Flawed Geoscience in Forensic Environmental Investigations

***Part I: The Effect of Daubert Challenges on Improving Investigations * ***

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*** Because of time restraints, all the topics covered** in the paper **could not be discussed during our presentation** at the conference**. The full paper is presented here and represents a revised version of the paper presented in the Proc.** ***NGWA Environmental Law & Ground Water Conference*****, May 5-6, 2004, Chicago, Ill., pp. 1-19.**

**** Please note that we do not, and can not, speak to matters of law in reviewing the available case literature or in any issue discussed in this paper. The issues discussed in this paper: a) are solely the present opinions of the authors, b) may change as additional information becomes available, and c) may not reflect the views of the companies with whom they are affiliated.**

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Abstract

Recent State and Federal Supreme Court Rulings are providing impetus to improve the quality of Forensic Environmental Investigations and avoid study flaws. Flaws can occur in the investigation philosophy, the methods, intentions, and conclusions of the geoscience expert. The responsibility of every technical expert witness in forensic geoscience is to evaluate and opine on the conditions present on the basis of the available data. Where deception may appear to be present in a case, it may only be a result of incompetence, intentional or unintentional, or of poor memory. The cause of the flaws in an expert's judgment may range from mis-remembering the position of EPA during the early years to the omission of data from a plot of constituents indicating blame where the full data set would clearly show otherwise. Some attorneys have complained that the courts, by limiting the testimony of experts in recent Daubert rulings, are rejecting so-called good geoscience. However, the reverse is often true; the courts are often eliminating bad science as well. When opposing experts can effectively demonstrate the flawed geoscience to the court, the courts are barring opinions based on bad science while properly performing their "gatekeeper" function. We will present examples of expert opinions that were based on flawed science and how such opinions originate and of how such can be compromised.

I. Introduction

There are six inter-related sections to this paper. The first part will present the basis for our opinions by providing a summary of our backgrounds. The second part represents the results of our review of the Daubert rulings and their impact on expert testimony in environmental litigation, especially that related to geoscience, and with our reaction to the various Daubert-related rulings. In the third and fourth parts, we'll provide some examples of how flaws in methodology can lead to ineffective geoscience testimony and the factors that can cause serious project errors and potentially flawed data on which experts must depend in providing testimony to the court. The fifth part deals with the misuse of academic experts. And, in a wrap-up, the sixth part presents our conclusions on how the court receives testimony on topics related to environmental geoscience.

II. Basis of Opinions

By highlighting our background and experience, we will allow the reader to place the opinions expressed here in the appropriate context. By doing this here, the reader will be made aware of the basis of our opinions before the issues under consideration are discussed, not in a brief biography found later at the end of the paper.

In the early to mid 1970s, the senior author served as Director of Research for National Water Well Association's (NWWA now NGWA) Research Facility in Columbus, Ohio, and at Rice University in managing EPA-funded research projects during the pre-RCRA era and in improving the technical communications between the professional geoscientist and the water well contractor. During the 1980s, he served in senior management positions with major environmental engineering consulting companies such as Law Engineering, Inc., ENSR Engineering and Consulting Company, and for DuPont Environmental as Regional Technical Manager responsible for six departments: geology, environmental specialties, design and construction engineering, and deep-well services. Since DuPont, he has been in private practice serving as Managing Partner in M. D. Campbell and Associates, L.P. dealing with a variety of industrial projects and providing expert witness services. He has served in almost 40 cases involving environmental, hydrogeological, water supply, mining and associated issues, 30 of which since leaving DuPont. The senior author is a licensed professional geoscientist in Texas and is a licensed or registered professional geologist or hydrogeologist in a number of other states and has served as Principal Instructor for the Institute of Environmental Technology and as Principal Hydrogeologist for the Environmental Litigation Associates, both in Houston, Texas.

The second author is a licensed professional geoscientist in Texas, a licensed professional engineer in Texas, and is also a ground-water professional certified by NGWA. In the early period of his career, he assisted his employer, D'Appalonia, a major environmental engineering consulting company of the period, with developing procedures for investigating and remediating waste sites in the early days of RCRA and Superfund. Since then he has been with, and is an owner of, Environmental Resources Management (ERM), today one of the few remaining dominant consulting companies with over 120 offices in the U.S. and overseas. He provides guidance and leadership to the company on industrial projects nationally and internationally and has been involved in more than 50 legal cases entailing environmental, hydrogeological, water supply, mining and associated issues. The second author served as a Regular Lecturer for the Institute of Environmental Technology, Houston, Texas.

The third author, while in College at Texas A&M University during the 1980's, was involved in natural resource investigations and worked on numerous environmental projects. After graduation in the early 1990s, he served as project coordinator and then project manager for major environmental consulting firms such as Carter & Burgess, Inc., Delta Environmental Services, Inc. and Terra Technologies. He has been serving M. D. Campbell and Associates, L.P. as Project Hydrogeologist and Program Manager since the mid 1990s in support of industrial and litigation activities and associated investigations. He is also a licensed professional geoscientist in the State of Texas.

III. The Daubert Difference

When the law comes together with science, two different perspectives collide. Brilis, *et al.*, (2000) suggest that Science is digital, focusing on measurement; whereas Law is analogical, it focuses on precedent. Science is predictive, general, replicable, and numerical; Law is retrospective, particular and subjective. Science is objective and universal; Law is normative, contingent and personal. Table 1 compares the terms O'Connor (2004), at the North Carolina Wesleyan College, suggests that the Daubert rulings, to allow for the differences, rejected the historical Frye test for the admissibility of scientific evidence. Instead of "general acceptance" in the scientific community, the new test requires an independent assessment of reliability by the courts and offers some continuity and guidance to other federal and state courts throughout the US.

Table 1 – Science and Law

(After Brilis, *et al*., 2000)

Science →	Impact	Law →	Impact
Digital	Focus on Measurement	Analogical	Focus on Precedent
Predictive	Objective	Retrospective	Normative
General	Universal	Particular	Contingent
Replicable	Impartial	Subjective	Personal

All this has a major impact on the testimony of expert witnesses, especially in environmental cases involving geoscience and ground water. The tests provide guidance to geoscientists in preparing their testimony and can provide an idea of how the courts are assessing our testimony and what they expect in terms of testimony. O'Connor says that in his discussions with many attorneys, no one is really sure what the Daubert test is all about but Daubert is gaining popularity in some state courts. For example, about 20% have accepted Daubert but 29% have decided to stick with Frye. Even 22% of the states have developed their own tests (see Table 2).

Table 2 – States Acceptance of Daubert or Frye Tests

(From O'Connor, 2004)

Accepting Daubert	Remaining w/ Frye	Individual Tests
Connecticut	Alaska	Arkansas
Indiana	Arizona	Delaware
Kentucky	California	Georgia
Louisiana	Colorado	Iowa
Massachusetts	Florida	Minnesota
New Mexico	Illinois	Montana
Oklahoma	Kansas	North Carolina
South Dakota	Maryland	Ohio
Texas	Michigan	Oregon
West Virginia	Missouri	Utah
	Nebraska	Vermont
	New York	Wyoming
	Pennsylvania	U.S. Military
	Washington	

Some or all of an expert's testimony that passes or fails a Daubert test can have a major impact on the outcome of a case. In the environmental field, the investigations conducted by experts are based on sampling and modeling protocols but reaching conclusions must be based on appropriate data and methodology supported by proper review, quality control and quality assurance procedures.

When Daubert has been applied to specific scientific techniques, some pass and some fail, all depending on the vagaries of the particular court. O'Connor (2000) indicates that computer simulation has failed Daubert because the experts can't explain the algorithms. Trace evidence comparisons has not been decided yet as a result of the controversy over the qualifications required for a forensic scientist or lab technician. Also, Daubert requires that in modeling all records must be documented, the model must be calibrated and the data generated be validated through a system of quality control and quality assurance procedures.

Ries and Jarrell (2002) report that in *GE vs. Joiner*, one the important post-Daubert rulings, the U.S. Supreme Court reviewed the connection between the methodology and the expert's conclusion and cautioned that there may be too great an analylitical gap between the data and the opinion offered. Then, in *Kumho vs. Carmichael*, another of the major post-Daubert rulings, the court indicated that the expert must employ in the courtroom the same level of intellectual rigor that characterizes the practice of an expert in the relevant field, and that experts should testify about matters growing naturally and directly out of research they have conducted independent of the litigation, or whether they have developed their opinions expressly for purposes of testifying, which would require a higher level of scrutiny.

