted to consideration of factual scientific issues in question and eliminate situations in which witnesses are encouraged to act as advocates. That is, legal counsel should be required to define narrowly the issue on which the expert's opinion is sought, and experts would be given fair and objectively based factual hypotheses on which to premise their opinions. Legal counsel should be discouraged from asking experts to provide opinions based only on factual assumptions that unfairly favour one side, and the courts should render inadmissible any argument which an expert may attempt to advance on behalf of their client.

c) Decision-makers should retain independent expert scientific witnesses. The independent expert can be particularly helpful to the decision-maker in situations where a) the adversarial system breaks down through a lack of opposition or ineffective opposition; b) where the decision-maker is aware in advance of a trial or hearing that a case will involve a considerable amount of complex scientific evidence and is likely to be conducted in an intensely adversarial manner; or c) if the decision-maker is aware that one or more expert witnesses who will give evidence has a reputation as a "hired gun" whose primary loyalty is to those willing to retain him rather than to the decision-maker.

9.1.4 Recommendation #4: Reducing the Influence of Legal Counsel on Expert Evidence

In response to problems relating to influence by legal counsel on the evidence given by expert scientific witnesses, the relationship between legal counsel and the expert scientific witnesses which they retain should be more effectively regulated. [367] In this regard it is recommended that:

a) Improper influence on expert witnesses may in some cases be ferreted out by effective cross-examination geared toward exposing such an impropriety.

b) Increased regulation of the lawyer-expert witness relationship should be instituted by the legal community through the professional conduct mechanisms employed by Canadian law societies and by the scientific community through its professional conduct requirements and processes.

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[367] See discussion section 6.7.4.

c) Persons being qualified as expert scientific witnesses should undergo training which sets out the expectations of the legal system toward expert scientific witnesses (including the issue of external influences). Successful completion of such training should be a mandatory prerequisite to an expert being qualified to give evidence before a court or administrative tribunal in Canada. From a practical perspective such a requirement would require a phase-in process.

9.1.5 Recommendation #5: Improved Environmental Decision-Making Procedures

In response to problems with the quality of scientific evidence attributable to constraints in the format for the presentation and adjudication of scientific evidence in current environmental decision-making processes, the following mechanisms should be instituted to improve quality assurance in scientific controversies:[368]

a) Doubts about measurement methodology might be resolved by submitting split samples to independent measurement.

b) Pre-trial and pre-hearing meetings between triers of fact and scientific experts could be utilized to determine areas of consensus between scientists and thereby limit the area of controversy.

c) Administrative tribunals could hear panels of witnesses rather than individuals. While this is currently done by some tribunals to save time, there is potential to use the interplay among a panel of witnesses to ensure a more integrated picture of the evidence for the decision-maker which avoids the fragmentation which is characteristic of a strictly linear process. Taking this approach one step further, a tribunal could require that all experts giving evidence with respect to a particular issue appear together, irrespective of who they represent. This would allow the decision-maker to evaluate the views of the various witnesses directly by seeing how they respond to issues raised by the tribunal. However, for such an approach to be effective, direct cross-examination of individual panel members must be allowed.

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[368] See discussion section 6.7.5.

9.1.6 Recommendation #6: Balancing Inequalities of Resources Available to Parties for the Presentation of Scientific/Technical Evidence

In response to problems with the quality of scientific/technical information introduced into environmental decision-making processes as a result of inequalities in resources available to parties participating in decision-making processes, the following recommendations are suggested:

1) Federal and provincial legislation should be amended to require parties applying for approval of proposed projects to be responsible for providing intervenor funding to decision-making agencies for the purpose of facilitating meaningful participation in decision-making processes by interested persons and organizations. These agencies would then be responsible for ensuring that such funding is equitably distributed to those persons or organizations wishing to participate in decision-making processes as intervenors. The funding would be provided to assist under-funded intervenors to obtain scientific/technical information for presentation to the decision-maker. This would include the retainer of scientific/technical experts independent of project proponents. While intervenor funding is provided by some environmental decision-makers, such as the Canadian Environmental Assessment Agency, such funding is usually taken from the public purse and is extremely limited. By making intervenor funding a "cost of doing business" borne by project proponents, environmental decision-makers are assured that the scientific/technical evidence presented is reasonably balanced, the cost is borne by those who stand to make a profit from the project rather than by the public, and project proponents know well in advance that such costs will be incurred, thereby allowing them to budget accordingly.

2) In situations where environmental decision-makers are aware of inequities in resources between parties appearing before them, decision-makers are advised to take pro-active steps to attempt to compensate for these inequities. For example, decision-makers may avail themselves of independent scientific/technical expertise to ensure that a balanced view of scientific issues is provided to them.

Implementation of these recommendations will require a significant policy shift on the part of federal and provincial governments across Canada.

9.2 Communication/Comprehension of Scientific Information in Environmental Decision-Making

9.2.1 Recommendation #1: Improved Communication Skills for Expert Scientific Witnesses

In response to problems associated with the communication of scientific evidence by expert scientific witnesses, the legal system should provide tangible and specific guidance for prospective expert witnesses about the concerns with respect to the ability of expert witnesses to communicate effectively in a legal decision-making setting. Further, professional bodies representing the scientific community[369] should respond to this concern by encouraging those scientists who appear as expert witnesses to improve their communication skills, particularly with respect to communicating scientific information to non-scientists. Such instruction could easily be included within existing professional development programs.

An alternative would be for training in effective communication of scientific concepts to be part of an overall training program for prospective expert scientific witnesses mandated by the legal system as a prerequisite for being qualified to appear as an expert witness.[370] While ideal, this approach may be considerably more difficult to implement due to logistical and funding issues.

9.2.2 Recommendation #2: Increased Role for Scientific Advisors

In response to problems experienced by legal counsel in presenting expert scientific evidence in chief and in cross-examining on expert scientific evidence, legal counsel should be encouraged to place increased reliance upon scientific advisors to assist with preparation of examination and cross-examination in environmental trials and administrative hearings.[371] This objective could easily be achieved through amendment to legal rules of procedure to facilitate the use of scientific advisors by legal counsel. This may include such changes as routinely permitting advisors to work directly with lawyers at the legal counsel table, and even allowing scientific advisors to conduct cross-examination on complex scientific issues.

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369 For example, in Alberta the Association of Professional Engineers, Geologists, and Geophysicists of Alberta, the Alberta Society of Professional Biologists, etc.

370 See discussion section 7.4.1.

371 See discussion section 7.4.1. It must be emphasized that scientific/technical experts who act as scientific advisors should never be called upon to perform a dual role as expert witnesses. As a scientific advisor the expert assumes the role of advocate. The advisor role will taint credibility of the expert who also appears as an expert witness; a role which should have as its primary responsibility to serve the court.

Implementing a cross-examination privilege to non-lawyers may require establishment of certifiable training.

It may be argued that cross-examination should remain the exclusive domain of those who meet the training and professional accreditation standards established by Canadian law societies - those who are called to the bar have the knowledge of courtroom procedure, rules of evidence, etc. important to successful cross-examination. While having merit, this argument fails when one considers that the vast majority of legal counsel conducting cross-examination of an expert witness on a complex scientific issue in an environmental trial or administrative hearing have little or no knowledge of the substantive issues upon which they are cross-examining. It is submitted that effective cross-examination is better achieved through allowing scientific advisors who have received training and certification in cross-examination to assist legal counsel in conducting cross-examinations than to allow legal counsel to cross-examine without technical assistance in an area in which they have little or no substantive knowledge.

9.2.3 Recommendation #3: Decision-Makers to Elicit Relevant Scientific Information Missed During Examination-in-Chief and Cross-Examination

In response to the problem of intentionally failing to elicit all available relevant scientific information during examination-in-chief or in cross-examination, if the decision-maker becomes aware that information relevant to resolution of a scientific issue may be within the knowledge of an expert witness but that information has not been elicited through the processes of examination, cross-examination or re-examination, the decision-maker should be under a positive obligation to directly elicit that information from the witness. The goal of reaching the best decision possible with respect to a scientific issue required in order to resolve a jurisprudential dispute can only be achieved if all relevant information has been obtained from expert scientific witnesses.[372]

9.2.4 Recommendation #4: Decision-Makers to Distinguish Between the Quality of Scientific Information and the Quality of Communication of that Information

In response to the problem of widely differing capabilities of expert scientific witnesses to communicate scientific information, decision-makers should be assisted in distinguishing between high quality scientific information and high quality presentation of

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[372] See discussion section 7.4.1.

scientific information.[373] This could be readily achieved by providing decision-makers with general validation questions they could use to test the quality of the scientific information they are presented.

9.2.5 Recommendation #5: Increased Scientific Training for Decision-Makers

In response to the problem of comprehension of complex scientific information by decision-makers who do not possess scientific training, it is recommended that decision-makers obtain increased knowledge in the key foundations of the scientific method.[374] The advantages of having judges and administrative tribunal members with a minimum standard of general training in science, and particularly with respect to scientific methods, are considerable.[375] Judges and tribunal members with this background are likely to be much better equipped to address the problems associated with scientific evidence than those who do not have such knowledge. The logistics associated with obtaining and utilizing this expertise are neither complicated nor expensive. Judges and tribunal members may undergo scientific methodology training as part of their in-service professional development. Those judges and tribunal members could then be assigned to those cases identified as having a high potential for complex scientific issues.

9.2.6 Recommendation #6: Decision-Makers to Retain Independent Scientific Expertise

In response to the problem of comprehension of complex scientific information by judges and administrative tribunal members who do not possess scientific training or who do not possess scientific expertise in the relevant area, these decision-makers should avail themselves of the appropriate independent scientific expertise required for each case.[376] This approach has two significant advantages:

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[373] See discussion section 7.4.1.

[374] See discussion section 7.4.2.

[375] In recommending greater scientific training for decision-makers, it should be emphasized that areas of expertise other than science are also a prerequisite to good decision-making. Scientific training alone will not turn a weak environmental decision-maker into a strong one.

[376] See discussion section 7.4.2. A small number of administrative tribunals, such as the Alberta Energy and Utilities Board have successfully used this strategy for years.

a) first, it provides decision-makers with assistance in defining terms of reference and focussing issues to prevent the situation where parties submit large amounts of information (which may not be relevant) causing information overload for decision-makers; and

b) second, it allows decision-makers to obtain expertise from persons who do not have a vested interest in the outcome of a case.

Rules of Court in many jurisdictions and statutes authorizing a large number of administrative decision-makers already allow for the retainer of independent scientific/technical expertise. Obstacles to decision-makers availing themselves of this resource appear to be primarily financial, with few courts or administrative tribunals providing for independent expertise in their budgets.

9.2.7 Recommendation #7: Standard of Review of Administrative Decisions in Judicial Review Applications to Take Account of Actual Special Knowledge and Expertise of Tribunal Members

In response to the potential problems associated with the appointment of administrative decision-makers who do not possess special knowledge and expertise, it is strongly recommended that judicial review procedures should be reformed so as to allow courts in determining the appropriate standard of review to take account of the actual special knowledge and expertise of tribunal members.[377] This requires that both the parties to a judicial review and the courts have access to the information required in order to evaluate whether such special knowledge and expertise in fact exists. This could be accomplished in a variety of ways. One simple method would be to require respondent administrative decision-makers to file an "affidavit of qualifications" which would set out the decision-maker's qualifications as it relates to the decision-maker's relevant special knowledge and expertise. The applicant would then be entitled to cross-examine the respondent on its affidavit thereby eliciting the necessary information with respect to the special knowledge and expertise of the administrative decision-maker. Such a process would not be unlike the current approach used by the courts to qualify expert witnesses on the basis of their special knowledge and expertise.

An alternative approach would be to reduce the politization of the appointment process for administrative decision-makers through the creation of an independent gate-keeping process for administrative appointments. This would offer some assurance that statutory delegates possess special knowledge and expertise.

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[377] See discussion section 7.4.2.

By ensuring that statutory delegates are appointed for their special knowledge and expertise, whether by enabling the courts to examine the qualifications of statutory delegates to determine whether these decision-makers actually possess special knowledge and expertise, or by creating an independent gate-keeping process for administrative appointments, confidence in environmental decisions will be maintained, and reticence by those with special knowledge and expertise to participate as decision-makers may be substantially reduced.

9.3 Scientific Uncertainty in Environmental Decision-Making

9.3.1 Recommendation #1: Recognition of Scientific Uncertainty

The first step in addressing problems of scientific uncertainty in environmental decision-making is formal recognition of the existence, nature and degree of scientific uncertainty encountered by decision-makers in reaching their decisions.[378] Changes to existing judicial and administrative decision-making processes and procedures to institute such a requirement would be minimal. Legislative and common law requirements for reasons for decisions of courts and administrative tribunals need only be amended to require decision-makers to include within their reasons the existence, nature and degree of scientific uncertainty found to exist and how the decision-maker has chosen to resolve that uncertainty in reaching the decision. The requirement of formal acknowledgement of scientific uncertainty in the reasons for decisions of administrative tribunals could be incorporated in legislation delegating administrative decision-makers their powers, or alternatively by changes to the right to reasons requirements of the common law. The decision-maker may go on to state its conclusion that, recognizing the uncertainty which exists, the standard of proof was either satisfied or not satisfied. Failure to meet the legal requirement would constitute a reviewable error by the courts under judicial review.

Flowing from this, once the existence of scientific uncertainty is formally recognized by environmental decision-makers it then becomes possible to make modifications to existing environmental decision-making processes to take account of that uncertainty and thereby improve the quality of environmental decision-making. This may occur in the contexts of both judicial and administrative environmental decision-making processes. Recommendations for modification of these processes follow.

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378 See discussion section 8.5.1.

9.3.2 Recommendation #2: Uncertainty Training For Decision-Makers

In response to problems associated with identified scientific uncertainty, a training requirement should be instituted for members of the judiciary and administrative tribunal members to assist them in coming to grips with the nature of scientific uncertainty so that they can be equipped to place that uncertainty within the context of the legislative/regulatory intent. This would allow judges and tribunal members to use their judgment skills, which they can not do if they have little or no understanding of the character and dimensions of scientific uncertainty.

9.3.3 Recommendation #3: Ongoing Monitoring

Courts and administrative tribunals should give consideration to issuing decisions which incorporate an element of ongoing monitoring in situations where current levels of scientific uncertainty are high and where this uncertainty may be reduced or eliminated through future monitoring. For example, in the judicial context courts faced with cases where claimants who have been unlawfully exposed to contaminants have unknown or unmanifested injuries could issue judgments providing for ongoing medical monitoring. The most attractive feature of this approach is that it reduces the information uncertainty characteristic of this type of case.[379]

In order for this approach to be implemented in the judicial context, some significant changes must occur. Specifically, the legal system must ensure that 3 requirements are met:

a) First, the courts must be willing to recognize ongoing medical monitoring as an independent head of damage which may be awarded notwithstanding the presence or absence of any other head of damage.

b) Second, an award for ongoing medical monitoring must not extinguish any future claim which may arise as injuries from the unlawful exposure manifest themselves through continued monitoring.

c) Third, statutory limitations must include a "discoverability" provision wherein statutory limitations begin to run when an injury or damage is actually discovered or ought reasonably to have been discovered. In the administrative context tribunals should consider making their regulatory approvals contingent on results obtained from ongoing monitoring. However, if they do so, tribunals must also ensure that they receive and review the monitoring results directly. Administrative tribunals should not rely on

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379 See discussion section 8.5.1.1.

parties who appeared at an administrative hearing to review monitoring reports on an ongoing basis and bring areas of concern to the attention of the tribunal. In many cases such parties are issue-driven, and may cease to exist following the hearing. In other situations parties may not have the resources to continually monitor to ensure that regulatory requirements are met. To leave the burden of such monitoring with those affected will likely result in hit-and-miss enforcement. This is in contrast to the continuity which may be provided by an administrative tribunal and its administrative infrastructure.

9.3.4 Recommendation #4: Pro-Active Approach by Decision-Makers to Ensure Consideration of All Relevant Evidence

In response to problems associated with information uncertainty and knowledge uncertainty, solutions to these problems go to the resolution of the underlying problem of uncertainty itself - a lack of reliable scientific information upon which to resolve a scientific issue required in order to decide a larger jurisprudential dispute. [380] Applicable legislation and the common law should be amended to place a positive requirement on courts and administrative tribunals to take a pro-active approach to ensure that all relevant evidence (which is otherwise receivable) which is readily obtainable or obtainable with some effort (if the matter justifies it) is presented to the court or tribunal.

Elimination of information uncertainty in circumstances where the information is readily available but is not presented requires decision-makers to adopt a two step process. First, the missing information should be identified by decision-makers. Second, decision-makers should be required to make reasonable efforts to ensure that the missing information is made available to them.

From a practical perspective, the first step of identification of missing information may be undertaken by decision-makers in a variety of ways. The most obvious approach is for decision-makers to be vigilant to identify missing information. This is particularly important in situations where the parties to a dispute possess unequal resources, making reliance on the adversarial process to bring missing information to light a risky proposition. This approach is most effective in situations where the decision-maker possesses scientific expertise in a relevant discipline or where the decision-maker has access to independent scientific expertise. An alternative approach is to amend rules of court and rules of administrative procedure to place a positive requirement upon parties to a dispute to identify deficiencies in information place before the decision-maker.

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380 See discussion section 8.5.2.

Once missing information is identified decision-makers should then be under an obligation to ensure that such information be provided to them for consideration. It is recommended that amendments be made to enabling legislation and/or the common law to place a mandatory positive requirement on judicial and administrative decision-makers to ensure that all relevant evidence (which is otherwise admissible) which is readily obtainable or obtainable with some effort (if the matter justifies it) is before the decision-maker. This would significantly improve the likelihood that decisions are made on the basis of most if not all of the available evidence. Enforcement of such a requirement could easily be carried out through appeal or judicial review. Alternatively, amendments to rules of court and to rules of administrative procedure could place a positive requirement upon parties to a dispute to provide all relevant information - both in support of their position and contrary to it - to the decision-maker. The adversarial process would remain intact, in that a party presenting scientific information contrary to its position could attempt to argue why that information should not be relied on by the decision-maker in reaching a decision. At the same time the decision-maker is alerted to the existence of this contrary information. Such a requirement could be enforced through amendments to enabling legislation creating an adverse evidential inference in the event that it is established that scientific information necessary for the resolution of scientific uncertainty is readily obtainable or obtainable with some effort by a party to a judicial or administrative proceeding, but has not been presented by that party.

In situations where scientific information is not readily available but is obtainable. the recommended solution is similar to that where the information is readily available, with the added issue of determining what cost is justified for obtaining the missing information. In situations where the adversarial system is functioning effectively the parties to a dispute will usually answer the question for themselves. In simplest of terms, how much is it worth to a party to obtain the missing information? Once that missing information is identified to the decision-maker, the decision-maker is then faced with the choice of requiring one or more parties to a dispute to provide the information or to proceed to render a decision in the absence of that information. The first alternative may result in considerable delays and expense in the decision-making process. The second alternative may result in an inferior decision. It is recommended that decision-makers take great care to ensure that standards of proof are strictly maintained in the face of missing but obtainable scientific information, even if delay is the result. Any other choice diminishes public confidence in the process itself - a cost which may far outweigh a trial adjournment or delays the development of a proposed project.

9.3.5 Recommendation #5: Legitimacy of Scientific Uncertainty

In response to problems involving uncertainty which is legitimately created through the course of a decision-making process and uncertainty which is illegitimately raised for the purpose of creating confusion and thereby winning a jurisprudential dispute, decision-makers should take steps to actively discourage uncertainty raised for the purpose of creating confusion.[381] For example, if a decision-maker finds that a party has led scientific evidence for the purpose of creating confusion, it would then be open to the decision-maker to censure that party, with options including a reprimand in the decision itself or an award of costs against the offending party. A decision-maker who takes a pro-active role in discouraging illegitimate uncertainty through the use of such deterrents may well find that the amount of uncertainty encountered will significantly decrease over time.

9.3.6 Recommendation #6: Avoidance of European and American Solutions

Finally, Canada should avoid the solutions to scientific uncertainty currently being promoted in Europe and the United States. As seen earlier, many of the solutions to the issue of scientific uncertainty attempted in Europe and the United States have serious flaws.[382] With the exception of ongoing medical monitoring, the solutions attempted in these jurisdictions seem directed toward making decisions with respect to jurisprudential disputes in spite of scientific uncertainty rather than attempting to resolve the underlying problem of uncertainty itself.

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381 See discussion section 8.5.1.2.

382 See discussion section 3.4.2.5.

10.0 Overall Conclusions

In addition to the conclusions and recommendations discussed above, two overall themes emerge from this thesis.

First, the findings of this thesis indicate that in attempting to manage environmental risk our society is faced with two distinct "layers" of uncertainty. The first layer is the well documented uncertainty associated with the scientific "inputs" into environmental decision-making processes. These include elements such as the inability of scientific research to generate perfect knowledge on all aspects of an issue and the variability of answers for different systems causing uncertainty in using scientific information in decision-making processes. The second layer of uncertainty, which is not well recognized, is uncertainty with respect to the ability of the legal system to determine the best answer in any given situation. Problems with the quality of scientific information, its communication and comprehension, and the presence of uncertainty itself leads to the inevitable conclusion that the operation of the legal system itself creates a latent but very significant internal or systemic uncertainty with respect to the results it may produce in addressing any environmental issue. This second layer of uncertainty can substantially reduce our confidence in the ability of the legal system to reach the best decision and thereby manage environmental risk to the benefit of society. From a practical perspective, the existence and nature of this second layer of uncertainty must be factored into consideration when evaluating the quality of environmental decision-making and when making any environmental decision with potential legal consequences.

Second, as stated in the Introduction, Canadian society perceives some environmental risks as acceptable and others as unacceptable. Still other risks are sufficiently uncertain that society is unsure as to their acceptability. The Canadian legal system is entrusted to allow those risks which are acceptable - prohibit and sanction those which are not - and attempt to ascertain the acceptability of those for which substantial uncertainty exists. In practical terms, there is no "right" answer to an issue involving environmental risk in any given fact situation. Rather, society relies on the legal system to determine the "best" answer. However, the legal system is often impeded in reaching its goal of determining the best answer by a range of problems which exist in our system of environmental decision-making. Many of these problems have been identified in this thesis. Some of these problems appear to be unresolvable. Others have solutions readily available. The key point is that our legal system is capable of making "better" environmental decisions. This objective is achievable through recognition of the problems which exist, and seeking out solutions to resolve the problems. It is somewhat ironic that in undertaking this task the legal system may benefit from principles of scientific research, which tenets include striving to identify problems, solving problems through the elimination of avoidable errors and acknowledging and accounting for problems which can not be resolved.

Sadly, society may not see the benefits of improved environmental decision-making for a considerable time. A prerequisite to implementation of the solutions recommended in this thesis and the development of others, is for the legal and scientific communities to come together to develop a dialogue with a focus of gaining a better understanding of the problems currently experienced in environmental decision-making in Canada. Unfortunately, indications are that the level of interdisciplinary understanding required for such an undertaking does not presently exist. For example, the Research Survey found that 0% of judges and only 14% of legal counsel and 11% of scientists rated the current "Level of understanding by the scientific community of the concerns of the legal community in environmental decision-making" to be either good or very good.[383] Similarly, a low level of respondents (19% of judges, 18% of legal counsel and 7% of scientists) found the current "Level of understanding by the legal community of the concerns of the scientific community in environmental decision-making" to be either good or very good.[384] For Canada to achieve a higher quality of environmental decision-making we must first foster a strong interdisciplinary understanding between our legal and scientific communities. We must avoid the interdisciplinary isolation which engenders a legal and scientific parochialism from which effective environmental decision-making may not be possible.

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383 Table 98.

384 Appendix 3 Table 100.

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Appendix 1

Research Methodology

1.0 Introduction

In January, 1994 an empirical research project entitled "Environmental Decision-Making: The Interfaces of Science and Law" ("Research Project") was undertaken by the Author in affiliation with the University of Alberta *Eco-Research* Chair in Environmental Risk Management. The details of the survey component of the Research Project ("Research Survey") was concluded in January of 1995. The methodological details of the Research Survey are summarized in this Section.

2.0 Purpose And Objectives

The overall purpose of the Research Survey was, *inter alia*, to examine the perceptions of four of the primary participants in environmental trials and administrative environmental hearings - the judiciary, administrative tribunal members, legal counsel and members of the scientific community, for the purpose of identifying problems which may exist with respect to the ability of Canada's legal-based environmental decision-making infrastructure to address scientific issues in environmental decision-making.

In order to achieve this objective the survey examined the perceptions of survey participants with respect to five contact points or "interfaces" between the scientific and legal systems which it is submitted are required for the effective introduction of scientific information into legal environmental decision-making structures and processes:

1) The quality of scientific information which is introduced into the decision-making process at trials and administrative environmental hearings involving environmental issues.

2) The communication of scientific information at environmental trials and administrative environmental hearings, and the comprehension of that information by participants in such trials and hearings.

3) The issue of scientific uncertainty in environmental trials and administrative environmental hearings.

4) The use of scientific information to establish the decision-making standards which are used by the legal system, and the translation of scientific information into those standards at environmental trials and administrative environmental hearings.

5) The suitability of legal decision-making institutions (such as courts of law and administrative tribunals) and legal procedures (such as rules of court, rules of evidence and rules of hearing procedure) for the resolution of scientific issues in environmental trials and administrative environmental hearings.

3.0 Methodology And Procedures

3.1 Inclusion Criteria

Inclusion criteria for survey subjects required past or present participation in environmental trials (or other legal proceedings) or in administrative environmental hearings involving the resolution of one or more scientific[1] issues by individuals who:

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1 The term "Scientific" was meant to refer to all relevant scientific and technical disciplines within the natural and applied sciences (for example, engineering, geography, hydrogeology, biology, limnology, botany, zoology, chemistry, ecology, geology, soil sciences, forestry, medicine and public health).

1) fall within any of the following four occupational categories:

   a) the judiciary;[2]
   b) administrative tribunal members;[3]
   c) legal counsel;[4] or
   d) expert scientific witnesses,[5]

2) within any one or more of the following five Canadian jurisdictions:

   a) Alberta;
   b) British Columbia;
   c) Ontario;
   d) Northwest Territories; and
   e) Yukon Territory.

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[2] The term "Judiciary" was intended to denote judges appointed to Provincial, Superior or Appellate courts in either Alberta, British Columbia, Ontario, the Northwest Territories or Yukon territory who heard a court trial (criminal/quasi-criminal or civil) or other legal proceeding (such as an injunction application or an application for judicial review of an administrative decision) in a matter involving an environmental issue.

[3] The term "Administrative Tribunal Members" was intended to denote persons appointed to administrative tribunals in either Alberta, British Columbia, Ontario, the Northwest Territories or Yukon territory who conducted a hearing in a matter involving an environmental issue.

[4] For the purposes of this Research Project the term "Legal Counsel" was intended to denote any member of one or more of the law societies of Alberta, British Columbia, Ontario, the Northwest Territories and Yukon Territory of Canada who either:

1) appeared as legal counsel; or
2) assisted as second counsel

in a court trial (criminal/quasi-criminal or civil) or other legal proceeding (such as an injunction application or an application for judicial review of an administrative decision) in a matter involving an environmental issue.

[5] For the purposes of this Research Project the term "Expert Scientific Witnesses" was intended to denote any member of the scientific community who either:

1) appeared as an expert scientific witness; or
2) appeared as an independent expert scientific witness appointed by the courts; or
3) acted as a scientific advisor (assisting legal counsel on scientific issues without actually appearing as an expert scientific witness)

in a court trial (criminal/quasi-criminal or civil) or other legal proceeding (such as an injunction application or an application for judicial review of an administrative decision) in a matter involving an environmental issue.

3.2 Identification Of Potential Respondents

In order to obtain a broad and representative sample of the target population, survey subjects were identified for recruitment through a variety of sources, including:

1) Legal and scientific directories[6];
2) Reported and unreported legal and administrative cases[7];
3) Environmental organization mailing lists[8]; and
4) Personal contacts of the author and advisory team.[9]

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6 Directories which were used for the identification of potential respondents include:

1) Canadian Bar Association Alberta Branch Environmental Law Section Membership List (1994).
2) Canadian Bar Association British Columbia Branch Environmental Law Section Membership List (1994).
3) Canadian Bar Association Environmental Law National Section Membership List (1994).
4) Canadian Bar Association Northwest Territories Branch Environmental Law Section Membership List (1994).
5) Canadian Bar Association Ontario Branch Environmental Law Section Membership List (1994).
6) Canadian Bar Association Yukon Territory Branch Environmental Law Section Membership List (1994).
7) Alberta Association of Professional Engineers, Geologists and Geophysicists 1994 Directory.

