Comments on
CIWMB Discussion and Request for Rulemaking Direction to Formally Notice Proposed Regulations for RCRA Subtitle D Program Research, Development and Demonstration Permits

Comments Submitted by
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In response to the request for comments on the CIWMB Discussion and Request for Rulemaking Direction to Formally Notice Proposed Regulations for RCRA Subtitle D Program Research, Development and Demonstration Permits, I wish to provide the following comments.

I am concerned that the RCRA Subtitle D Program Research, Development and Demonstration Permits could lead to increased groundwater pollution as part of various solid waste management agencies' and companies' beginning to practice leachate recycle/bioreactor operations of a landfill under this permit. While I support the proper treatment of wastes in a landfill to remove the fermentable and leachable components, there are few landfills in California where the addition of moisture, including leachate, will not lead to greater potential for groundwater pollution than exists without leachate recycle. The basic problem is that minimum Subtitle D landfills with a single composite liner can readily fail to prevent groundwater pollution by landfill leachate without this pollution being detected before it trespasses onto adjacent properties. The addition of moisture, including leachate, to the landfill in the so-called "bioreactor" mode of operation increases the potential for greater groundwater pollution than if the landfill were kept dry.

There is considerable misinformation on the reliability of the so-called "bioreactor" landfill to provide for rapid stabilization of the fermentable components of the municipal solid waste (MSW) stream. Further, the typical bioreactor landfill does not eliminate the potential for groundwater pollution by the nonfermentable organics in MSW, as well as the inorganics. In addition, the disposal of MSW in plastic bags that are only crushed (i.e., not shredded) leads to a situation where the rapid stabilization of all of the fermentable, gas-producing components of MSW will take a very long time – likely, many decades, to a hundred or so years. The polyethylene bags will decompose very slowly in a landfill environment; however, when they do decompose, any moisture in contact with the fermentable components will begin to produce landfill gas and leachate that has the potential to be a significant threat to pollute groundwater.

The problems of the bioreactor landfill are largely being ignored by those who advocate addition of moisture to landfills. If the CIWMB adopts RCRA Subtitle D Program Research, Development and Demonstration Permits, it should ensure that any permits issued which include the addition of moisture to landfills are only issued for use at landfills that are adequately designed, operated, maintained and closed to provide high degrees of public health and

environmental protection in the near term and long term – i.e., for as long as the wastes in the landfill will be a threat.

Background to Comments

I first became aware of the public health and environmental problems associated with the landfilling of MSW as an undergraduate student at San Jose State College in the Sanitary Science program. One of the topics covered in the coursework was management of MSW by landfilling. After obtaining a Master of Science in Public Health degree in 1957 from the University of North Carolina, and a PhD in environmental engineering from Harvard University in 1960, I taught graduate-level environmental engineering and environmental science courses for a period of 30 years at several major US universities. During this time, I conducted over five million dollars in research and published about 500 papers and reports on this research. I began work on the impact of municipal landfills in the 1960s and have continued this effort through the present, where I have been involved in evaluating about 75 landfills across the US, in Canada and in several other countries. One of the research topics that I undertook while a university professor was the ability of compacted clay and HDPE liners of the type used in landfills to prevent groundwater pollution for as long as the wastes in the landfill will be a threat.

In the mid-1980s Dr. Jones and I published a paper,

> Lee, G. F. and Jones, R. A., "Is Hazardous Waste Disposal in Clay Vaults Safe?" *J. American Water Works Association* 76:66-73 (1984),

in which we discussed the significant long-term problems with the "dry tomb" landfill in protecting public health and the environment from the hazardous and deleterious components of MSW for as long as the wastes in the landfill would be a threat. This paper was recognized by the Water Resources Division of the American Water Works Association as the best paper published in the *Journal* that year.

In the mid-1980s I was asked by the US Army Construction Engineering Research Laboratory in Champaign, Illinois, to undertake a review of the use of leachate recycle at military base landfills. This review generated a report,

> Lee, G. F.; Jones, R. A. and Ray, C., "Review of the Efficacy of Sanitary Landfill Leachate Recycle as a Means of Leachate Treatment and Landfill Stabilization," Report to the US Army Construction Engineering Research Laboratory, Champaign, IL, October (1985),

with the conclusion that while leachate recycle had the potential to significantly shorten the time that landfill gas production could occur, it also had the potential to significantly increase groundwater pollution. A summary paper covering the topics presented in this report was published as

> Lee, G. F.; Jones, R. A. and Ray, C., "Sanitary Landfill Leachate Recycle," *Biocycle* 27:36-38 (1986).

Further, we published another paper,

> Lee, G. F. and Jones, R. A., "Managed Fermentation and Leaching: An Alternative to MSW Landfills," *Biocycle* 31(5):78-80,83 (1990),

which discussed how leachate recycle should be conducted.

In 1989 I retired after 30 years of graduate-level teaching and research and expanded my part-time consulting that I had conducted while a university professor into a full-time activity. Dr. Jones-Lee (my wife) terminated her associate professorship in civil and environmental engineering and joined with me in my consulting activities. At that time we moved to El Macero, California (next to Davis). One of our areas of activity is the proper landfilling of MSW. We have established a website, www.gfredlee.com, on which we list and make available our papers and reports on the various topics in which we are active, including landfills.