Daubert and supporting rulings have served to both reject expert testimony and encourage testimony. Ries and Jarrell (2002) further indicate that the rejection was the exception rather than the rule. In *B.F. Goodrich vs. Betkowski*, the court noted that "environmental science, in particular, like epidemiology, is ill-suited to lead a fact-finder toward definitive answers, dealing as it does in statistical probabilities, or is a soft science and that a more liberal analysis should apply to the admissibility of expert opinions in those fields".

Then, Bibler and Nenser (2003) report that applications of Daubert tests to computer modeling occur with special focus on two problem areas, i.e., 1) the expert's reliance on other experts to create a model, and 2) the handling and responsibility for formulae and variables in the modeling. The popular models used in ground-water applications were prepared to deal with a range of standard conditions, i.e., ground-water flow rate and directions, among other contaminant transport issues. In our judgment, only the input variables should guide the results produced. Experts drive models, making sure the appropriate variables are selected. Modelers' responsibilities involve making sure that the model runs as designed; that it is stable and that it performs reliably.

Judge Posner of the U.S. Court of Appeals reporting in the majority in *Dura (Excel) vs. CTS Corp.* said "A scientist, however well credentialed he may be, is not permitted to be the mouthpiece of a scientist in a different specially". This appears to represent the reoccurring misunderstanding about ground-water models, hydrogeologists and modelers. Judge Posner reasoned that after receiving testimony from a well-know ground-water modeler that "modeling ground-water flow is inherently not the most precise of scientific tools because one never possesses complete geotechnical information". He concluded, "The process of constructing a valid and useful ground-water model is an iterative process that requires the exercise of sound technical judgment in evaluating all available geotechnical data to determine what input values should be used with respect to each parameter used in the model." The dissenting view pressed by Judge Wood strongly opposed the majority view by indicating that the central question was never explored because the court did not conduct a Daubert hearing or heard from opposing opinions that unreliable assumptions had been made or an unaccepted computer program had been utilized in reaching conclusions on a capture zone and the migration of contaminants.

The U. S. Supreme Court held (in the landmark *Daubert v. Merrell-Dow Pharmaceuticals, Inc*, ruling) that Rule 702 requires a trial judge to exercise a "gatekeeping responsibility" to preclude testimony that would or could confuse a jury, and should not be presented to a jury because when the "reasoning or methodology underlying the testimony is (not) scientifically valid (or was not) …properly …applied to the facts in issue." The Daubert court ruled that the testimony must be both relevant to the issues and that the opinion be reliable. In assessing reliability, the Court provided four primary criteria for trial judges to use:

- Can the theory or technique be tested?
- Has the theory or technique been peer reviewed or published?
- Is there a known or potential (statistical) error rate?
- Is it generally accepted in the scientific community?

Since the Supreme Court decision, several state appeals and supreme courts have established similar tests (see Table 2) and strengthened the gatekeeping role of trial judges in state courts. Most of these cases have dealt with medical data and the issue of causation of health effects, but increasingly both plaintiff and defense attorneys are pursuing Daubert challenges of environmental experts who opine on critical matters to a case and to which the above criteria are not easily applied. In providing the following examples of where flaws were identified in the work of another expert, we are providing suggested guidance on the application of the Daubert criteria to environmental testimony.

Specifically, we are proposing that the lines of questioning be rephrased as follows:

- Are the method(s) and technical approach(es) based either on published guidance, accepted practice or the reasonable application of scientific and engineering principles?
- Are the results reproducible (e.g., validated by duplicate sample data collected at a reasonable frequency) or consistent with expectations corroborated by other data or experience?
- Are the opinions based on prior experience supported by sufficient documentation, current or historical, to overcome the known shortcomings of human memory?
- Are the methods, objectives and processes for reaching conclusions objective and consistent with well-accepted practices? For example, are calculations based on inappropriate assumptions inconsistent with well-accepted practices?

We also propose that the previous acceptance by a regulatory agency should not be the test for the current acceptability of data or an opinion nor should current acceptability or use by a regulatory agency be the test for acceptance. In particular, regulatory agencies and rules have different objectives that reflect public policy and not necessarily scientific fact. For example, cleanup criteria often have safety factors built into their development and exceedances of such do not mean there is a basis to assume that someone was or could be harmed. We will show that, in the future, for an expert to testify it should be required that the expert's objectivity and reliability also be considered in addition to their credentials.

IV. Flaws in Philosophy, Methods, Objectives, and Conclusions

Forensic geoscience flaws can occur in expert's methods selection, development of objectives and conclusions, as well as the technical approach to an investigation. The responsibility of every technical expert witness is to evaluate and opine on the conditions present on the basis of the available data. Where deception may appear to be present in a case it may be a result of incompetence, intentional or unintentional, or of poor memory. These flaws in an expert's judgment may range in cause from mis-remembering the past (e.g., a prior position of the EPA) to erroneously omitting or adjusting data from a plot of constituents or other representation.

Example: Previous EPA Positions

As an example of mis-remembering previous EPA positions, we will discuss the generic outline of a case for which one of the authors once provided services as an expert witness. The case involved whether a particular constituent produced by a local foundry in the early 1970s was permitted to be part of fill material used to provide cover for an abandoned dump. Two retired regional EPA administrators, who served as expert witnesses in the case for the Plaintiffs, claimed that, according to their memory, the material was never permitted as fill material, especially in an abandoned dump. In searching the records of EPA meetings, documentation was found where one of the administrators had clearly stated in the recorded discussions of a meeting that the material was approved as fill material. This practice was later discontinued when polycyclic aromatic hydrocarbons (PAHs) and other constituents of concern were found in significant concentrations in the material. Looking back into history, however, both the Plaintiff experts failed to get it right in remembering and testifying to the policy of the EPA at the time. The expert testimony was not allowed and the case was dropped.

Example: Omission and Reproducibility of Data

In another case of a few years ago, one of the authors was engaged by counsel to evaluate documents and opine on the likely source of benzene, toluene, ethylbenzene and xylene (BTEX) and methyl tributyl ether (MTBE) contamination around a site once occupied by an operating filling station, where affected soils had been excavated and removed from the site. The data consisted of laboratory data provided by the owner of the property and Plaintiff's expert as an isopleth (isoconcentration) map of the total BTEX based on the results from sampling on and the around the subject property (see Figure 1).