7 Reported cases were identified through a number of Canadian legal encyclopaedia and case reporting services, including:

1) Canadian Abridgment.
2) Canadian Encyclopaedic Digest (C.E.D.) Western.
3) Quick Law (QL) Systems.
4) Supreme Court Reports (S.C.R.).
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7) Alberta Reports (A.R.).
8) Alberta Law Reports (A.L.R.).
9) British Columbia Reports (B.C.R.).
10) Ontario Reports (O.R.).
11) Northwest Territories Reports (N.W.T.R.).
12) Yukon Territory Reports (Y.T.R.).
13) Canadian Environmental Law Reports (C.E.L.R.).
14) Fisheries and Pollution Reports (F.P.R.).

8 These organizations included:

1) Environmental Law Centre, Edmonton, Alberta.
2) Canadian Environmental Defence Association, Toronto, Ontario.

9 Personal contacts included judges, legal counsel and expert scientific witnesses with whom the author became acquainted during several years of environmental law practice in the Province of Alberta.

3.3 Data Collection Strategy

Once survey subjects were identified, a systematic effort was made to contact as many members of the target population as possible. In this regard potential subjects identified as falling within the inclusion criteria (above) were initially contacted by a letter delivered via mail which briefly introduced the survey and requested their participation by completing and returning a survey questionnaire enclosed with the letter. A copy of the contact letter was also printed on the inside front cover of all survey questionnaires. Each survey questionnaire included a pre-addressed, postage paid envelope to facilitate return.

Preliminary investigations indicated that in order to obtain responses from the judiciary respondent group it would in almost all cases be necessary to make personal contact with potential respondents in the form of meetings and/or telephone calls prior to providing the initial contact letter and questionnaire. In order to increase response rates within the legal counsel and expert scientific witness respondent groups personal contact techniques were also used whenever possible.

Potential respondents who did not initially respond to the survey questionnaire were contacted with a follow-up letter and/or telephone call.

3.4 Response

Survey questionnaire response numbers are set out in Table 1. Total Distribution numbers refer to the total number of survey questionnaires which were distributed to each subject group. The Combined Response category sets out the total number of completed survey questionnaires which were returned. It is important to note that questionnaire booklets distributed to the legal counsel and expert scientific witness subject groups included two questionnaires - one for those who had experience with environmental trials and other legal proceedings and a second for those who had experience with administrative environmental hearings.[10] Thus the Total Response figures for the legal counsel and expert scientific witness subject groups includes questionnaires which were completed and returned by respondents who had experience in either environmental trials and other legal proceedings, administrative environmental hearings, or both. The Trial Experience Response column represents the total number of questionnaires which were completed and returned by respondents who had experience with environmental trials and other legal proceedings (and therefore are of interest to this Thesis). The Gross Response Rate is calculated by

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10 As information was unavailable as to whether individual potential respondents from the legal counsel and expert scientific witness survey groups had experience with environmental trials and other legal proceedings, experience with administrative environmental hearings, or both, it was deemed necessary to combine questionnaires relating to each of these environmental decision-making processes within each questionnaire booklet. Potential respondents would then indicate their eligibility to respond to either or both of the questionnaires.

multiplying the Trial Experience Response by 100 and dividing the result by the Total Distribution. A significant number of survey questionnaires were returned by potential respondents who indicated that they were not eligible to participate in the Research Survey. These responses are set out in the Returned Not Applicable column. The Adjusted Total Distribution column The Adjusted Response Rate is determined by comparing the number of respondents who returned completed questionnaires to those who indicated that they were not eligible to participate, and by assuming that the proportion of non-eligible members of the original target population is similar to the proportion observed in returned questionnaires. The Adjusted Response Rate is calculated by multiplying the Trial Experience Response by 100 and dividing the result by the Adjusted Total Distribution.

Table 1
Survey Questionnaire Response

Survey Group	Total Distribution	Combined Response	Trial Experience Response	Admin. Hearing Response	Returned Not Applicable	Adjusted Total Distribution	Adjusted Response Rate
Judiciary	20	18	18	N/A	0	20	90.0%
Admin. Tribunal	162	63	N/A	63	7	155	40.6%
Legal Counsel	1757	101	88	65	112	1645	6.1%
Expert Scientific Witnesses	390	107	88	79	44	346	30.9%

It is submitted that the high (90%) response rate received from the judges respondent group strongly indicates that these responses are representative of the judiciary within the survey boundaries. While there remains a statistical possibility that those respondent groups which received lower (adjusted) response rates (administrative tribunal members 40.6%, expert scientific witnesses 30.9% and legal counsel 6.1%) may not be representative of their respective constituency groups, it is submitted that this is an unlikely possibility in that the Research Survey data are representative of a diverse population, within their constituencies, who showed sufficient interest in these issues to complete a very detailed questionnaire. While they may not be entirely representative of their constituency, the validity of their views is established by their experience and interest in the issues. The nature of the diversity of respondents is described below.

3.4.1 Legal Counsel

The diversity of the legal counsel population is evidenced through the following factors:

1) Jurisdictions

The percentage of respondents who were involved in an environmental trial or
other legal proceeding or an administrative environmental hearing in one or more of the five jurisdictions included within the Research Survey is as follows:[11]

	Jurisdiction	Trials	Hearings
a)	Alberta	34.1%	37.9%
b)	British Columbia	34.1%	18.8%
c)	Ontario	40.9%	48.5%
d)	Northwest Territories	11.4%	4.5%
e)	Yukon Territory	2.3%	3.0%

2) Experiences

Legal counsel respondents also indicated that they had a wide range in terms of numbers of experiences as legal counsel at environmental trials and other legal proceedings. A total of 88 respondents indicated that they had " ... acted as legal counsel (or assisted as second counsel) in a court trial (criminal, quasi-criminal or civil) or other legal proceeding (such as an injunction application or an application for judicial review of an administrative decision) in a matter involving an environmental issue". The number of experiences of these respondents is as follows:

No. Of Experiences	No. Of Respondents
1	7
2	12
3	5
4	7
5	4
6	7
7	4

11 Some respondents indicated that they were involved in environmental trials or other legal proceedings in two or more of the five survey jurisdictions. Therefore percentages need not add up to 100%.

	8	3
	10	6
	11	1
	12	1
	15	8
	20	4
	25	7
	30	2
	35	1
	40	1
	50	3
	80	1
	100	2
	125	1
	300	1
Total	1636	88

3.4.2 Expert Scientific Witnesses

The diversity of the expert scientific witness population may also be seen in the following factors:

1) Area of Specialization

The 88 respondents in the expert scientific witness category represent 64 areas of scientific specialization, including:

1. Agriculture
2. Air Quality
3. Analytical Chemistry
4. Aquatic Biology
5. Aquatic Ecology
6. Aquatic Entomology
7. Aquatic Toxicology
8. Atmospheric Chemistry
9. Biochemistry
10. Biology
11. Botany
12. Chemical Engineering
13. Chemistry
14. Civil Engineering
15. Climatology
16. Contaminant Hydrogeology
17. Diffusion Meteorology
18. Ecology
19. Environmental Assessment
20. Environmental Chemistry
21. Environmental Engineering
22. Environmental Health
23. Environmental Medicine
24. Environmental Planning
25. Environmental Science
26. Environmental Spills Science
27. Environmental Toxicology
28. Experimental Design
29. Fisheries Biology
30. Food Science
31. Forestry
32. Geography
33. Geological Engineering
34. Geology
35. Geomorphology
36. Geotechnical Engineering
37. Groundwater Chemistry
38. Hydraulic Engineering
39. Hydrogeology
40. Hydrology
41. Industrial Hygiene
42. Marine Biology
43. Mechanical Engineering
44. Meteorology
45. Occupational Medicine
46. Organic Chemistry
47. Pathology
48. Plant Ecology
49. Pollution Biology
50. Pollution Control
51. Project Engineering
52. Project Management
53. Public Health
54. Pulmonary Medicine
55. Resource Management
56. Risk Management
57. Quaternary Geology
58. Soil Chemistry
59. Soil Science
60. Toxicology
61. Veterinary Medicine
62. Waste Management
63. Water Quality
64. Zoology

2) Scientific Training

Respondents indicated that they possessed the following scientific training:

a)	Practical Experience	65.4%
b)	High School	53.3%
c)	Workshops/Seminars/Short Courses	63.6%
d)	Technical School	11.2%
e)	University College Level Courses	57.0%
f)	Bachelor's Degree	73.8%
g)	Master's Degree	58.9%
h)	Ph.D	39.3%
I)	Post-Doctoral	17.8%

3) Type Of Employment

Respondents indicated that they are involved in a variety of employment types:[12]

a)	Administrative Tribunal	0.9%
b)	Corporation	6.5%
c)	Government	34.6%
d)	Private Consultant	46.7%
e)	University/College	11.2%

4) Jurisdictions

The percentage of respondents who were involved in an environmental trial or other legal proceeding in one or more of the five jurisdictions included within the Research Survey is as follows:[13]

a)	Alberta	49.0%
b)	British Columbia	44.7%
c)	Ontario	25.9%
d)	Northwest Territories	8.2%
e)	Yukon Territory	9.4%

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12 Respondents indicated only one employment type per individual respondent. Therefore percentages should add up to 100%.

13 Some respondents indicated that they were involved in environmental trials or other legal proceedings in two or more of the five survey jurisdictions. Therefore percentages need not add up to 100%.

5) Experiences

Expert scientific witness respondents also indicated that they had a wide range in terms of numbers of experiences as either expert scientific witnesses, independent expert witnesses and/or scientific advisors at environmental trials and other legal proceedings. A total of 85 respondents indicated that they had participated " ... in a court trial (criminal, quasi-criminal or civil) or other legal proceeding (such as an injunction application or an application for judicial review of an administrative decision) in a matter involving an environmental issue". These 85 respondents participated as either expert scientific witnesses, independent expert scientific witnesses appointed by the courts, or acted as a scientific advisor (assisting legal counsel on scientific issues without actually appearing as an expert scientific witness), in the following numbers:

a) Expert Scientific Witnesses

No. Of Experiences	No. Of Respondents
1	20
2	12
3	13
4	7
5	5
6	1
10	10
20	5
25	1
30	1
35	1
Total 432	76

b) Independent Expert Witness

No. Of Experiences	No. Of Respondents
1	6
2	2
3	1
6	2
10	1
20	1
Total 55	13

c) Scientific Advisor

No. Of Experiences	No. Of Respondents
1	16
2	11
3	13
4	2
5	6
6	1
7	2
8	1
10	1
15	1
20	1
100	1
200	1
Total 488	57

In the unlikely event that those respondent groups which received lower response rates were not representative of their constituencies, it is submitted that the significance of the results obtained from the Research Survey would remain largely undiminished, in that the number of experiences of those persons who did respond are sufficient to justify the conclusion that problems do in fact exist, irrespective of the perceptions of the remainder of the populations within these constituencies. For example, the 88 legal counsel who indicated that they had experience at an environmental trial or other proceeding represented a combined total of 1636 experiences. The 85 expert scientific witnesses who have participated in the legal process have a total of 975 experiences. These numbers must be viewed in terms of the comparatively small number of environmental court cases and administrative hearings which occur in the Canadian jurisdictions surveyed in relation to the United States where such events are far more common.

3.5 Survey Questionnaires

Survey questionnaires for each of the three survey groups were developed and printed.

3.5.1 Questionnaire Design

Each of the survey questionnaires contained the following ten components:

1. Front cover;
2. Initial contact letter (inside front cover);
3. Instructions;
4. Preliminary question cluster;
5. Scientific information interface question cluster;
6. Communication and comprehension interface question cluster;
7. Scientific uncertainty interface question cluster;
8. Environmental standards interface question cluster;
9. Institutional/procedural interface question cluster; and
10. Instructions for return of survey questionnaire.

The survey questionnaires utilized a "cluster" design wherein questions relating to each of the five interfaces were grouped together, with each cluster preceded by brief comments in bold type which indicate the area of questioning which is to follow. Each question cluster was itself comprised of sub-clusters which address individual issues within the larger survey area. For example, the "quality of scientific information" interface question cluster included the following three question sub-clusters:

1. Quality and type of scientific information provided to environmental decision-making processes.

2. Screening of those persons qualified to provide scientific information in environmental decision-making processes.

3. Use of "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of scientific information.

Each question sub-cluster was itself preceded by a "filter question" wherein respondents were requested to provide their response to statements which suggest that problems exist with respect to a particular aspect of the use of scientific information in environmental decision-making. In order to maintain consistent question design throughout the survey questionnaires, a format was adopted whereby statements contained within filter questions provide subjects with five possible responses:

1) Strongly Agree
2) Agree
3) Undecided
4) Disagree
5) Strongly Disagree

Respondents who either Strongly Agreed, Agreed or were Undecided with respect to the statement in the filter question were requested to answer the remaining questions (referred to as "filtered questions") in the sub-cluster which probed the perceived problem in more detail. Those respondents who either Disagreed or Strongly Disagreed with the statement in the filter question moved immediately to the next question sub-cluster where they answered the next filter question. To assist subjects in understanding questions, most questions had key words underlined.

Questions which followed the filter question, (filtered questions) within each sub-cluster provided subjects with five possible responses:

1) Major Problem
2) Minor Problem
3) Not a Problem
4) Undecided/No Opinion
5) Unfamiliar with Concept

Finally, each sub-cluster of questions concluded with an open-ended question which asked respondents to provide any comments which they may have with respect to the issues raised in the sub-cluster.

As discussed above, research in this area has been primarily anecdotal, with little or no quantitative or qualitative research having been undertaken. Therefore, in designing questions for inclusion in the survey questionnaires it was not possible to employ questions with demonstrated statistical reliability and validity. However, the questions were designed to provide a high degree of "face validity" and "content validity". In order to ensure face validity a number of steps were taken:

1) Review of questionnaires by members of the University of Alberta Department of Sociology with extensive experience in population research.

2) Pre-testing of legal counsel and expert scientific witness questionnaires.

3) Including within all filtered questions a response option "Unfamiliar with Concept" to avoid responses based on uninformed speculation. This response option received a very low response rate.

4) Including at the end of all question clusters an opportunity to provide comments with respect to the issues raised in the cluster. These comments were taken into consideration when interpreting responses.

Content validity was achieved through the development of questionnaires which covered a wide range of issues relevant to the subject matter. Content was derived from a broad spectrum of sources, including:

1) Review of relevant literature in the British common law jurisdictions of Australia, Canada, Great Britain and the United States.

2) Personal interviews were conducted with representatives of each of the respondent groups who are considered by their respective professional communities to possess a high level of knowledge in the subject area.

3) Review of draft questionnaires was conducted by representatives from each of the respondent groups who are considered by their respective professional communities to possess a high level of knowledge in the subject area.

3.5.2 Review And Testing

Prior to distribution to survey participants, draft copies of each of the three survey questionnaire designs were forwarded to members of the judiciary, legal counsel and scientific/technical experts who have participated in environmental decision-making processes for their review and comments.

"Pre-testing" of the survey questionnaires was also conducted with members of the legal counsel and expert scientific witness respondent groups for the purpose of identifying technical weaknesses within these questionnaire designs. Pre-testing was not conducted on the questionnaire developed for the judiciary as the numbers of the judicial respondent group were sufficiently limited that it was considered impractical to reduce the number of potential respondents from this group through involvement in a pre-testing exercise.

3.5.3 Ethics Review

An ethics review for research on human subjects is required by both the University of British Columbia and the University of Alberta. As the survey questionnaires were distributed through the *Eco-Research* Chair at the University of Alberta, it was considered appropriate to apply for ethical review to the University of Alberta Faculty of Medicine Ethics Review Committee for Human Experimentation. A request for ethical review was submitted on March 4, 1994 and approval of the application was granted on March 18, 1994.

3.6 Confidentiality

A number of precautions were taken to ensure that all information provided in survey questionnaires was strictly confidential and that individual respondents could not be identified. These precautions included the following:

1) No person (including the author or advisory team) was to be able to attribute survey questionnaire responses to an identifiable respondent. Survey questionnaire identification numbers were located on the inside back cover of the questionnaires, and were used solely for the purpose of facilitating follow-up reminder correspondence to potential respondents who did not return the surveys within the allotted time. These identification numbers were immediately removed from returned survey questionnaires by a single designated *Eco-Chair* staff member, which questionnaires were stored in a secure area pending data entry.

2) Survey questionnaires were then forwarded to a University of Alberta Population Research Laboratory employee whose sole responsibility was entry of the raw data (responses) into the University of Alberta MTS computer system.

3) Data obtained from survey questionnaires completed and returned by members of the judiciary in Alberta, British Columbia, Ontario, the Northwest Territories and Yukon Territory was pooled together and considered as a single statistical unit. This precaution was taken to ensure that individual or small numbers of judicial respondents from a single jurisdiction such as the Northwest Territories or Yukon Territory could not be indirectly identified.

3.7 Data Transfer

With the assistance of the University of Alberta Population Research Laboratory raw data were processed by the University MTS computer program, and then transferred into a statistical computer program (Statistical Program for the Social Sciences (SPSS)) which, *inter alia*, correlates data and allows for comparison of results.

3.8 Data Analysis

Data generated by each of the three empirical studies were analysed for the purpose of comparison of perceptions between each of each of the four survey groups.

3.9 Statistical Significance of Research Data

A census approach rather than random sampling was used to identify potential respondents. Therefore statistical significance tests were considered inappropriate were not performed.

3.10 Validity of Research Data

When analysing the significance of the research data the following considerations should be kept in mind:

1) The research methodology employed a "double negative" system in the survey questionnaires whereby respondents were given two opportunities in each question cluster to indicate that problems did not exist. First, respondents who initially indicated in a filter question at the beginning of a question cluster that they did not perceive the existence of problems in a subject area were requested to skip the remainder of the questions in that cluster and to move ahead to the next cluster of questions. Second, respondents who indicated in a filter question that problems did exist or that they were undecided as to whether problems existed were requested to continue answering questions in that question cluster, which questions provided respondents with the opportunity to set out their perceptions with respect to the identity of those problems or to once again indicate that they did not perceive a problem to exist. This process was undertaken for 2 reasons:

   a) To minimize the possibility that respondents would be influenced by survey questions which suggested the existence of potential problems; and

   b) To allow respondents who believed that problems did not exist with respect to an issue considered by a question cluster to complete the questionnaire more quickly.

2) While procedures employed by courts with respect to the introduction of scientific information in environmental trials and other legal proceedings are relatively uniform across the 5 jurisdictions within which the Research Survey was conducted, the same can not be said for the procedures employed by administrative tribunals across those same jurisdictions. Most administrative tribunals across Canada are the masters of their own

procedures, and therefore procedures vary considerably across the country.[14] Consequently, while response data for administrative environmental hearings is expressed in percentages (for the purpose of consistency with the reporting of trial data) it is recommended that caution be exercised in seeing percentages as an indicator of the perceptions of an entire survey group with respect to a common set of administrative procedures. Rather it is recommended that such percentages be considered in terms of the significance of numbers of individual respondents who perceive problems to exist or not exist across a wide range of such procedures.

3) Research Survey data regarding the introduction of scientific information into environmental trials and other legal proceedings may be considered in at least two contexts. First, it may be seen in terms of percentages of respondents who share a particular perception (such as "X% of expert scientific witnesses perceived that factor Y constitutes a major problem"), with a high percentage of such responses suggesting that this perception is of significant concern whereas a lower percentage of such responses indicating that the perception may not be of concern. A second approach may be to consider the percentage of respondents who share a particular perception in the context of the number of "experiences" which those percentages represent. Thus, for example, if only "25% of expert scientific witnesses share a perception that factor Y constitutes a major problem", this may still be significant if those 25% of expert scientific witnesses share 250 trial experiences - a significant number of environmental trials in which problems were perceived to have occurred!

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[14] See discussion, *infra*.

Appendix 2

Quality of Scientific Information Introduced into Environmental Decision-Making Processes

Table 2

Problems With The Quality Of Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings with respect to the quality of scientific information provided in the form of expert evidence by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	5.6%	11.4%	10.6%	5.6 -11.4%
Agree	50.0%	47.7%	57.6%	47.7 - 57.6%
Undecided	27.8%	17.0%	18.8%	17.0 - 20.5%
Disagree	16.7%	20.5%	12.9%	12.9 - 20.5%
Strongly Disagree	0.0%	3.4%	0.0%	0.0 - 3.4%

Table 3

Problems With The Quality Of Scientific Information

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings with respect to the quality of scientific information provided in the form of expert evidence by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	12.7%	4.5%	11.4%	4.5 - 12.7%
Agree	49.2%	59.1%	67.1%	49.2 - 67.1%
Undecided	23.8%	10.6%	10.1%	10.1 - 23.8%
Disagree	14.3%	19.7%	11.4%	11.4 - 19.7%
Strongly Disagree	0.0%	6.1%	0.0%	0.0 - 6.1%

Table 4

Inadequate Understanding of Environmental Decision-Making Processes*

(Environmental Trials and Other Legal Proceedings)

"Inadequate understanding by expert scientific witness of the trial or other legal proceeding in which they are participating"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	26.7% (22.2%)	15.2% (11.5%)	20.3% (17.6%)	15.2 - 26.7% (11.5 - 22.2%)
Minor Problem	46.7% (38.9)%	62.1% (47.2%)	41.9% (36.4%)	41.9 - 62.1% (36.4 - 47.2%)
Not a Problem	26.7% (22.2%)	15.2% (11.5%)	29.7% (25.8%)	15.2 - 29.7% (11.5 - 25.8%)
Undecided/ No Opinion	0.0% (0.0%)	7.6% (5.7%)	8.1% (7.0%)	0.0 - 8.1% (0.0 - 7.0%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 5

Inadequate Understanding of Environmental Decision-Making Processes*

(Administrative Environmental Hearings)

"Inadequate understanding by expert scientific witnesses of the administrative environmental hearing process in which they are participating"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	9.3% (7.9%)	10.2% (7.5%)	10.0% (8.8%)	9.3 - 10.2% (7.5 - 8.8%)
Minor Problem	55.6% (47.6%)	55.1% (40.8%)	51.4% (45.5%)	51.4 - 55.6% (40.8 - 47.6%)
Not a Problem	31.5% (26.9%)	30.6% (22.7%)	32.9% (29.1%)	30.6 - 32.9% (22.7 - 29.1%)
Undecided/ No Opinion	3.7% (3.1%)	4.1% (3.0%)	5.7% (5.0%)	3.7 - 5.7% (3.0 - 5.0%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 6

Adversarial System*

(Environmental Trials and Other Legal Proceedings)

"The inability of expert scientific witnesses to function effectively within the adversarial system used in environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	6.7% (5.5%)	22.7% (17.2%)	34.2% (29.7%)	6.7 - 34.2% (5.5 - 29.7%)
Minor Problem	46.7% (38.9%)	54.5% (41.4%)	41.1% (35.7%)	41.1 - 54.5% (35.7 - 41.4%)
Not a Problem	53.3% (44.3%)	18.2% (13.8%)	16.4% (14.2%)	16.4 - 53.3% (13.8 - 44.3%)
Undecided/ No Opinion	0.0% (0.0%)	3.0% (2.2%)	8.2% (7.1%)	0.0 - 8.2% (0.0 - 7.1%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.1%)	0.0% (0.0%)	0.0 -1.5% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 7

Adversarial System*

(Administrative Environmental Hearings)

"The inability of expert scientific witnesses to function effectively within the adversarial system used in administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	22.2% (19.0%)	14.3% (10.6%)	32.9% (29.1%)	14.3 - 32.9% (10.6 - 29.1%)
Minor Problem	46.3% (39.6%)	63.3% (46.9%)	48.6% (43.0%)	46.3 - 63.3% (39.6 - 46.9%)
Not a Problem	27.8% (23.8%)	20.4% (15.1%)	14.3% (12.6%)	14.3 - 27.8% (12.6 - 23.8%)
Undecided/ No Opinion	3.7% (3.1%)	2.0% (1.4%)	4.3% (3.8%)	2.0 - 4.3% (1.4 - 3.8%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 8

Competitiveness Factor*

(Environmental Trials and Other Legal Proceedings)

"A competitiveness factor, wherein expert scientific witnesses are motivated to attempt to "win" environmental trials and other legal proceedings and "defeat" opposing parties (and their expert scientific witnesses) involved in the litigation"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	33.3% (27.8%)	24.2% (15.8%)	29.7% (20.6%)	24.2 - 33.3% (15.8 - 27.8%)
Minor Problem	46.7% (38.9%)	53.0% (34.7%)	48.6% (33.6%)	46.7 - 53.0% (33.6 - 38.9%)
Not a Problem	13.3% (27.8%)	15.2% (43.6%)	12.2% (47.6%)	12.2 - 15.2% (27.8 - 47.6%)
Undecided/ No Opinion	6.7% (5.6%)	6.1% (4.0%)	9.5% (6.5%)	6.1 - 9.5% (4.0 - 6.5%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.0%)	0.0% (0.0%)	0.0 - 1.5% (0.0 - 1.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 9

Competitiveness Factor*

(Administrative Environmental Hearings)

"A competitiveness factor, wherein expert scientific witnesses are motivated to attempt to "win" administrative environmental hearings and "defeat" opposing parties (and their expert scientific witnesses) involved in the hearing"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	33.3% (28.5%)	24.5% (18.1%)	35.7% (31.6%)	24.5 - 35.7% (18.1 - 31.6%)
Minor Problem	42.6% (36.5%)	51.0% (37.8%)	42.9% (38.0%)	42.6 - 51.0% (36.5 - 38.0%)
Not a Problem	20.4% (17.4%)	18.4% (13.6%)	18.6% (16.4%)	18.4 - 20.4% (13.6 - 17.4%)
Undecided/ No Opinion	3.7% (3.1%)	6.1% (4.5%)	2.9% (2.5%)	2.9 - 6.1% (2.5 - 4.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 10

Psychological Stress*

(Environmental Trials and Other Legal Proceedings)

"The inability of expert scientific witnesses to deal with the psychological stresses associated with environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	13.3% (11.0%)	7.7% (5.8%)	6.8% (5.9%)	6.8 - 13.3% (5.8 - 11.0%)
Minor Problem	46.7% (38.9%)	44.6% (33.9%)	56.8% (49.4%)	44.6 - 56.8% (33.9 - 49.4%)
Not a Problem	0.0% (0.0%)	40.0% (30.4%)	20.3% (17.6%)	0.0 - 40.0% (0.0 - 30.4%)
Undecided/ No Opinion	33.3% (27.7%)	6.2% (4.7%)	16.2% (14.1%)	6.2 - 33.3% (4.7 - 27.7%)
Unfamiliar With Concept	6.7% (5.5%)	1.5% (1.1%)	0.0% (0.0%)	0.0 - 6.7% (0.0 - 5.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 11

Psychological Stress*

(Administrative Environmental Hearings)

"The inability of expert scientific witnesses to deal with the psychological stresses associated with administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	5.6% (4.7%)	6.3% (4.6%)	10.0% (8.8%)	5.6 - 10.0% (4.6 - 8.8%)
Minor Problem	20.4% (17.4%)	27.1% (20.1%)	55.7% (49.3%)	20.4 - 55.7% (17.4 - 49.3%)
Not a Problem	68.5% (58.7%)	60.4% (44.8%)	28.6% (25.3%)	28.6 - 68.5% (25.3 - 58.7%)
Undecided/ No Opinion	5.6% (4.7%)	6.3% (4.6%)	5.7% (5.0%)	5.6 - 6.3% (4.6 - 5.0%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 12

Validation of Scientific Theories or Models

(Environmental Trials and Other Legal Proceedings)

"A desire by expert scientific witnesses to have specific scientific theories or models validated/recognized by the courts"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	13.3% (11.0%)	13.6% (10.3%)	12.2% (10.6%)	12.2 - 13.6% (10.3 - 11.0%)
Minor Problem	40.0% (33.3%)	45.5% (34.6%)	35.1% (30.5%)	35.1 - 45.5% (30.5 - 34.6%)
Not a Problem	40.0% (33.3%)	21.2% (16.1%)	31.1% (27.0%)	21.2 - 40.0% (16.1 - 33.3%)
Undecided/ No Opinion	6.7% (5.5%)	16.7% (12.7%)	21.6% (18.8%)	6.7 - 21.6% (5.5 - 18.8%)
Unfamiliar With Concept	0.0% (0.0%)	3.0% (2.2%)	0.0% (0.0%)	0.0 - 3.0% (0.0 - 2.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 13

