Issues in Assessing the Effectiveness of US EPA's Presumptive Remedy for UCD LEHR Superfund Site Landfills in Protecting Groundwaters from Pollution by Landfill Wastes

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At the August 2006 remediation program managers (RPM) meeting, there was discussion of the proposed use of the US EPA "Presumptive Remedy" for addressing the remediation of the University of California, Davis (UCD), Laboratory for Energy-related Health Research (LEHR) Superfund site campus landfills. Presented herein is a discussion that can help the Davis South Campus Superfund Oversight Committee (DSCSOC) understand the potential reliability of this approach for remediation of the UCD campus landfills so that they do not cause further groundwater pollution.

Reducing the Cost of Remediation of Municipal Solid Waste Landfills

As part of developing approaches for remediation of Superfund sites, the US EPA concluded that it did not want to require that existing municipal landfills be investigated to a sufficient extent to fully characterize the waste in the landfill with respect to its potential to cause groundwater pollution and the release of landfill gas that could be hazardous to anyone within the sphere of influence of the landfill. Such an investigation would have revealed that many municipal landfills contain what the US EPA classifies, based on the Toxicity Characteristic Leaching Procedure (TCLP) (formerly, the Extraction Procedure Toxicity Test), as "hazardous" waste. Such a finding would then trigger the need to separate the hazardous waste from the nonhazardous waste, and deposit the hazardous waste in a US EPA Subtitle C landfill, while the so-called "nonhazardous" waste (which can, by definition, contain hazardous chemicals that are a threat to health and the environment) could be placed in a new Subtitle D municipal solid waste (MSW) landfill.

Lee and Jones-Lee (2006) have discussed the significantly improved groundwater quality protection that can be achieved when wastes are placed in a Subtitle C (hazardous waste) double composite lined landfill with its associated leak detection system between the two composite liners, compared to a minimum design Subtitle D landfill with a single composite liner that relies on groundwater pollution detection based on vertical monitoring wells spaced hundreds of feet apart, or an unlined landfill that has a low-permeability cap installed under the Presumptive Remedy. Deficiencies in the minimum design Subtitle D landfill have been recognized by at least half a dozen states, where double composite lined landfills are required for municipal solid waste landfilling.

While the detailed investigation, separation and appropriate landfilling approach would be the most protective of public health and the environment from future pollution of groundwaters by

the remediated landfill, the US EPA decided that the most economical approach within the Superfund program would be to determine that municipal landfills, including those that contained some hazardous chemicals (that, if investigated, would be classified as hazardous waste), should be remediated based on **"containment"** of all of the wastes within the landfill. This approach is called the Presumptive Remedy for investigation and remediation of municipal landfills that are part of Superfund sites.

Presumptive Remedy Approach

The US EPA (2006) has provided a discussion, "Presumptive Remedy for CERCLA Municipal Landfill Sites," on their website, at http://www.epa.gov/superfund/resources/presump/clms.htm. According to this webpage,

> *"This directive establishes **containment** as the presumptive remedy for CERCLA municipal landfills. The framework for the presumptive remedy for these sites is presented in a streamlining manual entitled* Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, *February 1991 (OSWER Directive 9355. 3-11).*
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> *Because treatment usually is impracticable, EPA generally considers containment to be the appropriate response action, or the 'presumptive remedy,' for the source areas of municipal landfill sites.*
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> *The presumptive remedy for CERCLA municipal landfill sites relates primarily to containment of the landfill mass and collection and/or treatment of landfill gas. In addition, measures to control landfill leachate, affected ground water at the perimeter of the landfill, and/or upgradient ground-water that is causing saturation of the landfill mass may be implemented as part of the presumptive remedy."*

With respect to treatment of municipal solid wastes being "impracticable," the US EPA ignored the extensive work that was done in the 1980s on landfill mining, where a number of Demonstration Projects were conducted which showed that it is possible to recover landfill space through excavation and sorting of the landfilled wastes (see Lee and Jones 1990, 1991).

The US EPA webpage on Presumptive Remedy further states,

> *"Highlight 1 identifies the components of the presumptive remedy. Response actions selected for individual sites will include only those components that are necessary, based on site-specific conditions."*

Highlight 1: Components of the Presumptive Remedy: Source Containments

- *Landfill cap;*
- *Source area ground-water control to contain plume;*
- *Leachate collection and treatment;*
- *Landfill gas collection and treatment; and/or*
- *Institutional controls to supplement engineering controls.*

In developing the Presumptive Remedy for municipal landfills, the US EPA apparently did not understand/acknowledge that many/most of the municipal landfills where the Presumptive Remedy would be considered are landfills that do not have leachate collection and removal systems. There is a significant difference in being able to detect and manage future pollution of groundwaters by the so-called "remediated" landfill between landfills with functioning, monitored and maintained leachate collection systems, and those like the UCD LEHR Superfund site landfills which do not have leachate and collection and removal systems. As discussed below, there are significant questions about whether the US EPA Presumptive Remedy should be applied to landfills like the UCD LEHR Superfund site landfills because of the long-term problems of detecting additional groundwater pollution by the "remediated" landfill.