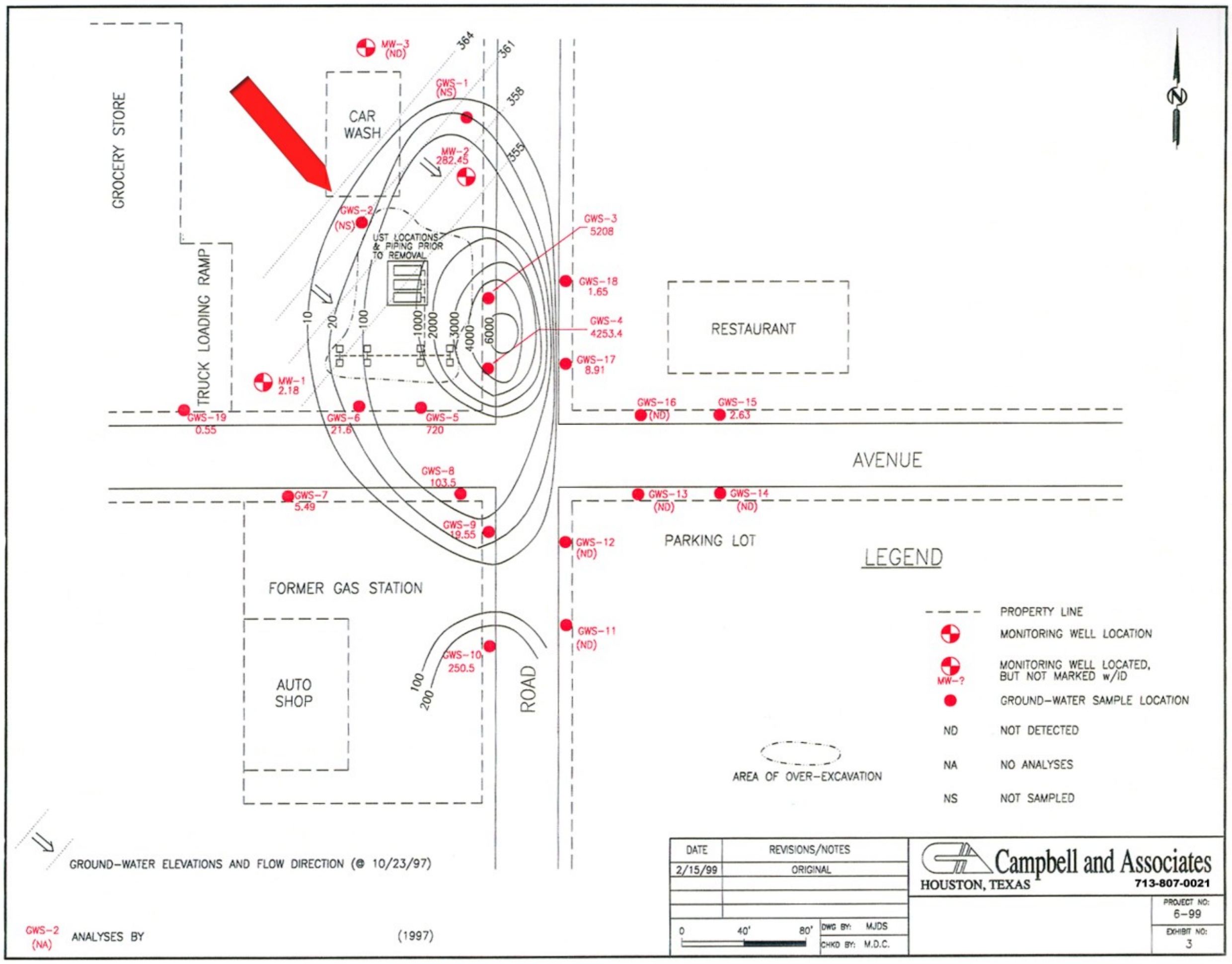

Figure 1 – Isopleth map interpreted by opposing consultant.

The general configuration of the plot appeared to be somewhat unusual; note the arbitrary interpretation of separation of plumes between Wells 9 and 10. Should another well be installed in between Wells 9 and 10? Should the "NS" (not sampled) wells (e.g, GWS-2 – noted by arrow) be resampled? Would any additional data be relevant to the old data when the wells were sampled? After some inquiries, one of the authors learned that the plaintiff's initial consultant had collected duplicate samples that were analyzed by a different laboratory. This duplicate data had not been included in the plaintiff's expert's data set and the sampling location had been mis-identified as "NS" (not sampled), on the map, when in actuality the data had been discarded because it was apparently "somewhat" contradictory. In the complete duplicate data set, however, the well data had been included, and, contained the highest values in the data set. The data's omission significantly affected the interpretation of the site conditions as shown on the following re-interpreted and re-drawn isopleth map (see Figure 2 below). In addition, trilinear plots of benzene, toluene, xylene, MTBE and di-isopropyl ether (DIPE) concentrations clearly show that the constituents contained in the sample from GWS-2 plotted in different areas of the plots, suggesting different source populations.

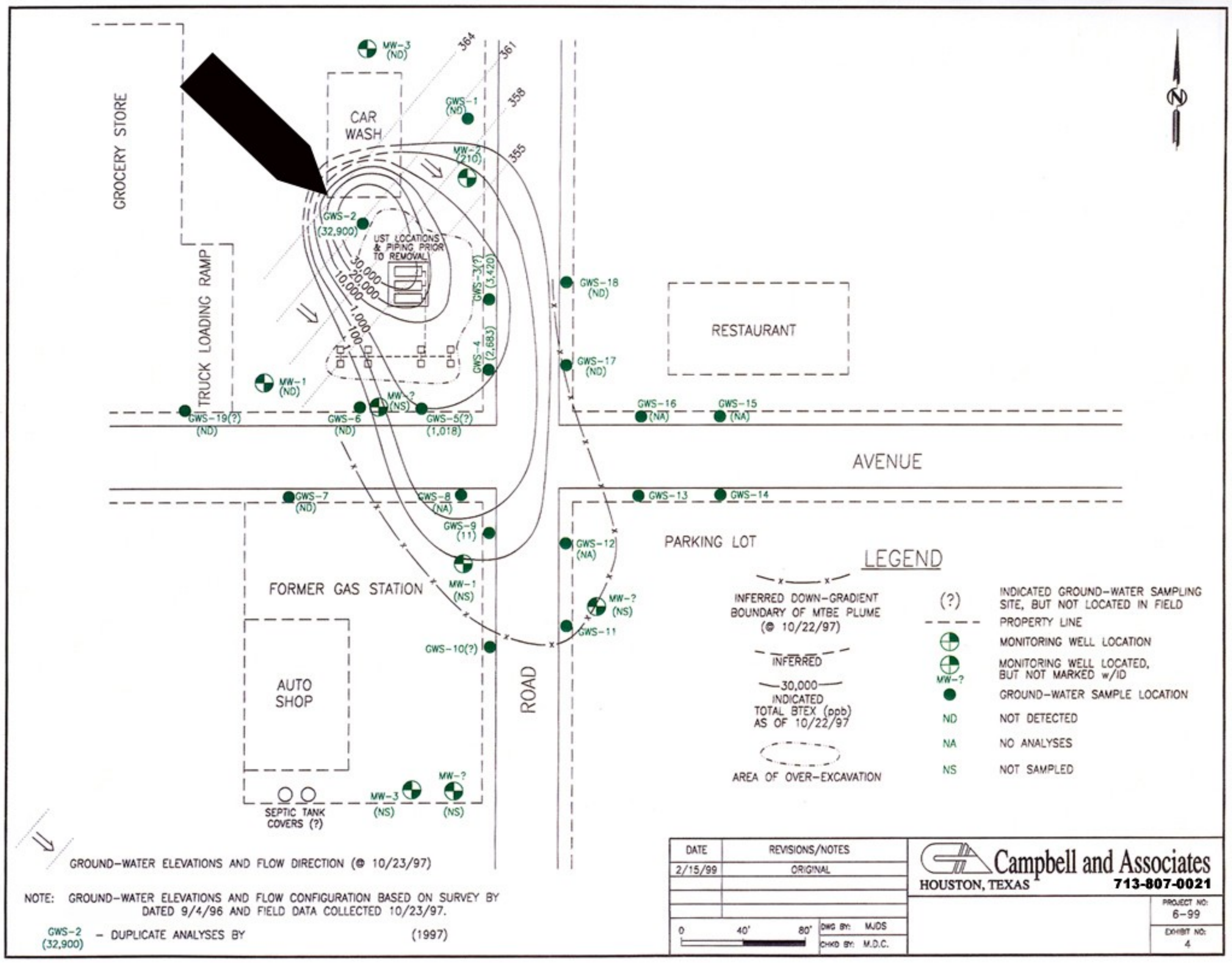

Figure 2 – Isopleth map based on duplicate sampling.

Taken together, this drastically affected the author's interpretation and conclusion on who should be responsible for remediating the site, and on the allocation of remediation costs among those responsible for the clean-up (see Figure 3).

Should duplicate data that are inconsistent in such an instance be allowed to be presented? Perhaps. Is it possible to determine the error rate? No. Should the duplicate data be omitted then? We suggest such data should be included when the use of such data results in an interpretation that is more "consistent with the natural, more likely distribution and migration of the BTEX based on historic experience." Should we have to illustrate this experience and justify the expectation of consistency?