Validation of Scientific Theories or Models*

(Administrative Environmental Hearings)

"A desire by expert scientific witnesses to have specific scientific theories or models validated/recognized by administrative decision-making bodies"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	18.5% (15.8%)	8.2% (6.0%)	10.0% (8.8%)	8.2 - 18.5% (6.0 - 15.8%)
Minor Problem	48.1% (41.2%)	46.9% (34.7%)	48.6% (43.0%)	46.9 - 48.6% (34.7 - 43.0%)
Not a Problem	24.1% (20.6%)	40.8% (30.2%)	31.4% (27.8%)	24.1 - 40.8% (20.6 - 30.2%)
Undecided/ No Opinion	9.3% (7.9%)	4.1% (3.0%)	10.0% (8.8%)	4.1 - 10.0% (3.0 - 8.8%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 14

Overconfidence in Ability of Science to Resolve Environmental Issues*

(Environmental Trials and Other Legal Proceedings)

"An underlying belief by expert scientific witnesses that 'any environmental problem can be overcome' through application of scientific knowledge"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	20.0% (16.6%)	12.1% (9.2%)	12.2% (10.6%)	12.1 - 20.0% (9.2 - 16.6%)
Minor Problem	26.7% (22.2%)	30.3% (23.0%)	29.7% (25.8%)	26.7 - 30.3% (22.2 - 25.8%)
Not a Problem	0.0% (0.0%)	33.3% (25.3%)	45.9% (39.9%)	0.0 - 45.9% (0.0 - 39.9%)
Undecided/ No Opinion	46.7% (38.9%)	22.7% (17.2%)	10.8% (9.4%)	10.8 - 46.7% (9.4 - 38.9%)
Unfamiliar With Concept	6.7% (5.5%)	1.5% (1.1%)	1.4% (1.2%)	1.4 - 6.7% (1.1 - 5.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 15

Overconfidence in Ability of Science to Resolve Environmental Issues*

(Administrative Environmental Hearings)

"An underlying belief by expert scientific witnesses that 'any environmental problem can be overcome' through application of scientific knowledge"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	20.4% (17.4%)	18.4% (13.6%)	15.7% (13.9%)	15.7 - 20.4% (13.6 - 17.4%)
Minor Problem	38.9% (33.3%)	38.8% (28.7%)	31.4% (27.8%)	31.4 - 38.9% (27.8 - 33.3%)
Not a Problem	29.6% (25.3%)	32.7% (24.2%)	44.3% (39.2%)	29.6 - 44.3% (24.2 - 39.2%)
Undecided/ No Opinion	11.1% (9.5%)	8.2% (6.0%)	8.6% (7.6%)	8.2 - 11.1% (6.0 - 9.5%)
Unfamiliar With Concept	0.0% (0.0%)	2.0% (1.4%)	0.0% (0.0%)	0.0 - 2.0% (0.0 - 1.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 16

Compartmentalization of Roles Played by Expert Scientific Witnesses*

(Environmental Trials and Other Legal Processes)

The "compartmentalization" of the roles played by expert scientific witnesses in environmental trials and other legal proceedings, wherein expert scientific witnesses provide scientific evidence within their areas of expertise without a full appreciation of the factual and scientific context of the trial or other legal proceeding in which they are participating"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	20.0% (16.7%)	20.9% (13.9%)	31.1% (21.5%)	20.0 - 31.1% (13.9 - 21.5%)
Minor Problem	33.3% (27.8%)	47.8% (31.7%)	41.9% (29.0%)	33.3 - 47.8% (27.8 - 31.7%)
Not a Problem	26.7% (22.2%)	23.9% (18.2%)	16.2% (14.0%)	16.2 - 26.7% (14.0 - 22.2%)
Undecided/ No Opinion	20.0% (16.7%)	6.0% (4.0%)	10.8% (7.5%)	6.0 - 20.0% (4.0 - 16.7%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.0%)	0.0% (0.0%)	0.0 - 1.5% (0.0 - 1.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 17

Compartmentalization of Roles Played by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

The "compartmentalization" of the roles played by expert scientific witnesses in administrative environmental hearings, wherein expert scientific witnesses provide scientific evidence within their areas of expertise without a full appreciation of the factual and scientific context of the hearing in which they are participating"

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	27.8% (23.8%)	12.2% (9.0%)	28.6% (25.3%)	12.2 - 28.6% (9.0 - 25.3%)
Minor Problem	40.7% (34.8%)	51.0% (37.8%)	44.3% (39.2%)	40.7 - 51.0% (34.8 - 39.2%)
Not a Problem	25.9% (22.1%)	32.7% (24.2%)	21.4% (18.9%)	21.4 - 32.7% (18.9 - 24.2%)
Undecided/ No Opinion	5.6% (4.7%)	4.1% (3.0%)	4.3% (3.8%)	4.1 - 5.6% (3.0 - 4.7%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.4% (1.2%)	0.0 - 1.4% (0.0 -1.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 18

Influence from Legal Counsel*

(Environmental Trials and Other Legal Proceedings)

"Influence from legal counsel in the preparation of expert scientific witnesses prior to giving evidence at environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	33.3% (27.7%)	23.9% (18.1%)	14.9% (12.9%)	14.9 - 33.3% (12.9 - 27.7%)
Minor Problem	33.3% (27.7%)	41.8% (31.8%)	32.4% (28.2%)	32.4 - 41.8% (27.7 - 31.8%)
Not a Problem	26.7% (22.2%)	28.4% (21.6%)	39.2% (34.1%)	26.7 - 39.2% (21.6 - 34.1%)
Undecided/ No Opinion	6.7% (5.5%)	4.5% (3.4%)	12.2% (10.6%)	4.5 - 12.2% (3.4 - 10.6%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.1%)	1.4% (1.2%)	0.0 - 1.5% (0.0 - 1.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 19

Influence from Legal Counsel*

(Administrative Environmental Hearings)

"Influence from legal counsel in the preparation of expert scientific witnesses prior to giving evidence at administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	25.9% (22.1%)	18.4% (13.6%)	14.3% (12.6%)	14.3 - 25.9% (12.6 - 22.1%)
Minor Problem	31.5% (26.9%)	42.9% (31.8%)	42.9% (38.0%)	31.5 - 42.9% (26.9 - 38.0%)
Not a Problem	27.8% (23.8%)	34.7% (25.7%)	37.1% (32.8%)	27.8 - 37.1% (23.8 - 32.8%)
Undecided/ No Opinion	11.1% (9.5%)	4.1% (3.0%)	5.7% (5.0%)	4.1 - 11.1% (3.0 - 9.5%)
Unfamiliar With Concept	3.7% (3.1%)	0.0% (0.0%)	0.0% (0.0%)	0.0 -3.7% (0.0 - 3.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 20

Influence from Scientific Advisors*

(Environmental Trials and Other Legal Proceedings)

"Influence from scientific advisors retained to assist legal counsel in the preparation of expert scientific witnesses prior to these witnesses giving evidence at environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	13.3% (11.0%)	3.0% (2.2%)	2.7% (2.3%)	2.7 - 13.3% (2.2 - 11.0%)
Minor Problem	13.3% (11.0%)	28.4% (21.6%)	23.0% (20.0%)	13.3 - 28.4% (11.0 - 21.6%)
Not a Problem	33.3% (27.7%)	49.3% (37.5%)	40.5% (35.2%)	33.3 - 49.3% (27.7 - 37.5%)
Undecided/ No Opinion	40.0% (33.3%)	16.4% (12.4%)	27.0% (23.5%)	16.4 - 40.0% (12.4 - 33.3%)
Unfamiliar With Concept	0.0% (0.0%)	3.0% (2.2%)	6.8% (5.9%)	0.0 - 6.8% (0.0 - 5.9%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 21

Influence from Scientific Advisors*

(Administrative Environmental Hearings)

"Influence from scientific advisors retained to assist legal counsel in the preparation of expert scientific witnesses prior to these witnesses giving evidence at administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	7.4% (6.3%)	2.0% (1.4%)	1.4% (1.2%)	1.4 - 7.4% (1.2 - 6.3%)
Minor Problem	18.5% (15.8%)	24.5% (18.1%)	28.6% (25.3%)	18.5 - 28.6% (15.8 - 25.3%)
Not a Problem	44.4% (38.0%)	59.2% (43.9%)	40.0% (35.4%)	40.0 - 59.2% (35.4 - 43.9%)
Undecided/ No Opinion	22.2% (19.0%)	14.3% (10.6%)	21.4% (18.9%)	14.3 - 22.2% (10.6 - 19.0%)
Unfamiliar With Concept	7.4% (6.3%)	0.0% (0.0%)	8.6% (7.6%)	0.0 - 8.6% (0.0 - 7.6%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 22

Influence from the Audience*

(Environmental Trials and Other Legal Proceedings)

"Influence from the audience observing environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	0.0% (0.0%)	1.5% (1.1%)	2.7% (2.3%)	0.0 - 2.7% (0.0 - 2.3%)
Minor Problem	13.3% (11.0%)	16.4% (12.4%)	10.8% (9.4%)	10.8 - 16.4% (9.4 - 12.4%)
Not a Problem	80.0% (66.6%)	71.6% (54.4%)	71.6% (62.3%)	71.6 - 80.0% (54.4 - 66.6%)
Undecided/ No Opinion	6.7% (5.5%)	7.5% (5.7%)	13.5% (11.7%)	6.7 - 13.5% (5.5 - 11.7%)
Unfamiliar With Concept	0.0% (0.0%)	3.0% (2.2%)	1.4% (1.2%)	0.0 - 3.0% (0.0 - 2.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 23

Influence from the Audience*

(Administrative Environmental Hearings)

"Influence from the audience observing administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	7.4% (6.3%)	2.0% (1.4%)	5.7% (5.0%)	2.0 - 7.4% (1.4 - 6.3%)
Minor Problem	18.5% (15.8%)	12.2% (9.0%)	24.3% (21.5%)	12.2 - 24.3% (9.0 - 21.5%)
Not a Problem	70.4% (60.3%)	77.6% (57.5%)	61.4% (54.4%)	61.4 - 77.6% (54.4 - 60.3%)
Undecided/ No Opinion	3.7% (3.1%)	6.1% (4.5%)	8.6% (7.6%)	3.7 - 8.6% (3.1 - 7.6%)
Unfamiliar With Concept	0.0% (0.0%)	2.0% (1.4%)	0.0% (0.0%)	0.0 - 2.0% (0.0 - 1.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 24

Influence from the Media

(Environmental Trials and Other Legal Proceedings)

"Influence from the media (including television, radio, newspapers, etc.)"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	0.0% (0.0%)	10.6% (8.0%)	5.4% (4.7%)	0.0 - 10.6% (0.0 - 8.0%)
Minor Problem	26.7% (22.2%)	27.3% (20.7%)	27.0% (23.5%)	26.7 - 27.3% (20.7 - 23.5%)
Not a Problem	60.0% (49.9%)	47.0% (35.7%)	55.4% (48.2%)	47.0 - 60.0% (35.7 - 49.9%)
Undecided/ No Opinion	13.3% (11.4%)	13.6% (10.3%)	10.8% (9.4%)	10.8 - 13.6% (9.4 - 11.4%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.1%)	1.4% (1.2%)	0.0 - 1.5% (0.0 -1.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 25

Influence from the Media

(Administrative Environmental Hearings)

"Influence from the media (including television, radio, newspapers, etc."				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	11.1% (9.5%)	4.1% (3.0%)	11.4% (10.1%)	4.1 - 11.4% (3.0 - 10.1%)
Minor Problem	27.8% (23.8%)	22.4% (16.6%)	32.9% (29.1%)	22.4 - 32.9% (16.6 - 29.1%)
Not a Problem	50.0% (42.8%)	65.3% (48.4%)	45.7% (40.4%)	45.7 - 65.3% (40.4 - 48.4%)
Undecided/ No Opinion	11.1% (9.5%)	6.1% (4.5%)	10.0% (8.8%)	6.1 - 11.1% (4.5 - 9.5%)
Unfamiliar With Concept	0.0% (0.0%)	2.0% (1.4%)	0.0% (0.0%)	0.0 - 2.0% (0.0 - 1.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 26

Primary Role of Expert Scientific Witnesses

(Environmental Trials and Other Legal Proceedings)

"*Perception of the primary role(s) of expert witnesses in giving expert scientific evidence at environmental trials and other legal proceedings*"				
Primary Role	Judges	Legal Counsel	Expert Scientific Witnesses	Range
To Assist The Party To The Litigation Who Retains Their Services	31.3%	48.3%	28.2%	28.2 - 48.4%
To Assist Legal Counsel Who Retains Their Services On Behalf Of A Client	37.5%	44.8%	32.1%	32.1 - 44.8%
To Assist The Court	55.6%	57.5%	58.0%	55.6 - 58.0%
To Assist No One, Only To Provide Scientific Information To Everyone Involved In The Litigation	46.7%	5.8%	42.9%	5.8 - 46.7%

Table 27

Primary Role Of Expert Scientific Witnesses

(Administrative Environmental Hearings)

"Perception of the primary role(s) of expert witnesses in giving expert scientific evidence at administrative environmental hearings"				
Primary Role	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
To Assist The Party To The Litigation Who Retains Their Services	54.2%	61.5%	35.9%	35.9 - 61.5%
To Assist Legal Counsel Who Retains Their Services On Behalf Of A Client	30.0%	49.2%	20.5%	20.5 - 49.2%
To Assist The Administrative Tribunal	53.3%	64.6%	60.8%	53.3 - 64.6%
To Assist No One, Only To Provide Scientific Information To Everyone Involved In The Litigation	35.6%	4.8%	45.5%	4.8 - 45.5%

Table 28

Secondary Role of Expert Witnesses

(Environmental Trials and Other Legal Proceedings)

"Perception of the secondary role(s) of expert witnesses in giving expert scientific evidence at environmental trials and other legal proceedings"				
Primary Role	Judges	Legal Counsel	Expert Scientific Witnesses	Range
To Assist The Party To The Litigation Who Retains Their Services	25.0%	41.4%	34.6%	25.0 - 41.4%
To Assist Legal Counsel Who Retains Their Services On Behalf Of A Client	25.0%	49.4%	43.6%	25.0 - 49.4%
To Assist The Court	18.8%	34.5%	33.3%	18.8 - 34.5%
To Assist No One, Only To Provide Scientific Information To Everyone Involved In The Litigation	20.0%	16.3%	19.5%	16.3 - 20.0%

Table 29

Secondary Role of Expert Witnesses

(Administrative Environmental Hearings)

"Perception of the secondary role(s) of expert witnesses in giving expert scientific evidence at environmental trials and other legal proceedings"				
Primary Role	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
To Assist The Party To The Litigation Who Retains Their Services	23.7%	30.8%	37.2%	23.7 - 37.2%
To Assist Legal Counsel Who Retains Their Services On Behalf Of A Client	43.3%	47.7%	59.0%	43.3 - 59.0%
To Assist The Administrative Tribunal	33.3%	29.2%	29.1%	29.1 - 33.3%
To Assist No One, Only To Provide Scientific Information To Everyone Involved In The Litigation	23.7%	20.6%	24.7%	20.6 - 24.7%

Table 30

Not the Role of Expert Witnesses

(Environmental Trials and Other Legal Proceedings)

"Perception of the secondary role(s) of expert witnesses in giving expert scientific evidence at environmental trials and other legal proceedings"				
Primary Role	Judges	Legal Counsel	Expert Scientific Witnesses	Range
To Assist The Party To The Litigation Who Retains Their Services	43.8%	10.3%	37.2%	10.3 - 43.8%
To Assist Legal Counsel Who Retains Their Services On Behalf Of A Client	37.5%	5.7%	24.4%	5.7 - 37.5%
To Assist The Court	18.8%	8.0%	8.6%	8.0 - 18.8%
To Assist No One, Only To Provide Scientific Information To Everyone Involved In The Litigation	33.3%	77.9%	37.7%	33.3 - 77.9%

Table 31

Not the Role of Expert Witnesses

(Administrative Environmental Hearings)

"Perception of the secondary role(s) of expert witnesses in giving expert scientific evidence at environmental trials and other legal proceedings"				
Primary Role	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
To Assist The Party To The Litigation Who Retains Their Services	22.0%	7.7%	26.9%	7.7 - 26.9%
To Assist Legal Counsel Who Retains Their Services On Behalf Of A Client	26.7%	3.1%	20.5%	3.1 - 26.7%
To Assist The Administrative Tribunal	13.3%	6.2%	10.1%	6.2 - 13.3%
To Assist No One, Only To Provide Scientific Information To Everyone Involved In The Litigation	40.7%	74.6%	29.9%	29.9 - 74.6%

Table 32

Problems with the Screening of Those Persons Qualified to Provide Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings with respect to the screening by the courts of those persons who are qualified to provide the courts with scientific information as expert witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	0.0%	9.1%	3.5%	0.0 - 9.1%
Agree	22.2%	22.7%	41.2%	22.2 - 41.2%
Undecided	16.7%	19.3%	31.8%	16.7 - 31.8%
Disagree	55.6%	47.7%	22.4%	22.4 - 55.6%
Strongly Disagree	5.6%	1.1%	1.2%	1.1 - 5.6%

Table 33

Problems with the Screening of Those Persons Qualified to Provide Scientific Information

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings with respect to the screening by administrative tribunals of those persons who are qualified to provide tribunals with scientific information as expert witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	1.6%	9.1%	6.3%	1.6 - 9.1%
Agree	24.2%	25.8%	50.6%	24.2 - 50.6%
Undecided	21.0%	9.1%	20.3%	9.1 - 21.0%
Disagree	48.4%	54.5%	19.0%	19.0 - 54.5%
Strongly Disagree	4.8%	1.5%	3.8%	1.5 - 4.8%

Table 34

Qualification Procedures*

(Environmental Trials and Other Legal Proceedings)

"The 'qualification' procedures which are employed by the courts in qualifying witnesses to give scientific evidence as expert witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	0.0% (0.0%)	24.4% (12.4%)	24.6% (18.8%)	0.0 -24.6% (0.0 - 18.8%)
Minor Problem	42.9% (16.6%)	44.4% (22.6%)	35.4% (27.0%)	35.4 - 44.4% (16.6 - 27.0%)
Not a Problem	57.1% (22.2%)	15.6% (7.9%)	24.6% (18.8%)	15.6 - 57.1% (7.9 - 22.2%)
Undecided/ No Opinion	0.0% (0.0%)	13.3% (6.7%)	10.8% (8.2%)	0.0 - 13.3% (0.0 - 8.2%)
Unfamiliar With Concept	0.0% (0.0%)	2.2% (1.1%)	4.6% (3.5%)	0.0 - 4.6% (0.0 - 3.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 35

Qualification Procedures*

(Administrative Environmental Hearings)

"In situations where administrative tribunals do 'screen' witnesses prior to giving scientific evidence as expert witnesses, the 'qualification procedures which are employed by administrative tribunals"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	7.1% (3.3%)	31.0% (13.6%)	13.1% (10.1%)	7.1 - 31.0% (3.3 - 13.6%)
Minor Problem	35.7% (16.7%)	41.4% (18.2%)	39.3% (30.3%)	35.7 - 41.4% (16.7 - 30.3%)
Not a Problem	14.3% (6.6%)	17.2% (7.5%)	11.5% (8.8%)	11.5 - 17.2% (6.6 - 8.8%)
Undecided/ No Opinion	25.0% (11.7%)	6.9% (3.0%)	14.8% (11.4%)	6.9 - 25.0% (3.0 - 11.7%)
Unfamiliar With Concept	17.9% (8.3%)	3.4% (1.4%)	21.3% (16.4%)	3.4 - 21.3% (1.4 - 16.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 36

Defining Areas of Expertise*

(Environmental Trials and Other Legal Proceedings)

"Failure of the courts to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.6% (11.1%)	35.6% (18.1%)	20.0% (15.3%)	20.0 - 35.6% (11.1 - 18.1%)
Minor Problem	42.9% (16.6%)	37.8% (19.3%)	49.2% (37.6%)	37.8 - 49.2% (16.6 - 37.6%)
Not a Problem	28.6% (11.1%)	11.1% (5.6%)	18.5% (14.1%)	11.1 - 28.6% (5.6 - 14.1%)
Undecided/ No Opinion	0.0% (0.0%)	13.3% (6.7%)	10.8% (8.2%)	0.0 - 13.3% (0.0 - 8.2%)
Unfamiliar With Concept	0.0% (0.0%)	2.2% (1.1%)	1.5% (1.1%)	0.0 - 2.2% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 37

Defining Areas of Expertise*

(Administrative Environmental Hearings)

"Failure of administrative tribunals to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	24.1% (11.2%)	41.4% (18.2%)	37.7% (29.1%)	24.1 - 41.4% (11.2 - 29.1%)
Minor Problem	37.9% (17.7%)	55.2% (24.2%)	37.7% (29.1%)	37.7 - 55.2% (17.7 - 29.1%)
Not a Problem	13.8% (6.4%)	3.4% (1.4%)	9.8% (7.5%)	3.4 - 13.8% (1.4 - 7.5%)
Undecided/ No Opinion	24.1% (11.2%)	0.0% (0.0%)	9.8% (7.5%)	0.0 - 24.1% (0.0 - 11.2%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	4.9% (3.7%)	0.0 - 4.9% (0.0 - 3.7%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 38

Limiting Scientific Evidence to Defined Areas of Expertise*

(Environmental Trials and Other Legal Proceedings)

"Failure of the courts to limit the scientific evidence provided by expert witnesses to those defined areas of expertise in which they are qualified to give expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.6% (11.1%)	35.6% (18.1%)	20.0% (15.3%)	20.0 - 35.6% (11.1 - 18.1%)
Minor Problem	57.1% (22.2%)	35.6% (18.1%)	50.8% (38.8%)	35.6 - 57.1% (18.1 - 38.8%)
Not a Problem	14.3% (5.5%)	13.3% (6.7%)	20.0% (15.3%)	13.3 - 20.0% (5.5 - 15.3%)
Undecided/ No Opinion	0.0% (0.0%)	13.3% (6.7%)	7.7% (5.8%)	0.0 - 13.3% (0.0 - 6.7%)
Unfamiliar With Concept	0.0% (0.0%)	2.2% (1.1%)	1.5% (1.1%)	0.0 - 2.2% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 39

Limiting Scientific Evidence to Defined Areas of Expertise*

(Administrative Environmental Hearings)

"Failure of administrative tribunals to limit the scientific evidence provided by expert witnesses to those defined areas of expertise in which they are qualified to give expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	17.2% (8.0%)	48.3% (21.2%)	39.3% (30.3%)	17.2 - 48.3% (8.0 - 30.0%)
Minor Problem	44.8% (20.9%)	48.3% (21.2%)	41.0% (31.6%)	41.0 - 48.3% (20.9 - 31.6%)
Not a Problem	13.8% (6.4%)	3.4% (1.4%)	9.8% (7.5%)	3.4 - 13.8% (1.4 - 7.5%)
Undecided/ No Opinion	24.1% (11.2%)	0.0% (0.0%)	6.6% (5.0%)	0.0 - 24.1% (0.0 - 11.2%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	3.3% (2.5%)	0.0 - 3.3% (0.0 - 2.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 40

Verification of Qualifications of Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"Verification by the courts of the qualifications of witnesses to give expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	14.3% (5.5%)	18.2% (9.3%)	21.5% (16.4%)	14.3 - 21.5% (5.5 - 16.4%)
Minor Problem	42.9% (16.6%)	31.8% (16.2%)	41.5% (31.7%)	31.8 - 42.9% (16.2 - 31.7%)
Not a Problem	42.9% (16.6%)	27.3% (13.9%)	24.6% (18.8%)	24.6 - 42.9% (13.9 - 18.8%)
Undecided/ No Opinion	0.0% (0.0%)	20.5% (10.4%)	7.7% (5.8%)	0.0 - 20.5% (0.0 - 10.4%)
Unfamiliar With Concept	0.0% (0.0%)	2.3% (1.1%)	4.6% (3.5%)	0.0 - 4.6% (0.0 - 3.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 41

Verification of Qualifications of Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Verification by administrative tribunals of the qualifications of witnesses to give expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	10.7% (5.0%)	10.7% (4.7%)	23.0% (17.7%)	10.7 - 23.0% (4.7 - 17.7%)
Minor Problem	39.3% (18.3%)	39.3% (17.2%)	42.6% (32.8%)	39.3 - 42.6% (17.2 - 32.8%)
Not a Problem	25.0% (11.7%)	46.4% (20.4%)	18.0% (13.8%)	18.0 - 46.4% (11.7 - 20.4%)
Undecided/ No Opinion	21.4% (10.0%)	3.6% (1.5%)	9.8% (7.5%)	3.6 - 21.4% (1.5 - 10.0%)
Unfamiliar With Concept	3.6% (1.6%)	0.0% (0.0%)	6.6% (5.0%)	0.0 - 6.6% (0.0 - 5.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 42

Distinguishing Between the Qualifications of Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"Distinguishing between the qualifications of expert scientific witnesses in situations where two or more experts in the same field give expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.6% (11.1%)	26.7% (13.6%)	26.2% (20.0%)	26.2 - 28.6% (11.1 - 20.0%)
Minor Problem	14.3% (5.5%)	35.6% (18.1%)	46.2% (35.3%)	14.3 - 46.2% (5.5 -35.3%)
Not a Problem	57.1% (22.2%)	20.0% (10.2%)	15.4% (11.7%)	15.4 - 57.1% (10.2 - 22.2%)
Undecided/ No Opinion	0.0% (0.0%)	13.3% (6.7%)	10.8% (8.2%)	0.0 - 13.3% (0.0 - 8.2%)
Unfamiliar With Concept	0.0% (0.0%)	4.4% (2.2%)	1.5% (1.1%)	0.0 - 4.4% (0.0 - 2.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 43

Distinguishing Between the Qualifications of Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Distinguishing between the qualifications of expert scientific witnesses in situations where two or more experts in the same field give expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	27.6% (12.9%)	31.0% (13.6%)	32.8% (25.3%)	27.6 - 32.8% (12.9 - 25.3%)
Minor Problem	31.0% (14.5%)	55.2% (24.2%)	42.6% (32.8%)	31.0 - 55.2% (14.5 - 32.8%)
Not a Problem	24.1% (11.2%)	13.8% (6.0%)	11.5% (8.8%)	11.5 - 24.1% (6.0 - 11.2%)
Undecided/ No Opinion	13.8% (6.4%)	0.0% (0.0%)	9.8% (7.5%)	0.0 - 13.8% (0.0 - 7.5%)
Unfamiliar With Concept	3.4% (1.5%)	0.0% (0.0%)	3.3% (2.5%)	0.0 - 3.4% (0.0 - 2.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 44

Problems With Respect to the Use of Traditional Knowledge

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings with respect to the use of "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	11.1%	11.5%	11.9%	11.1 - 11.9%
Agree	27.8%	27.6%	23.8%	23.8 - 27.8%
Undecided	50.0%	39.1%	51.2%	39.1 - 50.0%
Disagree	11.1%	21.8%	13.1%	11.1 - 21.8%
Strongly Disagree	0.0%	0.0%	0.0%	0.0%

Table 45

Problems With Respect to the Use of Traditional Knowledge

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings with respect to the use of "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	8.1%	10.6%	11.4%	8.1 - 11.4%
Agree	30.6%	27.3%	44.3%	27.3 - 44.3%
Undecided	33.9%	27.3%	26.6%	26.6 - 33.9%
Disagree	25.8%	33.3%	17.7%	17.7 - 33.3%
Strongly Disagree	1.6%	1.5%	0.0%	0.0 - 1.6%

Table 46

Willingness of Courts to Accept "Local Knowledge/Traditional Knowledge"*

(Environmental Trials and Other Legal Proceedings)