Importance of Leachate Collection and Removal System. For those municipal solid waste landfills that have a leachate collection and removal system, monitoring of the leachate collection and removal system can be a somewhat reliable approach for determining when the cap on the landfill is no longer preventing moisture from entering the landfill that leads to leachate generation. However, for older landfills, including the UCD campus landfills, under the minimum Presumptive Remedy, the way that the failure of the cap to be effective in restricting moisture from entering the landfill, and, therefore, generating leachate, would be detected is through detecting increased groundwater pollution by the landfill. This approach is not necessarily reliable for a number of reasons related to the inadequate groundwater monitoring program that UCD has been allowed to develop and maintain for assessing pollution of groundwaters by the LEHR Superfund site wastes.

Ignoring the Threat of Hazardous Waste in Municipal Landfills

UCD's campus landfills are not typical municipal solid waste landfills, in that they received considerable amounts of UCD laboratory wastes, some of which would be considered as hazardous wastes, in accord with the US EPA's limited-scope definition of hazardous wastes. The Landfill No. 2 pollution of groundwaters by chloroform has created a groundwater pollution plume that extends offsite over a mile from the landfill. These campus landfills have also polluted groundwaters with a variety of other recognized chemicals which render the groundwater unusable for domestic purposes. Further, there is no doubt that there are a wide variety of hazardous and nonhazardous unregulated chemicals in the UCD landfills that have the potential to cause groundwater pollution.

The US EPA's discussion of its Presumptive Remedy approach includes consideration of the fact that municipal landfills received industrial hazardous wastes. The Agency has chosen to arbitrarily determine that "limited" amounts of industrial hazardous wastes do not preclude the use of the Presumptive Remedy approach. As an example, the US EPA indicates in its website discussion that a 70-acre former municipal landfill which contained 200 drums of hazardous waste at unknown locations in the landfill and of unknown characteristics would not be precluded from being remediated under the Presumptive Remedy approach. This is clearly an arbitrary approach on the part of the US EPA to minimize the cost of Superfund site investigation/remediation by allowing municipal landfills that can, at some time in the future, be a significant threat to public health and the environment, to be remediated under the Presumptive Remedy approach.

First, it would be highly unlikely, without detailed investigation, that the number of drums of hazardous waste deposited in a former municipal landfill would be known. Second, it is entirely possible that drums of hazardous waste placed in a municipal landfill would not pollute groundwaters until the drums had rusted to a sufficient extent to release their contents. This could result in significant future pollution of groundwater, which, as discussed below, would not necessarily be detected/controlled under the "containment" approach allowed by the Presumptive Remedy. This is one of the components of the Presumptive Remedy that can fail to be protective of public health and the environment.

Application of the Presumptive Remedy Approach to the UCD LEHR Landfills

Basically, the Presumptive Remedy approach, as applied to the University of California, Davis, LEHR Superfund site three campus landfills, involves placing a low-permeability (not impermeable) cap on the landfill to reduce the amount of moisture entering the wastes through the surface of the landfill, and monitoring groundwaters for continued release of pollutants from the landfill. In principle, this so-called "containment" approach would be effective in short-term control of additional pollution of the groundwaters by the three campus landfills. There are, however, significant questions about how well this so-called "containment" approach will address the long-term threat that the wastes in the UCD three campus landfills represent to groundwater quality.

Lee and Jones-Lee (1997) have reviewed the potential problems of capping of wastes at hazardous chemical sites, including landfills, in providing true long-term public health and environmental protection. The key to control of future groundwater pollution by landfills such as the UCD LEHR landfills is the control of moisture (water) that enters the landfill through the surface of the landfill (cap). The US EPA, as part of its municipal landfilling regulations, does not require that an impermeable cap be installed, monitored and maintained for as long as the wastes in the landfill will be a threat. With respect to the UCD campus landfills, with the installation of a highly effective low-permeability cap on the landfill, the wastes in the landfills could become dormant with respect to producing leachate that can lead to further groundwater pollution. This means that, to the extent that the cap is effective in controlling moisture entering the landfills, the wastes in the landfills will be an ongoing threat to generate leachate at some time in the future when the cap is inadequately monitored and maintained and is, therefore, no longer effective in controlling moisture entering the landfill.

