Justification for Opposition by Residents of Mobile, Arizona, to the Siting of an Additional Landfill in Mobile

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Southpoint Environmental Services (SES) has proposed to construct an approximately 690-acre municipal solid waste (MSW) landfill in Mobile, Arizona. Mobile residents are opposed to the development of this landfill. This report presents a review of the information available and concludes that there is justification for this opposition.

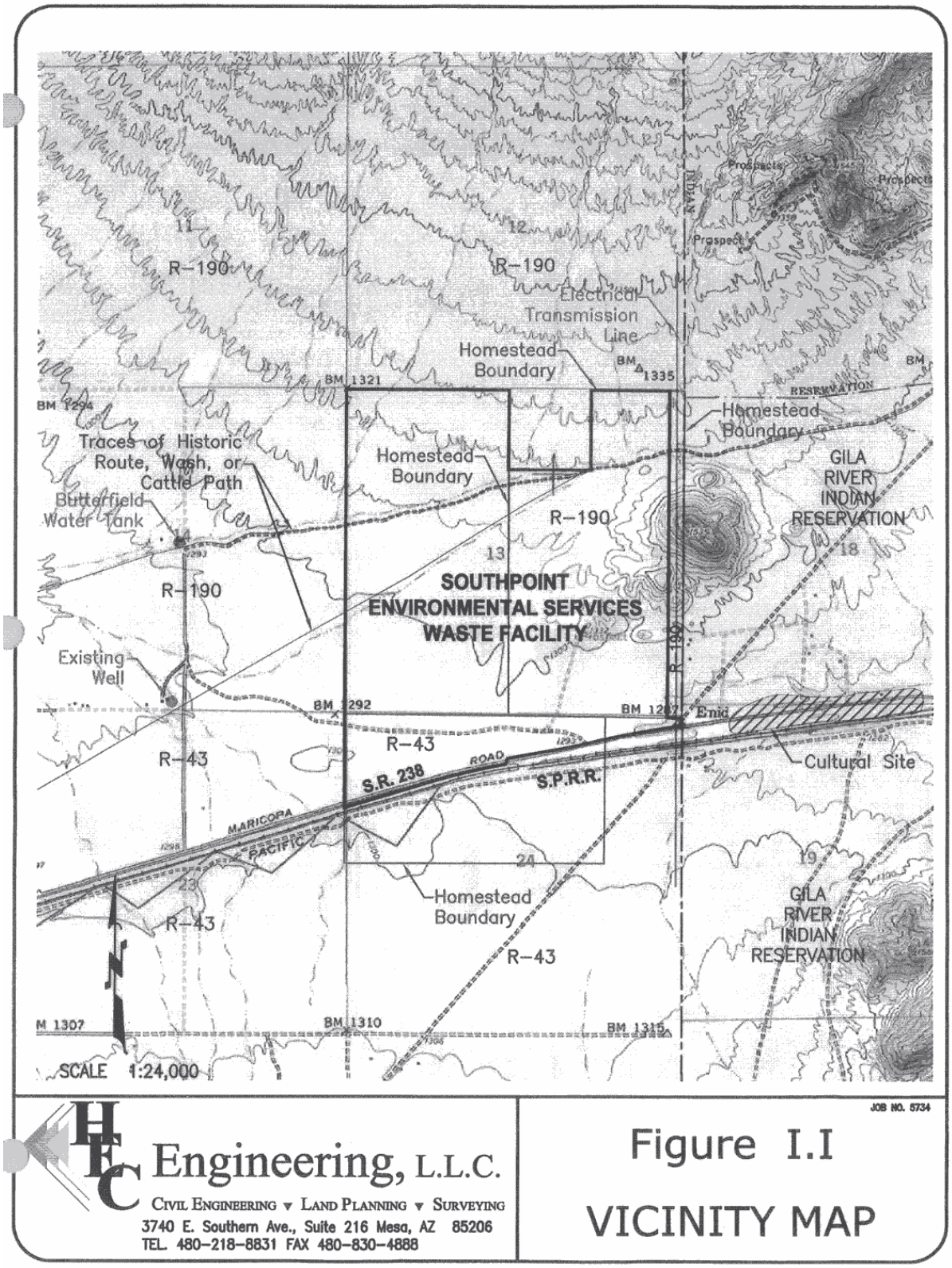
In developing this report we reviewed the documents listed in Attachment A. I (Dr. G. F. Lee) also visited Mobile and toured the area on June 11, 2004, with Kevin Howard who, at the time, was president of the Mobile Community Council, and Harold Shanker, attorney representing Mobile, AZ.

There are currently three landfills in the Mobile, Arizona, area. These include the Butterfield landfill (960 acres) operated by Waste Management, Inc. According to Waste Management (2002), this landfill has 113 years of capacity at the current waste acceptance rate. Adjacent to the Butterfield landfill is the Rainbow Valley landfill (238 acres), which takes construction waste and demolition debris. These landfills are located about 3 miles west of the proposed Southpoint landfill. The Sierra Estrella landfill (315 acres with 30 years of capacity, according to Waste Management, 2002) is located 5 miles to the east of the proposed Southpoint landfill. The Sierra Estrella landfill is owned by Waste Management and is inactive due to excess landfill capacity in the area.

Figure 1 presents a map of the area showing the location of the existing landfills in Mobile and adjacent areas. It also shows the proposed location for the Southpoint landfill and its proximity to several of the Mobile residential areas. Of particular concern is that one of the centers of population in Mobile is located just over a mile south of the proposed Southpoint landfill.

The primary justification for not siting yet another MSW landfill in Mobile is that each landfill in an area has existing and potential adverse impacts on public health, groundwater quality, groundwater resources, air quality, and other interests of those within the sphere of influence of the landfill. The sphere of influence of a landfill typically extends for several miles from the landfill. Each area, such as Mobile, has a finite capacity to accept landfill impacts without significant adverse impacts on the health, welfare and interests of the people in the region of the landfill. In the Mobile situation, in general, the people in Mobile have accepted that the adverse impacts of Waste Management's Butterfield landfill and the Rainbow Valley

Figure 1
Map of the Mobile, AZ area showing the proposed location of the Southpoint landfill



construction and demolition debris landfill, and the currently inactive Sierra Estrella landfill are tolerable. The residents are, however, justifiably concerned about the cumulative impacts that another large landfill located immediately adjacent to Mobile's population areas would have on the area, and that siting of an additional landfill would result in exceeding the landfill impact assimilative capacity of the Mobile area.