"The willingness of the courts to accept "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	6.3% (5.6%)	14.7% (11.5%)	21.1% (18.3%)	6.3 - 21.1% (5.6 - 18.3%)
Minor Problem	12.5% (11.1%)	27.9% (21.8%)	21.1% (18.3%)	12.5 - 27.9% (11.1 - 21.8%)
Not a Problem	37.5% (33.3%)	19.1% (14.9%)	9.9% (8.6%)	9.9 - 37.5% (8.6 - 33.3%)
Undecided/ No Opinion	12.5% (11.1%)	29.4% (22.9%)	38.0% (33.0%)	12.5 - 38.0% (11.1 - 33.0%)
Unfamiliar With Concept	31.3% (27.8%)	8.8% (6.8%)	9.9% (8.6%)	8.8 - 31.8% (6.8 - 27.8%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 47

Willingness of Administrative Tribunals to Accept "Local Knowledge/Traditional Knowledge"*

(Administrative Environmental Hearings)

"The willingness of administrative tribunals to accept "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	4.4% (3.1%)	9.3% (6.0%)	17.2% (14.1%)	4.4 - 17.2% (3.1 - 14.1%)
Minor Problem	24.4% (17.7%)	20.9% (13.6%)	31.3% (25.7%)	20.9 - 31.3% (13.6 - 25.7-%)
Not a Problem	48.9% (35.5%)	34.9% (22.7%)	21.9% (18.0%)	21.9 - 48.9% (18.0 - 35.5%)
Undecided/ No Opinion	13.3% (9.6%)	27.9% (18.1%)	21.9% (18.0%)	13.3 - 27.9% (9.6 - 18.1%)
Unfamiliar With Concept	8.9% (6.4%)	7.0% (4.5%)	7.8% (6.4%)	7.0 - 8.9% (4.5 - 6.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 48

Unwillingness of Courts to Accept "Local Knowledge/Traditional Knowledge"*

(Environmental Trials and Other Legal Proceedings)

"The unwillingness of the courts to accept "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of expert scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	18.8% (16.7%)	20.6% (16.1%)	15.5% (13.4%)	15.5 - 20.6% (13.4 - 16.7%)
Minor Problem	12.5% (11.1%)	19.1% (14.9%)	16.9% (14.6%)	12.5 - 19.1% (11.1 - 14.9%)
Not a Problem	37.5% (33.3%)	23.5% (18.3%)	19.7% (17.1%)	19.7 - 37.5% (17.1 -33.3%)
Undecided/ No Opinion	18.8% (16.7%)	27.9% (21.8%)	36.6% (31.8%)	18.8 - 36.6% (16.7 - 31.8%)
Unfamiliar With Concept	12.5% (11.1%)	8.8% (6.8%)	11.3% (9.8%)	8.8 - 12.5% (6.8 - 11.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 49

Unwillingness of Administrative Tribunals to Accept "Local Knowledge/Traditional Knowledge"*

(Administrative Environmental Hearings)

"The unwillingness of administrative tribunals to accept "local knowledge/traditional knowledge" from aboriginal and non-aboriginal witnesses as an alternative form of expert scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	17.8% (12.9%)	18.6% (12.1%)	15.9% (13.0%)	15.9 - 18.6% (12.1 - 13.0%)
Minor Problem	22.2% (16.1%)	20.9% (13.6%)	34.9% (28.7%)	20.9 - 34.9% (13.6 - 28.7%)
Not a Problem	31.1% (22.5%)	23.3% (15.1%)	20.6% (16.9%)	20.6 - 31.1% (15.1 - 22.5-%)
Undecided/ No Opinion	17.8% (12.9%)	30.2% (19.6%)	20.6% (16.9%)	17.8 - 30.2% (12.9 - 19.6-%)
Unfamiliar With Concept	11.1% (8.0%)	7.0% (4.5%)	7.9% (6.5%)	7.0 - 11.1% (4.5 - 8.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 50

Assigning Evidentiary Weight to Expert Evidence in the Form of "Local Knowledge/Traditional Knowledge"*

(Environmental Trials and Other Legal Proceedings)

"Assigning evidentiary weight to expert evidence in the form of "local knowledge/traditional knowledge" "				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	18.8% (16.7%)	29.4% (22.9%)	31.0% (26.9%)	18.8 - 31.0% (16.7 - 26.9%)
Minor Problem	12.5% (11.1%)	25.9% (19.5%)	11.3% (9.8%)	11.3 - 25.0% (9.8 - 19.5%)
Not a Problem	25.0% (22.2%)	13.2% (10.3%)	7.0% (6.0%)	7.0 - 25.0% (6.0 - 22.2%)
Undecided/ No Opinion	12.5% (11.1%)	22.1% (17.2%)	35.2% (30.5%)	12.5 - 35.2% (11.1 - 30.5%)
Unfamiliar With Concept	31.3% (27.8%)	10.3% (8.0%)	15.5% (13.4%)	10.3 - 31.3% (8.0 - 27.8%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 51

Assigning Evidentiary Weight to Expert Evidence in the Form of "Local Knowledge/Traditional Knowledge"*

(Administrative Environmental Hearings)

"Assigning evidentiary weight to expert scientific evidence in the form of "local knowledge/traditional knowledge""				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.9% (20.9%)	30.2% (19.6%)	35.9% (29.5%)	28.9 - 35.9% (19.6 - 29.5%)
Minor Problem	33.3% (24.1%)	32.6% (21.2%)	23.4% (19.2%)	23.4 - 33.3% (19.2 - 24.1%)
Not a Problem	4.4% (3.1%)	11.6% (7.5%)	4.7% (3.8%)	4.4 - 11.6% (3.1 - 7.5%)
Undecided/ No Opinion	24.4% (17.7%)	16.3% (10.6%)	21.9% (18.0%)	16.3 - 24.4% (10.6 - 18.0%)
Unfamiliar With Concept	8.9% (6.4%)	9.3% (6.0%)	14.1% (11.6%)	8.0 - 14.1% (6.0 - 11.6%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 52

Qualification Procedures Employed by the Courts in Qualifying Witnesses to Give Evidence in the Form of "Local Knowledge/Traditional Knowledge"*

(Environmental Trials and Other Legal Proceedings)

"The 'qualification' procedures which are employed by the courts in qualifying witnesses to give expert evidence in the form of "local knowledge/traditional knowledge""				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	25.0% (22.2%)	29.4% (22.9%)	23.9% (20.7%)	23.9 - 29.4% (20.7 - 22.9%)
Minor Problem	18.8% (16.7%)	25.0% (19.5%)	16.9% (14.6%)	16.9 - 25.0% (14.6 - 19.5%)
Not a Problem	18.8% (16.7%)	4.4% (3.4%)	5.6% (4.8%)	4.4 - 18.8% (3.4 - 16.7%)
Undecided/ No Opinion	12.5% (11.1%)	29.4% (22.9%)	40.8% (35.4%)	12.5 - 40.8% (11.1 - 35.4%)
Unfamiliar With Concept	25.0% (22.2%)	11.8% (9.2%)	12.7% (11.0%)	11.8 - 25.0% (9.2 - 22.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 53

Qualification Procedures Employed by the Courts in Qualifying Witnesses to Give Evidence in the Form of "Local Knowledge/Traditional Knowledge"*

(Administrative Environmental Hearings)

"The 'qualification' procedures which are employed by administrative tribunals in qualifying witnesses to give scientific evidence in to form of "local knowledge/traditional knowledge""				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	18.2% (13.2%)	16.3% (10.6%)	28.1% (23.1%)	16.3 - 28.1% (10.6 - 23.1%)
Minor Problem	15.9% (11.5%)	44.2% (28.8%)	14.1% (11.6%)	14.1 - 44.2% (11.5 - 28.8%)
Not a Problem	25.0% (18.1%)	7.0% (4.5%)	14.1% (11.6%)	7.0 - 25.0% (4.5 - 18.1%)
Undecided/ No Opinion	27.3% (19.8%)	23.3% (15.1%)	28.1% (23.1%)	23.3 - 28.1% (15.1 - 23.1%)
Unfamiliar With Concept	13.6% (9.8%)	9.3% (6.0%)	15.6% (12.8%)	9.3 - 15.6% (6.0 - 12.8%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 54

Failure of the Courts to Define Areas of Expertise for Local Knowledge/Traditional Knowledge Experts*

(Environmental Trials and Other Legal Proceedings)

"Failure of the courts to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert scientific evidence in the form of "local knowledge/traditional knowledge"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	12.5% (11.1%)	23.5% (18.3%)	26.8% (23.2%)	12.5 - 26.8% (11.1 - 23.2%)
Minor Problem	31.3% (27.8%)	22.1% (17.2%)	16.9% (14.6)	16.9 - 31.3% (14.6 - 27.8%)
Not a Problem	18.8% (16.7%)	11.8% (9.2%)	4.2% (3.6%)	4.2 - 18.8% (3.6 - 16.7%)
Undecided/ No Opinion	12.5% (11.1%)	30.9% (24.1%)	40.8% (35.4%)	12.5 - 40.8% (11.1 - 35.4%)
Unfamiliar With Concept	25.0% (22.2%)	11.8% (9.2%)	11.3% (9.8%)	11.3 - 25.0% (9.2 - 22.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 55

Failure of Administrative Tribunals to Define Areas of Expertise for Local Knowledge/Traditional Knowledge Experts *

(Administrative Environmental Hearings)

"Failure of administrative Tribunals to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert scientific evidence in the form of "local knowledge/traditional knowledge"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	15.6% (11.3%)	11.6% (7.5%)	32.8% (26.9%)	11.6 - 32.8% (7.5 - 26.9%))
Minor Problem	35.6% (25.8%)	39.5% (25.7%)	28.1% (23.1%)	28.1 - 39.5% (23.1 - 25.8%)
Not a Problem	17.8% (12.9%)	16.3% (10.6%)	7.8% (6.4%)	7.8 - 17.8% (6.4 - 12.9%)
Undecided/ No Opinion	22.2% (16.1%)	23.3% (15.1%)	23.4% (19.2%)	22.2 - 23.4% (15.1 - 19.2%)
Unfamiliar With Concept	8.9% (6.4%)	9.3% (6.0%)	7.8% (6.4%)	7.8 - 9.3% (6.0 - 6.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 56

Failure of Courts to Limit Expert Evidence in the Form of Local Knowledge/Traditional Knowledge to Defined Areas of Expertise*

(Environmental Trials and Other Legal Proceedings)

"Failure of the courts to limit the evidence provided by expert witnesses who are qualified to give expert evidence in the form of "local knowledge/traditional knowledge" to those defined areas of expertise in which they are qualified to give expert evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	6.3% (5.6%)	16.2% (12.6%)	25.4% (22.0%)	6.3 - 25.4% (5.6 - 22.0%)
Minor Problem	25.0% (22.2%)	22.1% (17.2%)	15.5% (13.4%)	15.5 - 25.0% (13.4 - 22.2%)
Not a Problem	31.3% (27.8%)	14.7% (11.4%)	7.0% (6.0%)	7.0 - 31.3% (6.0 - 27.8%)
Undecided/ No Opinion	12.5% (11.1%)	33.8% (26.4%)	40.8% (35.4%)	12.5 - 40.8% (11.1 - 35.4%)
Unfamiliar With Concept	25.0% (22.2%)	13.2% (10.3%)	11.3% (9.8%)	11.3 - 25.0% (9.8 - 22.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 57

Failure of Administrative Tribunals to Limit Expert Evidence in the Form of Local Knowledge/Traditional Knowledge to Defined Areas of Expertise*

(Administrative Environmental Hearings)

"Failure of administrative tribunals to limit the evidence provided by expert witnesses who are qualified to give expert evidence in the form of "local knowledge/traditional knowledge" to those defined areas of expertise in which they are qualified to give expert evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	20.5% (14.8%)	14.0% (9.1%)	35.9% (29.5%)	14.0 - 35.9% (9.1 - 29.5%)
Minor Problem	27.3% (19.8%)	34.9% (22.7%)	26.6% (21.8%)	26.6 - 34.9-% (19.8 - 22.7%)
Not a Problem	13.6% (9.8%)	16.3% (10.6%)	4.7% (3.8%)	4.7 - 16.3% (3.8 - 10.6%)
Undecided/ No Opinion	27.3% (19.8%)	25.6% (16.6%)	23.4% (19.2%)	23.4 - 27.3% (16.6 - 19.8%)
Unfamiliar With Concept	11.4% (8.2%)	9.3% (6.0%)	9.4% (7.7%)	9.3 - 11.4% (6.0 - 8.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 58

Verification of Qualifications of Local Knowledge/Traditional Knowledge Witnesses*

(Environmental Trials and Other Legal Proceedings)

"Verification by the courts of the qualifications of witnesses to give expert scientific evidence in the form of "local knowledge/traditional knowledge"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	25.0% (22.2%)	20.9% (16.3%)	15.5% (13.4%)	15.5 - 25.0% (13.4 - 22.2%)
Minor Problem	12.5% (11.1%)	20.9% (16.3%)	19.7% (17.1%)	12.5 - 20.9% (11.1 - 17.1%)
Not a Problem	25.0% (22.2%)	16.4% (12.8%)	7.0% (6.0%)	7.0 - 25.0% (6.0 - 22.2%)
Undecided/ No Opinion	12.5% (11.1%)	29.9% (23.3%)	45.1% (39.1%)	12.5 - 45.1% (11.1 - 39.1%)
Unfamiliar With Concept	25.0% (22.2%)	11.9% (9.3%)	12.7% (11.0%)	11.9 - 25.0% (9.3 - 22.2%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 59

Verification of Qualifications of Local Knowledge/Traditional Knowledge Witnesses*

(Administrative Environmental Hearings)

"Verification by administrative tribunals of the qualifications of witnesses to give expert scientific evidence in the form of "local knowledge/traditional knowledge"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	20.0% (14.5%)	4.8% (3.1%)	20.3% (16.7%)	4.8 - 20.3% (3.1 - 16.7%)
Minor Problem	15.6% (11.3%)	28.6% (18.6%)	35.9% (29.5%)	15.6 - 35.9% (11.3 - 29.5%)
Not a Problem	20.0% (14.5%)	28.6% (18.6%)	9.4% (7.7%)	9.4 - 28.6% (7.7 - 18.6%)
Undecided/ No Opinion	35.6% (25.8%)	28.6% (18.6%)	25.0% (20.5%)	25.0 - 35.6% (18.6 - 25.8%)
Unfamiliar With Concept	8.9% (6.4%)	9.5% (6.1%)	9.4% (7.7%)	8.9 - 9.5% (6.1 - 7.7%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 60

Overall Quality of Scientific Information*

(Environmental Trials and Other Legal Proceedings)

"Based on your experience, how would you rate the overall quality of scientific information which is introduced into the environmental decision-making process in environmental trials and other legal proceedings?"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	23.5%	10.3%	9.6%	9.5 - 23.5%
Good	58.8%	51.7%	57.8%	51.7 - 58.8%
Fair	17.6%	31.0%	25.3%	17.6 - 31.0%
Poor	0.0%	6.9%	6.0%	0.0 - 6.9%
Very Poor	0.0%	0.0%	1.2%	0.0 - 1.2%

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 61

Overall Quality of Scientific Information*

(Administrative Environmental Hearings)

"Based on your experience, how would you rate the overall quality of scientific information which is introduced into the environmental decision-making process in administrative environmental hearings?"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	13.1%	15.2%	12.8%	12.8 - 15.2%
Good	45.9%	48.5%	53.8%	45.9 - 53.8%
Fair	32.8%	31.8%	26.9%	26.9 - 32.8%
Poor	8.2%	4.5%	6.4%	4.5 - 8.2%
Very Poor	0.0%	0.0%	0.0%	0.0%

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Appendix 3

Communication and Comprehension of Scientific Information at Environmental Trials and Administrative Hearings

Table 62

Problems with Communication of Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings with respect to the communication of scientific information provided in the form of expert evidence by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	0.0%	11.4%	27.1%	0.0 - 27.1%
Agree	61.1%	50.0%	54.1%	50.0 - 61.1%
Undecided	11.1%	11.4%	9.4%	9.4 - 11.4%
Disagree	27.8%	26.1%	9.4%	9.4 - 27.8%
Strongly Disagree	0.0%	1.1%	0.0%	0.0 - 1.1%

Table 63

Problems With Communication of Scientific Information

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings with respect to the communication of scientific information provided in the form of expert evidence by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	7.9%	4.5%	16.5%	4.5 - 16.5%
Agree	49.2%	51.5%	70.9%	49.2 - 70.9%
Undecided	15.9%	12.1%	7.6%	7.6 - 15.9%
Disagree	27.0%	30.3%	3.8%	3.8 - 30.3%
Strongly Disagree	0.0%	1.5%	1.3%	0.0 - 1.5%

Table 64

Use of Technical Language Including Jargon and Terms of Art Which May Not be Understood by Participants in Environmental Decision-Making Processes*

(Environmental Trials and Other Legal Proceedings)

"The use of technical language including jargon and terms of art which may not be understood by participants in environmental trials and other legal proceedings such as judges and legal counsel"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	53.8% (38.8%)	39.1% (28.4%)	45.5% (41.2%)	39.1 - 53.8% (28.4 - 41.2%)
Minor Problem	46.2% (33.3%)	54.7% (39.8%)	46.8% (42.4%)	46.2 - 54.7% (33.3 - 42.4%)
Not a Problem	0.0% (0.0%)	3.1% (2.2%)	5.2% (4.7%)	0.0 - 5.2% (0.0 - 4.7%)
Undecided/ No Opinion	0.0% (0.0%)	1.6% (1.1%)	2.6% (2.3%)	0.0 - 2.6% (0.0 - 2.3%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 65

Use of Technical Language Including Jargon and Terms of Art Which May Not be Understood by Participants at Environmental Decision-Making Processes*

(Administrative Environmental Hearings)

"The use of technical language including jargon and terms of art which may not be understood by participants in administrative environmental hearings such as tribunal members and legal counsel"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.4% (22.1%)	15.6% (10.6%)	38.7% (36.7%)	15.6 - 38.7% (10.6 - 36.7%)
Minor Problem	56.5% (41.2%)	82.2% (55.9%)	53.3% (50.6%)	53.3 - 82.2% (41.2 - 55.9%)
Not a Problem	13.0% (9.4%)	0.0% (0.0%)	5.3% (5.0%)	0.0 - 13.0% (0.0 - 9.4%)
Undecided/ No Opinion	0.0% (0.0%)	2.2% (1.4%)	2.7% (2.5%)	0.0 - 2.7% (0.0 - 2.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 0.0% (0.0 - 0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 66

Failure Of Expert Scientific Witnesses to Effectively Communicate Scientific Information to Participants in Environmental Decision-Making Processes*

(Environmental Trials and Other Legal Proceedings)

"The failure of expert scientific witnesses to effectively communicate scientific information to participants in environmental trials and other legal proceedings such as judges and legal counsel"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	53.8% (38.8%)	43.8% (31.8%)	53.2% (48.1%)	43.8 - 53.8% (31.8 - 48.1%)
Minor Problem	46.2% (33.3%)	48.4% (35.2%)	40.3% (36.5%)	40.3 - 48.4% (33.3 - 36.5%)
Not a Problem	0.0% (0.0%)	4.7% (3.4%)	1.3% (1.1%)	0.0 - 4.7% (0.0 - 3.4%)
Undecided/ No Opinion	0.0% (0.0%)	1.6% (1.1%)	5.2% (4.7%)	0.0 - 5.2% (0.0 - 4.7%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 67

Failure of Expert Scientific Witnesses to Effectively Communicate Scientific Information to Participants in Environmental Decision-Making Processes*

(Administrative Environmental Hearings)

"The failure of expert scientific witnesses to effectively communicate scientific information to participants in administrative environmental hearings such as tribunal members and legal counsel"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.4% (22.1%)	24.4% (16.8%)	40.0% (38.0%)	24.4 - 40.0% (16.8 - 38.0%)
Minor Problem	56.5% (41.2%)	68.9% (46.9%)	54.7% (51.9%)	54.7 - 68.9% (41.2 - 51.9%)
Not a Problem	13.0% (9.4%)	2.2% (1.4%)	4.0% (3.8%)	2.2 - 13.0% (1.4 - 9.4%)
Undecided/ No Opinion	0.0% (0.0%)	4.4% (2.9%)	1.3% (1.2%)	0.0 - 4.4% (0.0 - 2.9%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 68

Distortion of Scientific Information as a Result of the Use of Cross-Examination by Opposing Legal Counsel*

(Environmental Trials and Other Legal Proceedings)

"The distortion of scientific information as a result of the use of cross-examination by opposing legal counsel"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	23.1% (16.6%)	21.9% (15.9%)	55.8% (50.5%)	21.9 - 55.8% (15.9 - 50.5%)
Minor Problem	53.8% (38.8%)	53.1% (38.6%)	36.4% (32.9%)	36.4 - 53.8% (32.9 - 38.8%)
Not a Problem	7.7% (5.5%)	21.9% (15.9%)	3.9% (3.5%)	3.9 - 21.9% (3.5 - 15.9%)
Undecided/ No Opinion	15.4% (11.1%)	1.6% (1.1%)	3.9% (3.5%)	1.6 - 15.4% (1.1 - 11.1%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 69

Distortion of Scientific Information as a Result of the Use of Cross-Examination by Opposing Legal Counsel*

(Administrative Environmental Hearings)

"The distortion of scientific information as a result of the use of cross-examination by opposing legal counsel"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.3% (20.6%)	20.0% (13.6%)	42.7% (40.5%)	20.0 - 42.7% (13.6 - 40.5%)
Minor Problem	37.0% (27.0%)	40.0% (27.2%)	45.3% (43.0%)	37.0 - 45.3% (27.0 - 43.0%)
Not a Problem	26.1% (19.0%)	35.6% (24.2%)	6.7% (6.3%)	6.7 - 35.6% (6.3 - 24.2%)
Undecided/ No Opinion	4.3% (3.1%)	4.4% (2.9%)	4.0% (3.8%)	4.0 - 4.4% (2.9 - 3.8%)
Unfamiliar With Concept	4.3% (3.1%)	0.0% (0.0%)	1.3% (1.2%)	0.0 - 4.3% (0.0 - 3.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 70

Differences in the Meanings to be Attributed to Technical Terms by Two or More Expert Scientific Witnesses at Environmental Decision-Making Processes*

(Environmental Trials and Other Legal Proceedings)

"The meanings to be attributed to technical terms (such as jargon and terms of art) may vary between expert scientific witnesses (for example, the meaning which a civil engineer associates with the term "physical stress" may be very different from the definition of that term which would be provided by a biologist)"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	23.1% (16.6%)	18.8% (13.6%)	28.6% (25.9%)	18.8 - 28.6% (13.6 - 25.9%)
Minor Problem	76.9% (55.5%)	54.7% (39.8%)	59.7% (54.0%)	54.7 - 76.9% (39.8 - 55.5%)
Not a Problem	0.0% (0.0%)	21.9% (15.9%)	6.5% (5.8%)	0.0 - 21.9% (0.0 - 15.9%)
Undecided/ No Opinion	0.0% (0.0%)	3.1% (2.2%)	5.2% (4.7%)	0.0 - 5.2% (0.0 - 4.7%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 71

Differences in the Meanings to be Attributed to Technical Terms by Two or More Expert Scientific Witnesses at Environmental Decision-Making Processes*

(Administrative Environmental Hearings)

"The meanings to be attributed to technical terms (such as jargon and terms of art) may vary between expert scientific witnesses (for example, the meaning which a civil engineer associates with the term "physical stress" may be very different from the definition of that term which would be provided by a biologist)"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.4% (22.1%)	11.1% (7.5%)	16.0% (15.2%)	11.1 - 30.4% (7.5 - 22.1%)
Minor Problem	45.7% (33.3%)	57.8% (39.3%)	69.3% (65.8%)	45.7 - 69.3% (33.3 - 65.8%)
Not a Problem	19.6% (14.3%)	26.7% (18.1%)	13.3% (12.6%)	13.3 - 26.7% (12.6 - 18.1%)
Undecided/ No Opinion	2.2% (1.6%)	4.4% (2.9%)	1.3% (1.2%)	1.3 - 4.4% (1.2 - 2.9%)
Unfamiliar With Concept	2.2% (1.6%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 2.2% (0.0 - 1.6%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 72

Translation of Technical Language into Languages such as Aboriginal Languages Which Do Not Have Equivalent Terminology at Environmental Decision-Making Processes*

(Environmental Trials and Other Legal Proceedings)

"The translation of technical language (such as jargon and terms of art) into languages such as aboriginal languages which do not have equivalent terminology"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.8% (22.2%)	11.3% (8.2%)	19.5% (17.6%)	11.3 - 30.8% (8.2 - 22.2%)
Minor Problem	23.1% (16.6%)	24.2% (17.6%)	16.9% (15.3%)	16.9 - 24.2% (15.3 - 17.6%)
Not a Problem	0.0% (0.0%)	9.7% (7.0%)	7.8% (7.0%)	0.0 -9.7% (0.0 - 7.0%)
Undecided/ No Opinion	30.8% (22.2%)	37.1% (27.0%)	40.3% (36.5%)	30.8 - 40.3% (22.2 - 36.5%)
Unfamiliar With Concept	15.4% (11.1%)	17.7% (12.8%)	15.6% (14.1%)	15.4 - 17.7% (11.1 - 14.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 73

Translation of Technical Language into Languages such as Aboriginal Languages Which Do Not Have Equivalent Terminology at Environmental Decision-Making Processes*

(Administrative Environmental Hearings)

"The translation of technical language (such as jargon and terms of art) into languages such as aboriginal languages which do not have equivalent terminology"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	24.4% (17.8%)	13.3% (9.0%)	24.0% (22.8%)	13.3 - 24.4% (9.0 - 22.8%)
Minor Problem	29.9% (21.8%)	28.9% (19.6%)	21.3% (20.2%)	21.3 - 29.9% (19.6 - 21.8%)
Not a Problem	15.6% (11.3%)	8.9% (6.0%)	17.3% (16.4%)	8.9 - 17.3% (6.0 - 16.4%)
Undecided/ No Opinion	22.2% (16.2%)	31.1% (29.5%)	24.0% (22.8%)	22.2 - 31.1% (16.2 - 29.5%)
Unfamiliar With Concept	8.9% (6.4%)	17.8% (12.1%)	13.3% (12.6%)	8.9 - 17.8% (6.4 - 12.6%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 74

Communication Between the Scientific and Legal Communities

(Environmental Trials and Other Legal Proceedings)

"Communication between the scientific and legal communities"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	12.5%	2.3%	2.4%	2.3 - 12.5%
Good	18.8%	30.7%	15.3%	15.3 - 30.7%
Fair	56.3%	47.7%	52.9%	47.7 - 56.3%
Poor	12.5%	15.9%	24.7%	12.5 - 24.7%
Very Poor	0.0%	3.4%	4.7%	0.0 - 4.7%

Table 75

Communication Between the Scientific and Legal Communities

(Administrative Environmental Hearings)

"Communication between the scientific and legal communities"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	0.0%	4.5%	1.3%	0.0 - 4.5%
Good	27.0%	34.8%	19.2%	19.2 - 34.8%
Fair	47.6%	39.4%	52.6%	39.4 - 52.6%
Poor	23.8%	18.2%	23.1%	18.2 - 23.8%
Very Poor	1.6%	3.0%	3.8%	1.6 - 3.8%

Table 76

Interaction Between the Scientific and Legal Communities

(Environmental Trials and Other Legal Proceedings)

"Interaction between the scientific and legal communities"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	6.3%	1.1%	1.2%	1.1 - 6.3%
Good	18.8%	16.1%	20.0%	16.1 - 20.0%
Fair	56.3%	48.3%	36.5%	36.5 - 56.3%
Poor	18.8%	29.9%	38.8%	18.8 - 38.8%
Very Poor	0.0%	4.6%	3.5%	0.0 - 4.6%

Table 77

Interaction Between the Scientific and Legal Communities

(Administrative Environmental Hearings)

"Interaction between the scientific and legal communities"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	0.0%	1.5%	3.9%	0.0 - 3.9%
Good	25.8%	16.9%	18.2%	16.9 - 25.8%
Fair	51.6%	55.4%	41.6%	41.6 - 55.4%
Poor	19.4%	23.1%	29.9%	19.4 - 29.9%
Very Poor	3.2%	3.1%	6.5%	3.1 - 6.5%

Table 78

Problems with Comprehension of Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings with respect to the comprehension/understanding by the courts and/or legal counsel of scientific information presented in the form of expert evidence by expert scientific witnesses."