It is well documented that landfill caps deteriorate over time in their ability to prevent moisture from entering the wastes and generating leachate, which can lead to groundwater pollution. It is also well known that the conventional approaches for monitoring the integrity of a landfill cap, through visual inspection of the soil surface layer of the cap, are not reliable for detecting deterioration of the low-permeability layer within the cap. These issues are discussed in Lee and Jones-Lee's "Flawed Technology" review (Lee and Jones-Lee 2006).

Inadequate Groundwater Monitoring

As DSCSOC has repeatedly pointed out over the years (see DSCSOC website at http://www.members.aol.com/dscsoc), the current UCD groundwater monitoring approach for downgradient assessment of groundwater pollution by various waste management units assumes

that groundwater pollution from a landfill occurs evenly across the footprint of the landfill and that monitoring of groundwater characteristics at any location downgradient of the landfill can reliably determine the pollution of groundwaters by the landfill. Such an assumption is, at best, tenuous, in that the wastes deposited in the UCD landfills was not of the same composition at all locations within each landfill, with the result that the pollution of groundwaters downgradient from the landfill will be variable, dependent on the characteristics of the leachate derived from each part of the landfill.

With the installation of a low-permeability cap on the landfill, the potential for the existing groundwater monitoring well array to fail to detect additional pollution by the capped landfill will become even more significant than it is now, as a result of the fact that the leakage of the cap will not be constant over the cap surface. There will be areas of deterioration in cap properties which are localized, leading to localized generation of leachate in the landfill underlying these areas. This, in turn, will lead to groundwater pollution by the newly generated leachate, which can have a high probability of not being detected by groundwater monitoring unless a significantly improved groundwater monitoring system is developed at the UCD LEHR Superfund site. This situation makes the US EPA's Presumptive Remedy approach for remediation of the UCD campus landfills at the LEHR Superfund site questionable in terms of being able to detect when the cap fails to prevent future leachate generation that leads to further groundwater pollution.

Leak Detectable Covers

There is an alternative approach for developing true "containment" of municipal landfill wastes, which has the potential to prevent groundwater pollution by the capped landfill waste. This involves the installation of leak detectable covers on the landfills. As discussed by Lee and Jones-Lee (1995, 1998, 2006), leak detectable covers have been developed which have a high probability of determining when the cover is no longer effective in preventing moisture from entering the landfill through he cap. In the 1990s, several companies developed leak detectable covers, including the Robertson approach (Robertson 1990). This approach involves a sandwiched double HDPE liner, consisting of panels of approximately one-acre size, in which the two HDPE layers are sealed at the edges and a vacuum is applied. Failure of the panel to maintain a vacuum is a potential indication that the panel is no longer effective in preventing moisture from entering the wastes, with the result that there is need to uncover the panel, which would be under a soil layer, and repair those areas of the panel where the HDPE layer has deteriorated. Gundle, now GSE, of Houston, Texas, imported technology from Europe involving electronic testing of HDPE layers to detect when the landfill cover is no longer effective in preventing moisture from entering the wastes (GSE, undated).

The leak detectable cover approach was not adopted by the federal and state regulatory agencies, based on opposition by public and private landfill owners, since it would mean that the landfill owner would be required to operate and maintain the leak detectable cover forever – i.e., for as long as the wastes in the landfill are a threat. No regulatory agency was willing to cause the public, who would ultimately have to pay for this approach, to have to increase their garbage management cost to pay for this approach, since this would be a politically unpopular approach for the governmental agencies responsible for overseeing the activities of the regulatory agencies.

The net result is that, for landfills such as the UCD landfills at the LEHR Superfund site, under the Presumptive Remedy approach, the ultimate failure of the cover to function effectively for containment of the leachable waste components may not be detected, with the result that additional pollution of the groundwaters by the "remediated" campus landfills will likely occur. Overall, the application of the Presumptive Remedy approach to remediation of the UCD LEHR Superfund site campus landfills can be fundamentally flawed in terms of protecting public health and the environment for as long as the wastes in the UCD landfills will be a threat.

A key issue that will need to be addressed as part of adopting the Presumptive Remedy for the UCD LEHR Superfund site campus landfills is how the integrity of the low-permeability layer in the cover that is developed on these landfills will be monitored to insure that the low-permeability characteristics are maintained throughout the time that the wastes in these landfills will be a threat (i.e., forever). Another key issue will be determining the reliability of detecting new groundwater pollution from the remediated landfill at any location downgradient from the landfill before significant additional groundwater pollution occurs.