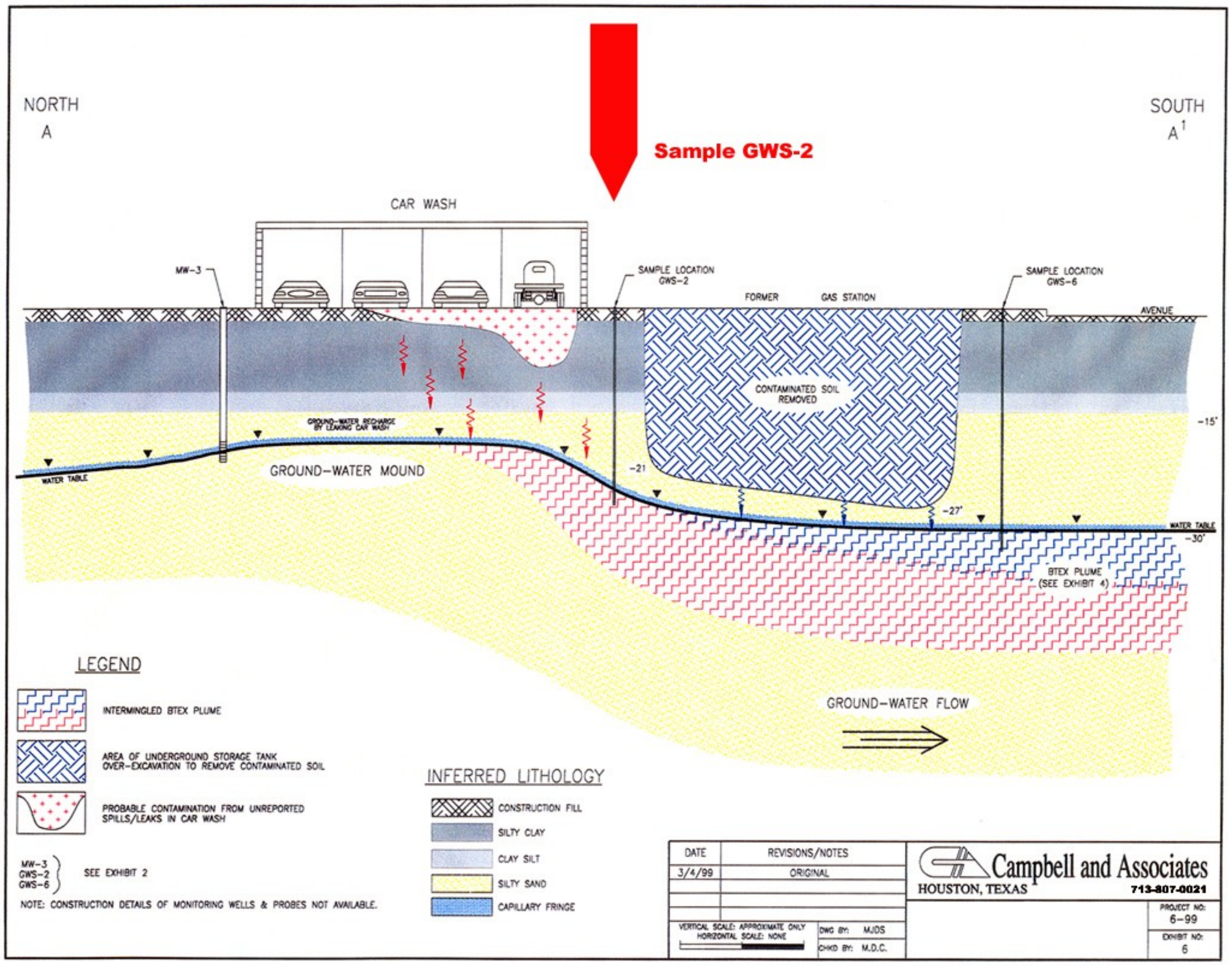

Figure 3 – Interpretation of subsurface conditions

Yes, we should be required to provide examples to illustrate and/or reference other recognized experts in the field who have made similar observations as to the natural migration of BTEX or to modeling ground-water flow. In addition, the arbitrary interpretation of the separation of the plumes should not have been allowed unless alternative interpretations that were just as likely had also been presented by the same expert. The case settled before the court ruled in this example.

<u>Other Examples of Common Flaws in Method and Assumption Selection</u>

The following are some of the more common technical issues that are often involved in litigation. Because of space limitations, we present only a few more common examples.

Drilling Through Contaminated Zones

The most troublesome of poor method selection entails how some Phase II environmental assessments are managed. Where depths below shallow affected zones are the targets of investigation, some consultants do not properly design and construct what are known as Type III monitoring wells. For such wells to protect the deeper zones from being contaminated by drilling though the shallow zones, cementing materials are used to fill borehole annulae in stages to prevent vertical migration of contamination from shallow to deeper zones. This often requires a greater attention to details when monitoring wells are being prepared and installed (Campbell and Lehr, 1973 and 1975). In one case, one of us opined that even the responsibility for overseeing the mixing of the cement lie with the supervising geoscientist, not with the drilling contractor. Type III monitoring wells were drilled at an industrial site where DNAPL was well known to be present in the shallow aquifer. The consultant supervised the drilling contractor during installation of the deep monitoring wells but subsequent investigations found that the cement grout installed as part of the Type III installation had shrunk, cracked and disappeared from the intended shallow zone of known contamination. A deep aquifer likely received constituents of concern.

The oil and gas and geotechnical engineering industries control of the drilling mud density, cementing characteristics and related factors, which is the responsibility of the supervising geoscientist, not the drilling crew. These steps are especially important considerations when drilling through intervals containing chlorinated hydrocarbons, which are known to interfere with the normal setting properties of bentonite cement (McCaulou and Huling, 1999).

Special cements using pozzlans, bentonite or other materials require added care and analyses because they set differently and are not as “workable” as are more common grouts and cements used for shallow monitoring wells (Gaber and Fisher, 1988; Nielsen and Schalla, 1991; ASTM, 1994. Common cement mixtures used in zones with chlorinated hydrocarbons often become fractured and more permeable, creating new regulatory problems for the landowner and potential liability for the consultant responsible for the investigations. The general relationships are illustrated in Figure 4.

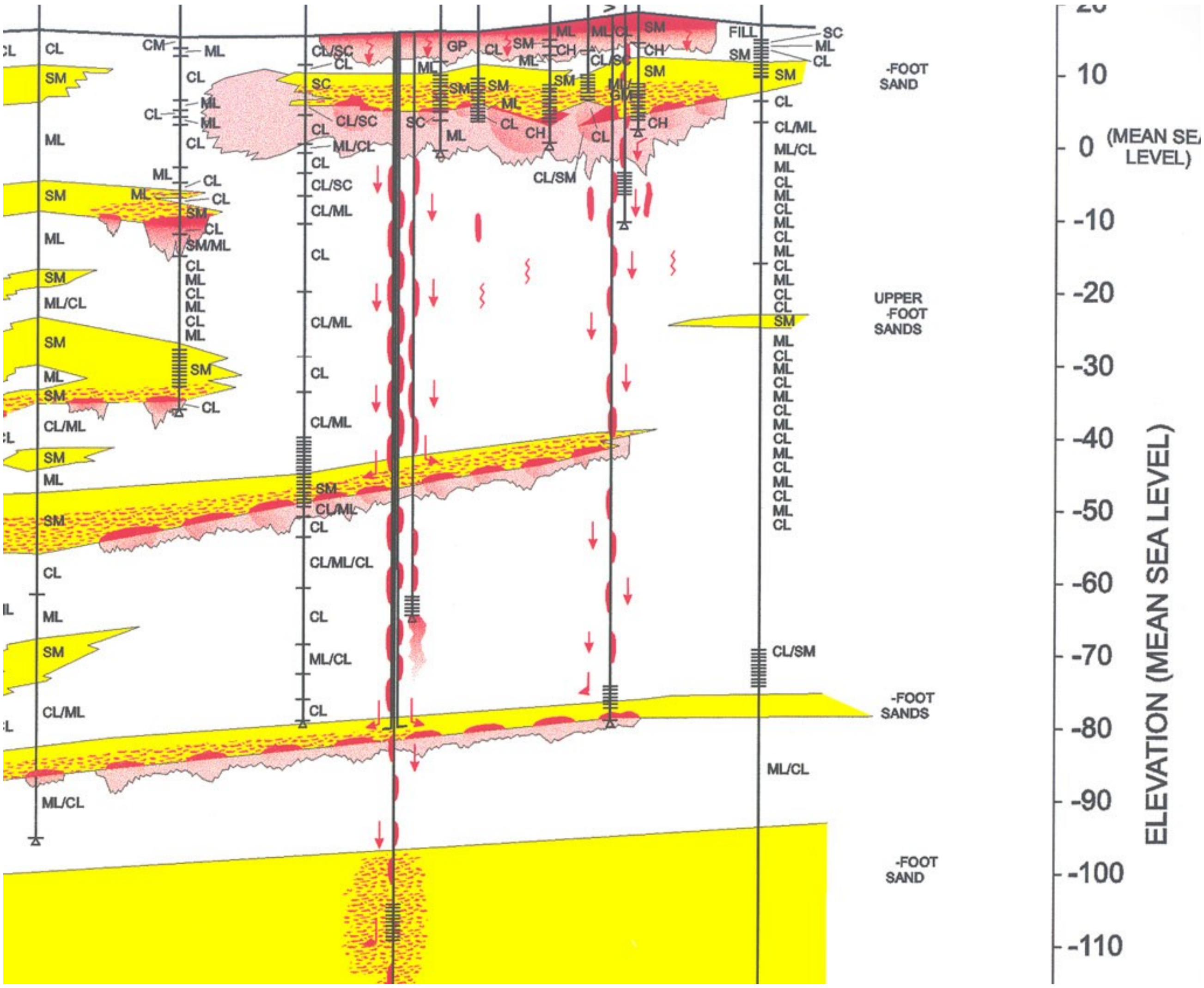

Figure 4 – Generalized view of drilling through shallow contaminated zones.