Justified NIMBY

Typically, landfill proponents will characterize opposition to a landfill as an ill-founded "Not In My Back Yard" (NIMBY) response of the public in the region. However, it is our experience that, with few exceptions, all of those within a few miles of a proposed landfill are justified in their NIMBY response. The authors have been involved in investigating over 80 landfills located in various parts of the US and in several other countries. They have also been appointed as consultants to advise public groups and agencies on the potential impacts of proposed and existing landfills. Several years ago we published the paper:

> Lee, G. F. and Jones-Lee, A., "Addressing Justifiable NIMBY: A Prescription for MSW Management," *Environmental Management Review*, Government Institutes, Rockville, MD, No. 31, First Quarter, pp. 115-138 (1994). http://www.gfredlee.com/funding.htm

which discusses when NIMBY is justified. We also made a slide presentation at an urban planning conference, which summarizes key issues on justified NIMBY:

> Lee, G. F.; Jones-Lee, A. and Martin, F., "Landfill NIMBY and Systems Engineering: A Paradigm for Urban Planning," In: *Systems Engineering: A Competitive Edge in a Changing World*, Proc. National Council on Systems Engineering Fourth Annual International Symposium, pp. 991-998, August (1994).

The slides used in that presentation are available at http://www.members.aol.com/duklee2307/NIMBY-UrbanPlanning.pdf. The above-cited paper and presentation slides provide a discussion of the potential impacts of landfills and, most importantly, how many of these impacts can be controlled through proper landfill siting, design, operation, closure and post-closure monitoring and maintenance. As discussed by Lee and Jones-Lee (1994), one of the key areas that can significantly reduce justified NIMBY is the provision for adequate buffer land between where wastes are deposited and adjacent properties. This buffer land is needed to dissipate the releases of waste-derived components in leachate ("garbage juice") and landfill gas.

Table 1 is from the Lee et al. (1994) paper. It lists the potential adverse impacts of landfills. The current typical municipal solid waste stream contains a wide variety of known and yet-to-be-identified hazardous and otherwise deleterious chemicals that are a threat to public health and the quality of groundwater that is used for domestic and agricultural purposes. Common household items such as batteries, fluorescent bulbs and cleaning fluids contain such hazardous chemicals. Among the components in municipal solid waste is a variety of heavy metals and organic compounds that are a threat to human health when ingested in drinking water. In addition, municipal solid waste contains inorganic salts and so-called "nonhazardous" organics, which, when present in landfill-leachate-polluted groundwaters, cause the groundwaters, among other

impacts, to have tastes and odors that render them unusable for domestic and many other purposes.

Table 1
Adverse Impacts of "Dry Tomb" Landfills on Adjacent/Nearby Property Owners/Users

- public health, economic and aesthetic aspects of groundwater and surface water quality
- methane and VOC migration - public health hazards, explosions and toxicity to plants
- illegal roadside dumping and litter near landfill
- truck traffic
- noise
- dust and wind-blown litter
- odors
- vectors, insects, rodents, birds
- condemnation of adjacent property for future land uses
- decrease in property values
- impaired view

From Lee, et al. (1994).

Landfills pose substantial, unavoidable environmental impacts. Rainfall can enter a landfill through defects in the landfill cover. Once water enters the landfill, it interacts with waste components to produce leachate (dissolved waste components) containing hazardous and otherwise deleterious substances. These substances escape the landfill through rips, tears and areas of deterioration in the liner system, and can contaminate groundwater beneath the landfill. The contaminated groundwater then moves to off-site properties, where it can pollute domestic and other water supply wells. In addition, in those situations where groundwaters are discharged to the surface through springs, surface water pollution can occur. The pollution of groundwaters and surface waters by landfill leachate is a significant threat to public health, aquatic life and wildlife. Drs. G. Fred Lee and Anne Jones-Lee's website (www.gfredlee.com) contains several papers discussing the potential impacts of groundwater pollution by municipal solid waste landfills.

While, depending on the design, construction and setting, a landfill liner and groundwater monitoring system of the general types proposed by SES can postpone the onset of groundwater pollution by landfill leachate, they cannot prevent it for as long as the wastes in the landfill will be a threat. Some of the waste components in an MSW landfill do not degrade; they are, therefore, a threat to cause groundwater pollution forever. Improved liners may postpone contamination further, but, as the US Environmental Protection Agency has recognized (see discussion below), any containment system will eventually develop defects that allow water to enter the landfill, and leachate to escape (see reviews by Lee and Jones-Lee, 1998a, 2004). While groundwater monitoring systems may detect that liner leakage has occurred, there is a strong likelihood that a groundwater monitoring system of the type proposed by SES will fail to reliably detect groundwater pollution at the point of groundwater monitoring compliance (see Lee and Jones-Lee, 1998b).

In addition, landfills release air pollutants that can, in both the near- and long-term, affect human health, as well as pollutants that contribute to global warming. Lee and Jones-Lee (1999)

have discussed the problems of predicting/managing landfill gas over the time that landfill gas production can occur in a landfill of the type proposed by SES. Some of the organic components in municipal solid waste can be converted in a landfill into landfill gas. Methane is produced in landfills from the fermentation of some of the organics in the waste; methane is not only a potential explosive hazard to residents near landfills, but also a potent cause of global warming. Further, gaseous emissions from landfills are a threat to cause groundwater pollution. These gaseous emissions contain a variety of volatile hazardous chemicals that are a threat to cause cancer and other diseases in those living/using areas near a landfill. While landfills contain landfill gas collection systems, such systems are not fully effective in preventing landfill gas and other volatile waste components from escaping from the landfill through the landfill cover. In addition, landfills can have a variety of additional impacts, such as odors, fugitive trash, dust, vermin, birds, etc., which are deleterious to the interests of those in the sphere of influence of the landfill.

Characteristics of the Proposed Southpoint Landfill

Mobile, Arizona, is situated in the Arizona desert about 21 miles from Phoenix. The area is part of the arid southwest with 3 to 4 inches of rain per year. While landfills located in such a climatic regime produce less leachate than landfills located in wetter climates, the leachate produced by such landfills still poses a significant threat to cause groundwater pollution.

There is groundwater underlying the area of the proposed landfill, and it is used for domestic water supply purposes. SES (2003) has indicated that the water depth for a well located about a half mile to the west of the proposed Southpoint landfill was 382 feet below ground surface, and the estimated depth to groundwater could range from 350 to 420 ft below ground surface. According to ADEQ (2004a), there is some confusion regarding the direction of groundwater flow.

The proposed landfill is expected to be excavated to about 50 feet below the existing ground level and extend to about 185 feet above the existing ground surface. It is projected to have about 170 daily hauling truck trips to and from the landfill. The current planning and land use permit allows the landfill to function for about 50 years. After landfill closure, groundwater and methane monitoring would continue for 30 years, according to ADEQ (2004b).

Southpoint Environmental Services (SES, 2003) has proposed that construction of Southpoint landfill incorporate less than a minimum US EPA Subtitle D design. ADEQ (2004a) has commented on a number of the inappropriate approaches that Southpoint Environmental Services has proposed for construction of this landfill that would not be acceptable for compliance with minimum Subtitle D requirements, such as the design of the landfill cover. ADEQ, however, has not, at least thus far, commented on the gross inadequacies of the groundwater monitoring system that Southpoint Environmental has proposed. There is only one downgradient monitoring well proposed. Such an approach is highly unreliable in detecting groundwater pollution from a plastic sheeting lined landfill.

