LUST Cleanup Landscape Changing: Landfilling Still In, Pump and Treat on the Way Out

By Paul Kostecki and Marc Nascarella

The following article was developed by the Northeast Regional Environmental Public Health Center at the University of Massachusetts using data collected from a U.S.E.P.A. project to survey states regarding the use of remedial technologies for contaminated groundwater and soils at LUST sites. Thirty five states responded to the survey in total or in part. The survey was comprised of 12 questions that dealt with the types of technologies used; use of technologies by site; changes in technology use over time; barriers to implementation; the impact monitored natural attenuation, RBCA and MTBE have had on cleanups; and needs for more information about technologies. The 2001 survey results are compared with data from a 1995 University of Massachusetts' survey that were collected from 45 states. Comparisons are made based on a percentage of total sites for each survey. Paul Kostecki, Ph.D., is Associate Director of the Northeast Regional Environmental Public Health Center and Research Associate Professor in the Environmental Health Sciences Department at the University of Massachusetts, Marc Nascarella was a former graduate student in the Environmental Health Sciences Department at the University of Massachusetts.

When the University of Massachusetts conducted its first states' survey in 1985 to determine how LUST sites were being remediated, the number one option for soil remediation wasn't even an actual remedial technology by most standards. The survey showed that landfilling (excavation to a landfill) was the most popular remedial option being applied to contaminated soils from LUST sites around the country. 72% of the 50 states surveyed reported using excavation to a landfill as a LUST site option. The next most popular option was landfarming that was reported by 58% of the states. Bioremediation, called in situ biodegradation and microbial degradation in the 1985 survey, was in its infancy and only used in 26% of the states on more than just a trial basis. Several other states reported that bioremediation was only used once on a trail basis.

The University has conducted two more surveys since 1985, one in 1995 and one just this past year. While each survey was conducted somewhat differently and direct comparisons are difficult in some areas, what becomes apparent from these results is that the fields of soil and groundwater remediation for petroleum contamination at LUST sites are maturing but not in the ways one might think.

Landfill

Take for example excavation to a landfill as a remedial option, the most popular option in the 1985 survey. One might believe that this option may be becoming less prevalent at LUST sites as an option of choice. Most professionals do not consider landfilling a viable option and are not in favor of its use. Rather than remediating, landfilling just transfers the contamination from one site to another! Environmentalists consider landfills (many of which are unlined or most likely have had the integrity of their linings compromised) ecological time-bombs destroying watersheds, groundwater and surface waters over time. Another factor in one's rationale that landfilling as a viable remedial option for LUST sites should be decreasing is that land values have increased enormously through the 90's. One may believe that the destruction of prime real estate by creating new landfills or expanding existing landfills would deter the use of landfills for petroleum contaminated soils (PCS). Even politicians appear to decry landfills as ecologically inappropriate and economically unsound for PCS.

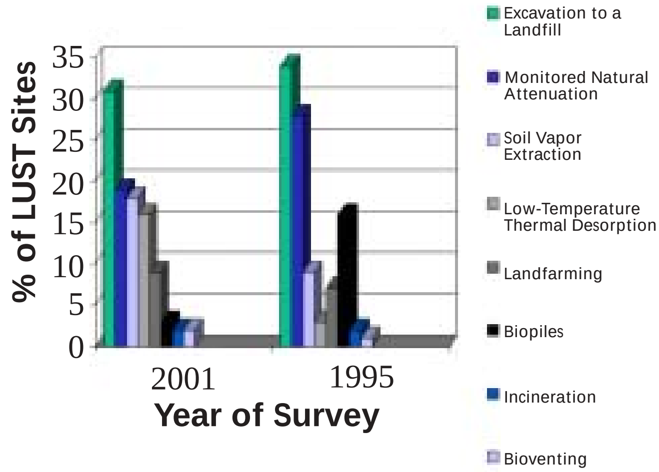

Figure 1. A comparison of technology use (% of total sites reported) for contaminated soils at LUST sites from a survey conducted by the University of Massachusetts Amherst in 1995 and 2001.

Landfilling of PCS from LUST sites is still very common as can be seen in Table 1. The relative use of excavation to a landfill decreased from about 34% in 1995 at all LUST sites to only 31% in 2001 (Figure 1). Landfilling opponents can hold out hope since 40% (10 out of the 25 states reporting) indicated a decrease in its use and only three states reported an increase. Unfortunately, landfilling was identified as the most important technology for soil remediation at LUST sites by the state respondents (Table 2).