Porosity in Transport Calculations

The term "porosity" refers to the void space between the particles of sand, silt or clay in formation. Porosity affects the permeability and rate of migration of constituents in an aquifer (Fetter, 1994). However, porosity has come to be used in two ways in the environmental field over recent years. One way is where the classical total pore space is used as porosity and another, which excludes the impact of the dead-end pore spaces and uses only those pore spaces that contribute to fluid transport though the unit volume of sediment or rock. The latter is called "effective porosity", which is the interconnected pore volume occupied by hydrodynamically available fluids.

We have noticed that some workers in the field still use total porosity in the classical Darcian ground-water transport calculations and modeling, but a value representing effective porosity should be used instead (Lovanh, *et al.,* 2000; Stephens, *et al*., 1998). The differences in arrival times of contaminants in ground water, for example, can be significant and in this case, old guidance should not be followed (see Figure 5), especially for sediments with very low hydraulic conductivity.

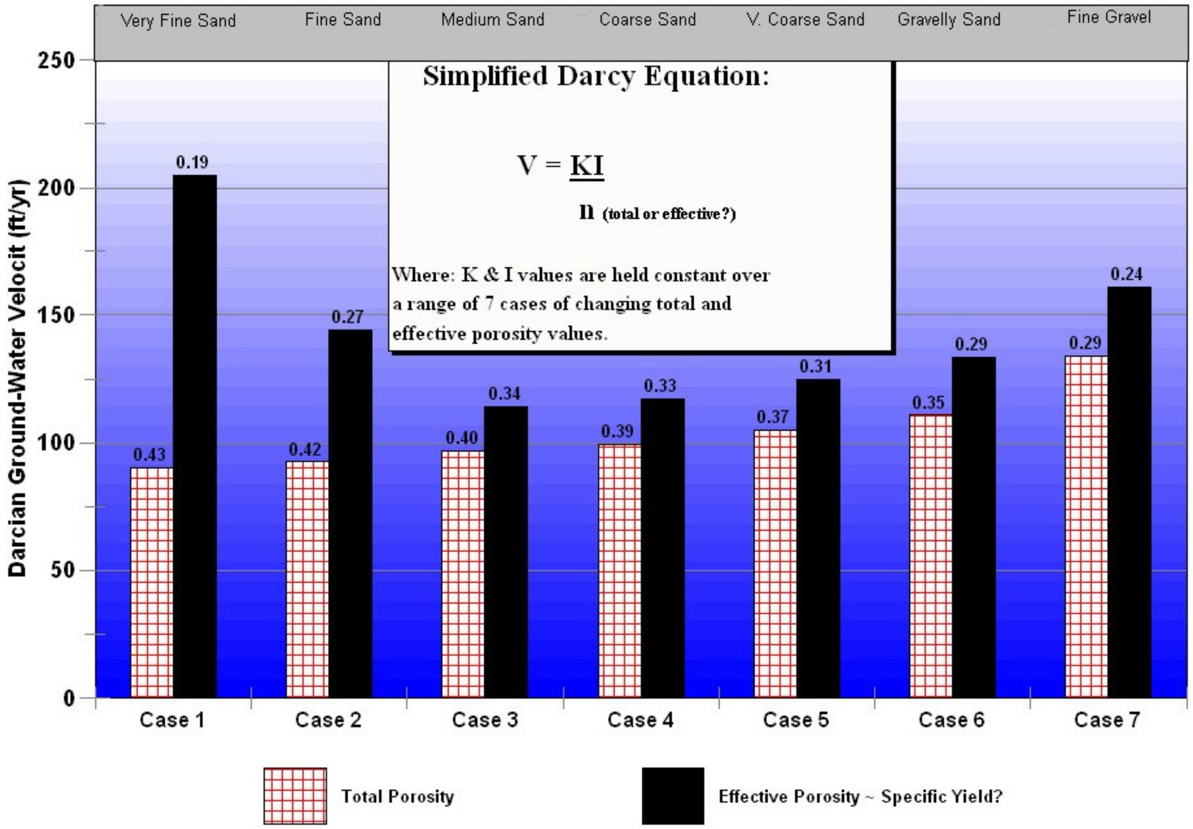

Figure 5 – Simplified Darcy equation showing effect of total and effective porosity over a range of sediment types on ground-water velocity (Modified after Weight and Sonderegger, 2001).

Based on published data for approximately 1,200 soil samples (over 5, 000 soil horizons) from 34 states, Rawls, *et al.,* (1983), report on 11 basic soil textures (See Figure 6). Note that the relationship between total and effective porosity show only a slight divergence from silty loam (Case 11) down in grain size to clay soil (Case 4), after which the difference between the two become more pronounced (from Case 3 to Case 1).

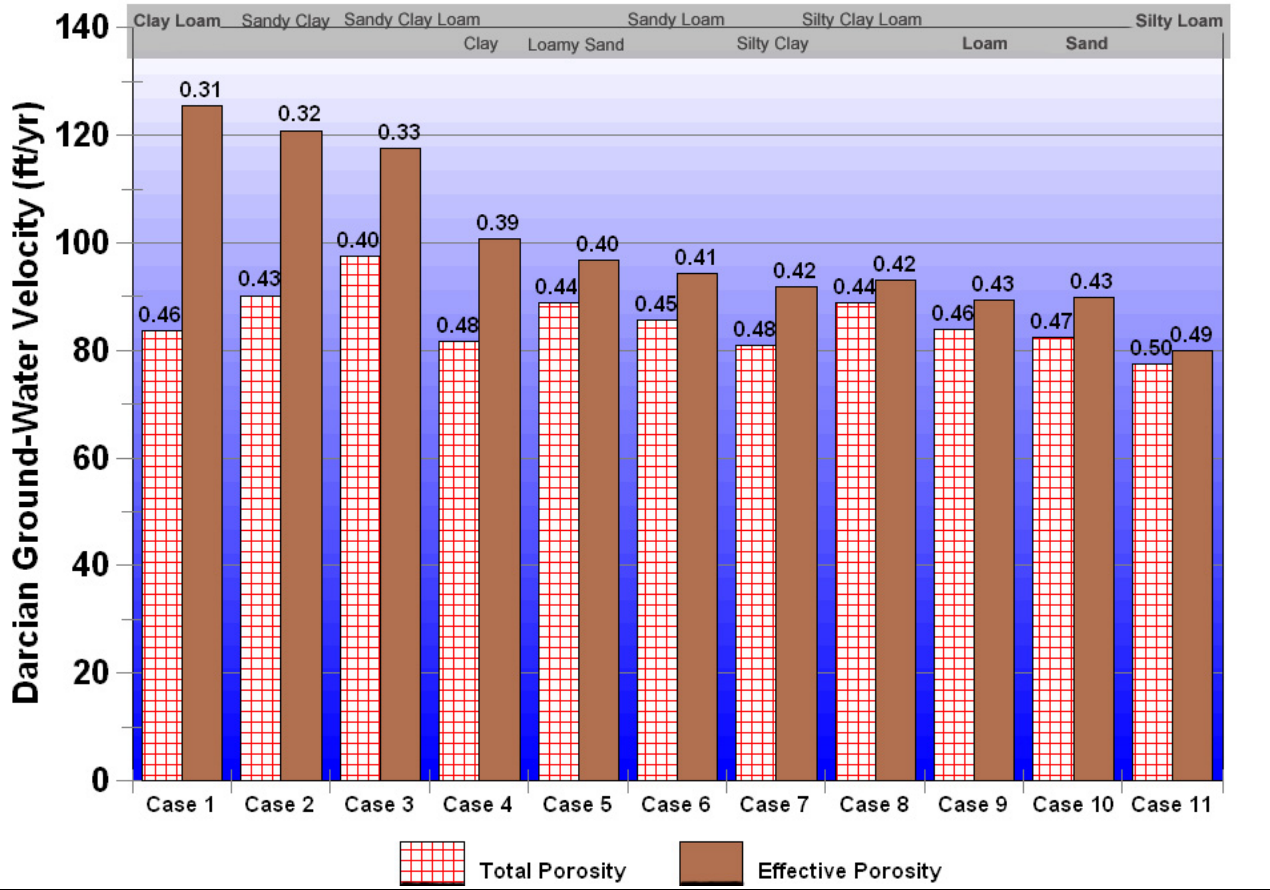

Figure 6 – Total and effective porosity over a range of soil types (Modified after Rawls *et al.,* 1983).

The technical literature contains numerous references to the literature on porosity, both total and effective. Some assistance is provided on specific yield values as well. The selection of these values for use in calculating ground-water flow, either in field equations or as input for modeling of ground-water flow, should be made with caution with a view as to how well the selection can be defended against potential criticism.