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	11.1%	19.3%	29.4%	11.1 - 29.4%
Agree	44.4%	53.4%	49.4%	44.4 - 53.4%
Undecided	16.7%	8.0%	11.8%	8.0 - 16.7%
Disagree	22.2%	19.3%	9.4%	9.4 - 22.2%
Strongly Disagree	5.6%	0.0%	0.0%	0.0 - 5.6%

Table 79

Problems With Comprehension Of Scientific Information

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings with respect to the comprehension/understanding by administrative tribunals and/or legal counsel of scientific information presented in the form of expert scientific evidence by expert scientific witnesses."				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	7.9%	4.5%	24.1%	4.5 - 24.1%
Agree	47.6%	51.5%	53.2%	47.6 - 53.2%
Undecided	15.9%	13.6%	13.9%	13.6 - 15.9%
Disagree	28.6%	28.8%	7.6%	7.6 - 28.8%
Strongly Disagree	0.0%	1.5%	1.3%	0.0 - 1.5%

Table 80

Courts Do Not Sufficiently Understand the Methods of Scientific Inquiry and Proof*

(Environmental Trials and Other Legal Proceedings)

"The courts do not sufficiently understand the methods of scientific inquiry and proof"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	23.1% (16.6%)	36.6% (29.5%)	44.2% (40.0%)	23.1 - 44.2% (16.6 - 40.0%)
Minor Problem	53.8% (38.8%)	42.3% (34.1%)	32.5% (29.4%)	32.5 - 53.8% (29.4 - 38.8%)
Not a Problem	15.4% (11.1%)	14.1% (11.3%)	15.6% (14.1%)	14.1 - 15.6% (11.1 - 14.1%)
Undecided/ No Opinion	7.7% (5.5%)	7.0% (5.6%)	7.8% (7.0%)	7.0 - 7.8% (5.5 - 7.0%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 81

Administrative Tribunals Do Not Sufficiently Understand the Methods of Scientific Inquiry and Proof*

(Administrative Environmental Hearings)

"Administrative tribunals do not sufficiently understand the methods of scientific inquiry and proof"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	11.1% (7.9%)	26.1% (18.1%)	39.4% (35.9%)	11.1 - 39.4% (7.9 - 35.9%)
Minor Problem	51.1% (36.4%)	50.0% (34.8%)	40.8% (37.2%)	40.8 - 51.1% (34.8 - 37.2%)
Not a Problem	33.3% (23.7%)	19.6% (13.6%)	11.3% (10.3%)	11.3 - 33.3% (10.3 - 23.7%)
Undecided/ No Opinion	2.2% (1.5%)	4.3% (2.9%)	8.5% (7.7%)	2.2 - 8.5% (1.5 - 7.7%)
Unfamiliar With Concept	2.2% (1.5%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 2.2% (0.0 - 1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 82

Legal Counsel Do Not Sufficiently Understand the Methods of Scientific Inquiry and Proof*

(Environmental Trials And Other Legal Proceedings)

"Legal counsel do not sufficiently understand the methods of scientific inquiry and proof"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	23.1% (16.6%)	33.8% (27.2%)	52.0% (47.1%)	23.1 - 52.0% (16.6 - 47.1%)
Minor Problem	61.5% (44.4%)	42.3% (34.1%)	28.0% (25.3%)	28.0 - 61.5% (25.3 - 44.4%)
Not a Problem	7.7% (5.5%)	18.3% (14.7%)	14.7% (13.3%)	7.7 - 18.3% (5.5 - 14.7%)
Undecided/ No Opinion	7.7% (5.5%)	5.6% (4.5%)	5.3% (4.8%)	5.3 - 7.7% (4.5 - 5.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 83

Legal Counsel Do Not Sufficiently Understand the Methods of Scientific Inquiry and Proof*

(Administrative Environmental Hearings)

"Legal counsel do not sufficiently understand the methods of scientific inquiry and proof"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	35.6% (25.4%)	34.8% (24.2%)	28.2% (25.7%)	28.2 - 35.6% (24.2 - 25.7%)
Minor Problem	42.2% (30.1%)	43.5% (30.2%)	56.3% (51.3%)	42.2 - 56.3% (30.1 - 51.3%)
Not a Problem	20.0% (14.2%)	19.6% (13.6%)	11.3% (10.3%)	11.3 - 20.0% (10.3 - 14.2%)
Undecided/ No Opinion	2.2% (1.5%)	2.2% (1.5%)	4.2% (3.8%)	2.2 - 4.2% (1.5 - 3.8%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 84

Courts Do Not Comprehend the Merits and Pitfalls of Statistical Analysis Provided by Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"The courts do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	46.2% (33.3%)	46.5% (37.5%)	48.1% (43.5%)	46.2 - 48.1% (33.3 - 43.5%)
Minor Problem	38.5% (27.4%)	36.6% (29.5%)	39.0% (35.3%)	36.6 - 39.0% (27.4 - 35.3%)
Not a Problem	7.7% (5.9%)	12.7% (10.2%)	6.5% (5.8%)	6.5 - 12.7% (5.8- 10.2%)
Undecided/ No Opinion	0.0% (0.0%)	4.2% (3.3%)	5.2% (4.7%)	0.0 - 5.2% (0.0 - 4.7%)
Unfamiliar With Concept	7.7% (5.4%)	0.0% (0.0%)	1.3% (1.1%)	0.0 - 7.7% (0.0 - 5.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 85

Administrative Tribunals Do Not Comprehend the Merits and Pitfalls of Statistical Analysis Provided by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Administrative tribunals do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	35.6% (25.4%)	30.4% (21.1%)	47.9% (43.6%)	30.4 - 47.9% (21.1 - 43.6%)
Minor Problem	42.2% (30.1%)	47.8% (33.2%)	45.1% (41.1%)	42.2 - 47.8% (30.1 - 41.1%)
Not a Problem	22.2% (15.8%)	15.2% (10.5%)	2.8% (2.5%)	2.8 - 22.2% (2.5 - 15.8%)
Undecided/ No Opinion	0.0% (0.0%)	6.5% (4.5%)	4.2% (3.8%)	0.0 - 6.5% (0.0 - 4.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 86

Legal Counsel Do Not Comprehend the Merits and Pitfalls of Statistical Analysis Provided by Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"Legal counsel do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Tange
Major Problem	53.8% (38.8%)	40.0% (32.2%)	42.1% (38.1%)	40.0 - 53.8% (32.2 - 38.8%)
Minor Problem	30.8% (22.2%)	42.9% (34.6%)	44.7% (40.4%)	30.8 - 44.7% (22.2 - 40.4%)
Not a Problem	0.0% (0.0%)	12.9% (10.4%)	6.6% (5.9%)	0.0 - 12.9% (0.0 - 10.4%)
Undecided/ No Opinion	7.7% (5.5%)	4.3% (3.4%)	5.3% (4.8%)	4.3 - 7.7% (3.4 - 5.5%)
Unfamiliar With Concept	7.7% (5.5%)	0.0% (0.0%)	1.3% (1.1%)	0.0 - 7.7% (0.0 - 5.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 87

Legal Counsel Do Not Comprehend the Merits and Pitfalls of Statistical Analysis Provided by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Legal counsel do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	42.2% (30.1%)	34.8% (24.2%)	40.8% (37.2%)	34.8 - 42.2% (24.4 - 37.2%)
Minor Problem	48.9% (34.9%)	50.0% (34.8%)	47.9% (43.6%)	47.9 - 50.0% (34.8 - 43.6%)
Not a Problem	6.7% (4.7%)	8.7% (6.0%)	7.0% (6.3%)	6.7 - 8.7% (4.7 - 6.3%)
Undecided/ No Opinion	2.2% (1.5%)	6.5% (4.5%)	4.2% (3.8%)	2.2 - 6.5% (1.5 - 4.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 88

Courts Do Not Comprehend the Value Premises and Professional Biases Which Underlie Scientific Information Provided by Expert Scientific Witnesses *

(Environmental Trials and Other Legal Proceedings)

"The courts do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.8% (22.2%)	40.8% (32.9%)	42.7% (38.6%)	30.8 - 42.7% (22.2 - 38.6%)
Minor Problem	53.8% (38.8%)	32.4% (26.1%)	40.0% (36.2%)	32.4 - 53.8% (26.1 - 38.8%)
Not a Problem	7.7% (5.5%)	19.7% (15.8%)	9.3% (8.4%)	7.7 - 19.7% (5.5 - 15.8%)
Undecided/ No Opinion	7.7% (5.5%)	7.0% (5.6%)	6.7% (6.0%)	6.7 - 7.7% (5.5 - 6.0%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.3% (1.1%)	0.0 - 1.3% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 89

Administrative Tribunals Do Not Comprehend the Value Premises and Professional Biases Which Underlie Scientific Information Provided by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Administrative tribunals do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	17.8% (12.7%)	21.7% (15.1%)	33.8% (30.8%)	17.8 - 33.8% (12.7 - 30.8%)
Minor Problem	55.6% (39.6%)	50.0% (34.8%)	50.7% (46.2%)	50.0 - 55.6% (34.8 - 46.2%)
Not a Problem	13.3% (9.4%)	21.7% (15.1%)	9.9% (9.0%)	9.9 - 21.7% (9.0 - 15.1%)
Undecided/ No Opinion	8.9% (6.3%)	6.5% (4.5%)	5.6% (5.1%)	5.6 - 8.9% (4.5 - 6.3%)
Unfamiliar With Concept	4.4% (3.1%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 4.4% (0.0 - 3.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 90

Legal Counsel Do Not Comprehend the Value Premises and Professional Biases Which Underlie Scientific Information Provided by Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"Legal counsel do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.8% (22.2%)	31.0% (25.0%)	32.0% (28.9%)	30.8 - 32.0% (22.2 - 28.9%)
Minor Problem	46.2% (33.3%)	42.3% (34.1%)	45.3% (41.0%)	42.3 - 46.2% (33.3 - 41.0%)
Not a Problem	0.0% (0.0%)	18.3% (14.7%)	16.0% (14.4%)	0.0 - 18.3% (0.0 - 14.7%)
Undecided/ No Opinion	23.1% (16.6%)	8.5% (6.8%)	5.3% (4.8%)	5.3 - 23.1% (4.8 - 16.6%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.3% (1.1%)	0.0 - 1.3% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 91

Legal Counsel Do Not Comprehend the Value Premises and Professional Biases Which Underlie Scientific Information Provided by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Legal counsel do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	35.6% (25.4%)	26.1% (18.1%)	25.4% (23.1%)	25.4 - 35.6% (18.1 - 25.4%)
Minor Problem	42.2% (30.1%)	50.0% (34.8%)	52.1% (47.5%)	42.2 - 50.0% (30.1 - 47.5%)
Not a Problem	13.3% (9.4%)	19.6% (13.6%)	21.1% (19.2%)	13.3 - 21.1% (9.4 - 19.2%)
Undecided/ No Opinion	4.4% (3.1%)	4.3% (2.9%)	1.4% (1.2%)	1.4 - 4.4% (1.2 - 3.1%)
Unfamiliar With Concept	4.4% (3.1%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 4.4% (0.0 - 3.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 92

Courts Do Not Comprehend the Key Doctrines and Premises of Whatever Scientific Discipline is Involved in Scientific Information Provided by Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"The courts do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.8% (22.2%)	39.4% (31.7%)	32.5% (29.4%)	30.8 - 39.4% (22.2 - 31.7%)
Minor Problem	30.8% (22.2%)	38.0% (30.6%)	53.2% (48.1%)	30.8 - 53.2% (22.2 - 48.1%)
Not a Problem	7.7% (5.5%)	18.3% (14.7%)	7.8% (7.0%)	7.7 - 18.3% (5.5 - 14.7%)
Undecided/ No Opinion	30.8% (22.2%)	4.2% (3.3%)	6.5% (5.8%)	4.2 - 30.8% (3.3 - 22.2%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 93

Administrative Tribunals Do Not Comprehend the Key Doctrines and Premises of Whatever Scientific Discipline is Involved in Scientific Information Provided by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Administrative tribunals do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	26.7% (19.0%)	28.3% (19.6%)	40.8% (37.2%)	26.7 - 40.8% (19.0 - 37.2%)
Minor Problem	40.0% (28.5%)	45.7% (31.8%)	43.7% (39.8%)	40.0 - 45.7% (28.5 - 39.8%)
Not a Problem	24.4% (17.4%)	21.7% (15.1%)	8.5% (7.7%)	8.5 - 24.4% (7.7 - 17.4%)
Undecided/ No Opinion	8.9% (6.3%)	4.3% (2.9%)	7.0% (6.3%)	4.3 - 8.9% (2.9 - 6.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 94

Legal Counsel Do Not Comprehend the Key Doctrines and Premises of Whatever Scientific Discipline is Involved in Scientific Information Provided by Expert Scientific Witnesses*

(Environmental Trials and Other Legal Proceedings)

"Legal counsel do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	30.8% (22.2%)	31.0% (25.0%)	32.9% (29.8%)	30.8 - 32.9% (22.2 - 29.8%)
Minor Problem	30.8% (22.2%)	46.5% (37.5%)	55.3% (50.1%)	30.8 - 55.3% (22.2 - 50.1%)
Not a Problem	0.0% (0.0%)	16.9% (13.6%)	5.3% (4.8%)	0.0 - 16.9% (0.0 - 13.6%)
Undecided/ No Opinion	38.5% (27.7%)	5.6% (4.5%)	6.6% (5.9%)	5.6 - 38.5% (4.5 - 27.7%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 95

Legal Counsel Do Not Comprehend the Key Doctrines and Premises of Whatever Scientific Discipline is Involved in Scientific Information Provided by Expert Scientific Witnesses*

(Administrative Environmental Hearings)

"Legal counsel do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	37.8% (26.9%)	28.3% (19.6%)	29.6% (26.9%)	28.3 - 37.8% (19.6 - 26.9%)
Minor Problem	44.4% (31.7%)	54.3% (37.7%)	49.3% (44.9%)	44.4 - 54.3% (31.7 - 44.9%)
Not a Problem	13.3% (9.4%)	13.0% (9.0%)	14.1% (12.8%)	13.0 - 14.1% (9.0 - 12.8%)
Undecided/ No Opinion	4.4% (3.1%)	4.3% (2.9%)	7.0% (6.3%)	4.3 - 7.0% (2.9 - 6.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 96

Reliance by the Courts on Cross-Examination for the Purposes of Clarifying and Testing Expert Scientific Evidence Creates a Problem in Circumstances Where Cross-Examination is Not Conducted or is Not Effectively Conducted*

(Environmental Trials and Other Legal Proceedings)

"Reliance by the courts on cross-examination for the purposes of clarifying and testing expert scientific evidence creates a problem in circumstances where cross-examination is not conducted or is not effectively conducted"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	61.5% (44.4%)	39.4% (31.7%)	50.6% (45.8%)	39.4 - 61.5% (31.7 - 45.8%)
Minor Problem	38.5% (27.7%)	42.3% (34.1%)	24.7% (22.3%)	24.7 - 42.3% (22.3 - 34.1%)
Not a Problem	0.0% (0.0%)	12.7% (10.2%)	6.5% (5.8%)	0.0 - 12.7% (0.0 - 10.2%)
Undecided/ No Opinion	0.0% (0.0%)	4.2% (3.3%)	15.6% (14.1%)	0.0 - 15.6% (0.0 - 14.1%)
Unfamiliar With Concept	0.0% (0.0%)	1.4% (1.1%)	2.6% (2.3%)	0.0 - 2.6% (0.0 - 2.3%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 97

Reliance by Administrative Tribunals on Cross-Examination for the Purposes of Clarifying and Testing Expert Scientific Evidence Creates a Problem in Circumstances Where Cross-Examination is Not Conducted or is Not Effectively Conducted*

(Administrative Environmental Hearings)

"Reliance by administrative tribunals on cross-examination for the purposes of clarifying and testing expert scientific evidence creates a problem in circumstances where cross-examination is not conducted or is not effectively conducted"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	62.2% (44.4%)	43.5% (30.2%)	51.4% (46.8%)	43.5 - 62.2% (30.2 - 46.8%)
Minor Problem	24.4% (17.4%)	37.0% (25.7%)	33.3% (30.3%)	24.4 - 37.0% (17.4 - 30.3%)
Not a Problem	8.9% (6.3%)	17.4% (12.1%)	6.9% (6.2%)	8.9 - 17.4% (6.2 - 12.1%)
Undecided/ No Opinion	4.4% (3.1%)	2.2% (1.5%)	8.3% (7.5%)	2.2 - 8.3% (1.5 - 7.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 98

Level of Understanding by the Scientific Community of the Concerns of the Legal Community in Environmental Decision-Making

(Environmental Trials and Other Legal Proceedings)

"Level of understanding by the scientific community of the concerns of the legal community in environmental decision-making"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	0.0%	0.0%	0.0%	0.0 - 0.0%
Good	0.0%	13.6%	10.6%	0.0 - 13.6%
Fair	68.8%	47.7%	32.9%	32.9 - 68.8%
Poor	25.0%	33.0%	48.2%	25.0 - 48.2%
Very Poor	6.3%	5.7%	8.2%	5.7 - 8.2%

Table 99

Level of Understanding by the Scientific Community of the Concerns of the Legal Community in Environmental Decision-Making

(Administrative Environmental Hearings)

"Level of understanding by the scientific community of the concerns of the legal community in environmental decision-making"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	3.2%	1.5%	2.6%	1.5 - 3.2%
Good	21.0%	18.2%	16.7%	16.7 - 21.0%
Fair	35.5%	45.5%	28.2%	28.2 - 45.5%
Poor	32.3%	30.3%	46.2%	30.3 - 46.2%
Very Poor	8.1%	4.5%	6.4%	4.5 - 8.1%

Table 100

Level of Understanding by the Legal Community of the Concerns of the Scientific Community in Environmental Decision-Making

(Environmental Trials and Other Legal Proceedings)

"Level of understanding by the legal community of the concerns of the scientific community in environmental decision-making"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	0.0%	0.0%	0.0%	0.0 - 0.0%
Good	18.8%	18.2%	7.1%	7.1 - 18.8%
Fair	50.0%	47.7%	36.5%	36.5 - 50.0%
Poor	31.3%	27.3%	42.4%	27.3 - 42.4%
Very Poor	0.0%	6.8%	14.1%	0.0 - 14.1%

Table 101

Level of Understanding by the Legal Community of the Concerns of the Scientific Community in Environmental Decision-Making

(Administrative Environmental Hearings)

"Level of understanding by the legal community of the concerns of the scientific community in environmental decision-making"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Good	3.3%	0.0%	1.3%	0.0 - 3.3%
Good	18.0%	21.2%	12.8%	12.8 - 21.2%
Fair	44.3%	45.5%	35.9%	35.9 - 45.5%
Poor	29.5%	31.8%	42.3%	29.5 - 42.3%
Very Poor	4.9%	1.5%	7.7%	1.5 - 7.7%

Table 102

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Reputation and Standing Within the Scientific Community

(Environmental Trials and Other Legal Proceedings)

"Reputation and standing within the scientific community"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	58.8%	63.6%	62.7%	58.8 - 63.6
Desirable	29.4%	34.1%	34.9%	29.4 - 34.9%
Doesn't Matter	11.8%	2.3%	2.4%	2.3 - 11.8%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 103

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Reputation and Standing Within the Scientific Community

(Administrative Environmental Hearings)

"Reputation and standing within the scientific community"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	49.1%	73.4%	63.2%	49.1 - 73.4%
Desirable	49.1%	25.0%	34.2%	25.0 - 49.1%
Doesn't Matter	1.8%	1.6%	2.6%	1.6 - 2.6%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 104

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Academic/Professional Credentials

(Environmental Trials and Other Legal Proceedings)

"Academic/professional credentials"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	58.8%	60.2%	60.2%	58.8 - 60.2%
Desirable	41.2%	38.6%	36.1%	36.1 - 41.2%
Doesn't Matter	0.0%	1.1%	3.6%	0.0 - 3.6%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 105

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Academic/Professional Credentials

(Administrative Environmental Hearings)

"Academic/professional credentials"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	47.4%	75.0%	64.5%	47.4 - 75.0%
Desirable	45.6%	23.4%	30.3%	23.4 - 45.6%
Doesn't Matter	7.0%	1.6%	5.3%	1.6 - 7.0%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 106

Qualities Legal Counsel Look For When Choosing Expert Witnesses:
A Proven Track Record

(Environmental Trials and Other Legal Proceedings)

"A proven "track record" as an expert witness"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	52.9%	47.7%	44.0%	44.0 - 52.9%
Desirable	29.4%	41.9%	38.1%	29.4 - 41.9%
Doesn't Matter	17.6%	9.3%	16.7%	9.3 - 17.6%
Undesirable	0.0%	1.2%	1.2%	0.0 - 1.2%
Very Undesirable	0.0%	0.0%	0.0%	%

Table 107

Qualities Legal Counsel Look For When Choosing Expert Witnesses: A Proven Track Record

(Administrative Environmental Hearings)

"A proven "track record" as an expert witness"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	59.6%	64.1%	44.7%	44.7 - 64.1%
Desirable	29.8%	28.1%	39.5%	28.1 - 39.5%
Doesn't Matter	10.5%	7.8%	15.8%	7.8 - 15.8%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 108

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Effectively Communicate Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Ability to effectively communicate scientific information"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	75.0%	85.2%	68.7%	68.7 - 85.2%
Desirable	12.5%	14.8%	27.7%	12.5 - 27.7%
Doesn't Matter	12.5%	0.0%	3.6%	0.0 - 12.5%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 109

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Effectively Communicate Scientific Information

(Administrative Environmental Hearings)

"Ability to effectively communicate scientific information"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	52.6%	84.1%	68.4%	52.6 - 84.1%
Desirable	43.9%	14.3%	30.3%	14.3 - 43.9%
Doesn't Matter	3.5%	1.6%	1.3%	1.3 - 3.5%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 110

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Work Well as Part of a Team

(Environmental Trials and Other Legal Proceedings)

"Ability to work well with legal counsel, scientific advisors and/or other expert witnesses as part of a "team"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	43.8%	45.5%	36.9%	36.9 - 45.5%
Desirable	50.0%	47.7%	50.0%	47.7 - 50.0%
Doesn't Matter	6.3%	6.8%	13.1%	6.3 - 13.1%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 111

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Work Well as Part of a Team

(Administrative Environmental Hearings)

"Ability to work well with legal counsel, scientific advisors and/or other expert witnesses as part of a "team"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	44.6%	54.7%	28.9%	28.9 - 54.7%
Desirable	42.9%	40.6%	59.2%	40.6 - 59.2%
Doesn't Matter	10.7%	4.7%	11.8%	4.7 - 11.8%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	1.8%	0.0%	0.0%	0.0 - 1.8%

Table 112

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Persuade a Court

(Environmental Trials and Other Legal Proceedings)

"Ability to persuade a court with respect to a scientific issue"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	66.7%	53.4%	43.4%	43.4 - 66.7%
Desirable	6.7%	35.2%	41.0%	6.7 - 41.0%
Doesn't Matter	26.7%	10.2%	14.5%	10.2 - 26.7%
Undesirable	0.0%	1.1%	1.2%	0.0 - 1.2%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 113

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Persuade an Administrative Tribunal

(Administrative Environmental Hearings)

"Ability to persuade an administrative tribunal with respect to a scientific issue"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	57.9%	60.9%	43.4%	43.4 - 60.9%
Desirable	28.1%	34.4%	42.1%	28.1 - 42.1%%
Doesn't Matter	7.0%	3.1%	11.8%	3.1 - 11.8%%
Undesirable	7.0%	1.6%	2.6%	1.6 - 7.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 114

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Low Professional Fee

(Environmental Trials and Other Legal Proceedings)

"A low professional fee for participation in the trial or other legal proceeding in order to minimize expert witness costs"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	6.3%	35.2%	1.2%	1.2 - 35.2%
Desirable	37.5%	63.6%	10.7%	10/7 - 63.6%
Doesn't Matter	50.0%	1.1%	72.6%	1.1 - 72.6%
Undesirable	6.3%	0.0%	7.1%	0.0 - 7.1%
Very Undesirable	0.0%	0.0%	8.3%	0.0 - 8.3%

Table 115

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Low Professional Fee

(Administrative Environmental Hearings)

"A low professional fee for participation in the administrative environmental hearing in order to minimize expert witness costs"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	5.7%	3.1%	1.3%	1.3 - 5.7%
Desirable	28.3%	34.4%	6.7%	6.7 - 34.4%
Doesn't Matter	52.8%	59.4%	80.0%	52.8 - 80.0%
Undesirable	11.3%	3.1%	5.3%	3.1 - 11.3%
Very Undesirable	1.9%	0.0%	6.7%	0.0 - 6.7%

Table 116

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Expert Who Usually Appears on Behalf of Only One Side of Litigation

(Environmental Trials and Other Legal Proceedings)

"An expert witness who usually appears only on behalf of one side or the other in a trial or other legal proceeding (for example, only appears as an expert witness for the prosecution/plaintiff rather than the defence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	6.3%	0.0%	8.6%	0.0 - 8.6%
Desirable	12.5%	4.5%	8.6%	4.5 - 12.5%
Doesn't Matter	6.3%	22.7%	42.0%	6.3 - 42.0%
Undesirable	62.5%	59.1%	32.1%	32.1 - 62.5%
Very Undesirable	12.5%	13.6%	8.6%	8.6 - 13.6%

Table 117

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Expert Who Usually Appears on Behalf of Only One Side of Litigation

(Administrative Environmental Hearings)

"An expert witness who usually appears only on behalf of one side or the other in an administrative environmental hearing (for example, only appears as an expert witness for the proponents of industrial projects rather than the opponents of such projects"

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	5.5%	3.1%	10.8%	3.1 - 10.8%
Desirable	25.5%	9.4%	13.5%	9.4 - 25.5%
Doesn't Matter	21.8%	20.3%	33.8%	20.3 - 33.8%
Undesirable	41.8%	54.7%	33.8%	33.8 - 54.7%
Very Undesirable	5.5%	12.5%	8.1%	5.5 - 12.5%

Table 118

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Minority View or New Theory if Necessary

(Environmental Trials and Other Legal Proceedings)

"In situations where scientific evidence presented by the other side to a dispute is widely held by the scientific community, an expert witness who holds a minority view or has a new theory"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	12.5%	0.0%	3.8%	0.0 - 12.5%
Desirable	31.3%	25.6%	26.9%	25.6 - 31.3%
Doesn't Matter	12.5%	29.3%	21.8%	12.5 - 29.3%
Undesirable	43.8%	42.7%	39.7%	39.7 - 43.8%
Very Undesirable	0.0%	2.4%	7.7%	0.0 - 7.7%

Table 119

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Minority View or New Theory if Necessary

(Administrative Environmental Hearings)

"In situations where scientific evidence presented by the other side to a dispute is widely held by the scientific community, an expert witness who holds a minority view or has a new theory"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	11.5%	1.7%	6.8%	1.7 - 11.5%
Desirable	34.6%	23.3%	23.0%	23.0 - 34.6%
Doesn't Matter	19.2%	31.7%	24.3%	19.2 - 31.7%
Undesirable	32.7%	41.7%	37.8%	32.7 - 41.7%
Very Undesirable	1.9%	1.7%	8.1%	1.7 - 8.1%

Table 120

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Willingness to Assist the Party to Litigation Who Retains their Services

(Environmental Trials and Other Legal Proceedings)

"A willingness to assist the party to the litigation who retains their services"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	25.0%	14.0%	14.8%	14.0 - 25.0%
Desirable	50.0%	65.1%	49.4%	49.4 -65.1%
Doesn't Matter	25.0%	12.8%	24.7%	12.8 - 25.0%
Undesirable	0.0%	8.1%	8.6%	0.0 - 8.6
Very Undesirable	0.0%	0.0%	2.5%	0.0 - 2.5%

Table 121

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Willingness to Assist the Party to Litigation Who Retains their Services

(Administrative Environmental Hearings)

"A willingness to assist the party to the litigation who retains their services"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	33.3%	19.0%	22.7%	19.0 - 33.3%
Desirable	49.1%	65.1%	53.3%	49.1 - 65.1%
Doesn't Matter	10.5%	6.3%	16.0%	6.3 - 16.0%
Undesirable	3.5%	7.9%	8.0%	3.5 - 8.0%
Very Undesirable	3.5%	1.6%	0.0%	0.0 - 3.5%