Southpoint Environmental Services has proposed to use a single composite liner for the landfill with a 60 mil HDPE plastic sheeting layer and geosynthetic clay liner. While some states (including Arizona, evidently) allow the substitution of a geosynthetic clay liner for the 2

feet of clay specified in US EPA Subtitle D regulations, such practice can readily allow more rapid failure of the composite liner than if the 2 feet of compacted clay had been used. A key problem with geosynthetic clay liners is that they are so thin that they have limited structural integrity and will allow rapid penetration of leachate through the liner by diffusion. While landfill applicants and their consultants, and unfortunately some regulatory agencies, will claim that the permeability of a geosynthetic clay liner of 10^{-9} cm/sec under 1 ft of head will control the rate of leachate passing through the liner, in fact because of diffusion it will pass through much more rapidly. The bottom-line issue is that a liner like the one proposed by SES (2003) for the Southpoint landfill will eventually allow leachate generated in the landfill to pass through the liner into the underlying groundwater system, thereby polluting it and rendering it unusable for domestic and many other purposes.

It is well-understood and known in the literature that minimum Subtitle D landfills with a single composite liner will initially leak through points of rupture, tears, areas of deterioration, etc., in the plastic sheeting layer of the landfill liner. As discussed by Lee and Jones-Lee (1998b) such leaks will give rise to finger-like plumes of leachate that can readily pass the point of compliance for groundwater monitoring without being detected. While information on the hydraulic characteristics of the groundwaters underlying the proposed landfill site is not available, it appears that monitoring wells would need to be spaced on the order of 10 feet apart along the downgradient side of the landfill in order to have any reasonable potential to comply with regulations that require the detection of leachate-polluted groundwater when it first reaches the point of compliance for groundwater monitoring.

While SES (2003) proposes to use a compacted soil layer in the landfill cover as the low-permeability layer for retarding the entrance of moisture into the landfill that would generate leachate, ADEQ (2004a) has correctly pointed out that that approach does not conform to minimum US EPA Subtitle D requirements for cover design. In accordance with Subtitle D requirements, it will be necessary to include a plastic sheeting layer in the cover. However, as discussed in our writings (e.g., Lee, 2003; Lee and Jones-Lee, 1998a, 2004), since a plastic sheeting layer is buried below topsoil and a drainage layer, it is not possible to detect when the plastic sheeting layer deteriorates sufficiently to allow moisture that enters the topsoil and drainage layer to pass into the landfill wastes. Unless Southpoint Environmental Services agrees to install, operate, and maintain in perpetuity a leak-detectable cover for this landfill, the landfill cover system will fail to prevent entrance of moisture into the landfill and generation of leachate even if it meets minimum Subtitle D requirements that are typically accepted by regulatory agencies. The leachate will, in turn, pass through the deteriorated liner system into the underlying groundwaters.

Southpoint Environmental Services proposes to establish a closure and post-closure program in keeping with the minimum required by Subtitle D with only a projected 30-year post-closure period of assured funding. It is, however, well-known that many of the components in MSW of the type that would be placed in the proposed Southpoint landfill will be a threat for causing groundwater pollution forever. Thirty years is an infinitesimal part of the time that assured post-closure funding will be needed to monitor, maintain, and eventually pay for remediation of the polluted groundwaters that will result under and downgradient of this landfill.

There is no doubt that the Southpoint landfill, if developed as proposed to conform to minimum Subtitle D requirements, will cause pollution of groundwater in the vicinity of the landfill by leachate and pollution of air by landfill gas. Further, because of the grossly inadequate buffer lands between the proposed location of the landfill and adjacent properties, amounting to a few hundred feet on each side, adjacent and nearby property owners will experience significant impacts to their health, welfare, and other interests during the active life of the landfill and beyond.

Regulatory Requirements

ADEQ (2004a) stated,

> *"Pursuant to Arizona Revised Statutes (ARS) § 49-762.04 and § 49-761.B, the Department uses the following basis and criteria for review and approval of municipal solid waste landfill facilities as referenced in 40 Code of Federal Regulations (40 CFR) Part 258, Subpart B through G and ARS § Chapter 4 Article 1 through 10, in reviewing and approving or disapproving the Southpoint Municipal Solid Waste Landfill facility plan:*
>
> *(1) The design, construction, and operational methods described will protect the public health, public safety or the environment;*
>
> *(2) The design and operation methods described will minimize or control environmental nuisances;*
>
> *(3) The proposed design, operation, monitoring, and financial assurance methods shall comply with the conditions stipulated in ARS Title 49, Chapter 4, Article 1 through 10; and*
>
> *(4) The proposed landfill design and operation criteria shall meet all established national minimum conditions/standards listed under the Resource Conservation and Recovery Act, Subtitle D."*

The proposed Southpoint landfill cannot comply with these requirements. While Southpoint Environmental Services claimed in materials that it distributed to the public on the purportedly protective nature of the proposed landfill (SES, 2004) that it will comply with regulatory requirements, those who understand the characteristics of municipal solid waste, landfill liner containment systems, and landfill monitoring systems know that complying with minimum design requirements prescribed for Subtitle D landfills at best postpones significant groundwater pollution; it does not prevent it.

In a flier that was distributed at a public meeting on the proposed landfill, Southpoint Environmental Services (SES, 2004) stated,

> *"Historically landfills were a cause for citizens concern throughout the country because of problems associated with their design and operation. To address these issues, in 1991 the U.S. Environmental Protection Agency (EPA) issued tough regulations requiring all landfills to meet stringent engineering performance requirements regarding their location, design and operating practices. The Arizona Department of Environmental Quality (ADEQ) has adopted these regulations, and Southpoint must develop its landfill following all these requirements."*

Those familiar with the facts concerning the adoption of the US EPA Subtitle D regulations in 1991 know that those regulations were put in place as part of environmental groups' litigation against the Agency. The Agency was under Congressional mandate to develop regulations for municipal solid waste by a certain date. When the Agency was unable to do this, an environmental group filed suit to force the Agency to develop Subtitle D regulations. This placed the US EPA in the difficult position of having to adopt regulations that it knew would not be protective. In 1988, as part of its draft Subtitle D regulations, the US EPA (1988a) stated,

> *"First, even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in MSWLF (municipal solid waste landfill) containment technologies suggest that releases may be delayed by many decades at some landfills."*

The US EPA (1988b) Criteria for Municipal Solid Waste Landfills stated,

> *"Once the unit is closed, the bottom layer of the landfill will deteriorate over time and, consequently, will not prevent leachate transport out of the unit."*

For a number of years following the adoption of the Subtitle D regulations, US EPA management indicated that the problems with Subtitle D landfills discussed in the draft regulations still existed, acknowledging that ultimately the liner system will fail to prevent groundwater pollution. At best, Subtitle D landfills only postpone pollution. In recent years and under a different administration, however, the US EPA has been espousing a different position intimating that for some unknown reason all of a sudden landfill liner systems – which have not changed – now will be protective. The facts regarding the protection afforded by Subtitle D regulations, and for that matter, ADEQ regulations, are discussed by Lee (2003).

