Unreliable/Inadequate Information on the Efficacy of Solidification/Stabilization of Sydney Tar Pond Sediments

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Recently the Sydney Tar Ponds Agency (STPA) has been attempting to justify its selection of cement-based solidification/stabilization (S/S)of the Sydney Tar Ponds sediments and Coke Oven soils as the remediation approach for these areas. STPA has enlisted the assistance of Dr. Colin Hills of the Center for Contaminated Land Reclamation in Kent, England, to make statements in support of the STPA proposed remediation approach. Recently, Dr. Hills has made several statements in an interview on CBC's Information Morning program in Sydney which reflect the superficial nature of his review of this matter. The following statement is attributed to Dr. Hills:

> *"Dr. Hills says solidification and stabilization has been used effectively for more than thirty years to cleanup similarly contaminated sites in the United States."*

In making this statement, Hills is ignoring the substantial literature that exists which questions the long-term efficacy of S/S treatment of high-organic wastes. My testimony, report to the Joint Review Panel and peer-reviewed paper,

> Lee, G. F., "Comments on, 'Remediation of Sydney Tar Ponds and Coke Ovens Sites Environmental Impact Statement, Sydney, Nova Scotia,' dated December 2005," Report of G. Fred Lee & Associates, El Macero, CA, USA, May 15 (2006). http://www.members.aol.com/annejlee/SydneyTarPondsReport.pdf
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> Lee, G. F., "Comments on Joint Review Panel Environmental Assessment Report - Sydney Tar Ponds and Coke Ovens Sites Remediation Project," Report of G. Fred Lee & Associates, El Macero, CA, July (2006).
> http://www.members.aol.com/annejlee/STPAES-Comments.pdf
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> Lee, G. F., "Assessment of the Adequacy & Reliability of the STPA Proposed Approach for Remediation of the Sydney Tar Ponds' Sediments," Presentation to the Sydney Tar Ponds and Coke Ovens Sites Remediation Project Joint Review Panel, Sydney, Nova Scotia, CANADA, PowerPoint Slides; G. Fred Lee & Associates, El Macero, CA, May 15 (2006).
> http://www.members.aol.com/annejlee/SydneyTarPondsPowerPt.pdf

discuss the inappropriateness of equating use of S/S remediation in the USA with proven successful use of this approach. Those familiar with how hazardous chemical site remediation decisions are made in the USA know that they are not based on a critical

evaluation of the potential efficacy of the approach in immobilizing the pollutants so that they do not release pollutants at a sufficient rate to continue to pollute the environment. While mixing cement and other solids into the Tar Ponds sediments could slow down the rate of pollution of the estuary by PCBs, PAHs, heavy metals and other uncharacterized pollutants in these sediments, the likelihood that this approach will be sufficiently effective in reducing the rate of mobilization of these pollutants to element the continuing pollution of the estuary is questionable. As I discussed in my report, this, coupled with the major water control problems that exist at the Tar Ponds site, makes the use of S/S as a remediation approach subject to failure to achieve the desired degree of remediation to eventually restore the estuary to a non-polluted state.

This assessment is based on over 45 years of professional work on the leaching of potential pollutants from sediments, soils and solid wastes. This experience includes considerable work on S/S treatment of wastes and contaminated soils/sediments. After obtaining my PhD degree from Harvard University in 1960 in environmental engineering with an emphasis on aquatic chemistry, I held university graduate-level teaching and research positions at several US universities. During this time I conducted over $5 million in research and published about 500 papers and reports. This work included evaluation of S/S treatment of high-organic wastes where it was found that this approach is not effective in immobilizing pollutants.

During the 1980s, while I held the position of Distinguished Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology, I also held the position of Director of the Site Assessment and Remediation Division of a multi-university hazardous waste research center. Further, I served as a part-time consultant to EBASCO Services on its $200-million US EPA contract to conduct remedial investigation/feasibility studies for Superfund sites east of the Mississippi River in the USA. This position involved serving as a technical advisor to the project managers on potential remediation approaches for the sites. I have continued to be involved in hazardous chemical site investigation/remediation over the past 17 years that I have been a full-time consultant. During this time I have published another 600 papers/reports on my work. These papers and reports are on my website, www.gfredlee.com. Additional information on my expertise and experience pertinent to commenting on Hills' statements about the reliable use of S/S treatment is provided beginning on page 3 of http://www.members.aol.com/annejlee/SydneyTarPondsReport.pdf.