Natural Attenuation and Biopiles

Somewhat surprising is that monitored natural attenuation (MNA) and biopiles appear to have lost appeal since 1995 as a technology for remediating contaminated soils at LUST sites (in spite of the fact that 25 out of 35 states report that they encour-

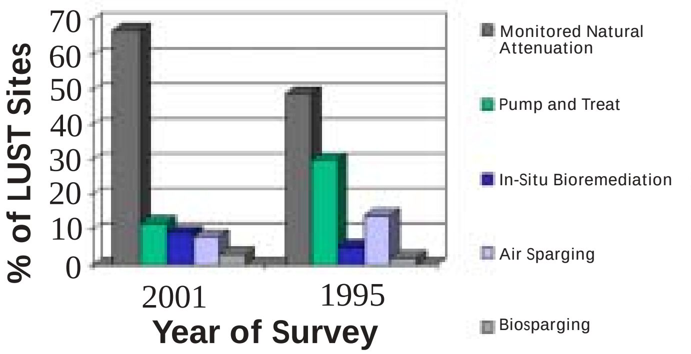

Figure 2. A comparison of technology use (% of total sites reported) for contaminated groundwater at LUST sites from a survey conducted by the University of Massachusetts Amherst in 1995 and 2001.

age MNA use). Their use declined from 28% and 16%, respectively, in 1995 to 19% and 3%, respectively, in 2001 (Figure 1). Respondents from the 2001 survey identified several barriers to biopile use at LUST sites including a lack of confidence in the technology; costs; lack of understanding by states; and the time it takes for cleanup. It is much clearer why MNA use has decreased: respondents strongly believe the main barrier to MNA use is that cleanups take too long (Table 3).

Landfarming

A more surprising result is that landfarming use has remained about the same in 2001 as in 1995. Landfarming use at LUST sites rose from 7% in 1995 to 9% in 2001. From a state perspective, landfarming remains about as popular in 2001 as it did in 1985: 58% of the states in 1985 reported using landfarming; 57% of the states in 2001. In the '80s many felt landfarming would decrease in use due to regulatory resistance since the methodology allowed the volatile constituents to be transferred from the soil to the air essentially creating an air contamination problem at the expense of cleaning up the soil. It was also believed that land tracts large enough and far enough away from populated areas to be useful for landfarming would become less available as land was developed in rural settings.

Soil Vapor Extraction

It appears that soil vapor extraction (SVE) and low-temperature thermal desorption have increased significantly in use from 1995 to 2001. SVE use rose from 9% of LUST sites in 1995 to 18% in 2001 (Figure 1). Low-temperature thermal desorption use rose from being applied to only 3% of the sites in 1995 to 16% in 2001. A comparison of a variety of remedial technology use for 1995 and 2001 for contaminated soils at LUST sites is shown in Figure 1.

Groundwater Remediation

The groundwater picture for remedial technology use at LUST sites shows MNA prominence as a technology of choice being used at five times as many sites as the next most popular technology, pump and treat (Table 1). This is a significantly different picture of technology use from the 1995 survey (Figure 2). The 2001 survey indicates that there has been a significant increase in MNA and even a more significant decrease in pump and treat use. Table 1 shows that MNA is being applied to 67% of LUST sites in 2001, up from 49% in 1995 while pump and treat use has fallen from 30% in 1995 to 12% in 2001. The decrease in pump and treat use is encouraging since many opponents believe that this type of remediation can spread contamination, rarely achieves long term cleanup levels and is extremely costly (i.e., time and money).

Other technology trends for contaminated groundwater at LUST sites appear to be a decrease in air sparging use from 14% in 1995 to 8% in 2001 and an increase in bioremediation use from 5% in 1995 to 9% in 2001. A comparison of a variety of remedial technology use for contaminated groundwater at LUST sites is shown in Figure 2.

Technology	% of LUST Sites
SOIL REMEDIATION	
Excavation to a Landfill	31
Monitored Natural Attenuation	19
Soil Vapor Extraction	18
Low-Temperature Thermal Desorption	16
Landfarming	9
Biopiles	3
Incineration	2
Bioventing	2
GROUNDWATER REMEDIATION	
Monitored Natural Attenuation	67
Pump and Treat	12
In-Situ Bioremediation	9
Air Sparging	8
Biosparging	3

Table 1. Use of technologies at LUST sites as a percentage of total sites for contaminated soils and groundwater. The data are from a survey of state agencies responsible for the environmental management of underground storage tanks and was conducted by the University of Massachusetts Amherst from April-August, 2001.