Environmental Justice Issues

Mobile, AZ, was established in the early 1900s as an area in Arizona where African-Americans could live (Shanker, 2004). It is an historically black community where the majority of the land near the proposed Southpoint landfill is owned by African-Americans. ADEQ (2004b) stated,

> *"ADEQ is also interested in receiving comments from those concerned about whether granting approval of the application is consistent with the Civil Rights Restoration Act (42 U.S. Code 2000d) and EPA regulations governing programs that are in receipt of EPA funding (40 Code of Federal Regulations Part 7). ADEQ is particularly interested in comments or information demonstrating that approval of this facility would cause an adverse and disparate impact on the local community as defined in EPA's disparate impact regulation (40 CFR Part 7). Sec Federal Register 39650, 29679 (2000)."*

A key issue that needs to be evaluated with respect to environmental justice is whether siting another large landfill in Mobile, an historically black community, will result in cumulative impacts that violate Title VI requirements for protection of minorities against sources of environmental problems. While there are already two operating landfills in Mobile, and a third

just across the county line, the location of these landfills relative to a substantial part of Mobile's population is sufficiently distant so that the population center of Mobile (i.e., where there is a large number of Mobile residents) is minimally affected by the releases from the existing landfills. That will not be the case should the Southpoint landfill be permitted. The proposed landfill would be located within about a mile of an existing Mobile community with a substantial number of residences. Some of the existing and potential future population of Mobile would be well within the sphere of influence of the proposed Southpoint landfill. Property owners in this area have the right to be able to use and develop their property without adverse impacts of the landfill.

Overall

Overall, Mobile residents are justified in their vigorous opposition to the construction and operation of the proposed Southpoint landfill. This landfill would be significantly adverse to the health, welfare and interests of Mobile residents.

References

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ADEQ, "Public Notice: Proposed Southpoint Municipal Solid Waste Landfill Facility, State Route 238, Mobile, Maricopa County, Arizona," Arizona Department of Environmental Quality, January 29 (2004b).

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SES, "Southpoint Environmental Services Waste Facility Project – Municipal Solid Waste Landfill Facility Application," Report prepared for Southpoint Environmental Services, Mesa, AZ, Submitted to Arizona Department of Environmental Quality, Phoenix, AZ, Prepared by HEC Engineering, Mesa, AZ June 2003; revised November 10 (2003).

SES, "Southpoint Environmental Services Municipal Landfill Project: Good for Maricopa and Pinal Counties, Good for Mobile," Southpoint Environmental Services, AZ (2004).

Shanker, H. M., "Southpoint Municipal Solid Waste Landfill – Environmental Justice Data and Response to March 8, 2004 Letter From Lucas Narducci (Apparently Counsel to Southpoint)," Letter to Stephen A. Owens, Director, Department of Environmental Quality, from The Shanker Law Firm, Tempe, AZ, May 21 (2004).

US EPA, "Solid Waste Disposal Facility Criteria: Proposed Rule," *Federal Register*, 53(168): 33314-33422, 40 CFR Parts 257 and 258, US Environmental Protection Agency, Washington, D.C., August 30 (1988a).

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Waste Management, Memorandum from Don Sassano to Hugh Jones, RE: Response to Your Questions on the Capacity of Butterfield and Sierra Estrella landfills, December 3 (2002).

Additional Information

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Jones-Lee, A. and Lee, G. F., "Groundwater Pollution by Municipal Landfills: Leachate Composition, Detection and Water Quality Significance," Proc. Sardinia '93 IV International Landfill Symposium, Sardinia, Italy, pp. 1093-1103, October (1993). http://www.gfredlee.com/lf-conta.htm

Attachment A
Documents Reviewed

Southpoint Environmental Services Waste Facility, Municipal Solid Waste Landfill Facility Application, Revised August 2003;

Southpoint Environmental Services Waste Facility, Municipal Solid Waste Landfill Facility Application Appendix – Volume I, Revised August 2003;

Southpoint Environmental Services Waste Facility, Municipal Solid Waste Landfill Facility Application Appendix - Volume 11, Revised August 2003;

Southpoint Environmental Services, Narrative Report, Maricopa County Special Use Permit, June 17, 2002;

Cultural Resources Inventory Report and Treatment and Data Recovery Plan, Southpoint Environmental Services Waste Facility, September 5, 2003;

Preliminary Geotechnical Report, Proposed Southpoint Environmental Services Waste Facility, Maricopa County, Arizona, June 10, 2002;

Geotechnical Report - Revision No. 2 Phase 1 Cell Design, Proposed Southpoint Environmental Services Waste Facility, Maricopa County, Arizona, September 5, 2003;

Engineering Development Plans for Southpoint Environmental Services Waste Facility, Maricopa County, Arizona, Sheet Numbers 1 through 18, Revised July 16, 2003;

Drainage Improvements for the Southpoint Environmental Services Waste Facility, Maricopa County, Arizona, Sheet Numbers 1 through 27, Revised July 16, 2003;

Phasing Plan for Southpoint Environmental Services Waste Facility, Maricopa County, Arizona, Sheet No. 6 of 18 (Renumbered Cell Layout Plan), Revised October 30, 2003;

Southpoint Environmental Services Waste Facility, Municipal Solid Waste Landfill Facility Application, Revised November 2003;

Southpoint Environmental Services Waste Facility, Set of 20 Landfill Layouts, Design, Stormwater Management Drawings, Revised November 2003;

Engineering Improvement Plan for Southpoint Environmental Services Waste Facility, Maricopa County, Arizona, Revised November 11, 2003, Drawing Sheet Numbers 1 through 20.

Attachment B

Background Information on Dr. G. Fred Lee's Qualifications in Support of Mobile's Opposition to Siting Another Landfill in Mobile

G. Fred Lee is a principal and the president of G. Fred Lee & Associates, a specialty consulting firm focusing on problems associated with water quality, water and wastewater treatment, control of water pollution in fresh and marine waters and groundwaters, and solid and hazardous waste disposal investigation and management. Prior to his current position with G. Fred Lee & Associates, he held numerous consulting and several university professorial graduate-level teaching and research positions spanning over three decades. During his university teaching and research career, he conducted more than $5 million in research related to various aspects of water quality, including studies on behalf of the U.S. Environmental Protection Agency on the materials used as liners to contain wastes at landfills. During that time he was also a part-time consultant to a number of governmental agencies, industry, and others in the U.S. and other countries.