Characteristic values for porosity and specific yield are available in the technical literature. A summary of these data is presented in Tables 3 and 4.

Table 3
Characteristic Values of Porosity and Specific Yield
for
Various Sediments and Rocks
(After Walton, 1991)

Deposit Name		Total Porosity	(Max)		Specific Yield	(Max)
Unconsolidated:						
Loess		0.40	0.55		0.15	0.35
Till		0.25	0.45		0.05	0.20
Peat		0.60	0.80		0.30	0.50
Silt		0.35	0.60		0.01	0.30
Clay		0.35	0.55		0.01	0.20
Clay, sandy		NA	NA		0.03	0.20
Sand, dune		0.35	0.45		0.30	0.40
Sand, fine		0.25	0.55		0.20	0.35
Sand, gravelly		NA	NA		0.20	0.35
Sand, coarse		0.30	0.45		0.20	0.35
Gravel, coarse		0.25	0.35		0.10	0.25
Gravel, medium		NA	NA		0.15	0.25
Sand and Gravel		0.20	0.35		0.15	0.30
Consolidated:						
Siltstone		0.25	0.40		0.01	0.35
Sandstone		0.25	0.50		0.10	0.40
Limestone		0.05	0.55		0.01	0.25
Shale		0.01	0.10		NA	NA
Salt Units		0.01	0.03		NA	NA
Other:						
Volcanic, pumice		0.80	0.90		NA	NA
Volcanic, vesicular		0.10	0.50		NA	NA
Volcanic. tuff		0.10	0.40		0.02	0.35
Volcanic, dense		0.01	0.10		NA	NA
Schist		0.05	0.50		NA	NA
Basalt		0.05	0.35		NA	NA
Igneous, dense		0.01	0.05		NA	NA
Igneous, weathered		NA	NA		0.20	0.30

Table 4 – (Ohio EPA, 1995)

Range of percentage of porosity for various geologic materials.

GEOLOGIC MATERIALS	BOUWER (1978)	TODD (1980)	FETTER (1994)	FREEZE AND CHERRY (1979)	SEVEE (1991)
gravel, mixed	20-30			25-40	25-40
gravel, coarse		28			
gravel, medium		32			
gravel, fine		34			
sand, mixed	25-50			25-50	15-48
sand, coarse	25-35	39			
sand, medium	35-40	39			
sand, fine	40-50	42			
sand & gravel	10-30		20-35		
silt	50-60	46	35-50	35-50	35-50
clay	50-60	42	33-60	40-70	40-70
glacial till	25-40	31-34	10-20		
limestone	10-20	30		0-20	0-20
karst limestone				5-50	5-50
shale		6		0-10	0-10
sandstone	5-30	33-37		5-30	5-40

Hydraulic Conductivity: Use of Laboratory or Field Test Data

Some issues just never seem to go away. Although the number of papers and books written on the subject of field testing has increased substantially since 1990 (Campbell, *el al*, 1990), the use of laboratory-generated values representing hydraulic conductivity is still widespread, especially in the field of geotechnical engineering and other engineering fields (see Figure 7).

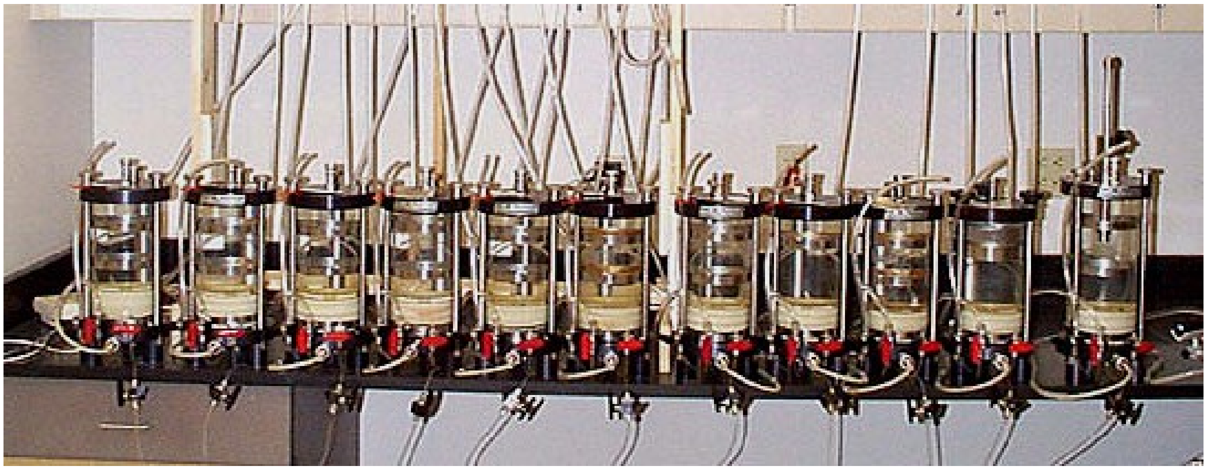

Figure 7 – Typical university geotechnical engineering lab with flexible wall permeameters (modified from Colorado State University, 2004).

In a few instances, even the use of grain-size distribution curves still are used to calculated hydraulic conductivity. Some professionals in the field of geoscience, who include those practicing as geotechnical engineers as well as environmental engineers, seem to avoid conducting the appropriate field tests for hydraulic conductivity, such as slug tests and others (see Figure 8).

Figure 8 – Typical field slug-testing activities (Northern Arizona University at 2004)

One method is defensible in court on hydrogeological applications while the other is not. One may be appropriate for approximation purposes, but only field-test data are reliable when more accurate data are needed.

V. Avoiding Common Project Flaws and Bad Experts

From time to time, the authors are engaged to review the procedures and activities of consultants during a contested geoscience project that has resulted in litigation between the client and consultant or business partner. This amounts to assessing the standard of care exercised by the consultant in a particular geographic area and time period involved (Skomsky, 2001). Over the years, we have found eight areas that consultants, large and small, often fail to address appropriately. These are: 1) marketing materials, 2) scoping of projects, 3) preparing project contracts, 4) viability of client, 5) QC/QA considerations, 6) checking staff and expert credentials, 7) providing appropriate training, and 8) the consultant's report (Campbell, 2004). They can, and often do, contribute directly to flaws in geoscience-related investigations.

<u>1. Marketing Materials</u>

Exaggerating marketing materials beyond actual capabilities is a common problem, one that can be used during litigation concerning other disagreements to undermine the credibility of the consultant. Judges and juries do not find this admirable. This may involve claims by the company in brochures, Web sites or other venues often concerning the availability and or involvement of senior staff or associated consultants when in reality they often have nothing to do with the project. Project experiences are too often the target of exaggeration as well. In overselling, the client's expectations are raised so high that when a project goes poorly, the client is doubly upset, thus fueling additional aggression for pressing litigation. Should such materials be allowed in a case? We suggest they should when the experts were involved in their development, because they reflect the intentions, bias or objectivity of the consultants.

2. <u>Scoping of Project</u>

The lack of appropriate scoping is an all too common source of later problems in a project. Misunderstandings on what activities the client was to perform, how the work was to be performed, and the personnel training and schedule for completing the work are often central issues in litigation involving geoscience-related environmental projects. These shortcomings can often be the result of the lack of senior oversight during the scoping stage of projects. If the scope has not been carefully assessed, then the estimated costs won't be accurate as well. Once again, if the consultant does not have the scope (or work plan in the proposal) established before initiating a project, the client doesn't know either and the client's expectations are not in synch with the consultant. Should a work plan always be developed? No, but doing so reduces the risk of disagreements and litigation. In the context of litigation, it should be evident that the methods selected and the technical approaches are consistent with well-accepted practices or validated by the sound application of scientific and engineering practices. In summary, insufficient scoping results in:

- *Only partial understanding of project,*
- *Inadequate project cost estimate, and*
- *Client expectations not established*

3. Project Contracts

Poorly prepared contracts are at the center of many disagreements between client and consultant (Andrejko, 2004). Some typical contract short-comings include: 1) broad-form indemnification and/or inappropriate indemnification language, 2) various forms of warranties or guarantees, 3) "highest standard of practice" language, 4) client-supplied data for use in the project that cannot be duplicated, verified or confirmed, 5) no provisions against third-party reliance on the project report. We recommend that contracts contain provisions for: 1) disclosure of hazardous conditions, 2) waiver for consequential damages, 3) limitations of consultant's liability, and 4) provisions for senior review and oversight (Q&A). The consultant may have to consider not accepting a project if the prospective client attempts to alter the scope or cost below certain levels**.**

Poorly Prepared Contracts often involve:

- *Broad-form indemnification,*
- *Lack of indemnification language*,
- *Warranties and Guarantees,*
- *Use of "highest standard of practice" language,*
- *Client-supplied data, and*
- *3rd-Party reliance on consultant's report*

A well-prepared contract (and the associated proposal) should contain, among other items, certain important provisions relating to:

- *Limitations of liability,*
- *Consequential damages waiver,*
- *Provisions for senior review (QA), and*
- *Disclosure of hazardous conditions*

4. Viability of Client

The client can also contribute to flawed geoscience investigations. Some clients will attempt to alter scope of the consultant's proposal and proposed contract, usually to reduce costs. Although there is nothing inappropriate for a client to minimize costs, but consultants' often are too quick to generate revenue by allowing a client to minimize costs below that required to execute a viable investigation. By cutting corners in the scoping and costing of a project, mistakes are made that often lead to client-consultant conflict and potential litigation. On the other hand, many consulting firms have experienced senior management or attorneys within the corporate structure or one on the outside who is available to review contracts to assess these potential problems.