RBCA and MTBE

The survey was also used to determine the influence the use of RBCA and the presence of MTBE at LUST sites may have on the selection of remedial technologies. While RBCA appears to have some modest influence on remedial selection (24 out of 35 states report it does), the presence of MTBE does not appears to be impacting remedial selection as prominently (17 out of 35 states report it does). Nonetheless both factors are impacting cleanups. RBCA's main impact is attributed to the need for more detailed investigations and forcing states to use analytical methods not typically used in the past to detect lower levels of contaminants.

The presence of MTBE at LUST sites appears to be impacting how and which sites are remediated. Several states indicated that more detailed site assessments are necessary over larger areas and attribute this to the fact that MTBE plumes tend to be larger than BTX plumes and less easily delineated. This leads to more sampling and monitoring wells (multilevel wells in some cases) resulting in greater cost and time expenditure. Other impact factors include an increase in regulatory attention to address MTBE when it is present and an increased urgency to act when MTBE is present. This urgency appears to stem from the regulator's belief that MTBE because of its environmental behavior is more likely to impact drinking water supplies. Thus, there is greater pressure to initiate active remediation at those sites and remediate sites that would otherwise not be considered a problem. MTBE presence may explain the decrease since 1995 in MNA use (Figure 1) and importance (Table 2) for contaminated soils. Source removal at LUST sites has always been a driving factor.

Technology	Ranking
SOIL REMEDIATION	
Excavation to a Landfill	1
Soil Washing	2
Incineration	3
Low-Temperature Thermal Desorption	4
Biopiles	5
Monitored Natural Attenuation	6
Bioventing	7
Soil Vapor Extraction	8
GROUNDWATER REMEDIATION	
Pump and Treat	1
Monitored Natural Attenuation	2 (tie)
Biosparging	2 (tie)
In-Situ Bioremediation	3
Air Sparging	4

Table 2. The most important technologies at LUST sites as reported by state agencies responsible for the environmental management of underground storage tanks. Data were collected from a survey conducted by the University of Massachusetts Amherst from April-August, 2001.

Identifying Useful Sources of Information

Lastly, the survey attempted to identify useful sources of information available to state regulatory staff and consultants to help them learn about LUST related issues. The following five sources were identified as the most useful (in order from more to less) from a proposed list of 15 related publications/conferences/databases:

1. "How to Effectively Recover Free Product at Leaking Underground Storage Tanks Sites: A Guide for State Regulators",
2. "How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites: A Guide for Corrective Action Plan Reviewers",
3. Contaminated Soil, Sediment and Water Magazine,
4. "Expedited Site Assessment Tools for Underground Storage Tank Sites: A Guide for State Regulators",
5. Annual State-by-State Survey, Association for Environmental Health and Sciences.

TECHNOLOGY OPTION	Cleanup Takes Too Long	Problems getting Permits	Method Not Understood by State	State Won't Reimburse	Methods Cost Too Much	State Policies Limit Use	Lack of Confidence in Technology
SOIL							
Excavation to a Landfill					X		
Monitored Natural Attenuation	X						
Soil Vapor Extraction	X				X		
Low-Temperature Thermal Desorption					X		
Landfarming						X	
Biopiles	X		X		X		X
Incineration					X		
Soil Washing					X		
Bioventing	X						X
GROUNDWATER							
Dual Phase Extraction					X		
Monitored Natural Attenuation	X						
Pump and Treat	X				X		
In-Situ Bioremediation	X						X
Air Sparging					X		
Biosparging			X		X		

Table 3. A summary of barriers preventing the implementation of various contaminated soil and groundwater treatment technology options at LUST sites. Data from a survey of state LUST agencies conducted by the University of Massachusetts Amherst, April - August, 2001.

Mixed Results

The 2001 survey results show soil and groundwater remediation activities at LUST sites are a mixed bag, especially when compared with past survey data. For soils, some tried-and-true technologies like SVE and landfarming continue to grow in popularity while another, landfilling, remains popular even though a slight decline was seen. Promising new technologies of the mid-90's, monitored natural attenuation and biopiles have declined in popularity, while low temperature thermal desorption has increased. Groundwater remediation at LUST sites is moving more towards monitored natural attenuation and in-situ bioremediation, less pump and treat and air sparging.

The most interesting result of the 2001 survey may be that no new technology has been developed to remediate contaminated soils and groundwater in the last decade.