I am fully aware of the politics and other non-technical issues that are often involved in selecting a remediation approach for a contaminated site. It is totally inappropriate for the STPA and Hills to claim that S/S treatment has been used successfully in the USA for over 30 years. S/S treatment is used largely by industry and some agencies since it is cheaper than proper excavation and reliable treatment of the polluted soils, sediments and wastes. In my report to the Expert Panel (cited above), I provided extensive quotes from the literature questioning the reliability of S/S treatment. These quotes, which begin on page 9 and in another section beginning on page 63 of http://www.members.aol.com/annejlee/SydneyTarPondsReport.pdf, were from peer-reviewed conference proceedings devoted to S/S treatment, as well as the literature,

including information from the US EPA staff member who was responsible for the evaluation of S/S treatment.

Lee (2006a) discussed many of the significant deficiencies in the STPA's proposed approach for remediation of the Sydney Tar Ponds sediments and Coke Ovens site soils with respect to providing immobilization/containment of pollutants present at these sites for as long as the pollutants would be a threat to cause further environmental pollution. Of particular concern is the STPA's assessment that S/S treatment of sediments with high organic content (over 50 percent total organic carbon) has been demonstrated to be a highly effective method of immobilizing pollutants. Lee (2006a) provides a review of the literature on the effectiveness of S/S-treatment of wastes and contaminated soils and sediments, focusing on the information provided in two ASTM conferences (Gilliam and Wiles 1992, 1996). As discussed in papers presented at these conferences, there are significant questions about the ability of S/S treatment of high-organic wastes to effectively immobilize organic pollutants so that they do not cause environmental pollution.

The Joint Review Panel report issued on July 12, 2006, is available online at http://www.gov.ns.ca/enla/ea/tarponds/TarPonds_EnvironmentalAssessmentReport.pdf. The Joint Review Panel concluded that STPA had failed to demonstrate that S/S was a proven technology, where it stated,

> *"Both the community and STPA have placed great importance on the use of proven technologies. The Panel is not convinced that the solidification/stabilization technology is proven for use in the Tar Ponds context—that is, to be applied to organic contaminants in organically enriched sediments in an estuary with potential groundwater and seawater influx."*

Perera et al. (2005) (from the Department of Engineering, University of Cambridge, Cambridge, UK; Viridis, Berkshire, UK; and S/S Remediation Consultancy, Nottingham, UK), in a report, "State of practice report UK stabilisation/solidification treatment and remediation, Part V: Long-term performance and environmental impact," have stated,

> *"The application of S/S, for the immobilisation of contaminants by the addition of cement-based additives has been widely practised for many years, and has been generally used successfully, although some contaminants are known to pose problems in treatment (Conner, 1990). However, most of this success is based on results of treatability studies, which are normally conducted over short time periods, typically up to 28 days after treatment. As a result, concerns regarding the long-term effectiveness of the technique have regularly been raised in recent years (Conner, 1990; Borns, 1997; Glasser, 1997; Loxham et al., 1997). These concerns are due to (i) the uncertainties in test methods, (ii) observed deficiencies in the process application, (iii) observed lack of chemical binding in crushed samples of treated waste, suggesting that contaminants could leach out under certain conditions and (iv) uncertainties of performance arising from anticipated behavioural degradation of the material over time.*

Degradation, however, ranges between two extremes: complete release of the contaminant in a relatively short time period and a gradual release over a long period of time. It is highly likely that degradation of S/S materials is possible as nothing lasts forever. Degradation with complete release of the contaminant in a relatively short time period is clearly not acceptable and such catastrophic failure is unlikely. However, a gradual release of some contaminants over a long period of time is more likely, and where the level of contaminant release at any time does not represent a significant risk it will satisfy remediation objectives.