Table 122

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Susceptibility to Influence by Legal Counsel

(Environmental Trials and Other Legal Proceedings)

"Is susceptible to "influence" by legal counsel or scientific advisors during preparation for, and in giving expert scientific evidence in environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	12.5%	1.1%	2.5%	1.1 - 12.5%
Desirable	12.5%	9.2%	14.8%	9.2 - 14.8%
Doesn't Matter	6.3%	6.9%	16.0%	6.3 - 16.0%
Undesirable	50.0%	50.6%	44.4%	44.4 - 50.6%
Very Undesirable	18.8%	32.2%	22.2%	18.8 - 32.2%

Table 123

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Susceptibility to Influence by Legal Counsel

(Administrative Environmental Hearings)

"Is susceptible to "influence" by legal counsel or scientific advisors during preparation for, and in giving expert scientific evidence in administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	5.4%	1.6%	3.9%	1.6 - 5.4%
Desirable	19.6%	15.6%	18.4%	15.6 - 19.6%
Doesn't Matter	12.5%	12.5%	22.4%	12.5 - 22.4%
Undesirable	44.6%	53.1%	36.8%	36.8 - 53.1%
Very Undesirable	17.9%	17.2%	18.4%	17.2 - 18.4%

Table 124

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Successfully Withstand Cross-Examination

(Environmental Trials and Other Legal Proceedings)

"Has the ability to successfully withstand cross-examination by opposing legal counsel"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	86.7%	63.2%	69.9%	63.2 - 86.7%
Desirable	0.0%	35.6%	30.1%	0.0 - 35.6%
Doesn't Matter	13.3%	1.1%	0.0%	0.0 - 13.3%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 125

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Successfully Withstand Cross-Examination

(Administrative Environmental Hearings)

"Has the ability to successfully withstand cross-examination by opposing legal counsel"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	59.6%	70.3%	69.7%	59.6 - 70.3%
Desirable	35.1%	28.1%	28.9%	28.1 - 35.1%
Doesn't Matter	3.5%	1.6%	1.3%	1.3 - 3.5%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	1.8%	0.0%	0.0%	0.0 - 1.8%

Table 126

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Assist Legal Counsel in the Preparation of Other Expert Witnesses

(Environmental Trials and Other Legal Proceedings)

"Is able to assist legal counsel in the preparation of expert scientific witnesses appearing on behalf of the opposing party in environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	87.5%	64.8%	58.5%	58.5 - 87.5%
Desirable	12.5%	34.1%	37.8%	12.5 - 37.8%
Doesn't Matter	0.0%	1.1%	3.7%	0.0 - 3.7%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Table 127

Qualities Legal Counsel Look For When Choosing Expert Witnesses: Ability to Assist Legal Counsel in the Preparation of Other Expert Witnesses

(Administrative Environmental Hearings)

"Is able to assist legal counsel in the preparation of cross-examination of expert scientific witnesses appearing on behalf of the opposing party in administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Very Desirable	47.4%	54.7%	53.9%	47.4 - 54.7%
Desirable	49.1%	43.8%	40.8%	40.8 - 49.1%
Doesn't Matter	3.5%	1.6%	5.3%	1.6 - 5.3%
Undesirable	0.0%	0.0%	0.0%	0.0%
Very Undesirable	0.0%	0.0%	0.0%	0.0%

Appendix 4

Scientific Uncertainty in Environmental Decision-Making

Table 128

Problems Where Scientific Information Provided in the Form of Expert Evidence Results in Uncertainty with Respect to Scientific Issues

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings where the scientific information provided in the form of expert evidence results in uncertainty with respect to one or more scientific issues"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	5.6%	11.4%	23.5%	5.6 - 23.5%
Agree	72.2%	48.9%	60.0%	48.9 - 72.2%
Undecided	5.6%	12.5%	14.1%	5.6 - 14.1%
Disagree	16.7%	26.1%	2.4%	2.4 - 26.1%
Strongly Disagree	0.0%	1.1%	0.0%	0.0 - 1.1%

Table 129

Problems Where Scientific Information Provided in the Form of Expert Evidence Results in Uncertainty with Respect to Scientific Issues

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings where the scientific information provided in the form of expert evidence results in uncertainty with respect to one or more scientific issues"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	19.0%	4.5%	19.2%	4.5 - 19.2%
Agree	57.1%	42.4%	69.2%	42.4 - 69.2%
Undecided	12.7%	12.1%	6.4%	6.4 - 12.7%
Disagree	9.5%	36.4%	5.1%	5.1 - 36.4%
Strongly Disagree	1.6%	4.5%	0.0%	0.0 - 4.5%

Table 130

Translating the Level of Scientific Certainty and Uncertainty Found Within Scientific Information Provided in the Form of Expert Evidence into the Level of Legal Certainty and Uncertainty Required to Meet Legal Standards of Proof*

(Environmental Trials and Other Legal Proceedings)

"Translating the level of scientific certainty and uncertainty found within scientific information provided in the form of expert evidence at environmental trials and other legal proceedings into the level of legal certainty and uncertainty required to meet legal standards of proof (such as "proof beyond reasonable doubt" required in criminal/quasi-criminal trials or "proof on the balance of probabilities" required in civil trials and by the due diligence defence in criminal/quasi-criminal trials)"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	53.3% (44.4%)	54.7% (39.8%)	71.1% (69.3%)	53.3 - 71.1% (39.8 - 69.3%)
Minor Problem	26.7% (22.2%)	31.3% (22.7%)	24.1% (23.5%)	24.1 - 31.3% (22.2 - 23-5%)
Not a Problem	20.0% (16.6%)	10.9% (7.9%)	3.6% (3.5%)	3.6 - 20.0% (3.5 - 16.6%)
Undecided/ No Opinion	0.0% (0.0%)	1.6% (1.1%)	1.2% (1.1%)	0.0 - 1.6% (0.0 - 1.1%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 131

Translating the Level of Scientific Certainty and Uncertainty Found Within Scientific Information Provided in the Form of Expert Evidence into the Level of Legal Certainty and Uncertainty Required to Meet Legal Standards of Proof *

(Administrative Environmental Hearings)

"Translating the level of scientific certainty and uncertainty found within scientific information provided in the form of expert evidence at administrative environmental hearings into the level of legal certainty and uncertainty required to meet the standards of proof required by administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	53.6% (47.5%)	43.6% (25.7%)	64.9% (61.5%)	43.6 - 64.9% (25.7 - 61.5%)
Minor Problem	35.7% (31.7%)	46.2% (27.2%)	31.1% (29.4%)	31.1 - 46.2% (27.2 - 31.7%)
Not a Problem	3.6% (3.1%)	7.7% (4.5%)	2.7% (2.5%)	2.7 - 7.7% (2.5 - 4.5%)
Undecided/ No Opinion	5.4% (4.7%)	2.6% (1.5%)	1.4% (1.3%)	1.4 - 5.4% (1.3 - 4.7%)
Unfamiliar With Concept	1.8% (1.5%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 1.8% (0.0 -1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 132

Where it Appears that Scientific Information Necessary to Reduce or Eliminate the Uncertainty Relating to a Scientific Issue is Available, but such Information is Not Presented as Evidence*

(Environmental Trials and Other Legal Proceedings)

"Where it appears that scientific information necessary to reduce or eliminate the uncertainty relating to a scientific issue is available, but such information is not presented as evidence at an environmental trial or other legal proceeding"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	46.7% (38.9%)	26.6% (19.3%)	30.1% (29.3%)	26.6 - 46.7% (19.3 - 38.9%)
Minor Problem	20.0% (16.6%)	37.5% (27.3%)	37.3% (36.4%)	20.0 - 37.5% (16.6 - 36.4%)
Not a Problem	0.0% (0.0%)	25.0% (18.2%)	18.1% (17.6%)	0.0 - 25.0% (0.0 - 18.2%)
Undecided/ No Opinion	26.7% (22.2%)	4.7% (3.4%)	13.3% (12.9%)	4.7 - 26.7% (3.4 - 22.2%)
Unfamiliar With Concept	6.7% (5.5%)	6.3% (4.5%)	1.2% (1.1%)	1.2 - 6.7% (1.1 -5.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 133

Where it Appears that Scientific Information Necessary to Reduce or Eliminate the Uncertainty Relating to a Scientific Issue is Available, but such Information is Not Presented as Evidence*

(Administrative Environmental Hearings)

"Where it appears that scientific information necessary to reduce or eliminate the uncertainty relating to a scientific issue is available, but such information is not presented as evidence at an administrative environmental hearing"

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	57.1% (50.7%)	20.5% (12.0%)	36.5% (34.6%)	20.5 - 57.1% (12.0 - 50.7%)
Minor Problem	30.4% (26.9%)	56.4% (33.2%)	44.6% (42.2%)	30.4 - 56.4% (26.9 - 42.2%)
Not a Problem	7.1% (6.3%)	15.4% (9.0%)	12.2% (11.5%)	7.1 - 15.4% (6.3 - 11.5%)
Undecided/ No Opinion	3.6% (3.1%)	7.7% (4.5%)	4.1% (3.8%)	3.6 - 7.7% (3.1 - 4.5%)
Unfamiliar With Concept	1.8% (1.5%)	0.0% (0.0%)	2.7% (2.5%)	0.0 - 2.7% (0.0 - 2.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 134

Where it Appears that Scientific Information Necessary to Reduce or Eliminate the Uncertainty Relating to a Scientific Issue is Not Immediately Available, but Could be Obtained with Additional Scientific Investigation*

(Environmental Trials and Other Legal Proceedings)

"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not immediately available for presentation at an environmental trial or other legal proceeding, but could be obtained with additional scientific investigation"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	20.0% (16.6%)	29.7% (21.6%)	25.6% (24.9%)	20.0 - 29.7% (16.6 - 24.9%)
Minor Problem	26.7% (22.2%)	45.3% (32.9%)	52.4% (51.1%)	26.7 - 52.4% (22.2 - 51.1%)
Not a Problem	6.7% (5.5%)	20.3% (14.7%)	9.8% (9.5%)	6.7 - 20.3% (5.5 - 14.7%)
Undecided/ No Opinion	46.7% (38.9%)	3.1% (2.2%)	11.0% (10.7%)	3.1 - 46.7% (2.2 - 38.9%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	1.2% (1.1%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 135

Where it Appears that Scientific Information Necessary to Reduce or Eliminate the Uncertainty Relating to a Scientific Issue is Not Immediately Available, but Could be Obtained with Additional Scientific Investigation*

(Administrative Environmental Hearings)

"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not immediately available for presentation at an administrative environmental hearing, but could be obtained with additional scientific investigation"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	48.2% (42.8%)	23.1% (13.6%)	28.4% (26.9%)	23.1 - 48.2% (13.6 - 42.8%)
Minor Problem	42.9% (38.0%)	53.8% (31.7%)	63.5% (60.1%)	42.9 - 63.5% (31.7 - 60.1%)
Not a Problem	3.6% (3.1%)	15.4% (9.1%)	6.8% (6.4%)	3.6 - 15.4% (3.1 -9.1%)
Undecided/ No Opinion	5.4% (4.7%)	7.7% (4.5%)	1.4% (1.3%)	1.4 - 7.7% (1.3 - 4.7%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 136

Where it Appears that Scientific Information Necessary to Reduce or Eliminate the Scientific Uncertainty Relating to a Scientific Issue is Not Available, and Cannot Reasonably be Obtained Given the Present State of Science*

(Environmental Trials and Other Legal Proceedings)

"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not available for presentation at an environmental trial or other legal proceeding, and cannot reasonably be obtained given the present state of science" to be either a major or minor problem"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	6.7% (5.5%)	20.3% (14.7%)	38.6% (37.6%)	6.7 - 38.6% (5.5 - 37.6%)
Minor Problem	33.3% (27.7%)	32.8% (23.8%)	30.1% (29.3%)	30.1 - 33.3% (23.8 - 29.3%)
Not a Problem	26.7% (22.2%)	39.1% (28.4%)	19.3% (18.8%)	19.3 - 39.1% (18.8 - 28.4%)
Undecided/ No Opinion	33.3% (27.7%)	3.1% (2.2%)	12.0% (11.7%)	3.1 - 33.3% (2.2 - 27.7%)
Unfamiliar With Concept	0.0% (0.0%)	4.7% (3.4%)	0.0% (0.0%)	0.0 - 4.7% (0.0 - 3.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 137

Where it Appears that Scientific Information Necessary to Reduce or Eliminate the Scientific Uncertainty Relating to a Scientific Issue is Not Available, and Cannot Reasonably be Obtained Given the Present State of Science*

(Administrative Environmental Hearings)

"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not available for presentation at an administrative environmental hearing, and cannot reasonably be obtained given the present state of science"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	45.5% (40.4%)	23.1% (13.6%)	50.0% (47.4%)	23.1 - 50.0% (13.6 - 47.4%)
Minor Problem	36.4% (32.3%)	38.5% (22.7%)	31.1% (29.4%)	31.1 - 38.5% (22.7 - 32.3%)
Not a Problem	10.9% (9.6%)	30.8% (18.1%)	17.6% (16.6%)	10.9 - 30.8% (9.6 - 18.1%)
Undecided/ No Opinion	7.3% (6.4%)	7.7% (4.5%)	1.4% (1.3%)	1.4 - 7.7% (1.3 - 6.4%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 138

The Adversarial System Promotes the Presentation of Conflicting Scientific Information Which Creates Confusion With Respect to Scientific Evidence*

(Environmental Trials and Other Legal Proceedings)

"The adversarial system used in environmental trials and other legal proceedings promotes the presentation of conflicting scientific information which creates confusion with respect to the scientific evidence"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	33.3% (27.7)	34.4% (25.0%)	65.1% (63.5%)	33.3 - 65.1% (25.0 - 63.5%)
Minor Problem	26.7% (22.2%)	29.7% (21.6%)	25.3% (24.6%)	25.3 - 29.7% (21.6 - 24.6%)
Not a Problem	26.7% (22.2%)	35.9% (26.1%)	6.0% (5.8%)	6.0 - 35.9% (5.8 - 26.1%)
Undecided/ No Opinion	13.3% (11.0%)	0.0% (0.0%)	3.6% (3.5%)	0.0 - 13.3% (0.0 - 11.0%)
Unfamiliar With Concept	0.0% (0.0%}	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 139

The Adversarial System Promotes the Presentation of Conflicting Scientific Information Which Creates Confusion With Respect to Scientific Evidence*

(Administrative Environmental Hearings)

"The adversarial system used in administrative environmental hearings promotes the presentation of conflicting scientific information which creates confusion with respect to the scientific evidence"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	57.1% (50.7%)	30.8% (18.1%)	68.9% (65.3%)	30.8 - 68.9% (18.1 - 65.3%)
Minor Problem	28.6% (25.3%)	33.3% (19.6%)	20.3% (19.2%)	20.3 - 33.3% (19.2 - 25.3%)
Not a Problem	14.3% (12.6%)	28.2% (16.6%)	9.5% (9.0%)	9.5 - 28.2% (9.0 - 16.6%)
Undecided/ No Opinion	0.0% (0.0%)	7.7% (4.5%)	1.4% (1.3%)	0.0 - 7.7% (0.0 - 4.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 140

Where Relevant Scientific Information is Presented by One Or More Parties for the Purpose of Creating Rather Than Reducing or Eliminating Scientific Uncertainty with Respect to a Scientific Issue eating Rather than Reducing or Eliminating Scientific Uncertainty with Respect to a Scientific Issue*

(Environmental Trials and Other Legal Proceedings)

"Where relevant scientific information is presented at an environmental trial or other legal proceeding on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	13.3% (11.0%)	23.4% (17.0%)	42.2% (41.1%)	13.1 - 42.2% (11.0 - 41.1%)
Minor Problem	40.0% (33.3%)	29.7% (21.6%)	34.9% (34.0%)	29.7 - 40.0% (21.6 - 34.0%)
Not a Problem	33.3% (27.7%)	40.6% (29.5%)	18.1% (17.6%)	18.1 - 40.6% (17.6 - 29.5%)
Undecided/ No Opinion	13.3% (11.0%)	4.7% (3.4%)	4.8% (4.6%)	4.7 - 13.3% (3.4 - 11.0%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 141

Where Relevant Scientific Information is Presented by One or More Parties for the Purpose of Creating Than Reducing or Eliminating Scientific Uncertainty with Respect to a Scientific Issue*

(Administrative Environmental Hearings)

"Where relevant scientific information is presented at an administrative environmental hearing on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.6% (25.3%)	25.6% (15.1%)	45.9% (43.5%)	25.6 - 45.9% (15.1 - 43.5%)
Minor Problem	42.9% (38.0%)	30.8% (18.1%)	31.1% (29.4%)	30.8 - 42.9% (18.1 - 38.0%)
Not a Problem	21.4% (19.0%)	33.3% (19.6%)	20.3% (19.2%)	20.3 - 33.3% (19.0 - 19.6%)
Undecided/ No Opinion	5.4% (4.7%)	10.3% (6.0%)	2.7% (2.5%)	2.7 - 10.3% (2.5 - 6.0%)
Unfamiliar With Concept	1.8% (1.5%)	0.0% (0.0%)	0.0% (%)	0.0 - 1.8% (0.0 - 1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 142

Where Irrelevant Scientific Information is Presented by One or More Parties for the Purpose of Creating Confusion with Respect to a Relevant Scientific Issue*

(Environmental Trials and Other Legal Proceedings)

"Where irrelevant scientific information is presented at an environmental trial or other legal proceeding on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	13.3% (11.0%)	18.8% (13.6%)	43.4% (42.3%)	13.3 - 43.4% (11.0 - 42.3%)
Minor Problem	46.7% (38.9%)	59.4% (43.2%)	39.8% (38.8%)	39.8 - 59.4% (38.8 - 43.2%)
Not a Problem	33.3% (27.7%)	18.8% (13.6%)	9.6% (9.3%)	9.6 - 33.3% (9.3 - 27.7%)
Undecided/ No Opinion	6.7% (5.5%)	1.6% (1.1%)	7.2% (7.0%)	1.6 - 7.2% (1.1 - 7.0%)
Unfamiliar With Concept	0.0% (0.0%)	1.6% (1.1%)	0.0% (0.0%)	0.0 - 1.6% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 143

Where Irrelevant Scientific Information is Presented by One or More Parties for the Purpose of Creating Confusion with Respect to a Relevant Scientific Issue*

(Administrative Environmental Hearings)

"Where irrelevant scientific information is presented at an administrative environmental hearing on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	32.1% (28.5%)	33.3% (19.6%)	47.3% (44.8%)	32.1 - 47.3% (19.6 - 44.8%)
Minor Problem	50.0% (44.4%)	43.6% (25.7%)	31.1% (29.4%)	31.1 - 50.0% (25.7 - 44.4%)
Not a Problem	12.5% (11.1%)	15.4% (9.0%)	10.8% (10.2%)	10.8 - 15.4% (9.0 - 11.1%)
Undecided/ No Opinion	3.6% (3.1%)	7.7% (4.5%)	10.8% (10.2%)	3.6 - 10.8% (3.1 - 10.2%)
Unfamiliar With Concept	1.8% (1.5%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 1.8% (0.0 - 1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 144

Problems Where There is Contradictory or Conflicting Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Problems exist in environmental trials and other legal proceedings where contradictory or conflicting scientific information in the form of expert evidence is provided by expert scientific witnesses"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	11.1%	10.2%	24.7%	10.2 - 24.7%
Agree	50.0%	46.6%	60.0%	46.6 - 60.0%
Undecided	16.7%	13.6%	14.1%	13.6 - 16.7%
Disagree	22.2%	26.1%	1.2%	1.2 - 26.1%
Strongly Disagree	0.0%	3.4 %	0.0%	0.0 - 3.4%

Table 145

Problems Where There is Contradictory or Conflicting Scientific Information

(Administrative Environmental Hearings)

"Problems exist in administrative environmental hearings where contradictory or conflicting scientific information in the form of expert evidence is provided by expert scientific witnesses"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	19.4%	6.1%	19.2%	6.1 - 19.4%
Agree	54.8%	43.9%	65.4%	43.9 - 65.4%
Undecided	12.9%	15.2%	7.7%	7.7 - 15.2%
Disagree	12.9%	28.8%	7.7%	7.7 - 28.8%
Strongly Disagree	0.0%	6.1%	0.0%	0.0 - 6.1%

Table 146

Assigning Evidentiary Weight to the Contradictory or Conflicting Scientific Information

(Environmental Trials and Other Legal Proceedings)

"Assigning evidentiary weight to the contradictory or conflicting scientific information"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	57.1% (44.4%)	54.8% (38.5%)	47.6% (47.0%)	47.6 - 57.1% (38.5 - 47.0%)
Minor Problem	28.6% (22.2%)	35.5% (24.9%)	29.8% (29.4%)	28.6 - 35.5% (22.2 - 29.4%)
Not a Problem	14.3% (11.1%)	4.8% (3.3%)	1.2% (1.1%)	1.2 - 14.3%% (1.1 - 11.1%)
Undecided/ No Opinion	0.0% (0.0%)	4.8% (3.3%)	15.5% (15.3%)	0.0 - 15.5%% (0.0 - 15.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	6.0% (5.9%)	0.0 - 6.0% (0.0 - 5.9%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 147

Assigning Evidentiary Weight to the Contradictory or Conflicting Scientific Information

(Administrative Environmental Hearings)

"Assigning evidentiary weight to the contradictory or conflicting scientific information"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	57.4% (49.9%)	55.8% (36.3%)	55.6% (51.3%)	55.6 - 57.4% (36.3 - 51.3%)
Minor Problem	35.2% (30.6%)	34.9% (22.7%)	37.5% (34.6%)	34.9 - 37.5% (22.7 - 34.6%)
Not a Problem	3.7% (0.0%)	7.0% (4.5%)	2.8% (2.5%)	2.8 - 7.0% (0.0 - 4.5%)
Undecided/ No Opinion	3.7% (0.0%)	2.3% (1.4%)	1.4% (1.2%)	1.4 - 3.7% (0.0 - 1.4%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	2.8% (2.5%)	0.0 - 2.8% (0.0 - 2.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 148

Distinguishing Between Scientific Information Which is Widely Accepted in the Scientific Distinguishing Between Scientific Information Which is Widely Accepted in the Scientific Community from Minority Views, New Theories or Junk Science

(Environmental Trials and Other Legal Proceedings)

"Distinguishing between scientific information which is widely accepted in the scientific community from minority views, new theories or what is commonly referred to as 'junk science'"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	14.3% (11.1%)	33.9% (23.8%)	27.4% (27.0%)	14.3 - 33.9% (11.1 - 27.0%)
Minor Problem	64.3% (50.0%)	56.5% (39.7%)	56.0% (55.3%)	56.0 - 64.3% (39.7 - 55.3%)
Not a Problem	14.3% (11.1%)	6.5% (4.5%)	7.1% (7.0%)	6.5 - 14.3% (4.5 - 11.1%)
Undecided/ No Opinion	7.1% (5.5%)	3.2% (2.2%)	9.5% (9.3%)	3.2 - 9.5% (2.2 - 9.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 149

Distinguishing Between Scientific Information Which is Widely Accepted in the Scientific Distinguishing Between Scientific Information Which is Widely Accepted in the Scientific Community from Minority Views, New Theories or Junk Science

(Administrative Environmental Hearings)

"Distinguishing between scientific information which is widely accepted in the scientific community from minority views, new theories or what is commonly referred to as 'junk science'"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	40.7% (35.4%)	25.6% (16.6%)	36.1% (33.3%)	25.6 - 40.7% (16.6 - 35.4%)
Minor Problem	37.0% (32.2%)	58.1% (37.8%)	47.2% (43.5%)	37.0 - 58.1% (32.2 - 43.5%)
Not a Problem	18.5% (16.1%)	9.3% (6.0)	12.5% (11.5%)	9.3 - 18.5% (6.0 - 16.1%)
Undecided/ No Opinion	1.9% (1.6%)	4.7% (2.3%)	2.8% (2.5%)	1.9 - 4.7% (1.6 - 2.5%)
Unfamiliar With Concept	1.9% (1.6%)	2.3% (1.4%)	1.4% (1.2%)	1.4 - 2.3% (1.2 - 1.6%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 150

Lack of Understanding by the Courts as to How Scientists Knowledgeable Within an Area Where Conflicting Evidence Exists Would Decide Which Information They Would Find Most Credible*

(Environmental Trials and Other Legal Proceedings)

"Lack of understanding by the courts as to how scientists knowledgeable within the area where conflicting evidence exists would decide which information they would find most credible"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	35.7% (27.7%)	38.7% (27.2%)	53.6% (52.9%)	35.7 - 53.6% (27.2 - 52.9%)
Minor Problem	42.9% (33.3%)	33.9% (23.8%)	35.7% (35.2%)	33.9 - 42.9% (23.8 - 35.2%)
Not a Problem	14.3% (11.1%)	17.7% (12.4%)	3.6% (3.5%)	3.6 - 17.7% (3.5 - 12.4%)
Undecided/ No Opinion	7.1% (5.5%)	9.7% (6.8%)	7.1% (7.0%)	7.1 - 9.7% (5.5 - 7.0%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 151

Lack of Understanding by Administrative Tribunals as to How Scientists Knowledgeable Within an Area Where Conflicting Evidence Exists Would Decide Which Information They Would Find Most Credible*

(Administrative Environmental Hearings)

"Lack of understanding by administrative tribunals as to how scientists knowledgeable within the area where conflicting evidence exists would decide which information they would find most credible"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	38.9% (33.8%)	27.9% (18.1%)	48.6% (44.8%)	27.9 - 48.6% (18.1 - 44.8%)
Minor Problem	31.5% (27.4%)	41.9% (27.3%)	43.1% (39.7%)	31.5 - 43.1% (27.3 - 39.7%)
Not a Problem	22.2% (19.3%)	20.9% (13.6%)	4.2% (3.8%)	4.2 - 22.2% (3.8 - 19.3%)
Undecided/ No Opinion	7.4% (6.4%)	7.0% (4.5%)	2.8% (2.5%)	2.8 - 7.4% (2.5 - 6.4%)
Unfamiliar With Concept	0.0% (0.0%)	2.3% (1.4%)	1.4% (1.2%)	0.0 - 2.3% (0.0 - 1.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 152

Choosing the Scientific Evidence of One Expert Scientific Witness Over Another Based Upon Their Respective Performances in Giving Evidence Rather Than on the Basis of the Scientific Information Itself*

(Environmental Trials and Other Legal Proceedings)

"Choosing the scientific evidence of one expert witness over another based upon their respective "performances" in giving evidence rather than on the basis of the scientific information itself"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	42.9% (33.3%)	51.6% (36.3%)	50.0% (49.4%)	42.9 - 51.6% (33.3 - 49.4%)
Minor Problem	21.4% (16.6%)	45.2% (31.8%)	38.1% (37.6%)	21.4 - 45.2% (16.6 - 37.6%)
Not a Problem	28.6% (22.2%)	1.6% (1.1%)	2.4% (2.3%)	1.6 - 28.6% (1.1 - 22.2%)
Undecided/ No Opinion	7.1% (5.5%)	1.6% (1.1%)	9.5% (9.3%)	1.6 - 9.5% (1.1 - 9.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 153

Choosing the Scientific Evidence of One Expert Scientific Witness Over Another Based Upon Their Respective Performances in Giving Evidence Rather Than on the Basis of the Scientific Information Itself*

(Administrative Environmental Hearing)

"Choosing the scientific evidence of one expert witness over another based upon their respective "performances" in giving evidence rather than on the basis of the scientific information itself"

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	40.7% (35.4%)	46.5% (30.3%)	51.4% (47.4%)	40.7 - 51.4% (30.3 - 47.4%)
Minor Problem	38.9% (33.8%)	41.9% (27.3%)	43.1% (39.7%)	38.9 - 43.1% (27.3 - 39.7%)
Not a Problem	16.7% (14.5%)	11.6% (7.5%)	4.2% (3.8%)	4.2 - 16.7% (3.8 - 14.5%)
Undecided/ No Opinion	1.9% (1.6%)	0.0% (0.0%)	1.4% (1.2%)	0.0 - 1.9% (0.0 - 1.6%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Appendix 5

Establishing Environmental Decision-Making Standards and Translating Scientific Information into Those Standards

Table 154

Problems Exist in the Use of Scientific Information to Establish the Decision-Making Standards Which are Used By the Legal System