There are a number of factors to consider when beginning a relationship with a new client. This is often considered "risk avoidance" because after reviewing the client in detail, it may be that the consultant can't afford to work for the client. These factors are:

Factor 1: Stability of Client

If the prospective client is a new company that may be under capitalized, of if you have learned that the client is under major pressure from state or federal agencies for alleged misdeeds, the consultant may not want to risk doing business with this client.

Factor 2: Experience of Client

Is the prospective client new in the business? Is he (or she) aware of their environmental responsibilities? Some have never dealt with RCRA and state requirements, or with the consultants who do. Bringing the new client "up to speed" may cost the company money not covered by a task item in any budget.

Factor 3: 3rd- Party Reliance

If a provision is not included in your environmental site assessment reports to your client that prohibits use by a 3rd party, the consultant may find itself being criticized, and perhaps even sued, where conditions have changed.

Factor 4: Litigious Record

Is the prospective client known as a company that brings lawsuits more than normal? If so, you may want to look elsewhere for clients.

Factor 5: Confidentiality & Disclosure of Hazardous Conditions

Is your prospective client unusually concerned about confidentially, especially about disclosing waste conditions on or around the company's property? If so, the consultant must be very careful to not be drawn in by complicity or subterfuge (Abbott, 2003c).

Factor 6: Limitation of Liability

If the prospective client will not allow language in your contracts or agreements providing for limitation of your liabilities, you may want to think again about working for this client. Indemnification should be in the consultant's favor, not the reverse.

5. QC/CA Considerations

An important and often-minimized part of geoscience investigations involves QC/QA. Quality Control can be built into the project in the early stages by project personnel. Full scoping, including all appropriate activities are described in the proposal or work plan and cost estimate, and subsequently discussed with Client. Execution of the project's workplan is the primary objective. Any changes resulting from unanticipated conditions would need to be discussed and approved by the Project Manager, which is subsequently discussed with the Client for final approval.

Senior personnel who are not part of the project team carry out Quality Assurance. This personnel is usually designated by senior management to make spot checks during field operations and to review data handling procedures and calculations in the office during data analysis and report preparation. Both processes, QC and QA, are designed to promote workplan execution, to re-enforce project team and senior management communications, and to maintain Client expectations according to the proposal and workplan, modified only by documented changes. When the report has been completed, it too will be reviewed by senior management to assess whether the report is consistent with the proposal and scope of work, and any changes that became necessary. Although at times tedious work, these checks and balances also foster good relations with the Client, while at the same time they help to minimize the consultant's liability.

6. Staff and Expert Credentials

Although staff and expert credentials would seem to be a topic unnecessary to consider, the Supreme Court Daubert ruling made it clear that an expert should have sufficient background, experience or credentials to be able to know that they are properly applying the methods and techniques to the issues of a case. In our collective experience far too many cases of false credentials have become known to omit their consideration here. Also note, that increasingly, when all else seems to fail, some attorneys will attack an expert's credibility and credentials based on how their credentials are presented in a resume and how accurately they match the facts. As a standard operating procedure, we recommend that the employer or client check the education (i.e., college, degrees, type and year) for each of the professional staff and expert members and that their descriptions be clear and not misleading. There should be specific procedures established to confirm educational credentials of the entire professional staff. Note that increasingly, an expert will not be allowed to testify if their credentials are not accurately presented.

7. Continuing Education and Training

The authors believe an environment of technical growth needs to be fostered. A professional whose career does not reflect continued growth, as required in most state professional licensing and registration programs, will generally not make a good expert and their credentials are likely to be challenged.

Training should include not only the standard methods employed in the field, but also writing skills. As experts, we should avoid litigious words or phrases that we commonly use in our everyday discussions but which are inappropriate and misleading if used in formal reports or informal memos. For example, to state that "The maximum concentration of a constituent at a site is X ppm" is inappropriate when the maximum reported is based on a limited amount of sampling and it is likely that a "hot spot" was missed. "The maximum concentration reported for a site" would be a more appropriate phrase. Geoscience consultants and experts should avoid making what come across as statements of absolute fact when they should be characterized as opinions. For example, more likely than not, the maximum concentration at a site is less than Y ppm when an appropriate statistical evaluation has been performed; such a statement would follow today's good practice. Lists of such words and phrases are commonly available.

The technical literature of the past often goes unrecognized but it can have a major impact on a case. One of the cases cited above illustrates this point. Keeping track of older journals and papers, plus keeping abreast on-line archives available though many of the professional societies often provide important background or direct evidence on past practices or conditions (see: Daughton, 2001).

Dealing with the press and adversarial groups in the field also needs to be part of any professional environmental geoscientist-training program, in addition to other topics such as health and safety in the field and in the office and home. An active training program reinforces professionalism among the staff and promotes responsibility for company business. It also serves to teach the value of interdisciplinary teamwork in environmental litigation. This is not to say that team members practice all sciences. Quite the contrary. The training program should demonstrate the often-clear boundaries of the various scientific and engineering disciplines, while at the same time show how cooperation can produce synergism into a project or case. Ram (2000) illustrates the advantages of this approach. This approach also formed the foundation for a new type of consulting group formed in 1996 (see references for the Environmental Litigation Associates (ELA).

Such training also helps to provide consistency in the application of methods and field practices. Theses were the objectives of the training program offered by the Institute of Environmental Technology (IET) during the early to mid 1990s in the Houston, Texas area (see references). However, too often, good methods are cited, but field staffs do not know or understand the methods or how to implement them consistent with good practice. As a result, inconsistent, unreliable data are obtained. Such data should not be presented to a judge but are often offered without consideration for quality control and quality assurance checks on the data produced. Judges do not always know the difference, and conclusions based on such poor data can be misleading to both the judge and jury. The judge cannot be the Gatekeeper envisioned by Daubert if he (or she) does not recognize that unreliable data and the associated faulty conclusions are passing through the gate before them.

8. The Consultant's Report

Although consultant's reports are considered instruments of professional services, your Client may still retain an interest in the report, its distribution, including the right to object to your compliance with a subpoena that may request a copy of your report. Your attorney should assist you in dealing with these matters of law, especially in preparing "Disclaimer" language. Also, he (or she) should assist the staff in determining which issues are matters of law and which are not, necessarily.

Adherence to strict rules of common sense often comes into play when the Consultant's report is being prepared. When diverging from company guidelines on field procedures, or from Standard Operating Procedures (SOPs), proposals, contracts, or other agreements, the consultant must describe such changes or deviations in detail in the report. In Phase I & II environmental site assessments, ASTM Guidelines reinforce this view, particularly in ASTM E–1527-00, E-1528-00, E-1903-97 (02?), especially *Section 9.2: Verifications of Assumptions* and *Note 8*. Ashcraft (1998) cautions that these should be reviewed with caution because there are a number of liabilities in the practice of geoscience.

Consultant's reports, an instrument of professional services, are not considered by many as being owned by the Client (Abbott, 2003a and b). As indicated earlier, because conditions on and in the subsurface under a property change with time, the report only records what is known at the time the investigation was conducted. New information also often becomes available after a report has been completed which impacts the conclusions made previously. If the report were considered to be owned by the Client, this implies it is a product that would be subject to "product liability" Tort law. If considered a "product" then defects (such as in "errors or omissions") could be considered "product defects" and therefore subject to strict liability rather than to the professional's standard of care of the time and place. As an instrument of professional service, the consultant often has greater protection under the law when your professional liability exposure is based on negligence only. Failure to retain ownership leads to unauthorized use by the client and by 3rd parties.