In 1993 Dr. Jones-Lee and I published a paper,

> Lee, G. F. and Jones-Lee, A., "Landfills and Groundwater Pollution Issues: 'Dry Tomb' vs F/L Wet-Cell Landfills," In: Proceedings of IAWQ Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp 1787-1796, October (1993),

in which we discussed the advantages and disadvantages of leachate recycle and recommended how this approach could be undertaken to prevent groundwater pollution from the increased hydraulic loading associated with adding leachate to the landfill. Further, we introduced the concept of clean-water washing of the fermented MSW to remove the nonfermentable but leachable components of the wastes that are a long-term threat to cause groundwater pollution.

With increased attention to the so-called "bioreactor" landfill as an alternative to the "dry tomb" landfill, where the potential problems of bioreactor landfills are not being discussed by proponents, by the author of a book on bioreactor landfills or by the US EPA in conference proceedings devoted to bioreactor landfills, we have published a comprehensive review on bioreactor landfills:

> Jones-Lee, A. and Lee, G. F. "Appropriate Use of MSW Leachate Recycling in Municipal Solid Waste Landfilling, " Proceedings Air and Waste Management Association 93rd national annual meeting, CD rom paper 00-455, Pittsburgh, PA, June (2000). http://www.gfredlee.com/nwqmcl.html

In addition, in response to a request for comments by the US EPA on leachate recirculation, we submitted the following comments:

> Lee, G. F., "Revision of Solid Waste Landfill Criteria - Leachate Recirculation," Submitted to US EPA Docket Number F-1999-MLFN-FFFFF, Washington D.C., January (2000).

This paper and these comments discuss how leachate recycle/bioreactor landfills should be designed, operated, closed and maintained.

Recently we have developed a review of the problems of landfilling of MSW in a "dry tomb" landfill, in which we have also discussed the potential problems with and how to properly develop a "bioreactor" landfill:

> Lee, G. F. and Jones-Lee, A., "Overview of Subtitle D Landfill Design, Operation, Closure and Postclosure Care Relative to Providing Public Health and Environmental Protection for as Long as the Wastes in the Landfill will be a Threat," Report of G. Fred Lee & Associates, El Macero, CA (2004).
> http://www.gfredlee.com/LFoverviewMSW.pdf

All of these recent papers and reports are available from our website at the URLs listed. These papers provide detailed discussions of the problems with and approaches that should be followed associated with adding moisture to "dry tomb" landfills.

Summary

In summary, the RCRA Subtitle D Program Research, Development and Demonstration Permits should not be a mechanism where public or private landfill owners can inexpensively dispose of leachate. Unfortunately, I have found that a number of landfill owners advocate leachate recycle/bioreactor landfills in order to reduce the cost of leachate management. Further, all additions of moisture to a landfill in so-called "bioreactor" operation should only be done in a double composite lined landfill in which there is a leak detection system between the two composite liners. If the upper composite liner is found to be leaking leachate through it at any time in the future, the landfill owner/operator should be prepared to either exhume the wastes or install a leak-detectable cover over the landfill that will be operated and maintained in perpetuity – i.e., for as long as the wastes in the landfill are a threat. This mode of operation will require that a dedicated trust fund of sufficient magnitude be developed to ensure that funds will be available to address plausible worst-case failure scenarios for as long as the wastes in the landfill will be a threat. In addition, only shredded/unbagged solid waste should be placed in the landfill.

The RCRA Subtitle D Program Research, Development and Demonstration Permits that could be issued by the CIWMB should not be issued to develop any more bioreactor landfills of the type developed in Yolo County. I was an invited reviewer of the proposed US EPA grant to develop the Yolo County bioreactor landfill. I pointed out in my comments,

> *"**Overall***
> *It is unfortunate that this project has gotten as far as it has without adequate review of fundamental issues and the implications of the results of this project on public health, groundwater resources and environmental protection. I am sorry to be so negative on the project; however, I am concerned that such a large amount of funds are going to be spent in the name of bioreactor technology development, where little is going to be gained over what was known as the result of John Pacey's work in Sonoma County in the 1970s."*

My July 2000 comments on the problems with this proposed bioreactor demonstration project are available from my website:

> Lee, G. F., "Comments on EPA Project XL: Final Project Agreement for the Yolo County Accelerated Anaerobic & Aerobic Composting (Bioreactor) Project, Dated June 22, 2000," Comments Submitted to US EPA Region 9 by G. Fred Lee & Associates, El Macero, CA, July 1 (2000), with additional comments dated September (2000). http://www.members.aol.com/apple27298/ProjectXL.pdf

The fall 2003 review of the Yolo County bioreactor landfill confirmed my predictions of the problems with this landfill in providing significant new information that would advance bioreactor technology.

I feel there is need to conduct a proper bioreactor landfill demonstration following the guidelines that I have been recommending for over 10 years. This would provide the information on cost, problems of operation and funding issues, and could serve as a guide to future bioreactor landfill development.