(Environmental Trials and Other Legal Proceedings)

"Problems exist in using scientific information to establish the decision-making standards which are used by the legal system in environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	5.6%	11.4%	9.4%	5.6 - 11.4%
Agree	16.7%	36.4%	63.5%	16.7 - 63.5%
Undecided	44.4%	29.5%	21.2%	21.2 - 44.4%
Disagree	33.3%	21.6%	5.9%	5.9 - 33.3%
Strongly Disagree	0.0%	1.1%	0.0%	0.0 - 1.1%

Table 155

Problems Exist in the Use of Scientific Information to Establish the Decision-Making Standards Which are Used By the Legal System

(Administrative Environmental Hearings)

"Problems exist in using scientific information to establish the decision-making standards which are used by the legal system in administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	19.4%	9.1%	11.5%	9.1 - 19.4%
Agree	38.7%	37.9%	60.3%	37.9 - 60.3%
Undecided	21.0%	30.3%	20.5%	20.5 - 30.3%
Disagree	21.0%	18.2%	7.7%	7.7 - 21.0%
Strongly Disagree	0.0%	4.5%	0.0%	0.0 - 4.5%

Table 156

Accuracy of Quantitative Standards Established By Governments in Reflecting the Current State of Available Scientific Information With Respect to the Effects of Pollution on the Environment*

(Environmental Trials and Other Legal Proceedings)

"'Quantitative' standards established by governments which specify prohibited levels of pollution within environmental legislation (for example, prohibiting the "... release of chemical X into the environment in a concentration in excess of 1 part per million") do not accurately reflect the current state of available scientific information with respect to effects of pollution on the environment"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	18.2% (12.1%)	44.1% (34.0%)	51.2% (48.1%)	18.2 - 51.2% (12.1 - 48.1%)
Minor Problem	18.2% (12.1%)	29.4% (22.7%)	31.3% (29.4%)	18.2 - 31.3% (12.1 - 29.4%)
Not a Problem	9.1% (6.0%)	10.3% (7.9%)	12.5% (11.7%)	9.1 - 12.5% (6.0 - 11.7%)
Undecided/ No Opinion	54.5% (36.3%)	16.2% (12.5%)	5.0% (4.7%)	5.0 - 54.5% (4.7 - 36.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 157

Accuracy of Quantitative Standards Established By Governments in Reflecting the Current State of Available Scientific Information With Respect to the Effects of Pollution on the Environment*

(Administrative Environmental Hearings)

"'Quantitative' standards established by governments which specify prohibited levels of pollution within environmental legislation (for example, prohibiting the "... release of chemical X into the environment in a concentration in excess of 1 part per million") do not accurately reflect the current state of available scientific information with respect to effects of pollution on the environment"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	50.0% (39.5%)	39.2% (30.3%)	48.6% (44.8%)	39.2 - 50.0% (30.3 - 44.8%)
Minor Problem	35.4% (28.0%)	27.5% (21.2%)	36.1% (33.3%)	27.5 - 36.1% (21.2 - 33.3%)
Not a Problem	0.0% (0.0%)	11.8% (9.1%)	9.7% (8.9%)	0.0 - 11.8% (0.0 - 9.1%)
Undecided/ No Opinion	14.6% (11.5%)	21.6% (16.6%)	5.6% (5.1%)	5.6 - 21.6% (5.1 - 16.6%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 158

Governments Place Too Little Emphasis on Scientific Information When Establishing Quantitative Standards in Environmental Legislation*

(Environmental Trials And Other Legal Proceedings)

"Governments place too little emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	9.1% (6.0%)	35.3% (27.2%)	36.2% (34.0%)	9.1 - 36.2% (6.0 - 34.0%)
Minor Problem	18.2% (12.1%)	29.4% (22.7%)	40.0% (37.6%)	18.2 - 40.0% (12.1 - 37.6%)
Not a Problem	0.0% (0.0%)	22.1% (17.0%)	13.7% (12.8%)	0.0 - 22.1% (0.0 - 17.0%)
Undecided/ No Opinion	72.7% (48.4%)	13.2% (10.2%)	10.0% (9.4%)	10.0 - 72.7% (9.4 - 48.4%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 159

Governments Place Too Little Emphasis on Scientific Information When Establishing Quantitative Standards In Environmental Legislation*

(Administrative Environmental Hearings)

"Governments place too little emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	35.4% (28.0%)	29.4% (22.7%)	43.7% (40.3%)	29.4 - 43.7% (22.7 - 40.3%)
Minor Problem	22.9% (18.1%)	29.4% (22.7%)	29.6% (27.3%)	22.9 - 29.6% (18.1 - 27.3%)
Not a Problem	16.7% (13.2%)	21.6% (16.6%)	21.1% (19.4%)	16.7 - 21.6% (13.2 - 19.4%)
Undecided/ No Opinion	25.0% (19.7%)	19.6% (15.1%)	5.6% (5.1%)	5.6 - 25.0% (5.1 - 19.7%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 160

Governments Place Too Much Emphasis on Scientific Information When Establishing Quantitative Standards In Environmental Legislation*

(Environmental Trials and Other Legal Proceedings)

"Governments place too much emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	0.0% (0.0%)	5.9% (4.5%)	1.2% (1.1%)	0.0 - 5.9% (0.0 - 4.5%)
Minor Problem	0.0% (0.0%)	11.8% (9.1%)	11.2% (10.5%)	0.0 - 11.8% (0.0 - 10.5%)
Not a Problem	18.2% (12.1%)	66.2% (51.1%)	71.2% (66.9%)	18.2 - 71.2% (12.1 - 66.9%)
Undecided/ No Opinion	81.8% (54.5%)	16.2% (12.5%)	15.0% (14.1%)	15.0 - 81.8% (12.5 - 54.5%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.2% (1.1%)	0.0 - 1.2% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 161

Governments Place Too Much Emphasis on Scientific Information When Establishing Quantitative Standards In Environmental Legislation*

(Administrative Environmental Hearings)

"Governments place too much emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	4.2% (3.3%)	7.8% (6.0%)	2.8% (2.5%)	2.8 - 7.8% (2.5 - 6.0%)
Minor Problem	14.6% (11.5%)	13.7% (10.5%)	18.1% (16.7%)	13.7 - 18.1% (10.5 - 16.7%)
Not a Problem	56.3% (44.5%)	58.8% (45.4%)	69.4% (64.0%)	56.3 - 69.4% (44.5 - 64.0%)
Undecided/ No Opinion	25.0% (19.7%)	19.6% (15.1%)	9.7% (8.9%)	9.7 - 25.0% (8.9 - 19.7%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 162

Recommendations in the Setting of Quantitative Standards Within Environmental Legislation May Not Accurately Reflect the Current State of Scientific Information*

(Environmental Trials and Other Legal Proceedings)

"Out of a concern that governments may place too much or too little emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation, scientific experts providing advice to governments in the setting of such standards may make recommendations which do not accurately reflect the current state of scientific information (for example, recommending lower concentrations of pollution than are scientifically justifiable to ensure that adequate safety is maintained)"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	0.0% (0.0%)	23.9% (18.4%)	27.5% (25.8%)	0.0 - 27.5% (0.0 - 25.8%)
Minor Problem	33.3% (22.2%)	25.4% (19.6%)	41.2% (38.7%)	25.4 - 41.2% (19.6 - 38.7%)
Not a Problem	8.3% (5.5%)	14.9% (0.9%)	20.0% (18.8%)	8.3 - 20.0% (0.9 - 18.8%)
Undecided/ No Opinion	58.3% (38.8%)	34.3% (26.5%)	10.0% (9.4%)	10.0 - 58.3% (9.4 - 38.8%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.1%)	1.2% (1.1%)	0.0 - 1.5% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 163

Recommendations in the Setting of Quantitative Standards Within Environmental Legislation May Not Accurately Reflect the Current State of Scientific Information*

(Administrative Environmental Hearings)

"Out of a concern that governments may place too much or too little emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation, scientific experts providing advice to governments in the setting of such standards may make recommendations which do not accurately reflect the current state of scientific information (for example, recommending lower concentrations of pollution than are scientifically justifiable to ensure that adequate safety is maintained)"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	31.3% (24.7%)	25.5% (19.7%)	15.3% (14.1%)	15.3 - 31.3% (14.1 - 24.7%)
Minor Problem	31.3% (24.7%)	29.4% (22.7%)	36.1% (33.3%)	29.4 - 36.1% (22.7 - 33.3%)
Not a Problem	12.5% (9.8%)	15.7% (12.1%)	25.0% (23.0%)	12.5 - 25.0% (9.8 - 23.0%)
Undecided/ No Opinion	25.0% (19.7%)	27.5% (21.2%)	22.2% (20.4%)	22.2 - 27.5% (19.7 - 21.2%)
Unfamiliar With Concept	0.0% (0.0%)	2.0% (1.5%)	1.4% (1.2%)	0.0 - 2.0% (0.0 - 1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 164

Problems Exist in Translating Scientific Information into Environmental Decision-Making Standards

(Environmental Trials And Other Legal Proceedings)

"Problems exist in translating scientific information into the decision-making standards which are used by the legal system in environmental trials and other legal proceedings"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	5.6%	5.7%	14.3%	5.6 - 14.3%
Agree	33.3%	51.1%	64.3%	33.3 - 64.3%
Undecided	38.9%	19.3%	15.5%	15.5 - 38.9%
Disagree	22.2%	23.9%	6.0%	6.0 - 23.9%
Strongly Disagree	0.0%	0.0%	0.0%	0.0%

Table 165

Problems Exist in Translating Scientific Information into Environmental Decision-Making Standards

(Administrative Environmental Hearings)

"Problems exist in translating scientific information into the decision-making standards which are used in administrative environmental hearings"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	11.1%	6.1%	11.5%	6.1 - 11.5%
Agree	46.0%	47.0%	60.3%	46.0 - 60.3%
Undecided	20.6%	19.7%	21.8%	19.7 - 21.8%
Disagree	22.2%	24.2%	6.4%	6.4 - 24.2%
Strongly Disagree	0.0%	3.0%	0.0%	0.0 - 3.0%

Table 166

Relating Scientific Information Provided in The Form of Expert Evidence to Quantitative Standards Found Within Environmental Legislation*

(Environmental Trials and Other Legal Proceedings)

"Relating the scientific information provided in the form of expert evidence at environmental trials and other legal proceedings to the "quantitative" standards found within environmental legilsation which specify prohibited levels of pollution (for example, prohibiting the "... release of chemical X into the environment in a concentration in excess of 1 part per million")"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	14.3% (11.1%)	13.4% (10.1%)	26.6% (25.0%)	13.4 - 26.6% (10.1 - 25.0%)
Minor Problem	35.7% (27.7%)	49.3% (37.5%)	44.3% (41.6%)	35.7 - 49.3% (27.7 - 41.6%)
Not a Problem	21.4% (16.6%)	23.9% (18.1%)	20.3% (19.1%)	20.3 - 23.9% (16.6 - 19.1%)
Undecided/ No Opinion	28.6% (22.2%)	11.9% (9.0%)	8.9% (8.3%)	8.9 - 28.6% (8.3 - 22.2%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.1%)	0.0% (0.0%)	0.0 - 1.5% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 167

Relating Scientific Information Provided in the Form of Expert Evidence to Quantitative Standards Found Within Environmental Legislation*

(Administrative Environmental Hearings)

"Relating the scientific information provided in the form of expert evidence at administrative environmental hearings to the "quantitative" standards found within environmental legilsation which specify prohibited levels of pollution (for example, prohibiting the "... release of chemical X into the environment in a concentration in excess of 1 part per million")"

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	28.6% (22.2%)	10.4% (7.5%)	27.4% (25.6%)	10.4 - 28.6% (7.5 - 25.6%)
Minor Problem	40.8% (31.7%)	52.1% (37.9%)	47.9% (44.8%)	40.8 - 52.1% (31.7 - 44.8%)
Not a Problem	16.3% (12.6%)	18.8% (13.6%)	11.0% (10.2%)	11.0 - 18.8% (10.2 - 13.6%)
Undecided/ No Opinion	14.3% (11.1%)	16.7% (12.1%)	13.7% (12.8%)	13.7 - 16.7% (11.1 - 12.8%)
Unfamiliar With Concept	0.0% (0.0%)	2.1% (1.5%)	0.0% (0.0%)	0.0 - 2.1% (0.0 - 1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 168

Relating Scientific Information Provided in the Form of Expert Evidence to Normative Standards Found Within Environmental Legislation*

(Environmental Trials and Other Legal Proceedings)

"Relating scientific information provided in the form of expert evidence at environmental trials to the "normative" (non-quantitative) standards found within environmental legislation (for example, prohibitions against causing "... a negative environmental impact" or "... harm to fish habitat" which do not specify prohibited levels of pollution)"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	21.4% (16.6%)	44.8% (34.0%)	51.9% (48.8%)	21.4 - 51.9% (16.6 - 48.8%)
Minor Problem	42.9% (33.3%)	41.8% (31.8%)	34.2% (32.1%)	34.2 - 42.9% (31.8 - 33.3%)
Not a Problem	21.4% (16.6%)	4.5% (3.4%)	1.3% (1.2%)	1.3 - 21.4% (1.2 - 16.6%)
Undecided/ No Opinion	14.3% (11.1%)	7.5% (5.7%)	12.7% (11.9%)	7.5 - 14.3% (5.7 - 11.9%)
Unfamiliar With Concept	0.0% (0.0%)	1.5% (1.1%)	0.0% (0.0%)	0.0 - 1.5% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 169

Relating Scientific Information Provided in the Form of Expert Evidence to Normative Standards Found Within Environmental Legislation*

(Administrative Environmental Hearings)

"Relating scientific information provided in the form of expert evidence at administrative environmental hearings to the "normative" (non-quantitative) standards found within environmental legislation (for example, prohibitions against causing "... a negative environmental impact" or "... harm to fish habitat" which do not specify prohibited levels of pollution)"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	55.1% (42.8%)	31.3% (22.7%)	39.7% (37.1%)	31.3 - 55.1% (22.7 - 42.8%)
Minor Problem	26.5% (20.5%)	52.1% (37.9%)	43.8% (40.9%)	26.5 - 52.1% (20.5 - 40.9%)
Not a Problem	8.2% (6.3%)	4.2% (3.0%)	2.7% (2.5%)	2.7 - 8.2% (2.5 - 6.3%)
Undecided/ No Opinion	8.2% (6.3%)	10.4% (7.5%)	13.7% (12.8%)	8.2 - 13.7% (6.3 - 12.8%)
Unfamiliar With Concept	2.0% (1.5%)	2.1% (1.5%)	0.0% (0.0%)	0.0 - 2.1% (0.0 - 1.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Appendix 6

Suitability of Legal Institutions and Procedures for the Resolution of Scientific Issues in Environmental Decision-Making

Table 170

Problems Exist in the Use of Legal Decision-Making Institutions (Such as Courts of Law) and Legal Procedures (Such as Rules of Court and Rules of Evidence) for the Resolution of Scientific Issues in Environmental Decision-Making

(Environmental Trials and Other Legal Proceedings)

"Problems exist in the use of legal decision-making institutions (such as courts of law) and legal procedures (such as rules of court and rules of evidence) for the resolution of scientific issues in environmental decision-making."				
	Judges	Legal Counsel	Expert Scientific Witnesses*	Range
Strongly Agree	5.6%	6.8%	22.4%	5.6 - 22.4%
Agree	55.6%	45.5%	62.4%	45.5 - 62.4%
Undecided	16.7%	14.8%	12.9%	12.9 - 16.7%
Disagree	11.1%	29.5%	0.0%	0.0 - 29.5%
Strongly Disagree	11.1%	3.4%	1.2%	1.2 - 11.1%

Table 171

Problems Exist in the Use of Administrative Decision-Making Institutions (Such as Administrative Tribunals) and Administrative Procedures (Such as Rules of Administrative Procedure) for the Resolution of Scientific Issues in Environmental Decision-Making

(Administrative Environmental Hearings)

"Problems exist in the use of administrative decision-making institutions (such as administrative tribunals) and administrative procedures (such as rules of administrative procedure) for the resolution of scientific issues in environmental decision-making."

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Strongly Agree	9.5%	3.0%	12.8%	3.0 - 12.8%
Agree	49.2%	42.4%	67.9%	42.4 - 67.9%
Undecided	17.5%	21.2%	14.1%	14.1 - 21.2%
Disagree	19.0%	28.8%	5.1%	5.1 - 28.8%
Strongly Disagree	4.8%	4.5%	0.0%	0.0 - 4.8%

Table 172

Existing Legal Environmental Decision-Making Process is Poorly Suited to Address Scientific Issues*

(Environmental Trials and Other Legal Proceedings)

"The existing legal process is poorly suited to address scientific issues"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Combined Average
Major Problem	35.7% (7.8%)	33.9% (22.7%)	60.2% (58.8%)	33.9 - 60.2% (7.8 - 58.8%)
Minor Problem	35.7% (27.8%)	45.8% (30.7%)	28.9% (28.2%)	28.9 - 45.8% (27.8 - 30.7%)
Not a Problem	14.3% (11.1%)	13.6% (9.1%)	1.2% (1.1%)	1.2 - 14.3% (1.1 - 11.1%)
Undecided/ No Opinion	14.3% (11.1%)	6.8% (4.5%)	9.6% (9.3%)	6.8 - 14.3% (4.5 - 11.1%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 173

Existing Administrative Environmental Decision-Making Process is Poorly Suited to Address Scientific Issues*

(Administrative Environmental Hearings)

"The existing administrative environmental decision-making process is poorly suited to address scientific issues"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	33.3% (25.3%)	20.5% (13.6%)	41.1% (38.9%)	20.5 - 41.1% (13.6 - 38.9%)
Minor Problem	41.7% (31.7%)	50.0% (33.3%)	47.9% (45.4%)	41.7 - 50.0% (31.7 - 45.4%)
Not a Problem	18.8% (14.3%)	25.0% (16.6%)	5.5% (5.2%)	5.5 - 25.0% (5.2 - 16.6%)
Undecided/ No Opinion	6.3% (4.8%)	4.5% (2.9%)	5.5% (5.2%)	4.5 - 6.3% (2.9 - 5.2%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 174

Courts of Law are Unable to Effectively Use Scientific Information in Environmental Decision-Making*

(Environmental Trials and Other Legal Proceedings)

"Courts of law are unable to effectively use scientific information in environmental decision-making"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	14.3% (11.1%)	18.6% (12.4%)	34.9% (34.0%)	14.3 - 34.9% (11.1 - 34.0%)
Minor Problem	28.6% (22.2%)	49.2% (33.0%)	42.2% (41.2%)	28.6 - 49.2% (22.2 - 41.2%)
Not a Problem	50.0% (38.9%)	25.4% (17.0%)	14.5% (14.1%)	14.5 - 50.0% (14.1 - 38.9%)
Undecided/ No Opinion	7.1% (5.5%)	6.8% (4.5%)	8.4% (8.2%)	6.8 - 8.4% (4.5 - 8.2%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 175

Administrative Tribunals are Unable to Effectively Use Scientific Information in Environmental Decision-Making*

(Administrative Environmental Hearings)

"Administrative tribunals are unable to effectively use scientific information in environmental decision-making"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	23.4% (17.8%)	11.4% (7.5%)	31.1% (29.4%)	11.4 - 31.1% (7.5 - 29.4%)
Minor Problem	21.3% (16.2%)	40.9% (27.2%)	45.9% (43.5%)	21.3 - 45.9% (16.2 - 43.5%)
Not a Problem	36.5% (27.8%)	43.2% (28.7%)	18.9% (17.9%)	18.9 - 43.2% (17.9 - 28.7%)
Undecided/ No Opinion	6.4% (4.8%)	4.5% (2.9%)	4.1% (3.8%)	4.1 - 6.4% (2.9 - 4.8%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 176

Adversarial System Promotes a Confrontational Climate Which Inhibits Obtaining a Consensus in Resolving Scientific Issues*

(Environmental Trials and Other Legal Proceedings)

"The use of the legal adversarial approach in environmental trials and other legal proceedings promotes a confrontational climate which inhibits obtaining a consensus in resolving scientific issues"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	35.7% (27.8%)	40.7% (27.4%)	69.9% (68.2%)	35.7 - 69.9% (27.4 - 68.2%)
Minor Problem	50.0% (38.9%)	37.3% (25.0%)	19.3% (18.8%)	19.3 - 50.0% (18.8 - 38.9%)
Not a Problem	14.3% (11.1%)	16.9% (11.3%)	4.8% (4.6%)	4.8 - 16.9% (4.6 - 11.3%)
Undecided/ No Opinion	0.0% (0.0%)	5.1% (3.4%)	4.8% (4.6%)	0.0 - 5.1% (0.0 - 4.6%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.2% (1.1%)	0.0 - 1.2% (0.0 - 1.1%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 177

Adversarial System Promotes a Confrontational Climate Which Inhibits Obtaining a Consensus in Resolving Scientific Issues*

(Administrative Environmental Hearings)

"The use of the legal adversarial approach in administrative environmental hearings promotes a confrontational climate which inhibits obtaining a consensus in resolving scientific issues"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	67.4% (51.3%)	25.0% (16.6%)	67.6% (64.0%)	25.0 - 67.6% (16.6 - 64.0%)
Minor Problem	23.9% (18.2%)	43.2% (28.7%)	28.4% (26.9%)	23.9 - 43.2% (18.2 - 28.7%)
Not a Problem	6.5% (4.9%)	29.5% (19.6%)	2.7% (2.5%)	2.7 - 29.5% (2.5 - 19.6%)
Undecided/ No Opinion	2.2% (1.6%)	2.3% (1.5%)	1.4% (1.3%)	1.4 - 2.3% (1.3 - 1.6%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 178

Motivations of Expert Scientific Witnesses and Legal Counsel are Incompatible*

(Environmental Trials and Other Legal Proceedings)

"The motivations of expert scientific witnesses and legal counsel in environmental trials and other legal proceedings are incompatible, in that the primary goal of scientists is the attainment of scientific truth, whereas the primary objective of legal counsel is to resolve jurisprudential disputes which may contain scientific issues"

	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	42.9% (33.4%)	25.4% (17.0%)	54.2% (52.9%)	25.4 - 54.2% (17.0 - 52.9%)
Minor Problem	35.7% (27.8%)	42.4% (28.4%)	27.7% (27.0%)	27.7 - 42.4% (27.0 - 28.4%)
Not a Problem	7.1% (5.5%)	23.7% (15.9%)	9.6% (9.3%)	7.1 - 23.7% (5.5 - 15.9%)
Undecided/ No Opinion	7.1% (5.5%)	8.5% (5.7%)	7.2% (7.0%)	7.1 - 8.5% (5.5 - 7.0%)
Unfamiliar With Concept	7.1% (5.5%)	0.0% (0.0%)	0.0% (0.0%)	0.0 - 7.1% (0.0 - 5.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 179

Motivations of Expert Scientific Witnesses and Legal Counsel are Incompatible*

(Administrative Environmental Hearings)

"The motivations of expert scientific witnesses and legal counsel" in administrative environmental hearings are incompatible, in that the primary goal of scientists is the attainment of scientific truth, whereas the primary objective of legal counsel is to resolve jurisprudential disputes which may contain scientific issues"

	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	50.0% (38.1%)	22.7% (15.1%)	50.0% (47.4%)	22.7 - 50.0% (15.1 - 47.4%)
Minor Problem	25.0% (19.0%)	31.8% (21.1%)	35.1% (33.2%)	25.0 - 35.1% (19.0 - 33.2%)
Not a Problem	16.7% (12.7%)	40.9% (27.2%)	10.8% (10.2%)	10.8 - 40.9% (10.2 - 27.2%)
Undecided/ No Opinion	8.3% (6.3%)	4.5% (2.9%)	2.7% (2.5%)	2.7 - 8.3% (2.5 - 6.3%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.4% (1.3%)	0.0 - 1.4% (0.0 - 1.3%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 180

Decisions by Courts of Law are Final and Can Not be Reopened/Reconsidered*

(Environmental Trials and Other Legal Proceedings)

"Decisions by courts of law are final and can not be reopened/reconsidered at a later date, even if the scientific information upon which a decision is based is later found to be incorrect"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	21.4% (16.6%)	30.5% (29.4%)	34.9% (34.0%)	21.4 - 34.9% (16.6 - 34.0%)
Minor Problem	28.6% (22.2%)	27.1% (18.1%)	32.5% (31.7%)	27.1 - 32.5% (18.1 - 31.7%)
Not a Problem	21.4% (16.6%)	32.2% (21.6%)	12.0% (11.7%)	12.0 - 32.2% (11.7 - 21.6%)
Undecided/ No Opinion	21.4% (16.6%)	8.5% (5.7%)	14.5% (14.1%)	8.5 - 21.4% (5.7 - 16.6%)
Unfamiliar With Concept	7.1% (5.5%)	1.7% (1.1%)	6.0% (5.8%)	1.7 - 7.1% (1.1 - 5.8%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 181

Decisions By Administrative Tribunals are Final and Can Not be Reopened/Reconsidered*

(Administrative Environmental Hearings)

"Decisions by administrative tribunals are final and can not be reopened/reconsidered at a later date, even if the scientific information upon which a decision is based is later found to be incorrect"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	21.3% (16.2%)	18.2% (12.1%)	39.2% (37.1%)	18.2 - 39.2% (12.1 - 37.1%)
Minor Problem	31.9% (24.3%)	29.5% (19.6%)	24.3% (23.0%)	24.3 - 31.9% (19.6 - 24.3%)
Not a Problem	29.8% (22.7%)	40.9% (27.2%)	18.9% (17.9%)	18.9 - 40.9% (17.9 - 27.2%)
Undecided/ No Opinion	14.9% (11.3%)	11.4% (7.5%)	10.8% (10.2%)	10.8 - 14.9% (7.5 - 11.3%)
Unfamiliar With Concept	2.1% (1.6%)	0.0% (0.0%)	6.8% (6.4%)	0.0 - 6.8% (0.0 - 6.4%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 182

Decisions by Courts of Law Fail to Acknowledge Scientific Uncertainty*

(Environmental Trials and Other Legal Proceedings)

"Decisions by courts of law often fail to acknowledge that a degree of "uncertainty" with respect to scientific issues may exist, thereby giving a false sense of scientific certainty to a decision"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	21.4% (16.6%)	37.3% (25.0%)	45.8% (44.7%)	21.4 - 45.8% (16.6 - 44.7%)
Minor Problem	35.7% (27.8%)	35.6% (23.8%)	38.6% (37.7%)	35.6 - 38.6% (23.8 - 37.7%)
Not a Problem	14.3% (11.1%)	20.3% (13.6%)	7.2% (7.0%)	7.2 - 20.3% (7.0 - 13.6%)
Undecided/ No Opinion	21.4% (16.6%)	6.8% (4.5%)	7.2% (7.0%)	6.8 - 21.4% (4.5 - 16.6%)
Unfamiliar With Concept	7.1% (5.5%)	0.0% (0.0%)	1.2% (1.1%)	0.0 - 7.1% (0.0 - 5.5%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 183

Decisions by Administrative Tribunals Fail to Acknowledge Scientific Uncertainty*

(Administrative Environmental Hearings)

"Decisions by administrative tribunals often fail to acknowledge that a degree of "uncertainty" with respect to scientific issues may exist, thereby giving a false sense of scientific certainty to a decision"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	37.5% (28.5%)	31.8% (21.1%)	37.8% (35.8%)	31.8 - 37.8% (21.1 - 35.8%)
Minor Problem	39.6% (30.1%)	36.4% (24.2%)	43.2% (40.9%)	36.4 - 43.2% (24.2 - 40.9%)
Not a Problem	20.8% (15.8%)	25.0% (16.6%)	12.2% (11.5%)	12.2 - 25.0% (11.5 - 16.6%)
Undecided/ No Opinion	2.1% (1.6%)	6.8% (4.5%)	5.4% (5.1%)	2.1 - 6.8% (1.6 - 5.1%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	1.4% (1.3%)	0.0 - 1.4% (0.0 - 1.3%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Table 184

Financial Costs Associated With Using Courts of Law for the Resolution of Scientific Issues in Environmental Decision-Making*

(Environmental Trials and Other Legal Proceedings)

"The financial costs associated with using courts of law for the resolution of scientific issues in environmental decision-making are too high"				
	Judges	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	42.9% (33.4%)	66.1% (51.4%)	61.4% (59.9%)	42.9 - 66.1% (33.4 - 59.9%)
Minor Problem	28.6% (22.2%)	15.3% (11.9%)	14.5% (14.1%)	14.5 - 28.6% (11.9 - 22.2%)
Not a Problem	7.1% (5.5%)	13.6% (10.5%)	6.0% (5.8%)	6.0 - 13.6% (5.5 - 10.5%)
Undecided/ No Opinion	21.4% (16.6%)	5.1% (3.4%)	15.7% (15.3%)	5.1 - 21.4% (3.4 - 16.6%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	2.4% (2.2%)	0.0 - 2.4% (0.0 - 2.2%)

Table 185

Financial Costs Associated With Using Administrative Tribunals for the Resolution of Scientific Issues in Environmental Decision-Making*

(Administrative Environmental Hearings)

"The financial costs associated with using administrative tribunals for the resolution of scientific issues in environmental decision-making are too high"				
	Administrative Tribunals	Legal Counsel	Expert Scientific Witnesses	Range
Major Problem	41.7% (31.7%)	45.5% (30.3%)	40.5% (38.3%)	40.5 - 45.5% (30.3 - 38.3%)
Minor Problem	33.3% (25.3%)	25.0% (16.6%)	32.4% (30.7%)	25.0 - 33.3% (16.6 - 30.7%)
Not a Problem	16.7% (12.7%)	25.0% (16.6%)	13.5% (12.7%)	13.5 - 25.0% (12.7 - 16.6%)
Undecided/ No Opinion	8.3% (6.3%)	4.5% (2.9%)	13.5% (12.8%)	4.5 - 13.5% (2.9 - 12.8%)
Unfamiliar With Concept	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)	0.0% (0.0%)

*Data without Brackets = Eligible Response % / Data within Brackets = Total Response %

Appendix 7

Quantitative Analysis of Research Data

7.1 Category 1 Results: Problems Meeting Threshold Level of Concern and Meeting a Threshold Level of Consensus

Responses to Research Survey questions which met the Threshold Level of Concern while also meeting the Threshold Level of Consensus are set out below.