In 1989, Dr. G. F. Lee retired after 30 years of university graduate-level teaching and research and expanded his part-time consulting activities into a full-time business. Over the years, he has published over 950 professional papers, chapters in books, professional reports, and similar materials, including over 80 papers and reports on the impacts of municipal and industrial waste landfills and the development of landfills that will be protective of public health, groundwater resources and the environment. Many of these papers and reports are available on Dr. Anne Jones-Lee (his wife) and his website, www.gfredlee.com. A summary of his professional activities that are pertinent to solid waste management and the evaluation of the impacts of landfills on public health and the environment is presented below.

Expertise and Experience in Municipal/Industrial Landfill Impact Assessment/Management

Dr. G. Fred Lee's work on hazardous chemical site and municipal/industrial landfill impact assessment began in the mid-1950s while he was an undergraduate student in environmental health sciences at San Jose State College in San Jose, California. His course and field work involved review of municipal and industrial solid waste landfill impacts on public health and the environment.

His Master of Science in Public Health degree from the University of North Carolina, Chapel Hill, in 1957 focused on water quality evaluation and management with respect to public health and environmental protection from chemical constituents and pathogenic organisms. Dr. Lee obtained a PhD degree specializing in environmental engineering from Harvard University in 1960. As part of this degree work he obtained further formal education in the fate, effects and significance and the development of control programs for chemical constituents in surface and ground water systems. An area of specialization during his PhD work was aquatic chemistry, which focused on the transport, fate and transformations of chemical constituents in aquatic (surface and groundwater) and terrestrial systems as well as in waste management facilities.

For a 30-year period, he held university graduate-level teaching and research positions in departments of civil and environmental engineering at several major United States universities, including the University of Wisconsin-Madison, University of Texas at Dallas, and Colorado State University. During this period he taught graduate-level environmental engineering courses in water and wastewater analysis, water and wastewater treatment plant design, surface and ground water quality evaluation and management, and solid and hazardous waste management. He has published over 950 professional papers and reports on his research results and professional experience. His research included, beginning in the 1970s, the first work done on the impacts of organics on clay liners for landfills and waste piles/lagoons.

His work on the impacts of hazardous chemical site and municipal/industrial solid waste landfills began in the 1960s when, while directing the Water Chemistry Program in the Department of Civil and Environmental Engineering at the University of Wisconsin-Madison, he became involved in the review of the impacts of municipal solid waste landfills on groundwater quality. In the 1970s, while he was Director of the Center for Environmental Studies at the University of Texas at Dallas, he was involved in the review of a number of municipal solid and industrial (hazardous) waste landfill situations, focusing on the impacts of releases from the landfill on public health and the environment.

In the early 1980s while holding a professorship in Civil and Environmental Engineering at Colorado State University, he served as an advisor to the town of Brush, Colorado, on the potential impacts of a proposed hazardous waste landfill on the groundwater resources of interest to the community. Based on this work, he published a paper in the Journal of the American Water Works Association discussing the ultimate failure of the liner systems proposed for that landfill in preventing groundwater pollution by landfill leachate. In 1984 this paper was judged by the Water Resources Division of the American Water Works Association as the best paper published in the journal for that year.

In the 1980s, he conducted a comprehensive review of the properties of HDPE liners of the type being used today for lining municipal solid waste and hazardous waste landfills with respect to their compatibility with landfill leachate and their expected performance in containing waste-derived constituents for as long as the waste will be a threat.

In the 1980s while he held the positions of Director of the Site Assessment and Remediation Division of a multi-university consortium hazardous waste research center and Distinguished Professor of Civil and Environmental Engineering at the New Jersey Institute of Technology, he was involved in numerous situations concerning the impact of landfilling of municipal solid waste on public health and the environment. He has served as an advisor to the states of California, Michigan, New Jersey and Texas on solid waste regulations and management. He was involved in evaluating the potential threat of uranium waste solids from radium watch dial painting on groundwater quality when disposed of by burial in a gravel pit. The public in the area of this state of New Jersey proposed disposal site objected to the State's proposed approach. Dr. Lee provided testimony in litigation, which caused the judge reviewing this matter to prohibit the State from proceeding with the disposal of uranium/radium waste at the proposed location.

Beginning in the 1960s, while a full-time university professor, Dr. Lee was a part-time private consultant to governmental agencies, industry and environmental groups on water quality and solid and hazardous waste and mining management issues. His work included evaluating the impacts of a number of municipal and industrial solid waste landfills. Much of this work was done on behalf of water utilities, governmental agencies and public interest groups who were concerned about the impacts of a proposed landfill on their groundwater resources, public health and the environment.

In 1989, he retired after 30 years of graduate-level university teaching and research and expanded the part-time consulting that he had been doing with governmental agencies, industry and community and environmental groups into a full-time activity. A principal area of his work since then has been assisting water utilities, municipalities, industry, community and environmental groups, agricultural interests and others in evaluating the potential public health and environmental impacts of proposed or existing hazardous, as well as municipal solid waste landfills. He has been involved in the review of approximately 85 different landfills and waste piles (tailings) in various parts of the United States and in other countries.

Dr. Anne Jones-Lee (his wife) and he have published extensively on the issues that should be considered in developing new or expanded municipal solid waste and hazardous waste landfills in order to protect the health, groundwater resources, environment and interests of those within the sphere of influence of the landfill. Their over 80 professional papers and reports on landfilling issues provide guidance not only on the problems of today's minimum US EPA Subtitle D landfills, but also on how landfilling of non-recyclable wastes can and should take place to protect public health, groundwater resources, the environment, and the interests of those within the sphere of influence of a landfill/waste management unit. They make many of their publications available as downloadable files from their web site, www.gfredlee.com.

Their work on landfill issues has particular relevance to Superfund site remediation, since regulatory agencies often propose to perform site remediation by developing an onsite landfill or capping waste materials that are present at the Superfund site. The proposed approach frequently falls short of providing true long-term health and environmental protection from the landfilled/ capped waste.

In the early 1990s, Dr. Lee was appointed to a California Environmental Protection Agency's Comparative Risk Project Human Health Subcommittee that reviewed the public health hazards of chemicals in California's air and water. In connection with this activity, Dr. Jones-Lee and he developed a report, "Impact of Municipal and Industrial Non-Hazardous Waste Landfills on Public Health and the Environment: An Overview," that served as a basis for the human health advisory committee to assess public health impacts of municipal landfills.

In addition to teaching and serving as a consultant in environmental engineering for over 40 years, Dr. Lee is a registered professional engineer in the state of Texas and a Diplomate in the American Academy of Environmental Engineers (AAEE). The latter recognizes his leadership roles in the environmental engineering field. He has served as the chief examiner for the AAEE in north-central California and New Jersey, where he has been responsible for

administering examinations for professional engineers with extensive experience and expertise in various aspects of environmental engineering, including solid and hazardous waste management.