Consolidation of UCD LEHR Site Campus Landfilled Wastes

At the August 2006 RPM meeting there was discussion about the possibility of moving the wastes in one or more of the three campus landfills and combining those wastes into an existing campus landfill to create an expanded landfill. The US EPA allows this approach to be followed without triggering the need to develop a hazardous waste US EPA Subtitle C landfill for the relocated wastes, even though the relocated wastes contain wastes that the US EPA would classify as "hazardous." The consolidation of Superfund wastes is discussed in "Superfund LDR Guide #5 Determining When Land Disposal Restrictions (LDRs) Are Applicable to CERCLA Response Actions" (US EPA 1989). According to this document,

> *"This guide outlines the process used to determine whether the Resource Conservation and Recovery Act (RCRA) land disposal restrictions (LDRs) established under the Hazardous and Solid Waste Amendments (HSWA) are "applicable" to a CERCLA response action.*
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> *For the LDRs to be applicable to a CERCLA response, the action must constitute placement of a restricted RCRA hazardous waste. Therefore, site managers (OSCs, RPMs) must answer three separate questions to determine if the LDRs are applicable:*
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> *(1) Does the response action constitute placement?*
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> *(2) Is the CERCLA substance being placed also a RCRA hazardous waste? and if so*
>
> *(3) Is the RCRA waste restricted under the LDRs?*
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> *Site managers also must determine if the CERCLA substances are California list wastes, which are a distinct category of RCRA hazardous wastes restricted under the LDRs (see Superfund LDR Guide #2).*
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> * * *
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> *If a CERCLA response includes disposal of wastes in any of these types of off-site land disposal units, placement will occur. However, uncontrolled hazardous waste sites often have widespread and dispersed contamination, making the concept of a RCRA unit less useful for actions involving on-site disposal of wastes. Therefore, to assist in defining*

when "placement" does and does not occur for CERCLA actions involving on-site disposal of wastes, EPA uses the concept of 'areas of contamination' (AOCs), which may be viewed as equivalent to RCRA units, for the purposes of LDR applicability determinations.

An AOC is delineated by the areal extent (or boundary) of contiguous contamination. Such contamination must be continuous, but may contain varying types and concentrations of hazardous substances. [Empahasis added] *Depending on site characteristics, one or more AOCs may be delineated. Highlight 1 provides some examples of AOCs."*

Highlight 1: EXAMPLES OF AREAS OF CONTAMINATION (AOCs)

- *A waste source (e.g., waste pit, landfill, waste pile) and the surrounding contaminated soil.*
- *A waste source, and the sediments in a stream contaminated by the source, where the contamination is continuous from the source to the sediments.**
- *Several lagoons separated only by dikes, where the dikes are contaminated and the lagoons share a common liner.*

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** The AOC does not include any contaminated surface or ground water that may be associated with the land-based waste source.*

Based on this guidance it appears that, since the three UCD LEHR Superfund site campus landfills are not continuous, the application of the AOC may be inappropriate for the LEHR site. This would certainly be the case for Landfill No. 3. Since Landfills No. 1 and 2 are separate units, it is likely not applicable to them as well.

At the RPM meeting, I mentioned, in connection with the possibility of combining the UCD landfilled wastes at the LEHR site, that Landfill No. 3 is significantly different in some of its characteristics than Landfills No. 1 and 2. In the summer of 1995, when DSCSOC first became involved at the LEHR site, we (J. Roth and G. F. Lee) were provided a tour of the site by the onsite manager. At that time we asked about Landfill No. 3. We were shown this landfill, where we found that UCD had constructed a large drainage ditch through the top of the landfill, in which Landfill No. 3 wastes were exposed. The exposed wastes contained a variety of constituents, including PCBs. We were told that the ditch did not drain to Putah Creek – i.e., there was no connection between the ditch and Putah Creek. Therefore there was no possibility that water that had been in contact with the exposed wastes would transport waste components to Putah Creek. I questioned this statement, since associated with the ditch on the levee was a valve and drainage structure, which appeared to connect the ditch to the creek.

In the fall of 1995, associated with the first major rainfall runoff event, I inspected the ditch and found that substantial amounts of water from the LEHR site and other areas of UCD were being transported via the ditch to Putah Creek. This eventually caused the RPMs to order UCD to prevent water from entering the Landfill No. 3 wastes through the ditch. UCD had gunnite applied to the surface of the wastes that were exposed in the ditch. As I indicated at the August

2006 RPM meeting, the placement of a low-permeability cover over Landfill No. 3 in accord with the Presumptive Remedy will require a significantly different approach than for Landfills No. 1 and 2, since gunnite is not necessarily a reliable cover for a landfill.

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