Survey Question	Table	Inter face #
"Problems exist in environmental trials and other legal proceedings with respect to the quality of scientific information provided in the form of expert evidence by expert scientific witnesses." (Initial filter question) (Judges 56% / Legal Counsel 59% / Expert Scientific Witnesses 68%)	2	1
"Problems exist in administrative environmental hearings with respect to the quality of scientific information provided in the form of expert evidence by expert scientific witnesses." (Initial filter question) (Tribunal Members 62% / Legal Counsel 64% / Expert Scientific Witnesses 79%)	3	1
"Inadequate understanding by expert scientific witnesses of the trial or other legal proceeding in which they are participating." (Follow-up question) (Judges 61% / Legal Counsel 51% / Expert Scientific Witnesses 43%)	4	1
"Inadequate understanding by expert scientific witnesses of the administrative environmental hearing process in which they are participating." (Tribunal Members 56% / Legal Counsel 48% / Expert Scientific Witnesses 54%)	5	1

Survey Question	Table	Inter face #
"The inability of expert scientific witnesses to function effectively within the adversarial system used in environmental trials and other legal proceedings." (Follow-up question) (Judges 44% / Legal Counsel 59% / Expert Scientific Witnesses 65%)	6	1
"The inability of expert scientific witnesses to function effectively within the adversarial system used in administrative environmental hearings." (Follow-up question) (Tribunal Members 59% / Legal Counsel 58% / Expert Scientific Witnesses 72%)	7	1
"A competitiveness factor, wherein expert scientific witnesses are motivated to attempt to "win" environmental trials and other legal proceedings and "defeat" opposing parties (and their expert scientific witnesses) involved in the litigation." (Follow-up question) (Judges 67% / Legal Counsel 51% / Expert Scientific Witnesses 54%)	8	
"A competitiveness factor, wherein expert scientific witnesses are motivated to attempt to "win" administrative environmental hearings and "defeat" opposing parties (and their expert scientific witnesses) involved in the litigation." (Follow-up question) (Tribunal Members 65% / Legal Counsel 56% / Expert Scientific Witnesses 70%)	9	1
"A desire by expert scientific witnesses to have specific scientific theories or models validated/recognized by administrative decision-making bodies." (Follow-up question) (Tribunal Members 57% / Legal Counsel 41% / Expert Scientific Witnesses 52%)	13	1
"The 'compartmentalization' of the roles played by expert scientific witnesses in environmental trials and other legal proceedings, wherein expert scientific witnesses provide scientific evidence within their areas of expertise without a full appreciation of the factual scientific context of the hearing in which they are participating." (Follow-up question) (Tribunal Members 59% / Legal Counsel 47% / Expert Scientific Witnesses 65%)	17	

Survey Question	Table	Inter face #
"Problems exist in environmental trials and other legal proceedings with respect to the communication of scientific information provided in the form of expert evidence by expert scientific witnesses." (Initial filter question) (Judges 61% / Legal Counsel 61% / Expert Scientific Witnesses 81%)	62	2
"Problems exist in administrative environmental hearings with respect to the communication of scientific information provided in the form of expert evidence by expert scientific witnesses." (Initial filter question) (Tribunal Members 57% / Legal Counsel 56% / Expert Scientific Witnesses 77%)	63	2
"The use of technical language including jargon and terms of art which may not be understood by participants in environmental trials and other legal proceedings such as judges and legal counsel." (Judges 72% / Legal Counsel 68% / Expert Scientific Witnesses 84%)	64	2
"The use of technical language including jargon and terms of art which may not be understood by participants in administrative environmental hearings such as tribunal members and legal counsel." (Tribunal Members 63% / Legal Counsel 67% / Expert Scientific Witnesses 87%)	65	2
"The failure of expert scientific witnesses to effectively communicate scientific information to participants in environmental trials and other legal proceedings such as judges and legal counsel." (Judges 72% / Legal Counsel 67% / Expert Scientific Witnesses 85%)	66	2
"Problems exist in environmental trials and other legal proceedings with respect to the comprehension/understanding by the courts and/or legal counsel of scientific information provided in the form of expert evidence by expert scientific witnesses." (Initial filter question) (Judges 56% / Legal Counsel 73% / Expert Scientific Witnesses 79%)	78	2

Survey Question	Table	Inter face #
"Problems exist in administrative environmental hearings with respect to the comprehension/understanding by administrative tribunals and/or legal counsel of scientific information provided in the form of expert evidence by expert scientific witnesses." (Initial filter question) (Tribunal Members 56% / Legal Counsel 56% / Expert Scientific Witnesses 77%)	79	2
"The courts do not sufficiently understand the methods of scientific inquiry and proof." (Follow-up question) (Judges 56% / Legal Counsel 73% / Expert Scientific Witnesses 79%)	80	2
"Legal counsel do not sufficiently understand the methods of scientific inquiry and proof." (Follow-up question) (Judges 61% / Legal Counsel 61% / Expert Scientific Witnesses 72%)	82	2
"Legal counsel do not sufficiently understand the methods of scientific inquiry and proof." (Follow-up question) (Tribunal Members 56% / Legal Counsel 54% / Expert Scientific Witnesses 77%)	83	2
"The courts do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses." (Judges 61% / Legal Counsel 67% / Expert Scientific Witnesses 79%)	84	2
"Legal counsel do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses." (Follow-up question) (Judges 61% / Legal Counsel 67% / Expert Scientific Witnesses 79%)	86	2
"Legal counsel do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses." (Follow-up question). (Tribunal Members 65% / Legal Counsel 59% / Expert Scientific Witnesses 81%)	87	2
"The courts do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses." (Follow-up question) (Judges 61% / Legal Counsel 59% / Expert Scientific Witnesses 75%)	88	2

Survey Question	Table	Inter face #
"Legal counsel do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses." (Follow-up question) (Judges 56% / Legal Counsel 59% / Expert Scientific Witnesses 70%)	90	2
"Legal counsel do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses." (Follow-up question) (Tribunal Members 56% / Legal Counsel 53% / Expert Scientific Witnesses 71%)	91	2
"Legal counsel do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses." (Follow-up question) (Tribunal Members 59% / Legal Counsel 57% / Expert Scientific Witnesses 72%)	95	2
"Reliance by the courts on cross-examination for the purposes of clarifying and testing expert scientific evidence creates a problem in circumstances where cross-examination is not conducted or is not effectively conducted." (Follow-up question) (Judges 72% / Legal Counsel 66% / Expert Scientific Witnesses 68%)	96	2
"Reliance by the courts on cross-examination for the purposes of clarifying and testing expert scientific evidence creates a problem in circumstances where cross-examination is not conducted or is not effectively conducted." (Follow-up question) (Tribunal Members 62% / Legal Counsel 56% / Expert Scientific Witnesses 77%)	97	2
"Problems exist in environmental trials and other legal proceedings where the scientific information provided in the form of expert evidence results in uncertainty with respect to one or more scientific issues." (Initial filter question) (Judges 78% / Legal Counsel 60% / Expert Scientific Witnesses 84%)	128	3

Survey Question	Table	Inter face #
"Translating the level of scientific certainty and uncertainty found within scientific information provided in the form of expert evidence at administrative environmental hearings into the level of legal certainty and uncertainty required to meet the standards of proof required by administrative environmental hearings." (Follow-up question) (Tribunal Members 79% / Legal Counsel 71% / Expert Scientific Witnesses 91%)	131	3
"Where it appears that scientific information necessary to reduce or eliminate the uncertainty relating to a scientific issue is available, but such information is not presented as evidence at an environmental trial or other legal proceeding." (Follow-up question) (Judges 56% / Legal Counsel 47% / Expert Scientific Witnesses 66%)	132	3
"Assigning evidentiary weight to the contradictory or conflicting scientific information." (Judges 67% / Legal Counsel 63% / Expert Scientific Witnesses 76%)	146	3
"Distinguishing between scientific information which is widely accepted in the scientific community from minority views, new theories or what is commonly referred to as 'junk science'." (Follow-up question) (Judges 61% / Legal Counsel 64% / Expert Scientific Witnesses 82%)	148	3
"Distinguishing between scientific information which is widely accepted in the scientific community from minority views, new theories or what is commonly referred to as 'junk science'." (Follow-up question) (Tribunal Members 68% / Legal Counsel 54% / Expert Scientific Witnesses 77%)	149	3
"Problems exist in translating scientific information into the decision-making standards which are used by the legal system in administrative environmental hearings." (Initial filter question) (Tribunal Members 57% / Legal Counsel 53% / Expert Scientific Witnesses 72%)	165	4

Survey Question	Table	Inter face #
"Relating scientific information provided in the form of expert evidence at administrative environmental hearings to the 'normative' (non-quantitative) standards found within environmental legislation (for example, prohibitions against causing "... a negative environmental impact" or "... harm to fish habitat" which do not specify prohibited levels of pollution) to constitute either a major or minor problem at administrative environmental hearings." (Follow-up question) (Tribunal Members 63% / Legal Counsel 61% / Expert Scientific Witnesses 78%)	169	4
"The financial costs associated with using courts of law for the resolution of scientific issues in environmental decision-making are too high." (Follow-up question) (Judges 56% / Legal Counsel 63% / Expert Scientific Witnesses 74%)	184	5
"The financial costs associated with using administrative tribunals for the resolution of scientific issues in environmental decision-making are too high." (Follow-up question) (Tribunal Members 57% / Legal Counsel 47% / Expert Scientific Witnesses 69%)	185	5

7.2 Category 2 Results: Problems Meeting a Threshold Level of Concern and Meeting a Threshold Level of Discord

Responses to Research Survey questions which met the Threshold Level of Concern while also meeting the Threshold Level of Discord are set out below.

Survey Question	Table	Interface #
"The failure of expert scientific witnesses to effectively communicate scientific information to participants in administrative environmental hearings such as tribunal members and legal counsel." (Follow-up question) (Tribunal Members 63% / Legal Counsel 64% / Expert Scientific Witnesses 90%)	67	2
"The distortion of scientific information as a result of the use of cross-examination by opposing legal counsel." (Follow-up question) (Judges 55% / Legal Counsel 55% / Expert Scientific Witnesses 83%)	69	2
"The meanings to be attributed to technical terms (such as jargon and terms of art) may vary between expert scientific witnesses (for example, the meaning which a civil engineer associates with the term "physical stress" may be very different from the definition of that term which would be provided by a biologist)." (Follow-up question) (Judges 72% / Legal Counsel 53% / Expert Scientific Witnesses 80%)	70	2
"The meanings to be attributed to technical terms (such as jargon and terms of art) may vary between expert scientific witnesses (for example, the meaning which a civil engineer associates with the term "physical stress" may be very different from the definition of that term which would be provided by a biologist)." (Follow-up question) (Tribunal Members 55% / Legal Counsel 47% / Expert Scientific Witnesses 81%)	71	2
"Administrative tribunals do not sufficiently understand the methods of scientific inquiry and proof." (Follow-up question) (Tribunal Members 44% / Legal Counsel 53% / Expert Scientific Witnesses 73%)	81	2
"Administrative tribunals do not comprehend the merits and pitfalls of statistical analysis provided by expert scientific witnesses." (Follow-up question) (Tribunal Members 56% / Legal Counsel 54% / Expert Scientific Witnesses 85%)	85	2

Survey Question	**Table**	**Interface #**
"Administrative tribunals do not comprehend the value premises and professional biases which underlie scientific information provided by expert scientific witnesses." (Follow-up question) (Tribunal Members 52% / Legal Counsel 50% / Expert Scientific Witnesses 77%)	89	2
"The courts do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses." (Follow-up question) (Judges 44% / Legal Counsel 62% / Expert Scientific Witnesses 78%)	92	2
"Administrative tribunals do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses." (Follow-up question) (Tribunal Members 48% / Legal Counsel 51% / Expert Scientific Witnesses 77%)	93	2
"Legal counsel do not comprehend the key doctrines and premises of whatever scientific discipline is involved in scientific information provided by expert scientific witnesses." (Follow-up question) (Judges 44% / Legal Counsel 63% / Expert Scientific Witnesses 80%)	94	2
"Problems exist in administrative environmental hearings where the scientific information provided in the form of expert evidence results in uncertainty with respect to one or more scientific issues." (Initial filter question) (Tribunal Members 76% / Legal Counsel 47% / Expert Scientific Witnesses 88%)	129	3
"Translating the level of scientific certainty and uncertainty found within scientific information provided in the form of expert evidence at environmental trials and other legal proceedings into the level of legal certainty and uncertainty required to meet the standards of proof such as 'proof beyond reasonable doubt' required in criminal/quasi-criminal trials or 'proof on the balance of probabilities' required in civil trials and by the due diligence defence in criminal/quasi-criminal trials." (Judges 67% / Legal Counsel 63% / Expert Scientific Witnesses 93%)	130	3

Survey Question	Table	Interface #
"Where it appears that scientific information necessary to reduce or eliminate the uncertainty relating to a scientific issue is available, but such information is not presented as evidence at an environmental trial or other legal proceeding." (Follow-up question) (Tribunal Members 78% / Legal Counsel 45% / Expert Scientific Witnesses 77%)	133	3
"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not immediately available for presentation at an administrative environmental hearing, but could be obtained with additional scientific investigation." (Follow-up question) (Tribunal Members 81% / Legal Counsel 45% / Expert Scientific Witnesses 87%)	135	3
"The adversarial system used in environmental trials and other legal proceedings promotes the presentation of conflicting scientific information which creates confusion with respect to the scientific evidence." (Follow-up question) (Judges 50% / Legal Counsel 47% / Expert Scientific Witnesses 88%)	138	3
"Where irrelevant scientific information is presented at an environmental trial or other legal proceeding on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue." (Follow-up question) (Judges 50% / Legal Counsel 57% / Expert Scientific Witnesses 81%)	142	3
"Where irrelevant scientific information is presented at an administrative environmental hearing on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue." (Follow-up question) (Tribunal Members 73% / Legal Counsel 45% / Expert Scientific Witnesses 74%)	143	3

Survey Question	**Table**	**Interface #**
"Problems exist in environmental trials and other legal proceedings when contradictory or conflicting scientific information in the form of expert evidence is provided by expert scientific witnesses." (Subsequent filter question) (Judges 61% / Legal Counsel 57% / Expert Scientific Witnesses 85%)	144	3
"Problems exist in administrative environmental hearings when contradictory or conflicting scientific information in the form of expert evidence is provided by expert scientific witnesses." (Subsequent filter question) (Tribunal Members 74% / Legal Counsel 50% / Expert Scientific Witnesses 85%)	145	3
"Assigning evidentiary weight to the contradictory or conflicting scientific information." (Follow-up question) (Tribunal Members 81% / Legal Counsel 59% / Expert Scientific Witnesses 86%)	147	3
"Lack of understanding by the courts as to how scientists knowledgeable within the area where conflicting evidence exists would decide which information they would find most credible." (Follow-up question) (Judges 61% / Legal Counsel 51% / Expert Scientific Witnesses 88%)	150	3
"Lack of understanding by administrative tribunals as to how scientists knowledgeable within the area where conflicting evidence exists would decide which information they would find most credible." (Follow-up question) (Tribunal Members 61% / Legal Counsel 45% / Expert Scientific Witnesses 85%)	151	3
"Choosing the scientific evidence of one expert witness over another based upon their respective "performances" in giving evidence rather than on the basis of the scientific information itself." (Follow-up question) (Judges 50% / Legal Counsel 68% / Expert Scientific Witnesses 87%)	152	3

Survey Question	Table	Interface #
"Choosing the scientific evidence of one expert witness over another based upon their respective "performances" in giving evidence rather than on the basis of the scientific information itself." (Follow-up question) (Tribunal Members 69% / Legal Counsel 58% / Expert Scientific Witnesses 87%)	153	3
"Problems exist in the use of scientific information to establish the decision-making standards which are used by the legal system in administrative environmental hearings." (Initial filter question) (Tribunal Members 58% / Legal Counsel 47% / Expert Scientific Witnesses 72%)	155	4
"'Quantitative' standards established by governments which specify prohibited levels of pollution within environmental legislation (for example, prohibiting the "... release of chemical X into the environment in a concentration of 1 part per million") do not accurately reflect the current state of available scientific information with respect to the effects of pollution on the environment." (Follow-up question) (Tribunal Members 68% / Legal Counsel 52% / Expert Scientific Witnesses 78%)	157	4
"Relating the scientific information provided in the form of expert evidence at administrative environmental hearings to the "quantitative" standards found within environmental legislation which specify prohibited levels of pollution (for example, prohibiting the "... release of chemical X into the environment in a concentration in excess of 1 part per million." (Follow-up question) (Tribunal Members 54% / Legal Counsel 45% / Expert Scientific Witnesses 70%)	167	4
"Relating scientific information provided in the form of expert evidence at environmental trials to the 'normative' (non-quantitative) standards found within environmental legislation (for example, prohibitions against causing "... a negative environmental impact" or "... harm to fish habitat" which do not specify prohibited levels of pollution) to constitute either a major or minor problem at administrative environmental hearings." (Follow-up question) (Judges 50% / Legal Counsel 66% / Expert Scientific Witnesses 81%)	168	4

Survey Question	Table	Interface #
"Problems exist in the use of legal decision-making institutions (such as courts of law) and legal procedures (such as rules of court and rules of evidence) for the resolution of scientific issues in environmental decision-making." (Initial filter question) (Judges 61% / Legal Counsel 53% / Expert Scientific Witnesses 85%)	170	5
"Problems exist in the use of legal decision-making institutions (such as courts of law) and legal procedures (such as rules of court and rules of evidence) for the resolution of scientific issues in environmental decision-making." (Initial filter question) (Tribunal Members 59% / Legal Counsel 45% / Expert Scientific Witnesses 81%)	171	5
"The existing administrative environmental decision-making process is poorly suited to address scientific issues." (Follow-up question) (Tribunal Members 57% / Legal Counsel 47% / Expert Scientific Witnesses 84%)	173	5
"The use of the legal adversarial approach in environmental trials and other legal proceedings promotes a confrontational climate which inhibits obtaining a consensus in resolving scientific issues." (Follow-up question) (Judges 67% / Legal Counsel 52% / Expert Scientific Witnesses 87%)	176	5
"The use of the legal adversarial approach in environmental trials and other legal proceedings promotes a confrontational climate which inhibits obtaining a consensus in resolving scientific issues." (Follow-up question) (Tribunal Members 70% / Legal Counsel 45% / Expert Scientific Witnesses 91%)	177	5
"The motivations of expert scientific witnesses and legal counsel in environmental trials and other legal proceedings are incompatible, in that the primary goal of scientists is the attainment of scientific truth, whereas the primary objective of legal counsel is to resolve jurisprudential disputes which may contain scientific issues." (Follow-up question) (Judges 61% / Legal Counsel 45% / Expert Scientific Witnesses 80%)	178	5

Survey Question	Table	Inte rfac e #
"Decisions by administrative tribunals often fail to acknowledge that a degree of 'uncertainty' with respect to scientific issues may exist, thereby giving a false sense of scientific certainty to a decision." (Follow-up question) (Tribunal Members 59% / Legal Counsel 45% / Expert Scientific Witnesses 77%)	183	5

7.3 Category 3 Results: Problems Failing to Meet a Threshold Level of Concern While Meeting a Threshold Level of Discord

Responses to Research Survey questions which failed to meet the Threshold Level of Concern but which did meet the Threshold Level of Discord are set out below.

Survey Question	Table	Inte rfac e #
"Problems exist in administrative environmental hearings with respect to the screening by administrative tribunals of those persons who are qualified to provide tribunals with scientific information as expert witnesses." (Initial filter question) (Tribunal Members 26% / Legal Counsel 35% / Expert Scientific Witnesses 57%)	33	1
"The 'qualification' procedures which are employed by the courts in qualifying witnesses to give scientific evidence as expert witnesses." (Follow-up question) (Judges 17% / Legal Counsel 35% / Expert Scientific Witnesses 46%)	34	1
"Failure of the courts to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert scientific evidence." (Follow-up question) (Judges 28% / Legal Counsel 37% / Expert Scientific Witnesses 53%)	36	1

Survey Question	**Table**	**Interface #**
"Failure of administrative tribunals to define with sufficient precision the areas of expertise in which witnesses are qualified to give expert scientific evidence." (Follow-up question) (Tribunal Members 29% / Legal Counsel 42% / Expert Scientific Witnesses 58 %)	37	1
"Failure of administrative tribunals to limit the scientific evidence provided by expert witnesses to those defined areas of expertise in which they are qualified to give expert scientific evidence." (Follow-up question) (Tribunal Members 29% / Legal Counsel 42% / Expert Scientific Witnesses 62%)	39	1
"Distinguishing between the qualifications of expert scientific witnesses in situations where two or more experts in the same field give expert scientific evidence." (Follow-up question) (Judges 17% / Legal Counsel 32% / Expert Scientific Witnesses 55%)	42	1
"Distinguishing between the qualifications of expert scientific witnesses in situations where two or more experts in the same field give expert scientific evidence." (Follow-up question) (Tribunal Members 27% / Legal Counsel 38% / Expert Scientific Witnesses 58%)	43	1
"The distortion of scientific information as a result of the use of cross-examination by opposing legal counsel." (Follow-up question) (Judges 55% / Legal Counsel 55% / Expert Scientific Witnesses 83%)	68	2
"The distortion of scientific information as a result of the use of cross-examination by opposing legal counsel." (Follow-up question) (Tribunal Members 48% / Legal Counsel 41% / Expert Scientific Witnesses 84%)	69	2
"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not immediately available for presentation at an environmental trial or other legal proceeding, but could be obtained with additional scientific investigation." (Follow-up question) (Judges 39% / Legal Counsel 55% / Expert Scientific Witnesses 76%)	134	3

Survey Question	Table	Interface #
"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not available for presentation at an environmental trial or other legal proceeding, and cannot reasonably be obtained given the present state of science." (Follow-up question) (Judges 33% / Legal Counsel 39% / Expert Scientific Witnesses 67%)	136	
"Where it appears that scientific information necessary to reduce or eliminate the scientific uncertainty relating to a scientific issue is not available for presentation at an administrative environmental hearing, and cannot reasonably be obtained given the present state of science." (Follow-up question) (Tribunal Members 73% / Legal Counsel 36% / Expert Scientific Witnesses 77%)	137	
"The adversarial system used in administrative environmental hearings promotes the presentation of conflicting scientific information which creates confusion with respect to the scientific evidence." (Follow-up question) (Tribunal Members 76% / Legal Counsel 38% / Expert Scientific Witnesses 85%)	139	3
"Where relevant scientific information is presented at an environmental trial or other legal proceeding on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue." (Follow-up question) (Judges 44% / Legal Counsel 39% / Expert Scientific Witnesses 75%)	140	3
"Where relevant scientific information is presented at an administrative environmental hearing on behalf of one or more parties to the litigation for the purpose of creating rather than reducing or eliminating scientific uncertainty relating to a scientific issue." (Follow-up question) (Tribunal Members 63% / Legal Counsel 33% / Expert Scientific Witnesses 73%)	141	3

Survey Question	Table	Interface #
"Problems exist in the use of scientific information to establish the decision-making standards which are used by the legal system in administrative environmental hearings." (Initial filter question) (Judges 22% / Legal Counsel 48% / Expert Scientific Witnesses 73%)	154	4
"'Quantitative' standards established by governments which specify prohibited levels of pollution within environmental legislation (for example, prohibiting the "... release of chemical X into the environment in a concentration of 1 part per million") do not accurately reflect the current state of available scientific information with respect to the effects of pollution on the environment." (Follow-up question) (Judges 24% / Legal Counsel 57% / Expert Scientific Witnesses 78%)	156	4
"Out of a concern that governments may place too much or too little emphasis on scientific information when establishing "quantitative" standards which specify prohibited levels of pollution within environmental legislation, scientific experts providing advice to governments in the setting of such standards may make recommendations which do not accurately reflect the current state of scientific information (for example, recommending lower concentrations of pollution than are scientifically justifieable to ensure that adequate safety is maintained)." (Judges 22% / Legal Counsel 38% / Expert Scientific Witnesses 65%)	162	4
"Problems exist in translating scientific information into the decision-making standards which are used by the legal system in environmental trials and other legal proceedings." (Initial filter question) (Judges 39% / Legal Counsel 57% / Expert Scientific Witnesses 79%)	164	4
"Relating the scientific information provided in the form of expert evidence at environmental trials and other legal proceedings to the "quantitative" standards found within environmental legislation which specify prohibited levels of pollution (for example, prohibiting the "... release of chemical X into the environment in a concentration in excess of 1 part per million." (Follow-up question) (Judges 39% / Legal Counsel 48% / Expert Scientific Witnesses 67%)	166	4

Survey Question	Table	Interface #
"The existing legal process is poorly suited to address scientific issues." (Follow-up question) (Judges 36% / Legal Counsel 53% / Expert Scientific Witnesses 87%)	172	5
"Courts of law are unable to effectively use scientific information in environmental decision-making." (Follow-up question) (Judges 33% / Legal Counsel 45% / Expert Scientific Witnesses 75%)	174	5
"Administrative tribunals are unable to effectively use scientific information in environmental decision-making." (Follow-up question) (Tribunal Members 34% / Legal Counsel 35% / Expert Scientific Witnesses 73%)	175	5
"The motivations of expert scientific witnesses and legal counsel in administrative environmental hearings are incompatible, in that the primary goal of scientists is the attainment of scientific truth, whereas the primary objective of legal counsel is to resolve jurisprudential disputes which may contain scientific issues." (Follow-up question) (Tribunal Members 57% / Legal Counsel 36% / Expert Scientific Witnesses 81%)	179	5
"Decisions by courts of law are final and can not be reopened/reconsidered at a later date, even if the scientific information upon which a decision is based is later found to be incorrect." (Judges 39% / Legal Counsel 48% / Expert Scientific Witnesses 66%)	180	5
"Decisions by administrative tribunals are final and can not be reopened/reconsidered at a later date, even if the scientific information upon which a decision is based is later found to be incorrect." (Tribunal Members 41% / Legal Counsel 32% / Expert Scientific Witnesses 60%)	181	5
"Decisions by courts of law often fail to acknowledge that a degree of "uncertainty" with respect to scientific issues may exist, thereby giving a false sense of scientific certainty to a decision." (Follow-up question) (Judges 44% / Legal Counsel 49% / Expert Scientific Witnesses 82%)	182	5