VI. Misuse of Academic Experts

The use of academic experts by attorneys often take advantage of many naive university professors whose history of geoscience and engineering research may be outstanding, but when applying this experience to litigation where geoscience issues are at hand, they often do not have the financial backing or time to develop the necessary data to evaluate the conditions under review. Hence, they cannot effectively opine about past or future exposure issues because they have no basis for making credible claims. Often, experts are chosen on the basis of their academic achievements (academic publications), political leanings, and on their ability to lecture a jury on the merits of their position in trial. However, they all too often provide inappropriate, although colorful, testimony by making claims in their expert reports that are not based on sound geoscience. Recent Daubert decisions on rejecting the testimony from some of these expert witnesses emphasize this trend (Brickley, 2003).

In a number cases, we have undertaken over the past 10 years and before, we have noticed a disturbing trend in the way some attorneys use their experts. In one case of particular note, one of the authors was tasked by counsel to prepare a list of deficiencies in the report offered by an opposing academic expert witness that may be useful in a Daubert hearing on the admissibility of the expert's testimony. The list contained 85 criticisms on the statements made by the expert, none of which had supporting evidence or basis for making the claims or statements or were immaterial to the issues at hand. Also involved in this expert's report was the reoccurring underlying theme aimed at the jury that the Plaintiffs deserved compensation and other considerations, which was not only inappropriate but also entirely beyond the scope of work the expert was asked to perform. The loss of objectivity and of being drawn into a cause, no matter how just, have no place in expert testimony. The expert was subsequently withdrawn and the case was settled after millions of dollars had been spent in defending the case.

In another case of substantial potential impact, the opposing academic expert prepared a report that contained a number of critical geologic cross sections. These were hand-drawn and generally illegible. Language in the report indicated that final versions of the sections would be submitted in the near future. Six months came and went, no sections. Most of the representations made by this expert depended on the sections but some claims were made also without a factual or rational basis. Daubert hearings were scheduled on this and other witnesses were abandoned when the parties settled. This expert's vulnerability may have been a consideration in the settlement.

VII. Client and/or Insurance Company Interference

In our collective experience, there are occasions when the client or the client's insurance company insinuates their presence into establishing the scope and content of the experts' investigations. For example, when the expert is asked to provide an opinion on subsurface conditions, monitoring wells are required to characterize the local hydrogeology and hydrochemistry. When asked to propose the scope and budget for such activities, the expert is told that the proposed budget is too expensive and is asked to reduce the scope of the project by reducing the number of monitoring wells and associated sampling and laboratory costs. Of course the response to this limitation is for the expert to threaten to withdraw from the case. If there is no capitulation, or if compromise is not possible, the expert has no choice but to withdraw with an explanation in writing to the engaging attorney and to the residing judge in the case.

If the expert chooses to continue the investigation, he (or she) can register the continuing dissatisfaction with the interference and deal with the information that is available. Of course the client and/or insurance company (and their consultants) should be aware that the expert was hired at the outset because of his (or her) experience in such studies and hence should not be second-guessed or countermanded by those personnel who are responsible for paying the expert's invoices. They are less qualified, less involved in the project, and less experienced in making technical judgments. Such interference can place the expert in a tenuous position in meeting Daubert requirements, possibly leading to a less-than-optimum performance by the expert because of insufficient data, and potentially, to greater losses than necessary for the client and/or the client's insurance company should the judge and/or jury not find in favor of the expert's clients.

There are other occasions where the client (or the client's insurance company) gets behind more than a few months in paying the expert's invoices, which often include charges for drilling, laboratory, and associated expenses. Under such conditions, the expert must either demand prompt payment, even if the scope of work, terms of payment, and provisions for late penalty have been incorporated in the original engagement agreement, or withdraw from the case and initiate legal proceedings to collect the outstanding invoices and late penalties, again with an explanation provided to the engaging attorney and to the residing judge in the case.

The above instances apply to experts involved in both defendant and plaintiff cases, the latter being under the most pressure to obtain sufficient funds from "investment" attorneys who are at risk in underwriting appropriate investigations designed to press righteous plaintiff causes but who are also at risk of offering experts who can not prevail in Daubert hearings or in court.

VIII. The Court and Environmental Geoscience Testimony

Although we do not, and can not, speak to matters of law in reviewing the available case literature on the quality of science in the courtroom for a recent case (some of which are cited below), we have been disturbed by how many courts seem to be languishing in their interpretations of how to employ the Daubert factors (i.e., empirical testing, peer review and publication, known or potential rate of error, the existence and maintenance of operational standards, and acceptance within a relevant scientific community (Daubert, 509 U.S. at 593-594)) in assessing the testimony of expert witnesses on technical matters. They seem to struggle in making the distinction between "hard science" (often referred to by the courts as "Newtonian science") and the supposed "soft science" involved in clinical medical testimony.

For environmental projects and cases that most of us deal with on a daily basis, we have found that when the testimony deals with subsurface conditions, our testimony often sounds to judges and juries more like that of a medical doctor describing a patient's condition than that of testing the frontiers of epidemiology and toxicology on which the court's attention often seem to be focused today. This analogy is further supported in that we have tests performed on the "patient" such as obtaining its temperature, pH, specific conductance of the fluids, a battery of laboratory tests of chemistry, metals, and even contaminants. We also deal with the pressure distribution system (fluid pressure?) as measured at certain points within the body of sediments by monitoring wells, an odd type of stethoscope. We also often evaluate and conduct screening of the microbiological conditions within the body, calling on bacteria and fungi to aid in attenuating unwanted contaminants present within the system. Also, these conditions change from day to day and year to year in response in changes in the environment within the subsurface system and in the environment above the ground surface (by some environmental impact). Many of these changes can be predicted based on established scientific principles (modeling?), but some are not well understood today or are not well documented, and only first-order estimates can be made. This is the nature of subsurface investigations and of the testimony associated with environmental geoscience.

Of particular interest here are the opinions of Judge Dennis (in *Moore v. Ashland Chemical, Inc* appeals brief cited below) who states that a trial judge must assess the testimony of an expert witness "to determine whether it is relevant to the case and reliable under the principles and methodology of the discipline involved." Later he suggests that the testimony must be focused on the principles and methodology employed and not on the merits (or reputation) of the expert's conclusion. However, in our view, the former should guide the latter but, as we have seen in some of the examples briefly discussed above, that does not always happen during litigation dealing with forensic geoscience investigations.

This is not meant to imply that consultants and experts must perform without error. The standard of care applied to professionals in science and engineering requires that any professional product or testimony measure up to common practice in the industry. Of course, this definition is often considered to be a matter of law; it indicates that the expert does not have to be perfect. Because of the nature of field operations in the environmental field, errors may occur, either in constructing monitoring wells or in reporting on or interpreting the data produced by sampling those wells or other media. The potential impact of any errors on the expert's conclusions is at issue here. If the error would materially alter the expert's conclusions then the error becomes critical to a case. If, on the other hand, the error doesn't impact the basic premise of an expert's opinion to any significant extent then the error can be considered to be of only minor importance to the testimony and does not change the basic conclusions of an expert. Any Daubert challenges of an expert need to keep these perspectives in mind.

We do concur with the staff of Science International, Inc., (2001), who in a recent SI newsletter, outlined a process by which the methods selected and technical approach should be developed by working backwards from the conclusions and are intended to test the ultimate conclusions. This concept will not always apply when it is only from phased investigations that we develop sufficient data on which to base reliable conclusions. But then those conclusions should be and can be tested by working backwards to verify that the methods and interpretive procedures support the conclusions reached and not just an educated guess or speculation (Fletcher and Paleologos, 2000).

In conclusion, we concur that the courts have an appropriate role to play in eliminating expert testimony based on speculation or belief rather than on sound scientific inquiry and the application of good geoscience and engineering practices. We also recommend that the courts make better use of court-appointed experts, with the appropriate backgrounds, to assist it in understanding the technical issues in the environmental field.

IX. Acknowledgements

The authors appreciate the input, reviews and comments provided by numerous associates and the assistance of Ms. Jessica Wiley Campbell in assembling the bibliography on the topics covered in this paper.

This project was identified and funded, in part, by personnel associated with *The Institute of Environmental Technology* based in Houston, Texas (http://www.ela-iet.com/texasnew/ietsplash.html) in providing a forum for continuing dialogue between the nearly 400 graduates of the IET program and in fostering research by IET personnel on environmental methods and techniques, field conditions in and around Houston, Texas, and on technology in use today and in the foreseeable future on projects conducted in the environmental field.

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