His work on landfill impacts has included developing and presenting several two-day short-courses devoted to landfills and groundwater quality protection issues. These courses have been presented through the American Society of Civil Engineers, the American Water Resources Association, and the National Ground Water Association in several United States cities, including New York, Atlanta, Seattle and Chicago, and the University of California Extension Programs at several of the UC campuses, as well as through other groups.

SUMMARY BIOGRAPHICAL INFORMATION

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EDUCATION

Ph.D. Environmental Engineering & Environmental Science, Harvard University, Cambridge, Mass. 1960

M.S.P.H. Environmental Science-Environmental Chemistry, School of Public Health, University of North Carolina, Chapel Hill, NC 1957

B.A. Environmental Health Science, San Jose State College, San Jose, CA 1955

ACADEMIC AND PROFESSIONAL EXPERIENCE

Current Position:
Consultant, President, G. Fred Lee and Associates

Previous Positions:

Distinguished Professor, Civil and Environmental Engineering, New Jersey Institute of Technology, Newark, NJ, 1984-89

Senior Consulting Engineer, EBASCO-Envirosphere, Lyndhurst, NJ (part-time), 1988-89

Coordinator, Estuarine and Marine Water Quality Management Program, NJ Marine Sciences Consortium Sea Grant Program, 1986

Director, Site Assessment and Remedial Action Division, Industry, Cooperative Center for Research in Hazardous and Toxic Substances, New Jersey Institute of Technology et al., Newark, NJ, 1984-1987

Professor, Department of Civil and Environmental Engineering, Texas Tech University, 1982-1984

Professor, Environmental Engineering, Colorado State University, 1978-1982

Professor, Environmental Engineering & Sciences; Director, Center of Environmental Studies, University of Texas at Dallas, 1973-1978

Professor of Water Chemistry, Department of Civil & Environmental Engineering, University of Wisconsin-Madison, 1961-1973

Registered Professional Engineer, State of Texas, Registration No. 39906

PUBLICATIONS AND AREAS OF ACTIVITY

Published over 950 professional papers, chapters in books, professional reports, and similar materials. The topics covered include:

- Studies on sources, significance, fate and the development of control programs for chemicals in aquatic and terrestrial systems.
- Analytical methods for chemical contaminants in fresh and marine waters.
- Landfills and groundwater quality protection issues.
- Impact of landfills on public health and environment.
- Environmental impact and management of various types of wastewater discharges including municipal, mining, electric generating stations, domestic and industrial wastes, paper and steel mill, refinery wastewaters, etc.
  Stormwater runoff water quality evaluation and BMP development for urban areas and highways.
- Eutrophication causes and control, groundwater quality impact of land disposal of municipal and industrial wastes, environmental impact of dredging and dredged material disposal, water quality modeling, hazard assessment for new and existing chemicals, water quality and sediment criteria and standards, water supply water quality, assessment of actual environmental impact of chemical contaminants on water quality.

LECTURES

Presented over 750 lectures at professional society meetings, universities, and to professional and public groups.

GRANTS AND AWARDS

Principal investigator for over six million dollars of contract and grant research in the water quality and solid and hazardous waste management field.

GRADUATE WORK CONDUCTED UNDER SUPERVISION OF G. FRED LEE

Over 90 M.S. theses and Ph.D. dissertations have been completed under the supervision of Dr. Lee.

ADVISORY ACTIVITIES

Consultant to numerous international, national and regional governmental agencies, community and environmental groups and industries.

Municipal Solid Waste Landfills and Groundwater Quality Protection Issues Publications

Drs. G. Fred Lee and Anne Jones-Lee have prepared several papers and reports on various aspects of municipal solid waste (MSW) management and hazardous waste management by landfilling, groundwater quality protection issues, as well as other issues of concern to those within a sphere of influence of a landfill. These materials provide an overview of the key problems associated with landfilling of MSW and hazardous waste utilizing lined "dry tomb" landfills and suggest alternative approaches for MSW management that will not lead to groundwater pollution by landfill leachate and protect the health and interests of those within the sphere of influence of a landfill. Copies of many of these papers and reports are available as downloadable files from Drs. G. Fred Lee's and Anne Jones-Lee's web page (http://www.gfredlee.com). Recent papers and reports on landfilling issues are listed below. Copies of the papers and reports listed below as well as a complete list of publications on this and related topics are available upon request.

Overall Problems with "Dry Tomb" Landfills

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

Lee, G. F., "Comments on GeoSyntec Consultants' Draft Report 'Landfill Facility Compliance Study Task 8 Report-Summary of Findings and Comprehensive Recommendations,' Dated May 2004," Comments Submitted to CIWMB by G. Fred Lee & Associates, El Macero, CA, June (2004). http://www.members.aol.com/duklee2307/GeoSyntecTask8-Comments.pdf

Lee, G. F., "Comments on the California Integrated Waste Management Board Landfill Facility Compliance Study," Comments Submitted to CIWMB by G. Fred Lee & Associates, El Macero, CA, November 2003. http://www.gfredlee.com/CIWMBcomments11-20-03.pdf

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http://www.gfredlee.com/CIWMBCompliance Study comments.pdf

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Lee, G. F. and Jones-Lee, A., "Developing Landfills that Protect People: The True Costs," *MSW Management* 7(6):18-23, Nov/Dec (1997).

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Groundwater Monitoring

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Lee, G. F., "Overview Assessment of the Potential Public Health, Environmental and Groundwater Resource and Other Impacts of the Proposed Adams Mine Site Landfill," Report to the AMSLF Public Liaison Committee and Metropolitan Toronto, Toronto, Canada (1995).

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Landfills Evaluated by
G. Fred Lee and Anne Jones-Lee

Arizona *(State Landfilling Regulations)*	Verde Valley - Copper Tailings Pile Closure Southpoint Landfill, Mobile, AZ
California *(State Landfilling Regulations)*	Colusa County - CERRS Landfill San Gabriel Valley - Azusa Landfill City of Industry - Puente Hills Landfill North San Diego County, 3 landfills San Diego County - Gregory Canyon Landfill El Dorado County Landfill Yolo County Landfill Half Moon Bay - Apanolio Landfill Pittsburg - Keller Canyon Landfill Chuckwalla Valley - Eagle Mountain Landfill Barstow - Hidden Valley Broadwell Hazardous Waste Landfills Cadiz - Bolo Station-Rail Cycle Landfill University of California-Davis Landfills (4) San Marcos - San Marcos Landfill Placer County - Western Regional Sanitary Landfill Placer County – Turkey Carcass Disposal Pits Imperial County - Mesquite Landfill Los Angeles County - Calabasas Landfill Los Angeles County – Palos Verdes Landfill Contra Costa County – Concord Naval Weapons Station Tidal Area Lanc
Colorado (*State Landfilling Regulations)*	Last Chance/Brush - Hazardous Waste Landfill Denver - Lowry Hazardous Waste Landfill Telluride/Idarado Mine Tailings
Florida (*State Landfilling Regulations*)	Alachua County Landfill
Illinois (*State Landfilling Regulations*)	Crystal Lake - McHenry County Landfill Wayne County Landfill
Indiana (*State Landfilling Regulations*)	Posey County Landfill New Haven-Adams Center Landfill (Hazardous Waste)
Michigan (*State Landfilling Regulations*)	Menominee Township - Landfill Ypsilanti- Waste Disposal Inc. (Hazardous Waste - PCB's)
Minnesota	Reserve Mining Co., Silver Bay - taconite tailings Wright County - Superior FCR Landfill
Missouri	Jefferson County - Bob's Home Service Hazardous Waste Landfill
New Jersey (*State Landfilling Regulations*)	Meadowlands – Landfill Fort Dix Landfill Scotch Plains Leaf Dump