These uncertainties can best be quantified by obtaining real-time long-term data. However, despite the widespread use of S/S techniques, evidence of validation in the long-term is still very limited and there is still no direct evidence of time-related material performance in the field (Kirk, 1996). Validation of the long-term effectiveness of any contaminated ground and waste treatment methodology is essential for its success and in the assessment of its sustainability."

Hills is also quoted to have stated in his recent interview on CBC's Information Morning program,

"Dr. Hills said despite what people may think, the contaminants in the Tar Ponds are not that unusual."

"It's a site that's quite contaminated," Dr. Hills said, "It's typical of these sorts of sites and its also typical of the sites which have been treated successfully, south of the border."

On the contrary, the Sydney Tar Ponds sediments are unusual in that they have high organic content compared to the typical site where S/S is applied. Further, the extremely wet environment of the Sydney Tar Ponds poses significant problems in that there is ample opportunity for water to leach the pollutants from the S/S-treated sediments.

As I discussed in my review of the STPA claims that S/S is an effective remediation of Tar Ponds sediments, Wiles and Barth (1992) of the US EPA S/S treatment evaluation program, in a paper, "Solidification/Stabilization: Is It Always Appropriate?" have discussed the fact that, while there has been some use of cement-based S/S for high-organic wastes, the evaluation of the effectiveness of this use for such wastes is lacking. As I indicated (Lee 2006a), Barth (pers. comm., 2006), has indicated that the situation today is no different than it was in the early 1990s with respect to evaluation of the potential effectiveness of S/S treatment of high-organic wastes.

Thornburg et al. (2006), in a recent study entitled "Effectiveness of *In Situ* Cement Stabilization for Remediation of Sediment Containing Coal Tar Derived Hydrocarbons," found that S/S treatment of these organic sediments was not effective in preventing release of pollutants from them.

The Perera et al. (2005) statements quoted above on this issue are similar to those that I quoted in my report to the Joint Review Panel (Lee 2006a). They demonstrate that, even today, there is still considerable uncertainty about the long-term effectiveness of S/S treatment of wastes, especially high-organic wastes such as the Sydney Tar Ponds sediments.

> *"Dr. Hills says he is confident the solidification and stabilization of the material in the Tar Ponds will contain the contaminants within the boundaries of the property."*
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> *"In solidification and stabilization binding agents such as cement powder and aggregate materials such as slag or gravel, are mixed in with the sediments. The gooey sludge is converted into something resembling regular soil. The addition of the reagents binds the contaminants to the material, and makes them less mobile, less soluble in water. The process increases the ability of the material to bear weight, and it increases its ability to resist intrusion by water."*

These statements, coupled with a review of Dr. Hills' expertise and experience based on the information he has placed on the Internet, raise questions about his understanding of water quality issues that must be considered in developing an **effective** remediation approach for the Tar Ponds sediments. As I commented in my report to the Joint Review Panel, on page 43 of http://www.members.aol.com/annejlee/SydneyTarPondsReport.pdf, the STPA did not understand the extremely low concentrations of PCBs that will have to be achieved in S/S treatment of the Tar Ponds sediments to prevent continued pollution of estuarine organisms. I discussed that STPA used inappropriate analytical methods to measure PCB release from the S/S-treated sediments, where release could have occurred and not be detected by the method used.

It appears that Hills has the same problem in evaluating the potential for S/S treatment of Tar Ponds sediments to adequately immobilize PCBs and other known and yet unknown pollutants in the Tar Ponds sediments. Failure to achieve adequate immobilization of pollutants in the Tar Ponds sediments could readily lead to the future conclusion that the STPA's currently planned remediation was not adequate and there is need to re-remediate these sediments to fully restore the estuary's beneficial uses. Basically, STPA is attempting to conduct an experimental remediation program that matches the amount of funds that were arbitrarily established, without adequate evaluation, as being needed to remediate the Tar Ponds sediments and Coke Ovens site soils.

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