New York	Staten Island - Fresh Kills Landfill, Niagara Falls - Hazardous Waste Landfill, New York City – Ferry Point Landfill
Ohio	Clermont County - BFI/CECOS Hazardous Waste Landfill, Huber Heights - Taylorville Road Hardfill Landfill
Pennsylvania	Pottstown Landfill Closure Committee – Pottstown, PA
Rhode Island	Richmond – Landfill
South Carolina	Spartanburg - Palmetto Landfill
Texas (*State Landfilling Regulations*)	Dallas/Sachse – Landfill Fort Worth - Acme Brick Hazardous Waste Landfill City of Dallas - Jim Miller Road Landfill
Vermont	Coventry, Vermont – Coventry Landfill
Washington (*State Landfilling Regulations*)	Tacoma - 304th and Meridian Landfill
Wisconsin	Madison and Wausau Landfills
INTERNATIONAL LANDFILLS	
Belize	Mile 27 Landfill
Ontario, Canada (*Prov. Landfilling Regulations*)	Greater Toronto Area - Landfill Siting Issues Kirkland Lake - Adams Mine Site Landfill Pembroke - Cott Solid Waste Disposal Areas
Manitoba, Canada (*Prov. Landfilling Regulations*)	Winnipeg Area - Rosser Landfill
New Brunswick, Canada (*Prov. Landfilling Regulations*)	St. John's - Crane Mountain Landfill
England	Mercyside Waste Disposal Bootle Landfill
Hong Kong	Three New MSW Landfills
Ireland	Bottlehill Landfill, County Cork Central Waste Management Facility, Ballyduff, County Clare
Korea	Yukong Gas Co. - Hazardous Waste Landfill
Mexico (*Haz. Waste Landfilling Regulations*	San Luis Pontosi - Hazardous Waste Landfill
New Zealand	North Waikato Regional Landfill
Puerto Rico	Salinas - Campo Sur Landfill

Surface and Groundwater Quality Evaluation and Management

and

Municipal Solid & Industrial Hazardous Waste Landfills

http://www.gfredlee.com

Dr. G. Fred Lee and Dr. Anne Jones-Lee have prepared professional papers and reports on the various areas in which they are active in research and consulting including domestic water supply water quality, water and wastewater treatment, water pollution control, and the evaluation and management of the impacts of solid and hazardous wastes. Publications are available in the following areas:

Landfills and Groundwater Quality Protection

Water Quality Evaluation and Management for Wastewater Discharges

Stormwater Runoff, Ambient Waters and Pesticide Water Quality Management Issues, TMDL Development, Water Quality Criteria/Standards Development and Implementation

Impact of Hazardous Chemicals -- Superfund

LEHR Superfund Site Reports to DSCSOC

Lava Cap Mine Superfund Site reports to SYRCL

Smith Canal

Contaminated Sediment -- Aquafund, BPTCP, Sediment Quality Criteria

Domestic Water Supply Water Quality

Excessive Fertilization/Eutrophication, Nutrient Criteria

Reuse of Reclaimed Wastewaters

Watershed Based Water Quality Management Programs:

Sacramento River Watershed Program

Delta -- CALFED Program

Upper Newport Bay Watershed Program

San Joaquin River Watershed DO and OP Pesticide TMDL Programs

Stormwater Runoff Water Quality Science/Engineering Newsletter

G. Fred Lee & Associates was organized in the late 1960s to cover the part-time consulting activities that Dr. Lee undertook while a full-time university professor. In 1989, when Dr. Lee retired from 30 years of graduate-level teaching and research, he and Dr. Anne Jones-Lee, who was also a university professor, expanded G. Fred Lee & Associates into a full-time business activity. Examples of governmental agencies, consulting firms, citizens groups, industries and others for whom G. Fred Lee has served as an advisor include the following:

U.S. Environmental Protection Agency - Various Locations
Vison, Elkins, Searls, Connally & Smith, Attorneys - Houston, TX
International Joint Commission for the Great Lakes
U.S. Public Health Service - Washington, DC
Attorney General, State of Texas - Austin, TX
Madison Metropolitan Sewerage District - Madison, WI
Great Lakes Basin Commission - Windsor, Ontario
U.S. Army Environmental Hygiene Agency - Edgewood Arsenal, MD
City of Madison - Madison, WI
Council on Environmental Quality - Washington, DC
National Academies of Sciences and Engineering - Washington, DC
Water Quality Board State of Texas - Austin, TX
U.S. General Accounting Office - Washington, DC
U.S. Army Corps of Engineers - Vicksburg, MS
Tennessee Valley Authority - Various locations in Tennessee Valley
National Oceanic & Atmospheric Administration - Various locations
Organization for Economic Cooperation & Development - Paris
Attorney General, State of Illinois - Chicago, IL
State of Texas Hazardous Waste Legislative Committee - Austin
State of New Mexico Environmental Improvement Agency - Santa Fe
New York District Corps of Engineers - New York, NY
San Francisco District Corps of Engineers - San Francisco, CA
Wisconsin Electric Power Company - Milwaukee, WI
WAPORA - Washington, DC
Reserve Mining Company - Silver Bay, MN
United Engineers - Philadelphia, PA
Automated Environmental Systems - Long Island, NY
Procter & Gamble Company - Cincinnati, OH
Inland Steel Development Company - Chicago, IL
Kennecott Copper Corporation - Salt Lake City, UT
U.S. Steel Corporation - Pittsburgh, PA
Nekoosa Edwards, Inc. - WI
Zimpro, Inc. - Rothschild, WI
FMC Corporation - Philadelphia, PA
Acme Brick Company - Forth Worth, TX
Monsanto Chemical Company - St. Louis, MO
Gould, Inc. - Cleveland, OH
Illinois Petroleum Council - Chicago, IL
Inland Steel Corporation - Chicago, IL
Industrial Biotest Laboratories - Northbrook, IL
Wisconsin Pulp & Paper Industries - Upper Fox Valley, WI

Thilmany Pulp & Paper Company - Green Bay, WI
Chicago Park District - Chicago, IL
Nalco Chemical Company - Chicago, IL
Boise Cascade Development Company - Chicago, IL
Foley & Lardner, Attorneys - Milwaukee, WI
Timken & Lonsdorf, Attorneys - Wausau, WI
Strasburger, Price, Kelton, Martin & Unis, Attorneys - Dallas, TX
Rooks, Pitts, Fullagar & Poust, Attorneys - Chicago, IL
Jones, Day, Cockley & Reaves, Attorneys - Cleveland, OH
Sullivan, Hanft, Hastings, Fride & O'Brien, Attorneys - Duluth, MN
Hinshaw, Culbertson, Molemann, Hoban & Fuller, Attnys - Chicago, IL
Colorado Springs - Colorado Springs, CO
Mayer, Brown & Platt, Attorneys - Chicago, IL
Pueblo Area Council of Governments - Pueblo, CO
Platte River Power Authority - Fort Collins, CO
Linquist & Vennum, Attorneys - Minneapolis, MN
Norfolk District Corps of Engineers - Norfolk, VA
Spanish Ministry of Public Works - Madrid, Spain
The Netherlands - Rijkswaterstaat - Amsterdam, The Netherlands
U.S. Department of Energy - Various locations in US
King Industries - Norwalk, CT
Attorney General, State of Florida - Tallahassee, FL
State of Colorado Governor's Office - Denver, CO
Cities of Fort Collins, Longmont, and Loveland - CO
E.I. DuPont - Wilmington, DE
Allied Chemical Company - Morristown, NJ
Outboard Marine - Waukegan, IL
Amoco Oil Company - Denver, CO
Appalachian Timber Services - Charleston, WV
Mission Viejo Development - Denver, CO
Fisher, Brown, Huddleston & Gun, Attorneys - Fort Collins, CO
Tom Florczak, Attorney - Colorado Springs, CO
Wastewater Authority - Burlington, VT
Tad Foster, Attorney - Pueblo, CO
Holmes, Roberts & Owen, Attorneys - Denver, CO
Center for Energy and Environment Research - Puerto Rico
City of Brush - Brush, CO
Rock Island District Corps of Engineers - Rock Island, IL
Santo Domingo Water Authority - Dominican Republic
Ministry of Public Works and Environment - Buenos Aires, Argentina
Neville Chemical - Pittsburgh, PA
Fike Chemical Company - Huntington, WV
Stauffer Chemical Company - Richmond, CA
Adolph Coors Company - Golden, CO
Water Research Commission - South Africa
Grinnell Fire Protection Systems - Lubbock, TX

City of Lubbock Parks Department - Lubbock, TX
National Planning Council - Amman, Jordan
City of Olathe - Olathe, KS
City of Lubbock - Lubbock, TX
US AID - Amman, Jordan
Buffalo Springs Lake Improvement Association - Buffalo Springs, TX
Union Carbide Company - Charleston, WV
Canadian River Municipal Water Authority - Lake Meredith, TX
Mobil Chemical Company - Pasadena, TX
Unilever Ltd. - Rotterdam, The Netherlands
Brazos River Authority - Waco, TX
U.S. Army Construction Engineering Research Laboratory - Champaign, IL
James Yoho, Attorney - Danville, IL
Zukowsky, Rogers & Flood, Attorneys - Crystal Lake, IL
State of California Water Resources Control Board - Sacramento
Public Service Electric & Gas - Newark, NJ
Health Officer - Boonton Township, NJ
Scotland & Robeson Counties - Lumberton, NC
International Business Machines Corporation - White Plains, NY
Newark Watershed Conservation & Development Authority - NJ
State of Vermont Planning Agency - Montpelier, VT
CDM, Inc. - Edison, NJ
Attorney General, State of North Carolina - Raleigh, NC
City of Vernon - Vernon, NJ
Ebasco Services - Lyndhurst, NJ
Kraft, Inc. - Northbrook IL, with work in Canada, FL and MN
USSR Academy of Sciences - Moscow, USSR
Tillinghast, Collins & Graham, Attorneys - Providence, RI
City of Richmond, RI
Idarado Mining Company - Telluride, CO
Levy, Angstreich, Attorneys - Cherry Hill, NJ
Newport City Development - Jersey City, NJ
Orbe, Nugent & Collins, Attorneys - Ridgewood, NJ
Schmeltzer, Aptaker & Shepard, Attorneys - Washington, DC
CP Chemical - Sewaren, NJ
Dan Walsh, Attorney - Carson City, NJ
William Cody Kelly - Lake Tahoe, NV
NJ Department of Environmental Protection - Trenton, NJ
Hufstedler, Miller, Kaus & Beardsley, Attorneys - Los Angeles, CA
Main San Gabriel Basin Watermaster - CA
Metropolitan Water District of Southern California - Los Angeles, CA
San Diego Unified Port District - San Diego, CA
Delta Wetlands - CA
Simpson Paper Company - Humboldt County, CA
City of Sacramento - CA
Northern California Legal Services - Sacramento, CA

Rocketdyne - Canoga Park, CA
RR&C Development Co. - City of Industry, CA
American Dental Association - Chicago, IL
Emerald Environmental - Phoenix, AZ
Clayton Chemical Company - Sauget, IL
Stanford Ranch - Rocklin, CA
Public Liaison Committee - Kirkland Lake, Ontario
Miller Brewing Company, Los Angeles, CA
ASARCO Inc., Tacoma, WA
CALAMCO, Stockton, CA
Yunkong Gas Company, South Korea
Sutherlands, Pembroke, Ontario
Silverado Constructors, Irvine, CA
Agricultural Interests in Puerto Rico
City of Winnipeg, Manitoba
Strain Orchards, Colusa, CA
Davis South Campus Superfund Oversight Committee, Davis, CA
Monterrey County, California Housing Authority, Salinas, CA
CROWD, Tacoma, WA
Newport Beach, CA
SOLVE, Phoenix, AZ
Sports Fishing Alliance, San Francisco, CA
Caltrans (California Department of Transportation)
Citizens Group near St. John's, New Brunswick
Colonna Shipyards, Norfolk, VA
Clermont County, OH
Wright County, MN
Waikato River Protection Society, New Zealand
Drobac & Drobac, Attorneys, Santa Cruz, CA
Phelps Dunbar, L.L.P., Houston, TX
Walters Williams & Co, New Zealand
Environmental Protection Department, Hong Kong
NYPRIG New York City, NY
DeltaKeeper, Stockton
City of Stockton, CA
Central Valley Regional Water Quality Board, Sacramento, CA
Carson Harbor Village, Carson, CA
Sanitary District of Hammond, IN
South Bay CARES, Los Angeles, CA
Memphremagog Regional Council, Quebec, CANADA
Mobile, AZ